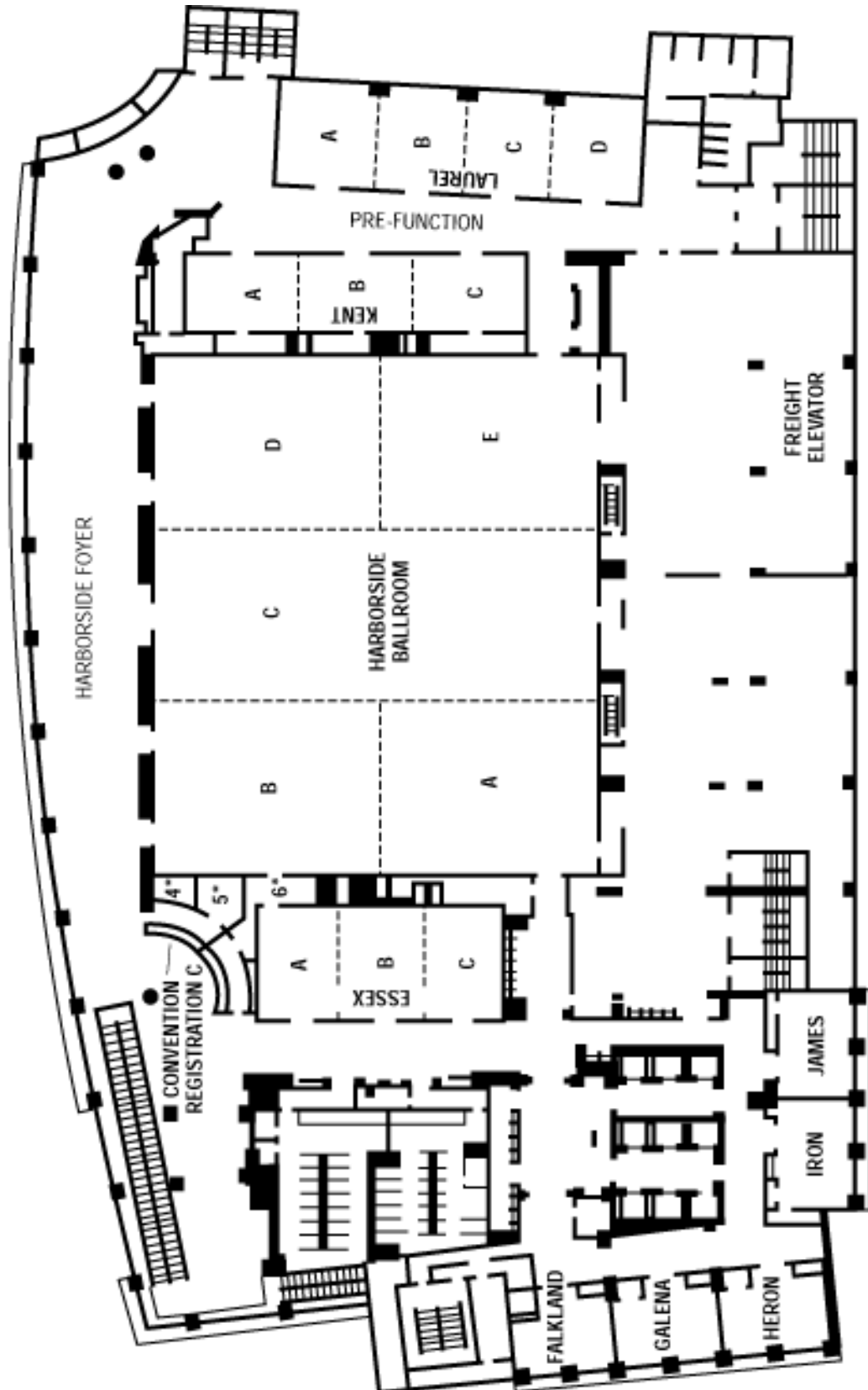# Marriott Baltimore Waterfront Floor Plan

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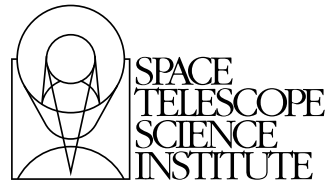
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Table of Contents

Conference Week-at-a-Glance

Sunday October 13, 2002

Registration (12:00pm - 6:30pm; Registration Desk)

Tutorial: **XML and Web Services for Astronomers** (1:00pm - 5:00pm; Harborside Ballroom C)

Conference Reception (7:00pm - 9:00pm; Harborside Foyer)

Monday October 14, 2002

Registration (7:30am - 5:00pm; Registration Desk)

Display Session and Demo Viewing (7:30am - 5:00pm; Harborside Ballroom A/B and Essex A/B/C)

Oral Session 1:	**VO Technologies** (8:20am - 10:00am; Harborside Ballroom C)	
Oral Session 2:	**Sky Surveys** (11:15am- 12:30pm; Harborside Ballroom C)	
Oral Session 3:	**Next-Generation Telescopes and Control Systems** (2:00pm-3:30pm; Harborside C)	
BoF Session 1:	**FITS** (4:30pm - 6:00pm; Harborside Ballroom C)	
	Re-usable Software Components (4:30pm - 6:00pm; Laurel A/B/C/D)	
	Education and Public Outreach (4:30pm - 6:00pm; Kent C)	
BoF Session 2:	**Python in Astronomy** (7:30pm - 9:00pm; Harborside Ballroom C)	
	Astronomical Websites (7:30pm - 9:00pm; Laurel A/B/C/D)	
	Teaching Scientific Computing with N-body Simulations (7:30pm - 9:00pm; Kent C)	

Tuesday October 15, 2002

Registration (7:30am - 5:00pm)

Display Session and Demo Viewing (7:30am - 5:00pm; Harborside Ballroom A/B and Essex A/B/C)

Oral Session 4:	**Data Management** (8:30am - 10:15am; Harborside Ballroom C)
Oral Session˚5:	**Calibration** (11:30am - 12:30pm; Harborside Ballroom C)
Oral Session˚6:	**Enabling Technologies** (2:00pm - 3:30pm; Harborside Ballroom C)
Oral Session 7:	**Data Management** (4:30pm - 5:45pm; Harborside Ballroom C)

Conference Banquet (6:30pm - 9:30pm; Della Notte)

Wednesday October 16, 2002

Registration (7:30am - 12:00pm)

Display Session and Demo Viewing (7:30am - 4:00pm; Harborside Ballroom A/B and Essex A/B/C)

Oral Session 8:	**Optimizing Science** (8:30am - 10:00am; Harborside Ballroom C)
Oral Session 9:	**Calibration** (11:15am - 12:15pm; Harborside Ballroom C)
Oral Session 10:	**VO Interoperability** (2:00pm - 3:30pm; Harborside Ballroom C)

Program

Sunday, October 13, 2002 Program

Tutorial: XML and Web Services for Astronomers (1:00pm to 5:00pm; Harborside Ballroom C) Roy Williams and Robert Brunner

Registration (12:00pm to 6:30pm; Registration Desk)

Conference Reception (7:00pm to 9:00pm; Harborside Foyer)

Monday, October 14, 2002 Program

Coffee and Light Breakfast Fare (7:30am to 8:30am; Harborside Foyer)

Oral Session 1: VO Technologies (8:20am to 10:00am; Harborside C)

8:20am	Welcome & Opening Remarks	William Smith, Jr. AURA President
8:30am	High Performance Computing (Invited)	Miron Livny
9:00am	Rapid Development for Distributed Computing, with Implications for the Virtual Observatory (Invited)	Michael Noble
9:30am	eSTAR: Building an Observational GRID	Alasdair Allan
9:45am	AstroComp: A Web Portal for High Performance Astrophysical Computing on a Grid of Supercomputers	Paola Di Matteo

Coffee Break, Display Session and Demo Viewing (10:00am to 11:15am)

Oral Session 2: Sky Surveys (11:15am to 12:30pm; Harborside C)

11:15am	Photometric and Astrometric Calibration of the Southern H-alpha Sky Survey Atlas (Invited)	Peter McCullough
11:45am	The XMM-Newton Serendipitous Sky Survey (Invited)	Michael Watson
12:15pm	ISOCAM Parallel Mode Survey	Stephan Ott

Lunch Break, Display Session and Demo Viewing (12:30pm to 2:00pm)

Oral Session 3: Next Generation Telescopes and Control Systems (2:00pm to 3:30pm; Harborside C)

2:00pm	Conceptual Design for the Square-Kilometer Array (Invited)	Ron Ekers
2:30pm	The James Webb Space Telescope Science & Operations Systems (Invited)	Joe Pollizzi
3:00pm	Adaptive Optics at the VLT: NAOS-CONICA (Invited)	Chris Lidman

Coffee Break, Display Session and Demo Viewing (3:30pm to 4:30pm)

Monday, October 14, 2002 Program, continued

BoF 1: FITS (4:30pm to 6:00pm; Harborside C)	Don Wells
BoF 2: Re-usable Software Components (4:30pm to 6:00pm; Laurel A/B/C/D)	Frank Tanner
BoF 3: Education and Public Outreach (4:30pm to 6:00pm; Kent C)	Steve McDonald
Dinner Break (6:00pm to 7:30pm)	
BoF 4: Python in Astronomy (7:30pm to 9:00pm; Harborside C)	Perry Greenfield
BoF 5: Astronomical Websites (7:30pm to 9:00pm; Laurel A/B/C/D)	Tony Ferro
BoF 6: Teaching Scientific Computing with N-body Simulations (7:30pm to 9:00pm; Kent C)	Vicki Johnson Peter Teuben

Tuesday, October 15, 2002 Program

Coffee and Light Breakfast Fare (7:30am to 8:30am; Harborside Foyer)

Oral Session 4: Data Management (8:30am to 10:15am; Harborside C)

8:30am	Data Management for the LSST (Invited)	Andrew Connolly
9:00am	Microlensing Events: Exploring the Time Domain (Invited)	Kem Cook
9:30am	The Raptor Real-Time Processing Architecture	Mark Galassi
9:45am	The Subaru Telescope Software Trinity System (Invited)	Ryusuke Ogasawara

Coffee Break, Display Session and Demo Viewing (10:15am to 11:30am)

Oral Session 5: Calibration (11:30am to 12:30pm; Harborside C)

11:30am	Data Calibration for the Low-Frequency Radio Telescope (Invited)	Jan Noordam
12:00pm	Calibration Techniques for the Sub-mm Imaging (Invited)	Stephane Guilloteau

Lunch Break, Display Session and Demo Viewing (12:30pm to 2:00pm)

Oral Session 6: Enabling Technologies (2:00pm to 4:00pm; Harborside C)

2:00pm	Micro Observatory (Invited)	Philip Sadler
2:30pm	Mirage: A Tool for Interactive Pattern Recognition from Multimedia Data	Tin Kam Ho
2:45pm	Montage: An On-Demand Image Mosaic Service for the NVO	Bruce Berriman
3:00pm	Architecture for All-Sky Browsing of Astronomical Datasets	Joseph Jacob
3:15pm	Scoping the UK's Virtual Observatory: AstroGrid's Key Science Drivers and Impact on System Design.	Nicholas Walton

Coffee Break, Display Session and Demo Viewing (3:30pm to 4:30pm)

Oral Session 7: Data Management (4:30pm to 5:45pm; Harborside C)

4:30pm	Data Management for the VO (Invited)	Patrick Dowler
5:00pm	The NRAO End-to-End (e2e) Project	Tim Cornwell
5:15pm	Data Organization in the SDSS Data Release 1	Aniruddha Thakar
5:30pm	HDX Data Model - FITS, NDF and XML implementation	David Giaretta

Conference Banquet (6:30pm to 9:30pm; Della Notte)

Wednesday, October 16, 2002 Program

Coffee and Light Breakfast Fare (7:30am to 8:30am; Harborside Foyer)

Oral Session 8: Optimizing Science (8:30am to 10:00am; Harborside C)

8:30am	New Science with LIGO: Past, Present and Future (Invited)	Kent Blackburn
9:00am	AstroVirgil: Interactive X-Ray Analysis for the EPO and First-Look	Steve McDonald
9:15am	An End-to-End Architecture for Science Goal Driven Observing	Anuradha Koratkar
9:30am	Small Theory Data and the Virtual Observatory	Jonathan McDowell
9:45am	Federating Catalogs and Interfacing Them with Archives: A VO Prototype	Doug Mink

Coffee Break, Display Session and Demo Viewing (10:00am to 11:15am)

Oral Session 9: Calibration (11:15am to 12:15pm; Harborside C)

11:15am	Calibration of Space IR Arrays (Invited)	Mark Dickinson
11:45am	Uncertainty Estimation & Propagation in SIRTF Pipelines (Invited)	Mehrdad Moshir

Lunch Break, Display Session and Demo Viewing (12:15pm to 2:00pm)

POC Meeting (12:15pm to 2:00pm)

Oral Session 10: VO Interoperability (2:00pm to 3:30pm; Harborside C)

2:00pm	SkyQuery - A Prototype Distributed Query Web Service for the VO	Tamas Budavari
2:15pm	Why Indexing the Sky is Desirable	Patricio Ortiz
2:30pm	Quantum Topic Maps: A Physicist's View of the Information Universe	Nikita Ogievetsky
2:45pm	A New Way of Joining Source Catalogs using a Relational DBMS	Clive Page
3:00pm	A Bit of GLUe for the VO: Aladin Experience	Pierre Fernique
3:15pm	Interoperability of the ISO Data Archive and the XMM-Newton Science Archive	Christophe Arviset
3:30pm	Closing Remarks	

Demo and Display Break-Down (4:00pm to 6:00pm)

Birds of a Feather (BoFs)

B1 FITS

Don Wells (NRAO)

A discussion, lead by the organizer, of new and pending proposals for the evolution of the FITS standard.

B2 Reusable Software Components

Frank Tanner (STScI)

Software Reusability has been one of the cornerstones of Object Oriented Technologies. Successful code reuse often saves development time and keeps project costs down. Many observatories are developing software components that could be easily adapted and reused by other missions. This BOF session will highlight some of the reusable software components that session participants have developed and are currently developing. The goal of this BOF will be to open a dialog between software developers to facilitate the reuse of both small and large bodies of software.

B3 Education and Public Outreach

Steve McDonald (UMASS Boston and Silicon Spaceships)

Education and public outreach plays an increasingly significant role in government funded astronomy projects. In this web dominated world, projects put vast background information, all of their observations and their analysis software on the web. Typically, this is all available to the general public.

Astronomy excites the general public more than other sciences and amateur astronomers contribute many important observations using their own telescopes. Is it possible to build a broad amateur community using archived data from world class observatories?

What projects have an amateur community using their data? What do they have in common? Are there useful scientific tasks for amateurs? What aspects of the analysis software inhibit its wider use?

This workshop will review projects that have or are trying to build an active amateur or student community. We will discuss the needs of non-professionals. We will try to identify data sets that possess the elements needed to reach amateurs but have not yet successfully done so.

B4   Python in Astronomy

Perry Greenfield (STScI)

An informal discussion of Python's current and future role in astronomy. In particular it will be a forum for those that wish to:
- Find out why Python is of interest.
- Describe current projects using Python.
- Find out what STScI's plans for Python are and provide feedback on existing STScI Python packages such as PyRAF, PyFITS, and numarray
- Help define what the priorities for Python libraries should be.
- Start collaborative efforts.

B5   Astronomical Websites

Tony Ferro (Arizona)

An informal get together to discuss the trials and tribulations associated with creating and running a website associated with the wacky world of astronomy. We will have some presentations and discussions on such topics as:
- Security concerns (e.g. securing CGI scripts, using HTTPS)
- Web development environments (e.g. ZOPE, Bluefish)
- What happens when the press release hits CNN
- How to manage a large or small web site (how much cpu do you need?)
- Distribution of large files (e.g. ftp vs. http)

We will try to stay away from such topics as XML and Web services, since those topics are covered in the tutorial.

B6   Teaching Scientific Computing with N-body Simulations

Vicki Johnson (Interconnect) Peter Teuben (UMD)

Many undergraduate students are not learning how to program, how to use Unix, or the basic principles of scientific computing and numerical estimation. The classic N-body problem can be used to illustrate many dimensions of scientific computing. The BoF participants will be invited to make specific suggestions how to use the classic N-body problem to introduce students to modeling (simple physics), algorithms, the development of simple programs to implement basic algorithms, the Unix environment and open source tools (gcc and gnuplot), tradeoffs between efficiency and accuracy, numerical analysis, visualization and animation, scalability (e.g. computations growing at N^2 or $N\log N$) and supercomputing (e.g., using low-cost GRAPE cards, optimized for the force calculations) and parallel programming, and interdisciplinary uses of N-body simulations, such as in computational biology and astrophysics.

The results will be posted on the web to provide teachers of math, computer science, physics, astronomy, biology, etc. with concrete examples to teach scientific computing.

Demonstrations

D1 Starlink Software Developments

Martin Bly, David Giaretta (Rutherford Appleton Lab, UK) Mark Taylor (University of Bristol)

We shall demonstrate some of the new features in the Spring 2002 release of the Starlink Software. We shall also present our recent work on Web Services and demonstrate some new Java tools for astronomical data processing.

D2 Virtual Observatory Initiatives at the ESO/ST-ECF Archive

Benoit Pirenne (ESO/DMD) Markus Dolensky (ESO/ST-ECF) Jonas Haase (ESO/ST-ECF) Jens Knudstrup (ESO/DMD) Alberto Micol (ESO/ST-ECF) Francesco Pierfederici (ESO/ST-ECF) Andreas Wicenec (ESO/DMD)

The ESO/ST-ECF archive, hosting data from HST, the VLT and many La Silla instruments has always been at the forefront of new initiatives in the area of archives. Recently, new technologies such as magnetic disk based archive systems (NGAS) have been developed and put in operations. The approved European initiative on a phase A study of an Astrophysical Virtual Observatory (AVO) has originated at and is coordinated by our site. This demo aims at presenting some of the newest technologies and concepts we are developing/using for the AVO in the areas of:

- infrastructure:
  - the NGAS system
  - our archive request handling system
  - the new OTFR system for HST data
  - previews of imaging data and spectra
- interoperability and GUI:
  - Querator: an advanced archive query tool, a result of the first ASTROVIRTEL cycles
  - Web Services
  - an improved type of WFPC2 associations, to provide deeper products to our archive researchers
  - a new tool for visualizing associations of spectra.

Furthermore we would like to discuss with you requirements, concepts, design, tools, software, databases, data-mining, and any other matter related with Virtual Observatories strategies in general.

D3 The Cosmo.Lab Project: Developing AstroMD, an Object Oriented, Open Source Visualization and Pre-analysis Tool for Astrophysical Data

Claudio Gheller (CINECA) Ugo Becciani, Daniela Ferro, Maura Melotti, Luigi Calori (INAF - Astrophysical Observatory of Catania)

The Cosmo.Lab project, financed by the European Community, has the object of developing AstroMD, a tool of visualization and analysis of astrophysical data. AstroMD responds to the requirements proposed by several research fields: data coming from cosmological simulations, from observational catalogues and extended objects like radio sources or clusters of galaxies. Its basic functionalities deal with the visualization of point-like distributions (stars, galaxies, n-body particles...), and their properties (spectral type, luminosity, temperature...) the visualization of continuous fields (gas density, gravitational potential...), the 3D navigation inside the data, the calculation of statistical properties of user-selected samples (correlation functions, power spectra, Minkowski Functional,...), the modeling of 3D shapes from 2D observed images (galaxies, radio lobes...). Specific tools, like Tipsy and FITS readers have been specifically implemented. As far as the design and implementation of AstroMD has been strongly influenced by object-oriented principles, it has been developed using C++ (for the numerical core) and IncrTcl (for the GUI) as programming languages and the Visualization Toolkit (VTK) as graphical library. VTK, by Kitware, is a freely available software portable on several platforms. AstroMD exploits the most advanced visualization technology, based on virtual reality, in order to build a leading edge instrument for scientific research. However it is a scalable software which can be used also on PCs or workstations. It is open-source and freely downloadable from the web site (http://cosmolab.cineca.it). In this demo we will present the basic feature of AstroMD both from the visualization and from the analysis points of view. Furthermore we will show how AstroMD can be used for educational proposes with the possibility of creating interactive lectures.

D4 IRAF Software Developments

Michael Fitzpatrick and the NOAO Science Data Systems Group (NOAO)

Members of the NOAO Science Data Systems (nee IRAF) Group will be on hand to demonstrate recent software developments in IRAF, X11IRAF, archiving, and to discuss other work currently in progress. New or on-going developments include major new releases of both IRAF and X11IRAF (including new platform support for Mac OS X), application enhancements for improved pixel mask support, new tasks for object detection and removal, network catalog queries, cosmic-ray removal, multi-amp CCD reductions, and an improved help and installation system. Demos of the new NOAO Science Archive, new XImtool functionality, and other new IRAF applications will also be available.

D5 New STScI Data Analysis Applications

Warren Hack, Ivo Busko, Robert Jedrzejewski (STScI)

PyDrizzle

The dither package within STSDAS provides all the basic tools to detect cosmic rays in sets of overlapping images, refine the registration between images, then combine them while removing the cosmic-rays and geometric distortion. However, using these tools can be a complex and frustrating experience. The Python task PyDrizzle provides the basis for automating all of these steps for HST images. PyDrizzle relies on PyRAF to interface with the IRAF tasks in the dither package (primarily drizzle), PyFITS to work with the FITS input and output images, and numarray to perform computations of parameters.

PyDrizzle makes it easy for a user to work with dithered or single images using either a simple IRAF task interface to run the task in one step or the Python syntax to provide investigative tools during processing. We will illustrate some of the most recent added capabilities; namely, drizzling input images to separate outputs, blotting images back, use of separate WCS information to specify the output product and support of independent computation of shifts to correct those computed from the headers to properly register images.

Specview

Specview is a spectral visualization tool designed to provide easy simultaneous display and analysis of multiple 1-D spectrograms of the same astronomical source taken with different instruments. It fully supports all spectral formats generated by HST instruments, as well as IUE NEWSIPS files and a generic text-based format. It is a standalone application written in Java that can as well be bundled with other Java software (currently it is bundled with the Star View archive data browser and analysis tool). Aside its main visualization mode, it also features a powerful spectral model fitting engine. The software can be downloaded from http://specview.stsci.edu.

D6 New STScI Data Analysis System Software

Perry Greenfield, Todd Miller, Jin-Chung Hsu, Richard White, Paul Barrett (STScI)

PyRAF

PyRAF is a new command-line facility for IRAF based on Python that is now officially released (v1.0). It allows running almost all IRAF executables and CL scripts. IRAF tasks can be run interactively using IRAF CL syntax or Python syntax with full image display and graphics capabilities. STSDAS v3.0 requires PyRAF for some of its new tasks.

PyFITS

This Python module enables reading and writing of FITS image and table data to and from Python arrays, and allows interactive access to header information via the Python interpreter. PyFITS has improved capabilities including a new I/O model, abil-

ity to handle scaled and boolean columns in tables, ascii tables, verification of output files, more convenience methods, better use of memory, and faster I/O.

numarray

Numarray is a Python module that provides IDL-like capabilities for efficient mathematical operations on large numeric arrays. It has been updated significantly and provides nearly all the functionality that is present in the module it replaces (Numeric). Support for new types has been added (complex, 64-bit ints); arrays can be pickled (i.e., saved to disk portably); and a C API has been added, including a compatibility layer that makes it much easier to adapt libraries written for Numeric (illustrated by the addition of the standard Numeric libraries FFT, RandomArray, and LinearAlgebra).

D7   National Virtual Observatory Efforts at SAO

Mark Cresitello-Dittmar, Janet DePonte, Ian Evans, Jonathan McDowell, Mike Noble (Harvard-Smithsonian Center for Astrophysics)

The National Virtual Observatory (NVO) project is an effort to federate astronomical resources, to provide seamless access to heterogeneous data at various centers throughout the world, and make them appear to the user as a homogeneous set. The NVO will reduce the user s need to obtain, recall and manage details such as passwords, band coverage, instrument specificity and access methodologies for each archive site in order to get and analyze data. The project will employ Grid technology and distributed computing techniques to manage enormous data volumes and processing needs.

At the Harvard-Smithsonian Center for Astrophysics (SAO), we are developing a small scale prototype implementation of the NVO paradigm. This demonstration will illustrate the directions being pursued toward this goal by allowing a user to request data from various resources, display the returned data, and interactively perform analysis on that data.

D8   ClassX: A Real Time X-ray Classifier

Tom McGlynn, Eric Winter, Lorella Angelini, Michael Corcoran, Stephen Drake, William Pence, Nicholas White (NASA/GSFC) Anatoly Suchkov, Megan Donahue,   Robert Hanisch, Marc Postman, Richard White (STScI) Sebastien Derriere, Francois Ochsenbein (CDS, Observatorie) Pierre Fernique (Ctr de Donnees Astro. de Strasbourg) Francoise Genova (Obs de Strasbourg)

We demonstrate use of the ClassX X-ray classifier in interactively classifying lists of objects requested by the user. ClassX extracts information for the list from diverse sources on the Web and uses this information as input to a network of trained classifiers.

Early classifiers use only luminosity and position information. These classifiers are good at distinguishing basic categories of objects, but as we include additional kinds of data (source extent, variability and more detailed spectral information) we anticipate greater power in distinguishing source classes.

ClassX is a two year project supported by NASAs AISR program.

D9   **A Consolidated Distribution System for STScI-developed Software**

Thomas Comeau, Bernie Shiao (STScI)

STScI currently distributes three software products written in Java. STGMS is distributed as both an applet and an application, while APT and Starview are distributed as applications.

We describe the implementation of a new distribution strategy for all three products using a COTS solution. We will demonstrate the new download and update system. We focus on the STGMS implementation, which requires moving most STGMS users from the applet to the new application.

D10   **N-body Testbed for Undergraduate Education Utilizing a Web Interface to NEMO and MD-GRAPE-2**

Vicki Johnson (Interconnect Technologies Corporation) Peter Teuben (University of Maryland) Bryan Penprase (Pomona College)

An N-body simulation testbed called **NBodyLab** was developed at Pomona College as a teaching tool for undergraduates. The testbed provides a web interface to selected back-end NEMO modeling and analysis tools and several integration methods which can optionally use an MD-GRAPE-2 PCI card on the server to accelerate calculation of particle-particle forces. The testbed provides a framework for using and experimenting with the main components of N-body simulation: data models and transformations, numeric integration, analysis and visualization products, and acceleration techniques (in this case, special purpose hardware). The testbed can be used by students with no knowledge of programming or Unix, freeing such students and their instructor to spend more time on scientific discovery. The advanced student can extend the testbed software and/or more quickly transition to the use of more advanced Unix-based toolsets such as NEMO, Starlab and model builders such as GalactICS. Cosmology students at Pomona College used the testbed to study collisions of galaxies with different speeds, masses, densities, collision angles, angular momentum, etc., attempting to simulate, for example, the Tadpole Galaxy and the Antenna Galaxies. The testbed framework is available as open-source to assist other researchers and educators. Experiences with visualizers running under Windows are discussed and recommendations made for testbed enhancements.

D11   AIPS++

Athol Kemball (NRAO)

The Astronomical Information Processing System (AIPS++) has recently released version v1.7. Free CD-ROM's for this release will be available at this demo booth, and developers will be on hand to discuss and demonstrate the package to anyone who would like further information regarding the status of the system, as well as recent developments.

D12   Interoperability of the ISO Data Archive and the XMM-NEWTON Science Archive

Christophe Arviset, John Dowson, Jose Hernandez, Pedro Osuna, Aurele Venet (ESA)

The ISO Data Archive (IDA) and the XMM-Newton Science Archive (XSA) have been developed by the Science Operations and Data Systems Division in Villafranca, Spain. They are both built using the same flexible and modular 3-tier architecture: (Data Products and Database, Business Logic, User Interface). This open architecture, together with Java and XML technology have helped in making the IDA and XSA inter-operable with other archives and applications.

Inter-operability has been achieved from these archives to external archives through:
- target name resolution with NED and SIMBAD
- access to electronic articles through ADS
- access to IRAS data through the IRSA server

Moreover, direct access to ISO and XMM-Newton data is provided, bypassing the standard user interface. The observation / exposure log is given to external archives or application together with a mechanism to access data via a Java Server Page. Later development will be described in particular the so-called Postcard and Product Server.

This is currently available from:
- the ADS WWW, that give then access to the data from the articles
- the CDS / Vizier catalogue
- the IRSA ISO Visualizer
- HEASARC archive

The ISO Data Archive can be accessed at: http://www.iso.vilspa.esa.es/ida

The XMM-NEWTON Science Archive can be accessed at:
http://xmm.vilspa.esa.es/xsa

Oral Presentations

VO TECHNOLOGIES

O1.1 **High Performance Computing (*Invited*)**

M. Livny (Univ. of Wisconsin)

No abstract provided.

O1.2 **Rapid Development for Distributed Computing, with Implications for the Virtual Observatory (*Invited*)**

Michael Noble (Harvard-Smithsonian Center for Astrophysics)

Compute nodes will require enabling technologies to participate in a virtual observatory (VO), yet much of the available GRID software exhibits the classic buy-in problem: a) it is distributed in relatively large packages that require regular updating as new versions are deployed, and platform-specific binaries for each CPU architecture, b) involves steep learning curves, and c) can require significant institutional commitment to install, utilize, and maintain.

These factors create a formidable entry barrier for metacomputing newcomers, a class into which a large majority of the astronomy community currently falls. Recent work, however, shows that combining Java tuplespaces with network class loaders can greatly simplify the configuration and management of distributed computations within heterogeneous networks. When added to the semantic clarity of tuplespace programming, such an approach could shrink the buy-in cost of VO participation considerably, at the very least in terms of the up-front costs needed to merely dabble in metacomputing, as well as simplify the iterative redeployment of experimental infrastructure and services that will prove necessary as the VO evolves.

To bolster this argument we outline an architecture which shows promise as a means of accessing diverse data and services through a virtual metacomputer interface. Early prototypes suggest that the approach offers a number of attractive VO-relevant features: (1) loosely couples service provider nodes, accessor nodes, and users across networks of all scales; (2) permits dynamic joining and leaving of service providers and accessors; (3) hides much of the complexity of distributed programming behind a clean and simple interface; (4) provides intrinsic scalability and fault tolerance, and comparatively simple replication; and (5) requires low institutional or individual buy-in, relative to other GRID tookits, for initial VO participation.

O1.3   STAR: Building an Observational GRID

Alasdair Allan, Tim Naylor (University of Exeter) Iain Steele, Dave Carter, Jason Etherton, Chris Mottram (Liverpool John Moores University)

The eSTAR Project is a programme to build a prototype robotic telescope network to design and test the infrastructure and software which could be used in larger scale projects. The network consists of a number of autonomous telescopes, and associated rapid data reduction pipelines, connected together using GLOBUS middleware. Intelligent agents carry out resource discovery, submit observing requests, and analyse the reduced data returned by the telescope nodes. The agents are capable of carrying out data mining and cross-correlation tasks using online catalogues and databases and, if necessary, requesting follow-up observations from the telescope nodes. We discuss the design and implications of the eSTAR software and its implications with respect to the GRID.

O1.4   AstroComp: A Web Portal for High-Performance Astrophysical Computing on a Grid of Supercomputers

Paola Di Matteo, Paolo Miocchi (Univ. of Rome) Vincenzo Antonuccio-Delogu, Ugo Becciani (Astroph. Obs. of Catania) Roberto Capuzzo Dolcetta (Univ. of Rome) Alessandro Costa (Astroph. Obs. of Catania) Vittorio Rosato (ENEA - Rome)

AstroComp is a project (initially funded by the Italian National Research Council, CNR) aiming at creating a portal that permits to handle and use high-performance numerical tools for Astrophysics, on a grid of supercomputers. The main motivation of the project is to construct a portal, which allows to set up a repository of computational codes and common databases, making them available and enjoyable, with a user-friendly graphical web interface, to the entire national (and international) community. AstroComp will allow the scientific community to benefit by the use of many different numerical tools implemented on high performance computing (HPC) resources, both for theoretical astrophysics and cosmology and for the storage and analysis of astronomical data, without the need of specific training, know-how and experience either in computational techniques or in database construction and management methods.

I will illustrate some examples of practical utilization of the present version of the AstroComp portal in the framework of the numerical simulations of globular clusters dynamics. I will show how to handle the various aspects related to the performing and managing of a typical N-body simulation.

A prototype of the portal can be visited at http://www.astrocomp.it/

SKY SURVEYS

O2.1   Photometric and Astrometric Calibration of the Southern H-alpha Sky Survey Atlas (SHASSA) (*Invited*)

Peter McCullough (STScI) John Gaustad (Swarthmore) Wayne Rosing (Google)

The Southern H-Alpha Sky Survey Atlas (SHASSA) is the primary data product of a robotic wide-angle imaging survey of the southern sky (δ = +15° to -90°) at 656.3 nm wavelength, the Hα emission line of hydrogen.

This presentation will focus on the photometric and astrometric calibration of the images in the Atlas.

O2.2   The XMM-Newton Serendipitous Sky Survey (*Invited*)

M. G. Watson (University of Leicester) on behalf of the XMM-Newton SSC

XMM-Newton provides a powerful facility for X-ray surveys by virtue of its high sensitivity and large field of view, coupled with excellent hard X-ray response. Over the course of each year s observations around 100 sq.deg. of the sky is covered by XMM-Newton observations, yielding a serendipitous catalogue of ~50,000 X-ray sources extending to faint X-ray fluxes.

This paper will describe two projects being undertaken by the XMM-Newton Survey Science Centre (SSC) which are designed to maximize the value of the XMM-Newton serendipitous sky survey:

(i) a programme of identification and follow-up of significant samples of sources serendipitously discovered in XMM-Newton observations. This project, underway since mid-2000, involves a substantial programme of spectroscopic identifications, coupled with extensive deep optical/infrared imaging of XMM-Newton fields.

(ii) the compilation of a comprehensive serendipitous source catalogue from all XMM-Newton observations, emphasizing sensitivity but with particular attention paid to uniformity and quality control. Specialized data processing for this catalogue started in April 2002 with the first installment will be publicly released in late 2002. The main properties of the catalogue will be presented.

O2.3   The ISOCAM Parallel Mode Survey

S. Ott, R. Siebenmorgen, N. Schartel (ANU)

During most of ESAs ISO mission, the mid-infrared camera ISOCAM continued to observe the sky mainly around 6.7μm with a pixel field of view of 6″ in its so-called parallel mode while another instrument was prime.

This permitted an unbiased survey of limited areas of the infrared sky, albeit with

varying depth and wavelength per field due to the different instrumental configurations used and the highly variable time spent per pointed observation.

Dedicated calibration, data reduction and source extraction methods were developed to analyse these serendipitously recorded data: 37000 individual pointings, taken during 6700 hours of observation. Using sophisticated cleaning and merging algorithms, over 42 square degrees of the sky --- roughly one per mille of the celestial sphere --- could be processed and catalogued.

We will give an overview of the data processing and results of this recently finished project, and outline the scientific potential of the generated data-set.

For the final point source catalogue, around 30000 sources are expected. Their mid-infrared flux goes down to 0.5 mJy, with a median of 2.7 mJy for sources outside the galactic plane, and 6.3 mJy for sources inside the galactic plane.

We will announce the release date of the ISOCAM Parallel Point Source Catalogue and of all calibrated ISOCAM parallel images to the general community at this conference, and hope this will become an attractive and valuable resource for all mid-infrared research activities and a major legacy from the ISO mission.

NEXT-GENERATION TELESCOPES AND CONTROL SYSTEMS

O3.1 Conceptual Design for the Square-Kilometer Array (*Invited*)

R. Ekers

No abstract provided.

O3.2 James Webb Space Telescope Science and Operations Center (*Invited*)

Joe Pollizzi (STScI)

The newly named James Webb Space Telescope is more than just a replacement telescope for the current Hubble Space Telescope. The JWST is the successor mission to that of Hubble---which means its goals are to be as successful in advancing our understanding of the universe, but in ways that are beyond Hubble s capabilities. Plus it is to build on Hubble s legacy of success at only a fraction of its cost. These are indeed tall goals. Certainly advances in technology will buy some of that capability, as will the L2 orbit of JWST, which will remove it from many of the visibility and other environmental constraints that Hubble experiences. But, we believe the proper application of the lessons we have learned in operating the Hubble will be as significant to JWST s success as are these more evident changes. Foremost among these lessons is in taking only the best of Hubble s ground systems and building upon them. This talk presents some of our thinking in how we ll use Hubble s systems and the kinds of changes we are planning in preparing the Science and Operations Center for the JWST.

This talk will first present an overview of the James Webb Space Telescope and highlight some of its features and differences from HST. It will then discuss how we intend to take advantage of these changes in simplifying the ground systems. Next we present our plans for where we will use existing systems and where we will acquire or build new components. The talk will conclude with a general overview of the planned S&OC system and our concepts of how it will support the JWST.

O3.3 Adaptive Optics at the VLT: NAOS-CONICA (*Invited*)

Chris Lidman, Wolfgang Brandner (ESO)

NAOS-CONICA is the first adaptive optics instrument to be offered to the community at the ESO VLT. This instrument is capable of diffraction limited imaging, spectroscopy, polarimetry and coronography in the 1 to 5 micron wavelength region. In this talk I will provide a description of the instrument and summarize NAOS-CONICA end-to-end operations.

DATA MANAGEMENT

O4.1   Data Management for the LSST (*Invited*)

Andrew Connolly (Univ. of Pittsburgh)

The Large-aperture Synoptic Survey Telescope (LSST) represents the next generation of wide-field survey telescopes. With repeated scans of the sky on timescales ranging from a few minutes to several years it will be one of the first of the wide-area survey facilities to open up the study of the time domain in astrophysics. The scientific returns from such an approach are numerous, ranging from the dynamics of near-Earth asteroids and Kuiper-belt objects through to the detection of intermediate and high redshift supernovae. We will discuss here the impact that such a diverse range of scientific questions will have on the analysis and management of the data flow from such a telescope. We will focus on a number of areas that must be addressed in order for the successful operation of the LSST. These will include: a) the computational challenge presented by a data rate in excess of 300GB per hour b) the impact of the optical design on the photometric accuracy and image quality of the system together with how this translates into implementing efficient techniques for measuring the differences between repeated observations or for co-adding multiple images to construct a deep image of the sky c) the impact on the design of the software due to the requirement that we be able to detect variability over a very broad range of temporal scales (from almost real-time though to several years). Throughout we will discuss the current state-of-the-art in analysis software and algorithms and how they might be expected to scale with the increase in computational resources over the coming decade. We will then identify which computational data management challenges we must address in the near future.

O4.2   Microlensing Surveys: Exploring the Time Domain (*Invited*)

Kem Cook and the MACHO Collaboration

In the last decade a number of different projects have been mounted to detect and follow the progress of gravitational microlensing by compact objects, an extremely rare event. These projects, driven by the need to monitor millions of potential source stars, have opened the time domain in wide-field time-domain astronomy. One of the original projects was the MACHO Project, a survey to determine whether there is significant baryonic component to the dark matter in the halo of the Milky Way.

The MACHO Project collected 8 years and 7.3 Tbyte of data on 99 square degrees toward the Magellanic Clouds and the bulge of the Milky Way. Half square degree fields were sampled, simultaneously in two bands, roughly every three days and light curves for about 55 million stars to a depth of about magnitude 21 have been collected in a photometry database. This database has been analyzed for microlensing and about 500 events toward the Bulge and about two dozen toward the Magellanic Clouds have been detected. We have also identified about 500,000 variable light stars. These have been analyzed yielding new results in the astrophysics of pulsating stars, new categories of stellar variability, and such disparate detections as new high proper motion

stars and new quasars.

I will present, from an astronomer s perspective, some of the data management issues encountered in the MACHO Project, a survey which pushed the boundaries of available technology. I will also recount some of the lesson s learned from MACHO s and other microlensing survey s experience in data mining in, and providing public access to, large image and photometry databases.

O4.3 The Raptor Real-Time Processing Architecture

Mark Galassi, D. Starr, K. Borozdin, D. Casperson, K. McGowan, W. T. Vestrand, R. White, P. Wozniak, J. Wren (Los Alamos National Laboratory)

The primary goal of Raptor is ambitious: to identify interesting optical transients from very wide field of view telescopes in real time, and then to quickly point the higher resolution Raptor fovea cameras and spectrometer to the location of the optical transient. Any application of real-time search and time-domain mapping of the sky is possible with Raptor, including the very interesting real-time search for orphan optical counterparts of Gamma Ray Bursts.

The sequence of steps (data acquisition, basic calibration, source extraction, astrometry, relative photometry, the smarts of transient identification and elimination of false positives, telescope pointing feedback...) is implemented with a component approach. All basic elements of the pipeline functionality have been written from scratch or adapted (as in the case of SExtractor for source extraction) to form a consistent modern API operating on memory resident images and source lists. The result is a pipeline which meets our real-time requirements and which can easily operate as a monolithic or distributed processing system.

Finally: the Raptor architecture is entirely based on free software (sometimes referred to as open source software). In this paper we also discuss the interplay between various free software technologies in this type of astronomical problem.

O4.4 The Subaru Telescope Software Trinity System (*Invited*)

Ryusuke Ogasawara (Subaru Telescope, NAOJ) Yoshihiro Chikada (Radio Astronomy Division, NAOJ) Yasuhide Ishihara (Fujitsu Ltd.) Atsushi Kawai (Fujitsu America Incorporation) Kenji Kawarai (Fujitsu Ltd.) George Kosugi (Subaru Telescope, NAOJ) Yoshihiko Mizumoto (Optical Infrared Astronomy Division, NAOJ) Junichi Noumaru, Toshiyuki Sasaki, Tadafumi Takata (Subaru Telescope, NAOJ) Masafumi Yagi (Optical Infrared Astronomy Division, NAOJ) Michitoshi Yoshida (Okayama Astrophysical Observatory, NAOJ)

The Subaru Telescope is the optical infrared telescope with 8.2m monolithic mirror located at the summit of Mauna Kea, Hawaii, USA, granted 100% by the Japanese government, Ministry of the Education, Culture, Sports, Science, and Technology. The Subaru Telescope began operation in January 1999, and opened the Open Use program for astronomers all over the world in December 2000. The Subaru Telescope Software Trinity System, which consists of Subaru Observation Software (SOSS),

Subaru Telescope Archive System (STARS), and Data Analysis System Hierarchy (DASH) is supporting Subaru Data Flow, observation, archiving and analysis. Observation on the Subaru Telescope is operated by SOSS. In SOSS, telescope and instruments are defined as external modules and interface methods for sending commands and receiving status from those modules are defined. Quick analysis tools and utilities for preparation of the observation procedure are also implemented on SOSS. The Observation Dataset created during the observation procedure by SOSS defines the relation of various categories of FITS frames such as calibration frames, standard stars, and object frames. FITS frames are transferred to the Hilo Data Center and archived automatically to the tape library system. STARS is running to support online registration of observation data in close relation with SOSS, and retrieving with DASH as well as WWW interface for astronomers. As a first trial in the history of the Japanese astronomy, the Subaru Telescope began a challenging project to develop a new platform to support pipeline analysis of data taken by the Subaru Telescope. The DASH project based on the Object Oriented Method and CORBA began in 1996 and completed in March 2002. Thus the whole data obtained by the Subaru Telescope will be reusable for observers to prepare for the new observation proposal of the Subaru Telescope. Even during the observation, the Subaru Telescope Software Trinity System would be useful to find optimum parameters for observations to achieve the best quality. This is the way how the quality control on the observation data is realized on the Subaru Telescope with the Subaru Telescope Software Trinity system. The basic concept of supporting Subaru Data Flow by the Subaru Software Trinity, detailed software methodology we have chosen to develop, the status of the current operation, and the upgrade plan for the future will be presented.

CALIBRATION

O5.1   Data Calibration for the Low-Frequency Radio Telescope (*Invited*)

J. Noordam (Astron)

No abstract provided.

O5.2   Calibration Techniques for Sub-mm Imaging (*Invited*)

S. Guilloteau

No abstract provided.

ENABLING TECHNOLOGIES

O6.1   The Design of the MicroObservatory Network of Educational Telescopes (*Invited*)

Philip M. Sadler (SAO)

Many students have a deep interest in astronomy, but a limited opportunity to use telescopes to explore the heavens. The MicroObservatory Network of automated telescopes is designed to provide access to classroom teachers who wish their students to conduct projects over the World-Wide Web. The intuitive interface makes it easy for even 10-year-olds to take pictures. Our telescopes can be remotely pointed and focused; filters, field of view, and exposure times can be changed easily. Images are archived at the website, along with sample challenges, and a user bulletin board, all of which encourage collaboration among schools. Wide geographic separation of instruments provides for access to distant night skies during local daytime. Operational since 1995, we have learned much about remote troubleshooting, designing for unattended use, and for acquiring the kinds of images that students desire. This network can be scaled up from its present capability of 240,000 images each year to provide telescope access for all U.S. students with an interest in astronomy. Our WWW address is: http://mo-www.harvard.edu/MicroObservatory/

O6.2   Mirage: A Tool for Interactive Pattern Recognition from Multimedia Data

Tin Kam Ho (Bell Laboratories)

Many data mining queries in astronomy involve an identification of objects that are similar or discernible in different aspects such as spectral shapes and features, light curves, morphology, positional proximity, or other derived attributes. Analyses need to go beyond conventional clustering algorithms that stop at computing a single proximity structure according to a specific criterion. We describe Mirage, a software tool designed for interactive exploration of the correlation of multiple partitional or hierarchical cluster structures arising in different contexts. The tool shows projected images of point classes and traversals of proximity structures in one, two, or higher dimensional subspaces, in linked views of tables, histograms, scatter plots, parallel coordinates, or over an image background. It also provides facilities for arbitrary plot configuration, manual or automatic classification, and intuitive graphical querying. We show applications of Mirage to find robust designs of optical devices, verify the consistence of DLS catalogs, and examine spectral classes from IRAS LRS.

O6.3   Montage: An On-Demand Image Mosaic Service for the NVO

G. B. Berriman, D. Curkendall, J. Good, J. Jacob, D. S. Katz, T. Prince, R. Williams (JPL, CalTech)

Montage will deliver a generalized toolkit for generating on-demand, science-grade custom astronomical image mosaics. Science-grade in this context requires that ter-

restrial and instrumental features are removed from images in a way that can be described quantitatively. Custom refers to user-specified parameters of projection, coordinates, size, rotation and spatial sampling, and whether the drizzle algorithm should be invoked.

The greatest value of Montage will be its ability to analyze images at multiple wavelengths, by delivering them on a common projection, coordinate system and spatial sampling and thereby allowing analysis as if they were part of the same multi-wavelength image. Montage will be deployed as a compute - intensive service through existing portals. It will be integrated into the emerging NVO architecture, and run operationally on the Teragrid, where it will process the 2MASS, DPOSS and SDSS SDSS image data sets. The software will also be portable and publicly available.

O6.4   Architecture for All-Sky Browsing of Astronomical Datasets

Joseph C. Jacob, Gary Block, David W. Curkendall (Jet Propulsion Laboratory, California Institute of Technology)

A new architecture for all-sky browsing of astronomical datasets, has been designed and implemented in the form of a graphical front-end to the yourSky custom mosaicking engine. With yourSky, any part of the sky can be retrieved as a single FITS image with user-specified parameters such as coordinate system, projection, resolution and data type [1]. The simple HTML form interface to yourSky has been supplemented with a graphical interface that allows: (i) All-sky, web-based pan and zoom; (ii) Interactive, multi-spectral viewing; (iii) Symbol overlays from object catalogs; (iv) Invocation of the yourSky mosaicking engine once a desired view has been selected; (v) Image pixel to sky coordinate conversions; and (vi) User control over display view size. The image viewed by the user at each instant is rendered from a collection of overlapping image plates with limited size for each zoom level. These plates are constructed in a Tangent Plane projection with tangent points selected at Hierarchical Triangular Mesh [2] vertices. The plate sizes are selected to limit the maximum distortion from image projection while providing sufficient overlap between neighboring plates that the sub-image in the view window is wholly contained within a single plate. This results in astrometric accuracy, rapid response time, and efficient data storage. Although the current implementation is interoperable with the yourSky mosaic engine, we believe this architecture should be applicable for front ends to other space science applications and, with little modification, to planetary science applications as well.

References:

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[2] P.Z. Kunszt, A.S. Szalay, I. Csabai and A.R. Thakar, The Indexing of the SDSS Science Archive , Proceedings of ADASS IX, Kona, HI, Oct., 1999.

O6.5   Scoping the UK s Virtual Observatory: AstroGrid s Key Science Drivers and Impact on System Design

Nicholas A Walton (Institute of Astronomy, Cambridge, UK) Andrew Lawrence (Institute for Astronomy, Edinburgh, UK) Tony Linde (Dept. Physics & Astronomy, Leicester, UK)

AstroGrid (see http://www.astrogrid.org), a UK eScience project with collaborating groups drawn from the major UK data archive centres, is creating the UK s first virtual observatory. AstroGrid is aiming to support a broad spectrum of astronomical activity, with an initial emphasis on meeting the needs expressed by the UK community. AstroGrid is aiming to balance the scientific requirements of a wide community which spans the Astronomy, Solar and STP areas.

This paper discusses how the AstroGrid project has captured a well scoped set of key science drivers. These represent a number of currently topical scientific areas where access to capabilities promised by a virtual observatory will make a significant impact on the researchers abilities to progress in these areas. At the same time, the tools and facilities developed to support these drivers will be employable in addressing a wider range of astronomical science problems. The drivers cover aspects of astronomy ranging from facilitating access to large scale survey data sets to speed the discovery of galaxy clusters, through understanding the onset of solar magnetic storms via the analysis of multi-sourced STP data sets.

This paper further describes the process by which the AstroGrid architecture has been formulated. Note is made of the interactive mechanisms provided by the project, linked from http://www.astrogrid.org. In particular the AstroGrid Wiki at http://wiki.astrogrid.org is highlighted as an excellent medium with which to capture user requirements and to disseminate back project developments via, for instance, meeting notes, architecture and other discussions.

The paper closes by noting how the science drivers have been used to determine the system design required to deliver the capabilities that AstroGrid will provide to its community by the end of its three year project lifetime.

DATA MANAGEMENT

O7.1   Data Management for the VO (*Invited*)

Patrick Dowler (CADC)

The Canadian Astronomy Data Centre has developed a a general purpose scientific data warehouse system and an API for accessing it.

The Catalog API defines a general mechanism for exploring and querying scientific content using a constraint-based design. The API provides access to separate but related catalogs and allows for entries in one catalog to be related to (usually derived from) entries in another catalog. The purpose of the API is to provide storage-neutral and content-neutral access methods to scientific data. The API defines a network-accessible Jini service.

We have implemented several instances of the warehouse to store related catalogs: the pixel catalog provides uniform access to our many archival data holdings, the source catalog stores the results of image analysis, and the processing catalog stores metadata describing exactly how sources are extracted from pixel data so that all results are reproducible. Thus, entries in the source catalog are connected to entries in the processing and pixel catalogs from which they are derived.

O7.2   The NRAO End-to-End (e2e) Project

Tim Cornwell, John Benson, Boyd Waters, Honglin Ye (NRAO)

The NRAO End-to-End (e2e) project has the goal of providing automated, streamlined handling of radio observations on NRAO telescopes all the way from proposal submission to archive access. Thus e2e will ease the use of NRAO telescopes both for expert radio astronomers and novices. The latter is particularly important in attracting new people to the use of NRAO telescopes. E2e must include new capabilities in the areas of proposal submission and handling, scripting of observations, scheduling (both conventional and dynamic), pipeline processing, and archive access. The project was initiated in July 2001 and has just completed the first cycle of development. To track and minimize the risk in our software development, we have chosen to adopt a spiral model, whereby a complete development cycle (from inception to testing and deployment) is completed in 9 months and thence repeated, hopefully learning more and more as we proceed. We expect to complete seven such cycles in the project, delivering new capabilities with each cycle.

The resources available are limited, thus placing a premium on careful costing, planning and scheduling, as well as reuse. We are endeavoring to reuse as much as possible, and so much of our work has been based in AIPS++. With this approach, a prototype archive has been completed with about 1 FTE-year of effort. We are placing an emphasis on early and frequent deployment, and so the archive prototype will be deployed for use with the VLA later this year, with deployment for GBT and VLBA planned for 2003. In the area of database access and presentation, we have developed

a Calibrator Source tool that can be used by astronomers to find suitable calibrator sources for synthesis observations. This also will be deployed later this year.

O7.3   Data Organization in the SDSS Data Release 1

Ani Thakar, Alex Szalay (JHU) Jim Gray (Microsoft BARC) Chris Stoughton (FNAL)

The first official public data release from the Sloan Digital Sky Survey (Data Release 1 or DR1) is scheduled for January 2003. Due to the unprecedented size and complexity of the datasets involved, we face unique challenges in organizing and distributing the data to a large user community. We discuss the data organization, the archive loading and backup strategy, and the data mining tools that we plan to offer to the public and the astronomical community, in the overall context of large databases and the VO.

It was originally thought that the catalog data would be a fraction of the size of the raw data, which is expected to be several Tb. However, with the multiple versions and data products of the catalog data that will be simultaneously maintained and distributed, it now appears that the size of the catalog data will indeed be comparable to that of the raw data, and organizing and loading it will be quite a daunting task.

The DR1 archive will be organized in multiple Microsoft SQL Server relational databases residing on a Windows cluster and logically linked to each other. There will be two calibrations (reruns) of the primary dataset available at any given time: the target rerun, from which the spectroscopic targets were selected, and the best rerun, which is usually the latest-greatest rerun. The third dataset will be the spectra. In addition to the live datasets, there will be hot spares and offline backups, and a legacy database will preserve all versions of the data served to date.

The raw data is stored at FermiLab on a LINUX cluster, so it must be loaded across a LINUX/Windows interface. We have attempted to automate the loading and validation process as much as possible using a combination of perl scripts on the LINUX side and VB scripts and DTS packages on the Windows side. Each step of the loading and validation process is logged in a log database. A separate poster discusses the SDSS DR1 storage configuration.

To facilitate data mining in the DR1 archive, we have a variety of interfaces available that allow users to run sophisticated SQL queries on the datasets as well as browse the data using web-based explore and navigation tools. Additionally, we have built a Hierarchical Triangular Mesh (HTM) spatial index into the SQL Server databases for fast spatial lookups and constructed a neighbors table for fast nearest-neighbor searches.

O7.4   HDX Data Model - FITS, NDF and XML implementation

David Giaretta, Mark Taylor, Peter Draper, Norman Gray, Brian McIlwrath (Starlink)

A highly adaptable data model, HDX, based on the concepts embodied in FITS, various proposed XML-based formats, as well as Starlink s NDF and HDS will be

described, together with the Java software that has been developed to support it. This follows on from the presentation given at ADASS 2001.

The aim is to provide a flexible model which is compatible FITS, can be extended to accommodate VO requirements, but which maintains enough mandatory structure to make application-level interoperability relatively easy. The implementation provides HDX factories and lower level data access classes allow a great deal of flexibility, in particular single FITS files can be regarded as HDX files, as can complex structures made up of XML and FITS and HDS components. It can also deal with distributed, large, datasets.

OPTIMIZING SCIENCE

O8.1   New Science with LIGO: Past, Present and Future (*Invited*)

Kent Blackburn (California Institute of Technology)

Significant analysis of data from LIGO s laser interferometric gravitational wave detector project began with a 25-hour stretch of data collected from its 40-meter prototype instrument located on the Caltech campus in 1994. Since then, construction of LIGO s 4-kilometer laser interferometric gravitational wave observatories in the states of Louisiana and Washington has been completed. Beginning in the spring of 2000, a series of multi-day engineering runs using these new multi-kilometer interferometers have collected 40 terabytes of data. The seventh of these engineering runs, also known as the upper limits run, collected data from both observatories continuously for a 17-day span in late 2001 and early 2002. During this upper limits run, data was analyzed in near real time for instrumental effects, terrestrial effects and astrophysical bursts and binary inspirals. After the data were collected, analyses for stochastic and periodic gravitational wave signals began. To handle the large data analysis requirement of LIGO data, each of the observatories along with MIT and Caltech have been equipped with distributed computer systems known as LDAS. These systems use custom software to integrate concurrent job control, parallel compute clusters and databases, managing the continuous data analysis requirements in near real time or better. LIGO will begin its first scientific run in late summer of 2002. LDAS again will be utilized to carry out scientific searches for gravitational waves as LIGO endeavors to open this new window on the universe.

O8.2   AstroVirgil: Interactive X-ray Analysis for EPO and First Look

Steve McDonald (University of Massachusetts at Boston and Silicon Spaceships)
Srikanth Buddha (University of Massachusetts at Boston)

This paper reviews AstroVirgil, a user friendly program for the analysis Chandra event files. AstroVirgil integrates photon filtering and visualization into a single GUI based tool. Photons can be filtered based spatial position (in multiple coordinate systems), photon energy level (using multiple measures) or time of arrival using various custom GUI panels. Filtered photons can be displayed as images, a spectrums or a lightcurves. Each display can be adjusted and improved using a variety of GUI controls. Many existing Chandra tools use a command line interface. This paper reviews some of the performance and memory consequences of performing non-disk file based processing.

It is hoped that a user friendly, GUI based, platform independent tool can reach broader community than traditional high-end Chandra tools. The initial evaluation from both amateur astronomers and the educational community will be discussed.

AstroVirgil is GPLed pure Java program. It is built on top of JSky, a collection of reusable Java components developed at the ESO and first described at ADASS 99. It is available at www.SiliconSpaceships.com.

O8.3 An End-to-End Architecture for Science Goal Driven Observing

Anuradha Koratkar (STScI) Sandy Grosvenor, Jeremy Jones (NASA/GSFC)
Karl Wolf (Aquilent, Inc.)

Many of the upcoming missions will not only have better detectors, greater on-board storage capacity, and on-board processing capabilities, they will also generate vast volumes of data. Although significant research and development efforts are underway to increase the download capacities, it is prudent to use the available bandwidth efficiently. The transmission efficiency of large data volumes is critical because, even when we have the high bandwidth it will come at a cost. The cost of downlink time and limitations of bandwidth will end the era where all exposure data is downloaded and all data processing is performed on the ground.

In addition, observing campaigns involving inherently variable targets will need scheduling flexibility to focus observing time and data download on exposures that are scientifically interesting. The ability to quickly recognize and react to such events by re-prioritizing the observing schedule will be an essential characteristic for maximizing scientific returns. It will also be a step towards increasing spacecraft autonomy, a major goal of NASAs strategic plan.

The science goal monitoring (SGM) system is a proof-of-concept effort to address these challenges. The SGM will have an interface to help capture higher level science goals from the scientists and translate them into a flexible observing strategy that SGM can execute and monitor. We are developing an interactive distributed system that will use on-board processing and storage combined with event-driven interfaces with ground-based processing and operations, to enable fast re-prioritization of observing schedules, and to minimize time spent on non-optimized observations.

This talk will focus on our strategy for developing SGM and the technical challenges that we have encountered. The SGM architecture and interfaces are designed for easy adaptability to other observing platforms, including ground-based systems and to work with different scheduling and pipeline processing systems.

O8.4 Small Theory Data and the Virtual Observatory

Jonathan McDowell (SAO)

The integration of large theoretical simulation archives with the VO has been widely discussed. I suggest it is also important to include smaller theoretical datasets and functional relationships in a structured way, and outline some possible standards.

First, I discuss metadata for simulations by drawing an analogy with X-ray spectral analysis, a domain in which complex new theoretical models have been rapidly integrated with the standard data analysis tools via a simple parameterized-function description. This paradigm can easily be extended to image simulations.

Secondly, I address the issue of resource discovery for tabular and functional theoretical and phenomenological results such as extinction laws, luminosity functions, isoch-

rones, and distance indicators. A structured extension of the CDS concept of UCDs could make tabular data of this kind easily available not only to astronomers but also to interoperable software.

O8.5   Federating Catalogs and Interfacing Them with Archives: A VO Prototype

Douglas J. Mink, Michael J. Kurtz (SAO)

A common scientific requirement is to perform a joint query on two or more remote catalogs, then use the resulting combined catalog as input to query an archive or catalog. We have developed techniques which enable the routine federation of several of the largest astrometric and photometric catalogs from either in-house or remote copies, and use this federated output to query the several archives of spectral and imaging data which we either manage or maintain local copies of.

Allowing the federation of arbitrary sections of large catalogs, with user defined match criteria; and then allowing this result to be used to query several large archives of spectral and imaging data (also subject to user constraints) is a key goal of all VO projects. The problems we have solved in developing our methods will also have to be addressed by any VO project which delivers similar capabilities.

CALIBRATION

O9.1 Calibration of Space IR Arrays (*Invited*)

M. Dickinson (STScI)

No abstract provided.

O9.2 Uncertainty Estimation & Propagation in SIRTF Pipelines (*Invited*)

Mehrdad Moshir, John Fowler, David Henderson, (SSC/Caltech/JPL)

In the course of reducing raw data from SIRTF into properly calibrated science products, many automated pipelines are utilized. In a typical pipeline, instrumental signatures are successively removed and previously computed calibration values are applied. For such a large-scale automated process one needs to assess quantitatively the results of data reduction to facilitate quality assessment, for example to verify that requirements are met. Furthermore, higher level science products such as point source extraction or mosaicking are dependent on trustable estimates of uncertainties in the data. In addition, it is essential that the end-user is supplied with statistically meaningful measures of confidence in the quoted fluxes or positions to allow full scientific utilization. For these reasons all of SIRTF pipelines have been designed to estimate and propagate uncertainties in each step. This paper will discuss the methods that we have adopted for estimating and propagating uncertainties. Our approach has been based on sound statistical reasoning while taking into account the implications of inherent uncertainties in the characterization of the instrumental signatures that we are trying to remove.

VO INTEROPERABILITY

O10.1 SkyQuery - A Prototype Distributed Query Web Service for the VO

Tamas Budavari, Tanu Malik, Alex Szalay, Ani Thakar, (JHU) Jim Gray (Microsoft Research)

We present SkyQuery, a prototype distributed query and cross-matching service for the VO community. SkyQuery enables astronomers to run combined queries on existing heterogeneous astronomy archives. SkyQuery provides a simple, user-friendly interface to run distributed queries over the federation of registered astronomical archives in the VO. SkyQuery not only provides location transparency, but also takes care of vertical fragmentation of the data and runs the query efficiently to minimize query execution costs.

The SkyQuery client connects to the portal, which is an XML Web Service. The portal farms the query out to the individual archives, which are also accessible via Web Services called SkyNodes. The cross-matching algorithm is run recursively on each SkyNode. Each archive is a relational DBMS with a HTM (Hierarchical Triangular Mesh) index built in for fast spatial lookups. The results of the distributed query are returned as an XML DataSet that is automatically rendered by the client. SkyQuery client web application also displays the image cutout corresponding to the query result.

The importance of a service like SkyQuery for the worldwide astronomical community cannot be overstated: scientific data on the same astronomical objects residing in various archives are mapped in different wavelength ranges and look very different due to the different errors, instrument sensitivities and other peculiarities of the data acquisition and calibration processes used for each archive. Our cross-matching algorithm preforms a probabilistic spatial join across multiple catalogs. This is far from a solved problem in astronomy - indeed, this type of cross-matching is currently often done by eye, one object at a time. Even if we built a static cross-identification table for a set of archives, it would become obsolete by the time we finished building it - the exponential rate of growth of astronomical data means that a dynamic cross-identification mechanism like SkyQuery is the only viable option. Finally, it should be noted that finding non-matches (dropouts) between datasets - objects that exist in some of the catalogs but not in others - is often as important as finding matches, and SkyQuery provides that capability.

O10.2 Why Indexing the Sky is Desirable

Patricio F. Ortiz (Leicester University)

Indexing the sky is a database-oriented term to indicate a partitioning scheme of the celestial sphere in order to achieve better performance in queries involving finding close neighbors (cone search, cross correlations amongst catalogues, etc.). Several schemes have been proposed (HTM, HEALPix, quasi-equal area tiles , cubic projec-

tion, etc.), and their use has been kept hidden from a more massive use. The scientific value of the internal indexation files is much higher though, as they keep track of the source density of catalogues allowing to answer a family of questions not easily handled by a standard DB system and providing an unusual visual aid: a snapshot of the location of sources listed in any catalog. The pros and cons of adopting an VO-oriented indexation scheme are analyzed.

O10.3 Quantum Topic Maps: A Physicist s View of the Information Universe

Nikita Ogievetsky (Cogitech, Inc.)

It is a continuation of work on RDF Topic Maps presented at Extreme 2001 [1] and KT2002 [2]; Quantum Topic Maps provide a very concise and intuitive way to represent experimental data. By experiment here we assume any examination or inquiry in experimental physics, other natural sciences, or any type of investigation whatsoever in the real world in general.

It will be shown how Quantum Topic Maps can be validated against DAML-OIL ontology.

[1] http://www.cogx.com/xtm2rdf/extreme2001
[2] http://www.cogx.com/kt2002/

O10.4 A New Way of Joining Source Catalogs using a Relational DBMS

Clive Page (University of Leicester)

As part of the AstroGrid and AVO projects we have been examining the facilities of a number of free and commercial DBMS for astronomical data processing, especially the handling of large source catalogs.

One particularly important operation is the cross-matching of sources in different catalogs, this being an important precursor to a wide range of data mining operations. This operation, sometimes called the fuzzy join, is difficult because it needs a match of spatial coordinates within the combined error radius. Unfortunately spatial-indexing rarely comes as standard, and even where it does (e.g. in PostgreSQL), R-trees do not cope well with the singularities in spherical-polar coordinate systems. A new algorithm is proposed here which makes use of a pixelation of the sky using, for example, HTM or HEALPix. This allows the use of a simple equi-join on integers, well within the capability of SQL on any relational DBMS. Using PostgreSQL it has been possible to compare the new PCODE method with the traditional approach based on R-tree indexing. A number of other results from our evaluations are also reported.

O10.5   A Bit of GLUe for the VO: Aladin Experience

Pierre Fernique, Andre Schaaff, Francois Bonnarel, Thomas Boch (CDS)

Aladin is now widely known as a tool to display and cross-match heterogeneous data and images anticipating future VO portals. It offers transparent access to Simbad, VizieR, NED, SkyView, SuperCosmos, NVSS and FIRST, as well as archive logs such as CFHT, Chandra, HST, HUT, ISO, IUE and Merlin. For each of these servers, Aladin knows how to access them, the required query syntax, the list of query parameters, and the fastest mirror site. This knowledge database is automatically updated by taking advantage of the GLU system on which Aladin is based.

We present in this article how the GLU system allows Aladin to integrate in an unique interface, several image and data servers. We describe how it works, how it is updated and how it is implemented in this java applet context.

We also present the evolutions we foresee in the GLU system in order to interact with the emerging web services like UDDI, WSDL...

O10.6   Interoperability of the ISO Data Archive and the XMM-NEWTON Science Archive

Christophe Arviset, John Dowson, Jose Hernandez, Pedro Osuna, Aurele Venet (ESA)

The ISO Data Archive (IDA) and the XMM-Newton Science Archive (XSA) have been developed by the Science Operations and Data Systems Division in Villafranca, Spain. They are both built using the same flexible and modular 3-tier architecture: (Data Products and Database, Business Logic, User Interface). This open architecture, together with Java and XML technology have helped in making the IDA and XSA inter-operable with other archives and applications.
Inter-operability has been achieved from these archives to external archives through:
* target name resolution with NED and SIMBAD
* access to electronic articles through ADS
* access to IRAS data through the IRSA server

Moreover, direct access to ISO and XMM-Newton data is provided, bypassing the standard user interface. The observation / exposure log is given to external archives or application together with a mechanism to access data via a Java Server Page. Later development will be described in particular the so-called Postcard and Product Server. This is currently available from:
* the ADS WWW, that give then access to the data from the articles
* the CDS / Vizier catalogue
* the IRSA ISO Visualizer
* HEASARC archive

The ISO Data Archive can be accessed at: http://www.iso.vilspa.esa.es/ida

The XMM-NEWTON Science Archive can be accessed at:
http://xmm.vilspa.esa.es/xsa

Posters

VO/ARCHIVES

P1.1 Metadata for the VO: the Case of UCDs

Sebastien Derriere, Francois Ochsenbein, Thomas Boch (CDS - Observatoire de Strasbourg)

The UCDs (Unified Content Descriptors) were first developed in the ESO/CDS data mining project, to describe precisely the contents of the individual fields (columns) of tables available from a data center. They have been used to describe the content of the 10^5 columns available in the different VizieR tables.

Owing to the wide diversity and high heterogeneity of table contents, UCDs constitute an excellent starting point for a hierarchical description of astronomy, for general data mining purposes.

We present different applications of UCDs: selection of catalogues, based on their content; identification of catalogues having similar fields; automated data conversion allowing direct comparison of data in cross-identifications. The compatibility of UCDs with semantic descriptions developed in other contexts (data models for space-time coordinates or image datasets) will also be addressed.

P1.2 Russian and fSU Resources to be Integrated in the IVO

A. Kilpio, O. Dluzhnevskaya, E. Kilpio, D. Kovaleva, O. Malkov

The first collection of many Russian and fSU resources of astronomical data accumulated in Russian observatories and institutions has been compiled. As a first step we plan to provide a transparent access to these resources for scientific and educational purposes in the frame of the Russian Virtual Observatory (RVO) project. The collection of the astronomical resources is updated constantly. We evaluate the quality of the resources, in particular, by conducting the expert analysis. Another important goal of the RVO project is to elaborate the method of information representation based on well-known and accepted standards, as well as to provide the new ones.

The Russian Centre for Astronomical Data (CAD) staff will carry out the activities on construction of the information hub of the Russian Virtual Observatory and on integration Russian and fSU resources in the International Virtual Observatory. CAD is one of the general purpose data centers for astronomy world-wide. CAD has been systematically collecting and distributing astronomical data for more than 20 years.

P1.3   The MAST Pointings Tables Project

K. Levay, P. Padovani, R. Thompson, M. Donahue, M. Corbin (STScI)

We have undertaken a project to create a database of all HST imaging observations organized by position on the sky. A web-based interface to this database has also been created, in supplement to the existing interface to the HST archive. These pointings tables enable quick identification of overlapping fields that can be used for multiwavelength studies of objects, and for variability studies by comparing images at a given pointing over different epochs. They will also allow for minisurveys by providing lists of images over a specified coordinate range, such as above and below the Galactic plane. We plan to develop pointings tables for other MAST missions besides HST, and expect these tables to form an important part of upcoming virtual observatories.

P1.4   Towards an AVO Interoperability Prototype.

Mark G. Allen, F. Genova, F. Ochsenbein, S. Derriere, C. Arviset, P. Didelon, S. Garrington, R. Mann, A. Micol, A. Richards, G. Rixon, A. Wicenec, M. Dolensky

As part of the Astrophysical Virtual Observatory (AVO) we are developing an interoperability prototype which aims to federate a set of astronomical archives, representative of a variety of techniques (space/ground, images/spectra, X-ray to Radio wavelengths) into the CDS VizieR and Aladin tools. The target archives for federation are: VLT, NTT, EIS (ESO), HST/ECF, ISO, XMM (ESA), Wide field UK archives, MERLIN, and Terapix. We demonstrate the interoperability of these federated archives with science examples using multiwavelength image data and catalog overlays, and highlight new functionalities of the federation and integration tools.

P1.5   The AXAF (Chandra) Guide and Acquisition Star Catalog V1.5 (AGASC 1.5)

Dennis Schmidt, Paul Green (SAO)

Chandra s Aspect Camera Assembly (ACA) measures positions of selected stars to acquire and hold target pointings, and for post facto aspect determination. The selection and matching of the guide stars is governed by data in the AXAF (Chandra) Guide and Acquisition Star Catalog (AGASC). Based originally on version 1.1 of the Guide Star Catalog for the Hubble Space Telescope, the AGASC has been extended and refined in several stages, with data from additional catalogs and with recalibrations based on experience with Chandra.

In 2002 the Chandra X-ray Center (CXC) completed a major upgrade of the AGASC. We merged data from three catalogs -- Tycho-2, GSC-ACT, and 2MASS. The Tycho-2 data substantially improve the photometric and astrometric measurements of stars as faint as V=12, while the GSC-ACT merge decreases by about half the systematic astrometric errors down to the catalog limit of about V=14.5. The 2MASS data identify galaxies down to J=12.5. These new catalog data enhance the value of the

AGASC for scientific as well as operational purposes.

Specifically for Chandra s use of the AGASC, we recalibrated the estimated ACA magnitudes based on Chandra on-orbit measurements, and implemented a more sophisticated calculation of the effect of nearby stars on the best-fit centroid of a guide star.

In the process of the upgrade, we encountered and corrected a variety of errors introduced in earlier merges from published source catalogs.

This paper presents the rationale for and the process of making each of the changes. It then discusses the improvements in performance that we expect to result.

This project is supported by the Chandra X-ray Center under NASA contract NAS8-39073.

P1.6 SkyDOT: A Publicly Accessible Variability Database, Containing Multiple Sky Surveys and Real-Time Data.

Dan Starr, Przemek Wozniak, W. Thomas Vestrand, Robert White (LANL)

The Sky Database for Objects in Time-Domain (SkyDOT) is a virtual observatory which allows general access to several massive variability surveys. Although initially intended publicly release the data from Los Alamos s RAPTOR project, this database now includes data sets from both OGLE II and ROTSE I. SkyDOT s emphasis on time derivative data is enhanced by its update with real-time RAPTOR data. This enables user access to the most recent measurements of a given object, as well as its variability history.

Our main task has been to construct an efficient relational database containing all existing data, while also handling a real-time influx of data. We provide useful web tools, which allow easy access to both astronomers and the public. In our implementation we employ a PostgreSQL database with a PHP based web interface. This server will initially allow common searches, specific queries, and access to light curves. In the future we will include: machine learning classification tools and access to spectral information.

P1.7 OASIS: A Data Fusion System Optimized for Access to Distributed Archives

J.C. Good, Mih-seh Kong, G.B. Berriman

The On-Line Archive Science Information Services (OASIS) client is accessible as a JAVA applet / JAR file through the NASA/IPAC Infrared Science Archive home page. It uses Geographical Information System (GIS) technology to provide data fusion and interaction services for astronomers. These services include the ability to process and display arbitrarily large image files, and user-controlled contouring, overlay regeneration and multi-table/image interactions.

OASIS has been optimized for access to distributed archives and data sets. It provides a mechanism that enables access to OASIS from third-party services and data providers. That is, any data provider who creates a query form to an archive containing a collection of data (images, catalogs, spectra) can direct the result files from the query into OASIS. Similarly, data providers who serve links to datasets or remote services on a web page can access all of these data with one instance of OASIS. In this way any data or service provider is given access to the full suite of capabilities of OASIS. We illustrate the third-party access feature with two examples: queries to the high-energy image datasets accessible from GSFC SkyView, and links to data that are returned from a target-based query to the NASA Extragalactic Database (NED).

OASIS also includes a file-transfer manager that reports the status of multiple asynchronous data downloads from remote sources to the client machine. It is a prototype for a request management system that will ultimately control and manage compute-intensive jobs submitted through OASIS to computing grids, such as requests for large scale image mosaics and bulk statistical analysis.

P1.8　　　　A Web-based Tool for SDSS and 2MASS Database Searches

Marci Hendrickson, Alan Uomoto, David Golimowski (JHU)

We have developed a website using HTML, PHP, Python, and MySQL that analyzes data from the Sloan Digital Sky Survey (SDSS) and the Two-Micron All-Sky Survey (2MASS). The goal of this project is to locate brown dwarf candidates in the SDSS database by looking at color cuts; however, this site could also be useful for other targeted searches of the two databases as well as being a prototype for easily implemented, customized searches of other large databases.

The site uses MySQL databases created from broad searches of SDSS and 2MASS data, retrieving specified information. The broad queries on the SDSS and 2MASS database servers are run weekly so observers have the most up-to-date information from which to select their observational candidates. Observers can look at detailed information about specific objects, including finding charts, images, and, when available, spectra. In addition, updates from previous observations can be added by any collaborators; this format makes observational collaboration simple. Observers can also restrict the database search, just before or during an observing run, to select objects of special interest.

P1.9　　　　Storage Options for Large VO Archives - The SDSS DR1 Experience

Jan vandenBerg, Alex Szalay (JHU) Jim Gray (Microsoft BARC) Ani Thakar (JHU)

We report on our experiences with evaluating storage hardware and firmware options for the SDSS Data Release 1 (DR1) archive. The unprecedented size of this archive presents daunting challenges with respect to storage of multiple datasets and providing high availability and performance to a large user community. Not only are the datasets large and complex, but the need to maintain several versions simultaneously

and ensure the I/O speeds necessary for efficient data mining means that we are always pushing the envelope in terms of the available storage hardware.

This is not meant to be an exhaustive thesis on the available options and technology for large archive storage. However, since we have spent considerable time in evaluating and choosing the storage options for DR1, we felt that the knowledge and insights that we have gained in the process will be useful to other groups that plan to publish or mirror large astronomical archives for the VO community in the near future.

P1.10 Digital Access to Aero- and Astrophotographic Archives

J.-P. De Cuyper

The aim of this test-bed project, initiated and financed by the Belgian Federal Government, is to acquire, within the coming 4 years, the necessary know-how, hardware and software in order to preserve the historic scientific information contained in aero- and astrophotographic archives; to provide user-friendly internet access to the catalogue and the (meta)data and to make the photographic information scientifically exploitable again through a high resolution digitisation technique. We are constructing a high accuracy scanner XY airbearing table with laser interferometer steering, giving sub-micrometer absolute positioning accuracy, in order to attain the limiting positional accuracy determined by the internal plate errors.

The archives concerned are the astrophotographic plate archive of the Royal Observatory of Belgium and the aerophotographic images of the National Geographic Institute and of the Royal Museum of Central Africa (Congo, Rwanda, Burundi). All contain photographs on glass plates as well as on film sheets.

The technique of first making an analogue copy on roll film, allowing unattended all time scanning, will be studied in detail, as well as the photochemical treatment of fungi and deteriorations, in order to determine the introduced geometric and radiometric deformations. A digital catalogue is generated in a ODBC database that is to be distributed on intranet and internet (html files, ActiveX objects, C++ and Javascript programmation).

P1.11 Construction of the Japanese Virtual Observatory (JVO)

Yoshihiko Mizumoto, Masatoshi Ohishi, Naoki Yasuda, Yuji Shirasaki, Masahiro Tanaka (NAOJ) Yoshifumi Masunaga (Ochanomizu Univ. and NAOJ) Ken Miura, Hirokuni Monzen, Kenji Kawarai, Yasuhide Ishihara, Yasushi Yamaguchi, Youji Yanaka (Fujitsu Ltd.)

The National Astronomical Observatory of Japan (NAOJ) has been operating several large astronomical facilities, such as the SUBARU telescope in Hawaii, the 45 m radio telescope and the Nobeyama Millimeter Array in Nobeyama, Japan, and plans to construct the Atacama Large Millimeter Array in Chile under close collaborations with astronomers in the US and the EU. Since January 2002, the NAOJ has been connected to the SuperSINET with 10 Gbps, and it has become possible to provide huge amount of observed multi-color data and analyses facilities to other astronomical

institutions not only in Japan but in other countries through SuperSINET. Thus we have started the Japanese Virtual Observatory (JVO) project since April 2002 (see, http://jvo.nao.ac.jp/index-e.html). JVO utilizes the Grid technology to combine several remote computational facilities (observed databases in Hawaii and in several locations in Japan, servers for the data analyses, machines for data mining, etc.). We have completed to define the query language for the JVO, and have been designing on the deployment of JVO components (user interfaces, manager for virtual observations, execution modules to perform virtual observations, registries to resolve observation information, etc.). We plan to construct a JVO-prototype by the end of 2002.

P1.12 The NOAO Science Archive, Version 2.0

R. Seaman, N. Zarate, T. Lauer, P. Warner (NOAO)

The NOAO Science Archive (NSA) is a step toward building a comprehensive scientific archive of the optical and infrared data holdings of the National Optical Astronomy Observatory. The goals for the NSA are to:

- Rapidly create a scientifically useful archive of NOAO Survey data,
- Develop in-house expertise in the relevant technologies,
- Identify requirements for NOAO s future comprehensive archive, and
- Create a high level of visibility as well as utility for both the NOAO Archive and NOAO Surveys, for example, through new Web services.

The holdings of the NSA (http://archive.noao.edu) will be drawn from the NOAO Survey projects (http://www.noao.edu/gateway/surveys/programs.html) as well as from other coherent imaging or spectral, optical/IR reduced datasets that may be identified as candidates from NOAO or community facilities. Catalogs and other derived data products will be included in addition to images, spectra and the tools necessary to evaluate them. Synoptic, time-domain data is a special focus in anticipation of the needs of the LSST. The NSA team is working in coordination with other groups at NOAO who are focusing on data handling and data pipeline systems.

Planning for the NSA was started in November of 2001 by the Science Data Systems Group of the NOAO Data Products Program. Version 1.0 of the NSA was released in early April, version 1.1 in July and version 1.2 in October of 2002. We discuss plans for Version 2.0 of NSA to be released in January of 2003.

WEB SERVICES/PUBLICATIONS/OUTREACH

P2.1 ADS Web Services for the Discovery and Linking of Bibliographic Records

Alberto Accomazzi, Guenther Eichhorn, Carolyn S. Grant, Michael J. Kurtz, Stephen S. Murray (Harvard-Smithsonian Center for Astrophysics)

The NASA Astrophysics Data System (ADS) currently provides free access to over 2.5 million records in four bibliographic databases through a sophisticated search interface. In addition to the basic metadata about a published paper, the ADS provides links to any relevant on-line resources, including full-text articles and published data tables. Similarly, an increasingly larger number of publishers and institutions are using the ADS to verify the existence and availability of references published in the scientific literature. To facilitate the exchange of metadata necessary to establish these links, the ADS is developing prototype Web Services based on emerging industry standards such as SOAP and WSDL as part of a collaboration with the major NASA Astrophysics Data Centers. Some examples illustrating the use of this technology in resource discovery, sharing and validation are presented and discussed. The ADS is funded by NASA Grant NCC5-189.

P2.2 Web Services in AIPS++

B. Waters, J. Benson, T. Cornwell

The richness and transparency of the Glish distributed-computing model has traditionally obviated the need for standard networking components, such as the network classes found in Java, Python, or Perl. However, Glish is able to wrap arbitrary commands, enabling us to link powerful Java-based toolkits to Glish s event-based, client-server processing model. We have used this technique to implement a SOAP-based Cone Search web service for the Virtual Observatory.

P2.3 Turning Besan on Observatory On-line Facilities into the VO - Galactic Model Simulation, Binary Star, Molecular Collisional and TNO Data Bases

Bernard Debray (Besan on Observatory) Marie-Lise Dubernet-Tuckey (LERMA, Paris Observatory and University of Franche-Comt) Alain Grosjean, Edouard Oblak, Jean-Marc Petit, C line Reyl , Annie Robin (Besan on Observatory)

For several years, the Besan on Observatory has been developing scientific facilities that are, or will be in the near future, accessible on-line through the World-Wide Web, namely:
• the Model of stellar population synthesis of the Galaxy which produces simulations of the stellar content in various galactic directions, suitable for observation preparations and interpretations;

- the Double and Multiple Star data base for retrieval of data on all observational categories of binaries;
- the Molecular Collisional data base for ro-vibrational bibliographic data and H_2O+H_2 collisional excitation rates which is to be used for the Herschel and ALMA projects;
- a database of discovery and recovery observations of TNOs and an unbiased sample of well determined orbits of these objects, in the framework of the Observatory s involvement in the scheduling and real-time processing of observations for the Ultra-Wide Ecliptic component of the CFHT Legacy Survey.

We describe how we envisage turning these facilities as elements of the Virtual Observatory mesh, by using, as a first step, emerging standards such as VOTables and Unified Column Descriptors (UCD).

P2.4 Manuscript Preparation, Submission and Features of the Electronic IBVS

Andras Holl (Konkoly Observatory, Budapest, Hungary)

IBVS is a small journal in the field of variable star research, which is fully electronic now. The HTML version of the journal features object database links and reference links. The necessary markup is provided by the authors, using the macros implemented in the LaTeX style file. We are testing a web-based manuscript submission tool, which would enable authors to submit data files, draw or upload simple figures, and enter plain ASCII or LaTeX text. The text is typeset on the server. The submitted manuscript can be pre-viewed, and links tested by the authors themselves. The markup has been designed to facilitate automatic information exchange between the journal and databases.

A short description is given on the other features of the electronic IBVS.

P2.5 Web Services and their use in Starlink software

Mark Taylor, Roy Platon, Alan Chipperfield, Peter Draper, David Giaretta (Starlink)

Web Services are gaining great popularity in the Grid community, and with good reason. The Starlink project is adopting Web Services as the method of interapplication communication. This is being done natively in new Java-based applications while older applications are being wrapped to provide Web Service interfaces. We are in this way providing interoperability between the generations of software in a heterogeneous, distributed manner thereby allowing the Starlink software to be useable in a distributed environment such as the GRID.

P2.6 A Collaborative Extension to the Solar Web Tool

Romain Linsolas, Isabelle F. Scholl, Eric Legay (IAS)

The number of archives of solar observations is continuously growing and the location of their storage is more and more scattered. Consequently, the number of tools or websites existing for consulting these observation catalogs (i.e. metadata) is equally in augmentation. The interest of a single program capable of accessing distributed and heterogeneous archives is therefore obvious. The Solar Web Project, developed by the MEDOC IAS team, is clearly designed to come up to these expectations. It is a first step toward a Virtual Solar Observatory.

The architecture of the current version of Solar Web (which will be available soon at http://www.medoc-ias.u-psud.fr/archive/solar_web) is based on a 3-tier model. All clients are connected to a single server which provides them with results by querying all accessible databases. This centralized view can have a significant impact on security, performance and flexibility of policy management.

The main evolution of Solar Web consists in moving to a distributed architecture. In this purpose, two solutions are currently considered. The first solution is to create collaborative servers, where all instances of the Solar Web server are networked together, and make a collaborative work in the sense that a query sent by a client can be distributed to all servers. The second solution is built on top of peer-to-peer networks technology. It consists in redesigning the network level by using JXTA (Sun s peer-to-peer technology) infrastructure. This solution can easily provide new features such as the dynamic creation of groups of users based on their field of interest.

In this paper, we will present concepts for both solutions with their advantages and disadvantages.

P2.7 The ADASS XII Meeting Web Site

Carolyn Liou (University of Maryland/STScI) Steve Hulbert (STScI)

We present the architecture, design, and implementation details of the ADASS XII web site. The web site was implemented in Zope, a high-performance application server, web server, and content management system rolled into one. Zope includes a robust, scalable object database, web services architecture, and powerful programming capabilities. The web site was built to conform to HTML, CSS, and accessibility standards as adopted by the W3C. This dynamic web site also taps into a back-end Sybase database while requiring a minimal amount of coding. We offer this site as a prototype web site suitable for reuse in supporting future ADASS meetings.

This site was created by the Information Services Team of the Computing and Information Services Division of Space Telescope Science Institute.

DATA ANALYSIS SOFTWARE AND SYSTEMS

P3.1 Synchronous Observations of Ground Based Optical and X-ray Space Born Telescopes

Alexei Pozanenko (IKI) Sergei Bondar (State Technical Research Center-Kosmoten) Grigorii Beskin (SAO) Marat Gilfano (IKI/MPA) Vasilij Rumyantsev (CrAO)

Simultaneous multiwavelength observations are critically important for understanding physical and astronomical properties of many celestial phenomena. We consider simultaneous X- ray/optical observations of two types of objects that are of particular importance for high energy astrophysics: cosmic gamma-ray bursts (GRB) and low mass x-ray binaries (LMXB).

An important task of optical transients observation requires continuous wide field telescope surveys. Based on available observations we discuss criteria of development optical wide- field camera and present the current status of the automatic telescope that is being developed at IKI for the purpose of simultaneous optical observations of GRBs counterparts. The instrument will have the FOV = 15 deg, and limiting magnitude 10.5 at 0.1 s exposure. The flow of successive frames will be stored and compared with catalog for on-line identification of optical transients. The post analysis of accumulated frames increase limiting magnitude of the system up to 14 magnitude. Subsequent cross-analysis with x-ray telescopes improves probability of transient identification. Simultaneous observation with X-ray camera at HETE-2 spacecraft would result in few cases per year of simultaneous observation of GRB error box.

We also discuss details of synchronous optical/X-ray observations of LMXBs with high time resolution using the 6m telescope at SAO and Rossi X-ray Timing Explorer. We report preliminary results on the optical observations with sub- millisecond time resolution of Sco X-1 and Cyg X-2 during the 2002. The observations were performed on the 6-meter telescope of Special Astrophysical Observatory (SAO) of with Multichannel Panoramic Photometer-Polarimeter in the primary focus and MANIA registration system with time resolution of 2 microsec.

P3.2 An Interactive Java Plotting Package for Astronomy

Anzhen Zhang, John Good, Bruce Berriman (IPAC/Caltech)

This paper describes the architecture and functionality of QtPlot, a general purpose 2-dimensional plotting package for astronomy. It is a modification of an Open Source Java Plotting package, PtPlot, version 5.1p1, made available by the Ptolemy project at the University of California. QtPlot is on operation at the Infrared Science Archive (IRSA), where it supports interactive plotting of spectra from the Submillimeter Wave Astronomical Satellite (SWAS), and light curves from the American Association of Variable Star Observers (AAVSO). It has also been integrated into OASIS, IRSAs data fusion toolkit. QtPlot displays local files and remote files through HTTP protocols. It supports ASCII table files and XML files, which have been structured for astronomical plot directives. QtPlot has a rich suite of user-controlled functions, for

modifying plot appearance (symbol, color etc.), plot boundaries, and annotation. Finally, QtPlot has a panning and zooming feature.

P3.3   SAS, the Scientific Analysis System of the XMM-Newton Observatory

Carlos Gabriel, Matteo Guainazzi (ESA / VILSPA) Fred Jansen, Uwe Lammers, Giuseppe Vacanti (ESA / ESTEC)

XMM-Newton, the most sensitive X-ray satellite ever built, is successfully operating since January 2000. It is providing the scientific astronomical community with the deepest X-ray images ever along more than two decades in energy (0.1-15 keV), as well as with high-resolution spectra (resolving power in the range 200-800) in the soft X-rays (0.5-2 keV). Simultaneous optical and UV coverage is ensured by the Optical Monitor on board.

The Scientific Analysis System (SAS) is a state-of-the-art interactive analysis package for the calibration and analysis of all the XMM-Newton data. It represents a combined effort of more than 30 scientific institutes in the world, coordinated by the Science Operation Center (Villafranca del Castillo, Spain) and the Science Survey Center (Leicester, UK).

Reduced and calibrated scientific products, directly usable for scientific analysis, are produced running SAS in a semi-automatic fashion by the SSC and distributed to the community.

A large and sophisticated part of the SAS is dedicated to make multidimensional data analysis easy, efficient and user friendly. This maximizes the exploitation of the basic four dimensional information (RA, DEC, energy and time) the XMM-Newton instruments are obtaining from each collected X-ray photon.

Special emphasis will be put on the high level quality control performed both on the software components as on the distributed data products. The large capabilities of the SAS will be demonstrated going over examples of scientific results achieved.

P3.4   XAssist: A System for the Automation of X-ray Astrophysics Analysis

Andrew Ptak (JHU) Richard Griffiths (CMU)

XAssist is a NASA AISR funded project for the automation of X-ray astrophysics, with emphasis on galaxies. It is nearing completion of its initially funded effort, and is working well for Chandra and ROSAT data. By the fall of 2002 ASCA processing should be well supported as well as initial support for XMM-Newton data. It is capable of data reprocessing, source detection, and preliminary spatial, temporal and spectral analysis for each source with sufficient counts. We intend XAssist to eventually become part of the NVO, and non-interactive access to tables at HEASARC is already implemented.

P3.5 Solving for Polarization Leakage in Radio Interferometers using Unpolarized Sources

Sanjay Bhatnagar (NRAO-Socorro,USA/NCRA-Pune,India) R.V. Urvashi (BITS-Pilani,India/NCRA-Pune,India) R. Nityanada (NCRA-Pune,India)

Polarization leakage in the antennas of a radio interferometer can occur due to mechanical imperfections or dipole mis-alignment or due to imperfect electronics. These leakages manifest themselves as closure errors in co-polar visibility measurements of unpolarized sources. For many working radio telescopes, these leakage amplitudes range from a few percent to as much as ten percent. Further, many telescopes offer lower integration times and/or larger number of frequency channels across the RF band for co-polar observations. Consequently, significant fraction of observations are done in co-polar mode. Computation of antenna based leakage gains using co-polar visibilities is therefore scientifically useful as well as valuable for debugging and calibrating the instrument.

This paper presents an algorithm for solving antenna based leakage gains in a radio interferometer using co-polar observations of unpolarized sources. Complex antenna gains and leakage gains, modeled as additive terms, are solved for simultaneously. An additional transformation of the solutions which maximizes the power in the antenna gains, then separates the leakage gains from the usual antenna gains. The algorithm is robust in the presence of RFI or otherwise corrupted data and was extensively tested with simulations and with controlled experiments with the Giant Meterwave Radio Telescope (GMRT). Degeneracy in the solutions due to the use of unpolarized sources is also discussed. Interpretation of the leakage gains on the Poincare sphere and the connection between the leakage induced closure phase and the Pancharatnam phase of optics is also discussed.

P3.6 Generalized Self-Calibration for Space VLBI Image Reconstruction

Sergey F. Likhachev

Generalized self-calibration (GSC) algorithm as a solution of a non-linear optimization problem is considered. The algorithm allows one to work easily with the first and the second derivatives of visibility function phases and amplitudes. This approach is important for high orbiting Space VLBI data processing. The implementation of the GSC algorithm for radio astronomy image restoration is shown. The comparison with other self-calibration algorithms is demonstrated. The GSC algorithm was implemented in the radio astronomy imaging software project Astro Space Locator (ASL) for Windows developed at the Astro Space Center.

P3.7 FUSE Flat-Field Calibration using Wavelets

Paul Barrett (STScI) Alex Fullerton (JHU)

This paper describes an investigation into using Wavelets to characterize and then to create FUSE flat-field calibration files. The basic approach is to transform the FUSE

ground flat data, which has a relatively high number of counts per pixel (~20) and uniform illumination, into the Flight Aligned Reference Frame (FARF). We apply wavelet techniques to enhance detector features in the ground and in-flight data by filtering and de-noising in the frequency and spatial domains. Small subarrays of the enhanced ground and in-flight flats are then cross-correlated over the entire image to determine the transformation matrix or the local offset in pixels between the two sets of data.

P3.8   Projecting 3-D Simulations Into Pseudo Observations

Alex Antunes, John Wallin (GMU)

We present methods for converting particle method three-dimensional simulations into observationally verifiable projected column densities, channel maps, fluxes, and velocity contours. Such projections are suitable for direct comparison with radio data (such as produced by AIPS), X-ray observations (e.g. ximage), optical, and IR. Whereas modeling usually involves NBody, mesh, SPH, or LPR calculations upon an idealized 3-D space, our observational data is always limited to a single line of sight projection, observing only one plane of the object, emission from which may or may not include extinction. For models to have any validity, we must be able to generate pseudo-observational data from the model, to compare with actual observations. This connects our modeling with the real universe we see; herein we discuss the methods for creating such projections.

P3.9   PacketLib: a C++ Library for Satellite Telemetry Oriented Applications

Andrea Bulgarelli, Fulvio Gianotti, Massimo Trifoglio (CNR/IASF Bologna)

PacketLib is a C++ open-source software library for writing applications which deal with satellite telemetry source packets, provided that the packets are compliant with the ESA Telemetry and Telecommand Standards. The library is being used in the context of the space mission AGILE of Italian Space Agency (ASI) for simulation, graphical display, processing and decoding of the telemetry generated by the Test Equipment of two AGILE detectors and by the AGILE Payload EGSE. From an input stream of bytes, the library is able to recognize automatically the source packets (described by a simple configuration file), and provides a simple access to each packet field by means of an object-oriented interface. In the same way the library writes source packets to the output stream. Various types of input and output streams are abstracted by a software layer. This paper presents the architecture of the library and some examples of applications developed with it.

P3.10   Chandra Ray Tracer (ChaRT): A Web Interface to Chandra PSF Simulations

Clayton Carter, Margarita Karoska, Diab Jerius, Ken Glotfelty, Steve Beikman (Harvard-Smithsonian Center for Astrophysics)

Calculation of point spread functions (PSF) for the Chandra High Resolution Mirror Assembly (HRMA) and detectors is an important part of the analysis of Chandra data. Since the HRMA PSFs are highly variable, no analytical model exists and each PSF must be simulated individually. Existing methods for doing so have a limiting accuracy; while the most direct and accurate method is subject to a steep learning curve, prodigious computing requirements and implementations that are proprietary in nature. With the introduction of Chandra Ray Tracer (ChaRT), we hope to address all of these complications.

ChaRT is a web application by which users can easily generate SAOsac simulations of the HRMA PSF. Users are allowed to specify multiple source locations, each characterized by either a monochromatic energy or an input spectrum. ChaRT then verifies and submits these sources for SAOsac to simulate, notifying the user when their data are available for download. This is accomplished using scripts, developed at the Chandra X-ray Center (CXC), that work in conjunction with some commonly available software components on a distributed computer network at the CXC. Additionally, the system was designed to be extensible and ChaRT s infrastructure may be used as a model for future projects experiencing the same complications as Chandra s PSF calculations.

In this paper we will review the software components and hardware architecture used to implement this system, and we will address possible future work. This project is supported by the Chandra X-ray Center under NASA contract NAS8-39073.

P3.11   Calibration of BIMA Data in AIPS++

Daniel Goscha, David Mehringer, Raymond Plante (NCSA) Anuj Sarma (University of Illinois)

We summarize the general approach to calibration of millimeter interferometer data from the BIMA telescope using AIPS++ and illustrate the use of the relevant software tools. In particular, we will discuss flagging, phase calibration, flux calibration, and polarization calibration, and we will show how we take advantage of the unique capabilities of AIPS++ to meet the special needs of BIMA data. We will show how BIMA calibration tools can be used to hide some of the complexity of the processes while still allowing access to specialized variations if desired. We will illustrate how these tools are pipelined together for end-to-end processing both within the BIMA Image Pipeline and on the user s desktop. Finally, we will present some a comparison of data calibrated in MIRIAD and AIPS++.

P3.12   Status of the BIMA Imaging Pipeline

David M. Mehringer, Raymond L. Plante

We report on the current status of the metadata-driven BIMA Imaging Pipeline. At the time of abstract submission, we are nearing production mode in which we will produce first-order images of target sources as well as plots of images and calibration solutions. All these products will be ingested into the BIMA Data Archive where they will be available to users.

P3.13   AIPS++ Reduction and Analysis of GBT Single-Dish Spectral Data

James Braatz, Joseph McMullin, Robert Garwood, Athol Kemball (NRAO)

The Green Bank Telescope (GBT) is a new 100-m diameter antenna with an unblocked aperture and an active surface. It is designed to observe at frequencies from 300 MHz to 100 GHz, and includes state of the art continuum and spectral backends. AIPS++ is the integral software package for analysis of GBT data both for scientific analysis as well as for control and engineering analysis of the component systems. We will give an overview of how the AIPS++ system is used in processing spectral line data. AIPS++ allows a layered approach to software development whose usefulness is highlighted by the spectral analysis capabilities. At the heart of AIPS++ is a suite of tools which are capable of astronomy-specific calculations as well as general purpose mathematical analysis, data visualization, GUI development, and scripting. A tool for analyzing single-dish data, DISH, is developed on this platform. DISH includes a number of modern features such as bulk processing of datasets and versatile GUI interaction. A simplified CLI interface designed to work with scan-based data is a recent addition to DISH, and was originally built as a thin layer on the DISH core structure. The Interim Automated Reduction and Display System (IARDS) is built as another layer on DISH and provides the run-time display of GBT spectra.

P3.14   Spectral Extraction using aXe

Norbert Pirzkal, Anna Pasquali, Richard Hook, Jeremy Walsh, Rudi Albrecht (ST-ECF)

New large-format spectroscopic instruments have become available to the astronomical community. These produce images containing large numbers of spectra and can be very time consuming to analyze. One of these is the Advanced Camera for Surveys (ACS), which has recently been installed on HST. The ACS provides for both grism and prism slitless spectroscopy and these modes can result in data sets containing hundreds of spectra on the large format detectors. A method of easily extracting the information from these data and quickly producing spectra of individual objects is highly desirable. To this end we have developed a new extraction software package called aXe which was specifically designed to handle the ACS spectrophotometric data. Using a pair of direct/grism or direct/prism images, aXe can extract tilted spectra, estimate and subtract the local background, wavelength calibrate, flat-field, and flux calibrate them.

Due to the increasing number of instruments on modern telescopes capable of performing spectrophotometric observations similar to those of ACS, aXe was designed to also be used with non-ACS data. In this poster, we describe aXe and its use with ACS grism data, as well as with grism and short slit spectroscopic data from the ESO VLT FORS instrument.

P3.15   CIR: A New Package for Interactive Data Reduction of ISOCAM Data

Rene D. Gastaud (DAPNIA/SIDE, CEA/SACLAY) Pierre Chanial (DAPNIA/ SAP, CEA/SACLAY)

There is already a good tool for interactive data reduction of ISOCAM data: CIA[1], based upon IDL. We describe here a new package of IDL routines, which kept all the main functionalities of the previous one, but has been completely re-drawn, using our 8 years of experience with ISOCAM data reduction, and some new features of IDL. Architecture is simplified, routines are re-written. The package is slimmed down from 1000 to less than 200 routines and is quicker (up to twice). The code is easier to understand, to maintain and to evolve. It has been used for 2 years at SAP Saclay. Sources with HTML documentation and examples are freely available. This tool has also been used to simulate some Herschel/PACS data. This tool can help to quickly test new algorithms and data structure for new IR cameras (SIRTIF).

[1]ADASS X 2000 CIA v 5.0 The legacy Package for ISOCAM Interactive Analysis

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P3.16   New Features of SAOImage DS9

William Joye (SAO)

SAOImage DS9 is an astronomical imaging and data visualization application. DS9 supports FITS images and binary tables, multiple frame buffers, region manipulation, and many scale algorithms and colormaps. It provides for easy communication with external analysis tasks and is highly configurable and extensible.

A number of new important features have been developed for DS9. They include:
* Support for the Virtual Observatory, which allows users to view and analyze remotely-located data from their local site.
* Improved support for external analysis, which allows users to integrate their own analysis tasks into DS9.
* Fits Binary Table 3D binning, which allows users to create a 3D Fits Data cube and view the data as an interactive movie.
* New projection, panda, and compass regions. Of most interest is, the interactive projection region, which displays an arbitrary cut of the image data, projected along a line.
* New built-in help facility. The reference manual and FAQ documentation are available on all platforms, and no longer require the use of a web browser and network access.

- Full support for Fits Multiple WCS. Images may rotated and aligned, and coordinate grids displayed using any available WCS (including equatorial and linear).

P3.17 Migrating Astronomical Software Systems from Tcl/Tk to Java

Alberto Maurizio Chavan, Tim Canavan, Dario Dorigo, Nick Kornweibel, Fabio Sogni (ESO)

ESO began developing its Phase I proposal management system in 1994, while development of the Phase II tools began two years later. This first generation of the tools was developed using Tcl/Tk. In 1998 it was decided to migrate all tools to Java, and that activity is now nearing completion. This paper describes the rationale behind the decision to migrate, the migration process itself, and the lessons we learned during these years. We will not attempt to compare two very different programming languages: we ll try instead to describe the challenges and risks we faced in migrating medium-sized, mission-critical systems from one language to the other.

P3.18 New IRAF Messaging Applications

Francisco Valdes, Michael Fitzpatrick, Robert Seaman (NOAO)

New examples of IRAF applications interacting using a low-volume, socket-based text messaging scheme are described and demonstrated. The tasks may be distributed across multiple CPUs or locations, using a many-to-one or one-to-many client-server architecture. Server applications respond to messages without blocking so other activities such as data processing, user interaction through a GUI, or responding to another client application, may take place.

Messaging is based on a simple text-based scheme consisting of either commands beginning with a colon or data in keyword/value pairs. This also allows any non-IRAF application which understands the protocol to participate as either a new client or server application. The commands have the same form as IRAF GUI commands so that applications may easily interact with GUI tasks. One such server application demonstrated is a GUI IRAF processing monitor. IRAF (or non-IRAF) data reduction tasks send status and processing information to GUI server tasks which provide graphical displays and interaction with the received information.

One motivation for this is the powerful and easily customizable nature of IRAF GUIs by means of the GUI description files (which are currently TCL interpreted modules), and the need for such a component in the NOAO Mosaic Data Product Pipeline. This pipeline uses multiple IRAF data reduction tasks and data parallel processing distributed across a network, requiring a central monitoring facility to ensure proper operation of the pipeline. Other applications of this messaging scheme are also discussed.

ALGORITHMS

P4.1 Pointing Refinement of SIRTF Images

Frank Masci, David Makovoz, David Shupe, Mehrdad Moshir, John Fowler

The soon-to-be-launched Space Infrared Telescope Facility (SIRTF) shall produce image data with an a-posteriori pointing knowledge of 1.4 (1 sigma radial) with a goal of 1.2 in the ICRS coordinate frame. In order to perform robust image coaddition, mosaic generation, extraction and position determination of sources to faint levels, the pointing will need to be refined to better than few-tenths of an arcsecond. Input to the position refinement software are point sources extracted from a mosaic of overlapping images. The software will use this information to find a global minimization of all relative offsets amongst all overlapping images. This is a novel method utilizing a generic linear sparse matrix solver. The pointings and orientations of SIRTF images can be refined in either a relative sense where pointings become fixed relative to a single image of a mosaic, or, in an absolute sense (in the celestial frame) if absolute point source information is known. Our goal is to produce science products with sub-arcsecond pointing accuracy.

P4.2 A Theoretical Photometric and Astrometric Performance Model for Point Spread Function CCD Stellar Photometry

Kenneth J. Mighell (NOAO)

Using a simple two-dimensional Gaussian Point Spread Function (PSF) on a constant (flat) sky background, I derive a theoretical photometric and astrometric performance model for analytical and digital PSF-fitting stellar photometry. The theoretical model makes excellent predictions for the photometric and astrometric performance of over-sampled and under-sampled CCD stellar observations even with cameras with pixels that have large *intra*-pixel quantum efficiency variations. The performance model is demonstrated to accurately predict the photometric and astrometric performance of realistic space-based observations from segmented-mirror telescope concepts like the Next Generation Space Telescope with the MATPHOT algorithm for digital PSF CCD stellar photometry which I presented last year at ADASS XI. The key PSF-based parameter of the theoretical performance model is the effective background area which is defined to be the reciprocal of the volume integral of the <u>square</u> of the (normalized) PSF; a critically-sampled PSF has an effective background area of 4π (~12.57) pixels. A bright star with a million photons can theoretically simultaneously achieve a signal-to-noise ratio of 1000 with a (relative) astrometric error of a *milli*pixel. The photometric performance is maximized when either the effective background area or the effective-background-level measurement error is minimized. Real-world considerations, like the use of poor CCD flat fields to calibrate the observations, can and do cause many existing space-based and ground-based CCD imagers to fail to live up to their theoretical performance limits. Future optical and infrared imaging instruments can be designed and operated to avoid the limitations of some existing space-based and ground-based cameras. This work is supported by grants from the Office of Space Science of the National Aeronautics and Space Administration (NASA).

P4.3 Adaptive Optics Software on the CfAO Web Page

Andreas Quirrenbach, Vesa Junkkarinen, Rainer Koehler (UCSD)

Several software packages are publicly available on the web site of the Center for Adaptive Optics (CfAO). These packages support the development of adaptive optics systems, and the analysis of data obtained with adaptive optics.

We will discuss the structure and support of the web site, and give an overview of the capabilities of the individual available packages.

P4.4 Image Reduction Pipeline for the Detection of Variable Sources in Highly Crowded Fields

Claus A. Goessl, Arno Riffeser

We present a reduction pipeline for CCD (charge-coupled device) images which was built to search for variable sources in highly crowded fields like the M 31 bulge and to handle extensive databases due to large time series. We describe all steps of the standard reduction in detail with emphasis on the realization of per pixel error propagation: Bias correction, treatment of bad pixels, flatfielding, and filtering of cosmic rays. The problems of conservation of PSF (point spread function) and error propagation in our image alignment procedure as well as the detection algorithm for variable sources are discussed: We build difference images via image convolution with a technique called OIS (optimal image subtraction, Alard & Lupton 1998), proceed with an automatic detection of variable sources in noise dominated images and finally apply a PSF-fitting, relative photometry to the sources found. For the WeCAPP project (Riffeser et al. 2001) we achieve 3-sigma detections for variable sources with an apparent brightness of e.g. $m = 24.9$ mag at their minimum and a variation of $dm = 2.4$ mag (or $m = 21.9$ mag brightness minimum and a variation of $dm = 0.6$ mag) on a background signal of 18.1 mag / arcsec^2 based on a 500 s exposure with 1.5 arcsec seeing at a 1.2 m telescope. The complete per pixel error propagation allows us to give accurate errors for each measurement.

P4.5 Representations of Spectral Coordinates in FITS

Eric W. Greisen (NRAO) Francisco G. Valdes (NOAO) Mark R. Calabretta (Australia Telescope National Facility) Steven L. Allen (UCO/Lick Observatory)

In Paper I, Greisen & Calabretta (2002) describe a generalized method for specifying the coordinates of FITS data samples. Following that general method, Calabretta & Greisen (2002) in Paper II describe detailed conventions for defining celestial coordinates as they are projected onto a two-dimensional plane. The present paper extends the discussion to the spectral coordinates of wavelength, frequency, and velocity. World coordinate functions are defined for spectral axes sampled evenly in wavelength, frequency, or velocity, evenly in the logarithm of wavelength or frequency, as projected by ideal dispersing elements, and as specified by a lookup table. Papers I and II have been accepted into the FITS standard by at least the North American FITS Committee; we expect the present work to be accepted as well.

P4.6   Image Compression using CFITSIO

William Pence (NASA/GSFC)

The CFITSIO subroutine library now transparently supports reading and writing of FITS images in a new tile-compressed image format. The image is divided into a grid of rectangular tiles and then each tile of pixels is individually compressed (using a choice of different algorithms) and is stored in a variable length array column in a FITS binary table. The advantages of using this format are a) the header keywords remain uncompressed for fast access, and b) it is possible to extract sub-images without having to uncompress the entire original image, because only the tiles that contain pixels in the subimage have to be uncompressed. This image format also supports a lossy compression technique that is very effective for floating point data type images by throwing away the noise bits without sacrificing any scientifically useful information. This paper will demonstrate the effectiveness of this image compression technique on a number of different FITS images that were all extracted from existing public data archives.

P4.7   Restoration of Digitized Astronomical Plates with the Pixon Method

P.R. Hiltner, R. Nestler, P. Kroll

Applications of the Pixon restoration method to digitized plates of the Sonneberg Plate Archive - the world s 2nd largest - are reported. Results so far obtained show that the severe astigmatism/coma distortion present in the outer parts of these wide field images can almost completely be removed. Also, object definition (FWHM) of point sources and S/N improve by factors of 2 to 7, depending on the object s strength and location (background etc.). We discuss consequences for the automated astronomical processing of the restored plates, which are of crucial importance for the inclusion of digitized archives in the virtual observatory context.

P4.8   sso_freeze: De-smearing Solar System Objects in Chandra Observations

Roger Hain, Jonathan McDowell, Arnold Rots, K. J. Glotfelty (Harvard-Smithsonian Center for Astrophysics)

Observations from the Chandra X-Ray Observatory are made in a fixed inertial coordinate frame. Most objects observed with Chandra, such as supernova remnants, quasars, or pulsars, are at infinity for all practical purposes and the observations produce sharp, focused images. However, the motion of objects observed within the solar system, such as planets or comets, will cause the object s image to appear blurred when viewed in a fixed inertial frame. This effect is similar to the blur which would be seen if a fixed camera were to take a photograph of a fast moving car.

To reconstruct the image, the CXC CIAO tool sso_freeze corrects for this effect. An origin is chosen at the center of the object, and moves along with the object as it moves with respect to inertial space. The positions of the source photons are then

recalculated with respect to this moving origin. The image formed from the recalculated photons now shows a clear object, such as a disk for a planet. As an effect of this processing, fixed X-ray sources become smeared in the image. The effect is similar to moving the camera to follow the fast moving car in the earlier example. The car becomes clearly focused, and the scene around the car is blurred. Images which demonstrate the effect of sso_freeze are shown for Jupiter and Comet C/1999 S4 Linear.

P4.9   Merging of Spectral Orders from Fiber Echelle Spectrographs

Petr Skoda, (Astronomical Institute of the Academy of Sciences of the Czech Republic) Herman Hensberge (Royal Observatory of Belgium)

We have reviewed the data reduction of two fiber-based echelle spectrographs (HEROS and FEROS) with emphasis on similarities of the inconsistencies between the overlap of spectral orders before merging. The literature on echelle data reduction shows that such inconsistencies are commonly observed (and usually handled by rather heuristic procedures - mostly interactively). For both instruments, it seems to be the calibration unit which introduces through the flat fielding the major part of the problems. We discuss strategies to treat the problems and to remove the inconsistencies before merging the spectral orders with a minimum of interactive, subjective algorithms.

P4.10   Automated Object Classification with ClassX

Anatoly Suchkov (STScI) Tom McGlynn, Eric Winter, Lorellla Angelini, Michael Corcoran, Sebastien Derriere (NASA/GSFC) Megan Donahue (STScI) Stephen Drake (NASA/GSFC) Pierre Fernique, Francoise Genova (CDS) R.J. Hanisch (STScI) Francois Ochsenbein (CDS) W.D. Pence (NASA/GSFC) Marc Postman (STScI) Nicolas White (NASA/GSFC) Richard White (STScI)

We report preliminary results from the ClassX project. ClassX is aimed at creating an automated system to classify unclassified X-ray sources and is envisaged as a prototype of the Virtual Observatory. The ClassX team has used machine learning methods to generate, or train classifiers from a variety of training data sets, each representing a particular sample of known objects that have measured X-ray fluxes complemented, wherever possible, with data from other wavelength bands. Specifically in this paper, a classifier is represented by a set of oblique decision trees (DT) induced by a DT generation system *OC1*. We integrate different classifiers into a network, in which each classifier can make its own class assignment for an unclassified X-ray source from a classifier-specific list of class names (object types). An X-ray source is input into a classifier as a set of X-ray fluxes and possibly other parameters, including data in the optical, infrared, radio, etc. In the network, each classifier is optimized for handling different tasks and/or different object types. Therefore, having a set of unclassified X-ray sources, a user would generally select a certain classifier to make, for instance, a most *complete* list of candidate QSOs, but a different classifier would be used to make a most *reliable* list of candidate QSOs. Still different classifiers

would be selected to make similar lists for other object types. Along with the straight-forward class name assignment, a network classifier outputs the probability for a source to belong to the assigned class as well as probabilities that the source belongs, in fact, to other classes in the given class name list. We illustrate the current capabilities of ClassX and the emerging concept of a classifiers network(s) with the results obtained with classifiers trained on data from ROSAT (the WGA catalog), complemented with data from the Guide Star Catalog (GSC2) and the 2-Micron All-Sky Survey.

P4.11   Genetic Programming and Other Fitting Techniques in Galactic Dynamics

Peter Teuben (University of Maryland)

Fitting is the bread and butter of astronomy. Non-linear fitting, especially large scale ones, present themselves with many problems. Genetic programming is one such solution. In this poster I will present some galaxy dynamics fitting techniques, in particular those of velocity fields, and apply new techniques such as genetic programming.

P4.12   FLY: A Tree Code towards the Adaptive Mesh Refinement

U. Becciani, V. Antonuccio-Delogu (INAF - Astrophysical Observatory of Catania)

We have developed a powerful N-body code to evolve three-dimensional self-gravitating collisionless systems with a large number of particles ($N > 10^7$). FLY (**F**ast **L**evel-based N-bod**Y** code) is a fully parallel code based on a tree algorithm. It adopts periodic boundary conditions implemented by means of the Ewald summation technique. FLY is based on the one-side communication paradigm to share data among the processors that access remote private data avoiding any kind of synchronism. The code was originally developed on a CRAY T3E system using the logically SHared MEMory access routines (*SHMEM*) and it was ported on SGI ORIGIN systems and on IBM SP, on the latter making use of the Low-Level Application Programming Interface routines (*LAPI*). FLY is based on four main characteristics: it adopts a simple domain decomposition, a grouping strategy, a dynamic load balancement mechanism without significant overhead, and a data buffering that allows us to minimize data communication. It is an open source free code and more details are available at http://www.ct.astro.it/fly/. This paper show an example of integration of a tree code with an adaptive grid scheme.

PARAMESH is a package of Fortran 90 subroutines using *SHMEM* and *MPI* libraries, designed to provide an application developer with an easy route to extend an existing serial code which uses a logically cartesian structured mesh into a parallel code with an adaptive mesh refinement (AMR). The computational domain is hierarchically subdivided into sub-blocks following a 3D tree data-structure.

The use of *SHMEM* and the tree data-structure allow an easy integration with FLY that adopts the same data structure and the same parallel communication library. This

implementation of FLY with PARAMESH makes available the output of FLY integrated with an adaptive grid, having the same data structure of PARAMESH. The adaptive grid structure can be read by FLY or generated from it, and contains the potential field of each data block of the grid, following the PARAMESH scheme.

Moreover, the same procedure of FLY will be also available like an external procedure that will allow to create a PARAMESH grid from any data point distribution in a cubic region, e.g. a cosmological dark matter distribution. This new implementation will allow the FLY output, and more generally any binary output, to be used with any hydrodynamics code, that adopt PARAMESH data structure, to study compressible flow problems.

P4.13 Classification using Labeled and Unlabeled Data

David Bazell (Eureka Scientific, Inc.) David Miller (Penn State University) Kirk Borne (Raytheon)

We will discuss several novel approaches to the exploration, understanding, and classification of astronomical data. We are exploring the use of unlabeled data for supervised classification and for semi-supervised clustering. Current automated classification methods rely heavily on supervised learning algorithms that require training data sets containing large amounts of previously classified, or labeled, data. While unlabeled data is often cheap and plentiful, using a human to classify the data is tedious, time consuming, and expensive. We are examining methods whereby supervised classification techniques can use cheaply available, large volumes of unlabeled data to substantially improve their ability to classify objects. We are also exploring a unified framework where learned models provide clustering or classification solutions, or both, depending on the needs of the user.

P4.14 Predictive Mining of Time Series Data in Astronomy

Eric Perlman, Akshay Java (Joint Center for Astrophysics, UMBC)

We discuss the development of a Java toolbox for astronomical time series data. Rather than using methods conventional in astronomy (e.g., power spectrum and cross-correlation analysis) we employ rule discovery techniques commonly used in analyzing stock-market data. By clustering patterns found within the data, rule discovery allows one to build predictive models, allowing one to forecast when a given event might occur or whether the occurrence of one event will trigger a second. We have tested the toolbox and accompanying display tool on datasets representing several classes of objects from the RXTE All Sky Monitor. We use these datasets to illustrate the methods and functionality of the toolbox. We have found predictive patterns in several ASM datasets. We discuss possible applications, for example in maximizing the return for scheduling either survey or target of opportunity observations. We also discuss problems faced in the development process, particularly the difficulties of dealing with discretized and irregularly sampled data.

P4.15 NIRCAM Image Simulations for NGST Wavefront Sensing

Russell B. Makidon, Anand Sivaramakrishnan, Donald F. Figer, Robert I. Jedrzejewski, Howard A. Bushouse, John E. Krist, H. S. Stockman, Philip E. Hodge, Nadezhda M. Dencheva, Bernard J. Rauscher, Victoria G. Laidler, Catherine Ohara, David C. Redding, Myungshin Im, Joel D. Offenberg

The Next Generation Space Telescope (NGST) will be a segmented, deployable, infrared-optimized 6.5m space telescope. Its active primary segments will be aligned, co-phased, and then fine-tuned in order to deliver image quality sufficient for the telescope s intended scientific goals. Wavefront sensing used to drive this tuning will come from the analysis of focussed and defocussed images taken with its near-IR science camera, NIRCAM. There is a pressing need to verify that this will be possible with the near-IR detectors that are still under development for NGST. We create simulated NIRCAM images to test the maintenance phase of this plan. Our simulations incorporate Poisson and electronics read noise, and are designed to be able to include various detector and electronics non-linearities. We present our first such simulation, using known properties of HAWAII HgCdTe focal plane array detectors. Detector effects characterized by the Independent Detector Testing Laboratory are included as they become available. Simulating InSb detectors can also be done within this framework in future. We generate Point-Spread Functions (PSF s) for a segmented aperture geometry with various wavefront aberrations, and convolve this with typical galaxy backgrounds and stellar foregrounds. We then simulate up-the-ramp (MULTIACCUM in HST parlance) exposures with cosmic ray hits. We pass these images through the HST NICMOS CALNICA calibration task to filter out cosmic ray hits. The final images are to be fed to wavefront sensing software, in order to find the ranges of exposure times, filter bandpass, defocus, and calibration star magnitude required to keep the NGST image within its specifications.

P4.16 Integrating Statistical Tools with Databases

Adrian Pope, Tamas Budavari, Alex S. Szalay (JHU) Istvan Szapudi (Univ of Hawaii) Andrew J. Connolly (Univ of Pittsburgh)

With the advent of large astronomical surveys the way scientific calculations are done is changing. Dedicated telescopes are collecting incredible amounts of information about the Universe that are stored in databases. We describe a method to do angular clustering analysis of 50 million galaxies in the Science Archive of the Sloan Digital Sky Survey. Using a Web Service attached to the database, we stream only the relevant coordinates into the correlation function code called eSpICE that computes the angular correlation function directly. The pipeline is set up to take a query that selects the galaxies by different ranges of absolute luminosity and spectral type and returns the angular clustering results. The processing time is remarkable; it is several orders of magnitude faster than traditional implementations of the optimal two-point estimator.

DATABASE SYSTEMS

P5.1   Optimizing the Performance of ISO and XMM Data Archives

Jose Hernandez, Christophe Arviset, John Dowson, Pedro Osuna, Aurele Venet (ESA)

The ISO Data Archive and the XMM-Newton Science Archive have been developed in Java using a multi-tier architecture, the archives are accessed through a Java Applet running inside any standard browser, they have been used from more than 10 different platforms and thousands of users.

Here we present the experience acquainted in the last 4 years and a few techniques we have used to dramatically improve the performance of the application, as well as the main difficulties we have found along the way. In particular will touch upon the following points:
- Techniques used to optimize the performance of the application:
  - Session management, Objects caching
  - Minimize number of client-server transactions
  - Data compression, optimize the object Serialization
  - How to maintain the interface configurable
  - When do we stop optimizing: Problems/Bugs introduced during the optimization
- Techniques used to optimize the size of the applet:
  - obfuscation
  - building a thin client
  - jar loading on demand

P5.2   ANDES--NOAO s Observatory Database System

David Gasson, Dave Bell, Mia Hartman (NOAO)

ANDES (the Advanced NOAO Database Expert System) is NOAO s new observatory database system. Recent improvements include the phase-out of legacy components, such as our previous Access-based effort called ALPS++. New work focuses on post-TAC procedures such as scheduling, collection of observing reports on the mountain, automatic compilation of various statistics, and publication tracking as ways to extend the usefulness of ANDES. The ultimate goal is to provide an environment which allows a comprehensive understanding of the collection, evaluation, scheduling, observing and post-observing (including publications) of proposals and programs.

P5.3   Chandra Data Archive Download and Usage Database

Emily Blecksmith, Stephane Paltani, Arnold Rots, Sherry Winkelman (CfA/CXC)

In order to support regular operations, the Chandra Data Archive Operations Group has developed a database that records and monitors the user activities that affect the

archive servers. This database provides information on the number of users that are connected at a given time, what archive interfaces they use (we have several), and how much data are being downloaded.

The database consists of three tables, populated by a set of three scripts that parse the archive server logs, the ftp logs and the login logs. User activity can be tracked through each of those logs, making information from a given connection easily accessible.

With this tool, the Archive Group will be able to gather statistics and monitor trends, which in the future will improve the accessibility of Chandra data.

P5.4 A Simple Rule Based Query Service for Querying Complex Databases

Niall Gaffney, Lisa Gardner, Molly Brandt (STScI)

Moving towards a Virtual Observatory model for archive services has demonstrated that more generic query services will be needed. For many advanced query services that exist today, one must understand the structure of data source to query it - often going as far as making the user hand craft SQL. From the beginning of its JAVA incarnation, StarView has separated the task of getting qualification information from the user from formatting of the SQL. We have recently replaced a very cumbersome and Space Telescope database structure specific LISP program with one based on three simple database tables and a Perl script to build queries for our database. StarView (or any other program) need only submit the equivalent of the SQL SELECT and the qualifiable portion of the WHERE clauses (with no database specific join information). The service takes this information and, for our SQL driven database, adds in all the needed SELECT, FROM, and complete WHERE clauses that is a valid query. With this tool, any program can query the STScI archive database without prior knowledge of how the database tables relate. Only the fields/keywords that are to be queried and returned are specified. Further as new tables and databases are added, the service can be simply updated with the join rules for the new tables without any changes to the software system.

Our poster will outline how the system works in the general case using the STScI databases as an example of a preexisting and complex data source can be simply modeled. We will demonstrate how this system could work for any relational database to be queried by software without knowing its schema and explore possible functionality for such a generic query service in the context of the currently rapidly evolving Virtual Observatory.

P5.5 **Performing Dynamic Overlaps Between Astronomical Archives using HTM**

Gretchen Green, Alex Szalay, Antonio Volpicelli, Karen Levay, Paolo Padovani, George Fekete, Wil O Mullane

An experimental system recently developed provides a method for dynamic computation of overlapping regions between astronomical archives using the Hierarchical Triangulated Mesh (HTM) spatial index. The test bed for this system is based on the SDSS Science Archive and the HST Pointing Catalog. Region boundaries described with HTM polygons provide a common frame for performing joins between the large-scale SDSS survey and the sparse coverage of HST. We expect to provide Web services for performing these intersections to facilitate the navigation of these multi-instrument observations. These methods are valuable in demonstrating the value of HTM standard region specifications for the space-time definitions of astronomical datasets that can be used for NVO discovery technology.

P5.6 **An AIPS++-based Archive System for Radio Telescopes**

John Benson, Boyd Waters, Tim Cornwell (NRAO)

The NRAO End-to-End (e2e) project has the goal of providing automated, streamlined handling of radio observations on NRAO telescopes all the way from proposal submission to archive access. As an early part of this project, we have constructed an archive system for NRAO telescopes using mainly tools available in the Astronomical Information Processing System (AIPS++). Since the tools are available to anyone using AIPS++, this amounts to a generic archive capability for any telescope for which the AIPS++ data conversion program exists. The rich tool set available in AIPS++ has enabled very rapid development: our entire effort took no more than about 1 FTE-year. Additional capabilities were required to connect AIPS++ to the web. The system is now being deployed at the NRAO as a prototype archive system for the Very Large Array with deployment for the Green Bank Telescope and Very Long Baseline Array planned for 2003.

P5.7 **The XMM-Newton SSC Database: Taking Advantage of a Full Object Data Model.**

Laurent Michel, Christian Motch (Observatoire Astronomique de Strasbourg)
Clive Page, Mike Watson (Leicester University)

One of the main responsibilities of the Science Survey Consortium (SSC) of the XMM-Newton satellite is to carry out a systematic analysis of all instrument data. These high quality products are shipped to the guest observer and eventually enter the XMM-Newton archive. In addition, the SSC compiles a catalogue of X-ray sources and provides identification for the ~ 50,000 new sources detected every year. In order to check product quality and support the catalogue and source identification programmes, all SSC generated products are stored into a data base developed for that purpose.

The database is a powerful tool to browse and evaluate XMM-Newton data and to perform various kinds of scientific analysis. It provides online data views including relevant links between products and correlated entries extracted from many archival catalogues available at CDS and NED.

Because of the large number of transversal links, our data model is difficult to map into relational tables. It has been therefore designed with object oriented technology for both user s interface and data repository (OODBMS O2).

Besides browsing, the Web based user interface provides facilities to select data collections with any constraints on any keywords but also with constraints on correlated data patterns.

P5.8   Representations of DEIMOS Data Structures in FITS

Steven L. Allen, De A. Clarke, Robert I. Kibrick (UCO/Lick Observatory)

DEIMOS (the DEep Imaging Multi-Object Spectrograph) began producing scientific data from the Keck II telescope in 2002 June. The instrument is extremely configurable, and the form of the output data is highly variable. Filters and gratings may be swapped, gratings and mirrors tilt, readout modes and active amplifiers of the 8-CCD mosaic change, and numerous field-specific astrometric slitmasks may be inserted. For archival purposes and to enable fully-automated data reduction, FITS files from DEIMOS document the instrument state, all aspects of the slitmask design, and multiple world coordinate systems for the mosaic images. The FITS files are compatible with existing local conventions for mosaic image display systems and also with incipient FITS WCS standards.

OBSERVATORY OPERATIONS - FRONTEND

P6.1   CCD meets Geodetic Astronomy: The Digital Zenith Camera, a Geodetic State-of-the-art Instrument for Automatic Geographic Positioning in Real-Time

Christian Hirt (Institut fuer Erdmessung, University of Hanover)

The determination of positions on the earth s surface by using stars as celestial reference used to be the main task of practical astronomy in the past. Whereas the basic principle remained unvaried throughout the centuries, observation techniques changed - from purely visual to photographic methods. Today, the availability of CCD sensors lead to completely digital and automatic methods for the astronomical determination of geographic coordinates. Combined with GPS, these methods are applied in geodesy for the determination of vertical deflections and hence of the earth s gravity field.

In this presentation, a digital zenith camera developed at the Institut fuer Erdmessung, University of Hanover, is introduced as mighty geodetic state-of-the-art instrumentation for astronomical position determination. Using CCD technology for imaging zenithal stars, a GPS equipment for high-precision time measurement and the new powerful data processing system AURIGA (Automatic Real-time Image Processing System For Geodetic Astronomy), this configuration allows the determination of the geographic coordinates longitude and latitude based on a fully automatic procedure in real-time up to an accuracy of at least 0.2 arcseconds. The design and performance of the digital zenith camera are depicted. Main emphasis is laid on data acquisition and data processing by using AURIGA.

Besides a description of astrometric algorithms for image data reduction, the applicability of precise star catalogues Tycho-2, GSC, UCAC and A2.0 as reference for geographical position determination is discussed. Besides the high-precision determination of the earth s gravity field as main application area of the digital zenith camera, future applications like monitoring of near zenith atmospheric effects (systematic refraction and scintillation) are indicated.

P6.2   The Wonderful Worlds of the ITE

Leslie Zimmerman Foor (STScI)

The Integrated Test Environment (ITE) is a test environment designed by the Software Testing Team (STT) to simulate the HST planning and scheduling system from proposal development through the generation of the Science Mission Specification (SMS). More than just a mirror of the operational environment, the ITE allows users the flexibility of choosing the versions of the software they would like to use. Various configurations can be used simultaneously by multiple users on any number of machines. In fact, one user can have multiple configurations at the same time on one computer.

In addition to the testing flexibility, it also gives developers the ability to investigate

operational problems by using operational data with operational versions of the software in their own environment without the risk of interfering with the daily operational work.

P6.3   A Generic Process Coordinator, Developed For The Planck-Surveyor Mission

Wolfgang Hovest, Frank Dannemann, Thomas Riller, Matthias Bartelmann

Planck is the third medium-sized mission of ESAs Horizon-2000 scientific programme. Starting in 2007, Planck will obtain full-sky maps in nine frequency bands in the microwave regime between 30 and 857 GHz. The primary goal of Planck is to map the Cosmic Microwave Background (CMB) with unprecedented resolution and sensitivity. The accurately measured angular power spectrum of the CMB will allow the precise determination of all relevant cosmological parameters. Planck will also test the inflationary model of the early universe. For the purpose of data reduction of the huge amount of data Planck will obtain and for simulation-purposes a process coordinator (ProC) is being developed. The ProC will allow to build up pipelines from single modules (written in FORTRAN, C, C++, or Java) and execute it in a distributed heterogeneous network in an automatic fashion. Besides the main results all parameters, all provisional results of the single modules of the pipeline and any information about the processing itself will be traced and saved in an oo-database. The current state of this Process Coordinator will be detailed.

P6.4   Extending ORAC-DR to Multiple Observatories

Brad Cavanagh, Paul Hirst, Malcolm J. Currie, Tim Jenness, Frossie Economou (Joint Astronomy Centre) Stuart Ryder (Anglo-Australian Observatory) Stephen P. Todd (Edinburgh University / UK Astronomy Technology Centre)

ORAC-DR, a flexible and extensible data reduction pipeline, has been successfully used for on-line data reduction for data from UFTI and IRCAM (infrared cameras), CGS4 (near-infrared spectrometer), MICHELLE (mid-infrared Echelle spectrometer), all at UKIRT, and SCUBA (sub-millimetre bolometer array) at JCMT. We have now added the infrared imager and spectrometer IRIS2 at the Anglo-Australian Telescope and the infrared imaging spectrometer UIST at UKIRT to the list of officially supported instruments. We also present initial support for the multi-object spectrograph GMOS, the near-infrared imager NIRI, and MICHELLE at Gemini. This paper briefly describes features of the pipeline, along with details of adopting ORAC-DR for other instruments on telescopes around the world.

P6.5   SIRTF Web Based Tools for QA and Instrument Performance Monitoring

Bob Narron, Irene Bregman, John White

The SIRTF Science Center is developing two Web based tools which will be used during operations. One tool is for Quality Analysis. It will allow the analysts to display

images and plots of new data and then to record status and comments in the central database. The other tool is for display of Instrument Performance Monitoring data. It provides an easy to use way for the science staff to create plots and ASCII files of this data. Both tools use Java applets to display images and plots Perl for everything else. The standard Perl DBI interface is used to access the database

P6.6 Monitoring the Chandra X-ray Observatory via the Wireless Internet

Bradley D. Spitzbart, Scott J. Wolk

The Chandra X-ray Observatory, launched in July 1999, continues to provide unprecedented high energy astrophysical discoveries with efficiency and reliability. From time to time, though, urgent operational decisions must be made by engineers, instrument teams, and scientists, often on short notice and at odd hours. There are several real-time, mostly Internet-based data resources available to aid in the decision-making discussions when a crisis arises. In addition, Chandra s Science Operations Team has been experimenting with emerging Wireless Application Protocol (WAP) technologies to create yet another pathway for data flow. Our WAP Internet pages provide anytime, anywhere access to critical spacecraft information through cellular phones or other WAP-enabled devices. We currently offer several dynamic web pages including a live telemetry stream, information on the radiation environment, the real-time contact schedule, the week s observing schedule, and contact information for key personnel. The protocol even allows CGI or other server-side executable code, which is implemented here to facilitate users queries for past data sets. There are, of course, many challenges in attempting to present useful, meaningful content on a 5 X 12 character screen over limited bandwidth in a way that is user-friendly and beneficial. This paper will discuss our experience with this developing, promising new medium, design strategies, and future enhancements. This work is supported by NASA contract NAS8-39073.

P6.7 A Java-based Calibrator Search Tool for Radio Astronomy

Honglin Ye, John Benson (NRAO)

Astronomers using radio synthesis arrays often need to search for calibrator sources to be used during observations. The desired properties of the source depend upon the context: for example, sometimes a bright, somewhat resolved source close to the target is preferable to a more compact source further away. The desired brightness of the calibrator depends upon things like the array configuration, and atmospheric coherence time. For these reasons, human interaction is often the easiest and best way to select calibrators. With this in mind, we have designed a Java-based tool for selecting calibrators based upon information gathered by NRAO scientists from various information sources. This tool is based around a display of the target region of the sky, with known calibrator sources displayed accompanied by user-selectable annotation as to brightness and positional accuracy. Further information about selected sources is given in tabular and graphical forms. The light curve, spectra behavior, resolution curve, and a typical image can all be shown if desired. In connection with the development of this tool, we have merged several information sources into one database. This

enables the tool to be used for VLA and VLBA observations.

The tool is currently being tested by NRAO scientists and will be made available to NRAO users later this year. The development of the tool is part of the NRAO End-to-End (e2e) project, which has the goal of providing automated, streamlined handling of radio observations on NRAO telescopes all the way from proposal submission to archive access. Further development of the calibrator search tool will focus on integration into the emerging overall toolset of the e2e project. Thus, for example, the calibrator search tool will ultimately be integrated with the tool for preparing an observation script.

P6.8   COSMOS-3: The 3rd Generation Telescope Control Software System of Nobeyama Radio Observatory

Koh-Ichiro Morita, Naomasa Nakai, Masatoshi Ohishi, Toshikazu Takahashi, Kazuhiko Miyazawa (NAOJ) Takashi Tsutsumi (CfA) Shigehisa Takakuwa (ASIAA) Hiroyuki Ohta (Fujitsu) Kiyohiko Yanagisawa (FNS)

The Nobeyama 45 m telescope and Nobeyama Millimeter array at Nobeyama Radio Observatory has been operated since 1982. The control system for these telescopes has evolved from a centralized architecture (COSMOS-1) based on IBM compatible mainframe to current hierarchical distributed system (COSMOS-3) running on a distributed environment of WS s and PC s.

COSMOS-3 is functionally divided into three levels. Tools at top level provide various user interfaces for various observing requirements. There are Supervisor, Merger, and Qlook at middle level. Supervisor and Merger control message/data flow between upper level and bottom level. Qlook shows current observing results. At bottom level, there are many Local Controllers to communicate with each device.

Important design concepts of COSMOS-3 are,
* Communication interfaces between different levels should be simple as possible.
* No direct connection between different Local Controller s.
* The system provides a wrapping mechanism for control programs written by non-expert software engineers in Local Controllers.

Because of these concepts, it is very easy and quick to add new functions or new devices to the system.

P6.9   Remote Observing on the Keck Telescopes

Patrick L. Shopbell (Caltech) Robert Kibrick (UCO/Lick Observatory)

We present a summary of ongoing efforts to use the Keck telescopes remotely from the U.S. mainland. This work has been spearheaded by one of us (RK) at UC Santa Cruz, but is now expanding to include remote sites at Caltech and UC San Diego. Additional sites are planned for the future. In this paper we describe the remote observing architecture, including network reliability issues, data replication methods, and interface aspects, such as videoconferencing. We provide quantitative and qualitative analyses of the Caltech remote observing runs thus far, from which we derive a

number of lessons and suggestions for improving remote observing with large telescopes.

P6.10 Chandra Monitoring, Trends, and Response

Scott J. Wolk, Bradley Spitzbart, Takashi Isobe

The Chandra X-Ray Observatory was launched in July, 1999 and has yielded extraordinary scientific results. Monitoring and Trends Analysis (M&TA) system has proven to be a valuable resource. With three years worth of on-orbit data, we have available a vast array of both telescope diagnostic information and analysis of scientific data to access Observatory performance. The primary goal of M&TA is to provide tools for effective decision making leading to the most efficient production of quality science output from the Observatory. M&TA analyzes the most crucial parameters in realtime through C++ tools linked to perl scripts that provide e-mail and pager alerts in the case of limit violations or unexpected spacecraft states. In addition, the telemetry stream is formatted for easy access through a web browser or wireless device. More comprehensive monitoring alerts and trending plots are generated on daily and mission length timelines.

The system utilizes input from the raw telemetry stream, telemetry dumps, processed science products and the archival databases. Output is given in the form of e-mail and/or pager alerts when necessary. Long term monitoring and trending is presented on the world wide web, and all data are archived in SQL and RDB databases. This variety allows for the easy creation of custom studies, showing, for instance, the relation between space weather and co-dependent current rates or charge transfer inefficiency degradation as a function of radiation fluence. This work is supported by NASA contract NAS8-39073.

P6.11 The SCUBA2 Data Acquisition System

Xiaofeng Gao, Dennis Kelly, Michael MacIntosh, William Duncan, Trevor Hodson, Damian Audley, Wayne Holland, (UK ATC)

SCUBA2 is a Second generation sub-millimeter imager for the JCMT currently being designed by a consortium led by the UK ATC. We describe the SCUBA2 data acquisition system, which consists of multiplexed digitization controlled by FPGAs connected by optical fiber to a network of PCs running RTLinux.

OBSERVATORY OPERATIONS - BACKEND

P7.1   Data Calibration Pipeline for the Far Ultraviolet Spectroscopic Explorer

William V. Dixon, David J. Sahnow, The FUSE SDP Group (JHU)

CalFUSE is the calibration software pipeline used at the Johns Hopkins University to process data from FUSE, the Far Ultraviolet Spectroscopic Explorer. The pipeline corrects for a variety of instrumental effects, extracts target spectra, and applies the appropriate wavelength and flux calibrations. The software is written in C and runs under the Solaris, DEC Alpha, and Linux operating systems. In this poster, we present recent improvements in the pipeline, including a new module to correct for the effects of spacecraft motion during an observation, and announce the availability of calibrated spectral files, created using CalFUSE v2.1.0, from MAST, the Multimission Archive at STScI.

P7.2   The Next Step for the FUSE Calibration Pipeline

David J. Sahnow, William V. Dixon, The FUSE SDP Group (JHU)

The calibration pipeline for the Far Ultraviolet Spectroscopic Explorer (FUSE) was designed years before the satellite was launched in June of 1999. After launch, a number of unexpected instrumental features were discovered; as the FUSE team dealt with each of them, the pipeline was modified appropriately. Eventually, these changes made the design so cumbersome that the pipeline became difficult to maintain. In 2002, we began to develop a new pipeline concept that takes into account the actual instrument characteristics. We will present our plans for this improved calibration pipeline and describe the progress we have made toward that goal. In addition, we will discuss the lessons learned while modifying the original design.

P7.3   Building a Middle Tier for the CXC Data Archive

Alexandra Patz, Peter Harbo, John Moran, David Van Stone, Panagoula Zografou

The Chandra Data Archive at the Chandra X-ray Center is developing a middle tier that can be utilized by both the current J2EE web application (WebChaSeR) and the Java Swing application (ChaSeR) to provide a uniform interface to the archive. This middle tier consists of a collection of independent services, from authenticating users to returning data such as an observation image or a proposal abstract. The services are accessible through an HTTP interface, allowing ChaSeR, WebChaSeR or any other HTTP client to access them. The services are run on an application server, implemented in Java using Apache s open-source tool, Struts. Having a central interface to the archive, shared by all client applications, will allow for code reusability and easier maintenance. This poster discusses the design of the middle tier. This project is supported by the Chandra X-ray Center under NASA contract NAS8-39073.

P7.4 ClassX: A VOTABLE-Enabled X-ray Correlation and Classification Pipeline

Eric Winter (NASA/GSFC, Science Systems and Applications, Inc.) Thomas McGlynn (NASA/GSFC, USRA), Anatoly Suchkov, William Pence (NASA/GSFC), Marc Postman (STScI), Nicholas White (NASA/GSFC), Richard White (STScI)

The ClassX project aims to provide a Web service to classify unclassified astronomical X-ray sources. This objective requires collecting and assimilating data from a wide variety of sources. These data sources differ in both syntax and semantics, and therefore must be translated to a common format to be useful in the classification process. The ClassX pipeline addresses this problem by using the VOTABLE XML DTD (http://us-vo.org/xml/VOTable.dtd) to store and manipulate data from multiple remote sources.

An extensive Perl API for the VOTABLE format was developed during the project, and has been released for use by the NVO community. The lessons learned during the development of the ClassX pipeline provide significant experience in identifying and addressing similar problems that will be encountered during the development of the National Virtual Observatory.

P7.5 The Automated Data Processing Pipelines for SIRTF IRS

Fan Fang, Clare Waterson, Jing Li, Bob Narron, Iffat Khan, Wen P. Lee, John Fowler, Russ Laher, Mehrdad Moshir

We present the design, structure, and implementation of the automated data processing pipelines for the Infrared Spectrograph (IRS) onboard Space Infrared Telescope Facility (SIRTF). This includes science data reduction pipelines that generate Basic Calibrated Data (BCD) and enhanced science (Post-BCD) products, and calibration pipelines generating calibration data that allows reduction of the science data.

P7.6 Self-calibration for the SIRTF GOODS Legacy Project

David Grumm, Stefano Casertano (STScI)

Data analysis for the SIRTF GOODS Legacy Project must be able to achieve a level of calibration noise well below a part in 10,000. To achieve such a high level of fidelity, a form of self-calibration is required in which the sky intensity and the instrumental effects are derived simultaneously. Two methods being investigated are a least squares approach based on the work of Fixsen and Arendt at GSFC, and an iterative method. Both methods have been applied to derive the sky, flat field, and offset from simulated data for instruments to be flown on SIRTF; the results will be discussed.

P7.7   Calibration of COS Data at STScI

Philip Hodge (STScI)

This paper describes the program for pipeline calibration of Cosmic Origins Spectrograph (COS) data at the Space Telescope Science Institute. CALCOS is written in Python. Image and table data are read from and written to FITS files using PyFITS, and the data arrays are manipulated using the numarray module, with C extension code for special cases not included in numarray.

P7.8   An Automatic Image Registration and Coaddition Pipeline for the Advanced Camera for Surveys.

John P. Blakeslee, Kenneth Anderson, Daniel Magee, Gerhardt R. Meurer

We have written an automatic image processing pipeline for the Advanced Camera for Surveys (ACS) Guaranteed Time Observation program. The pipeline supports the different cameras available on the ACS instrument and is written in the Python programming language using a flexible object oriented design that simplifies the incorporation of new pipeline modules. It also makes use of the PyFits and Pyraf packages distributed by STScI, as well as other external software. The processing steps include empirical determination of image offsets and rotation, cosmic ray rejection, and image combination using the drizzle software, as well as the production of object catalogs and XML markup for ingestion into the ACS Team archive.

P7.9   OPUS: A CORBA Pipeline for Java, Python, and Perl Applications

Walter Warren Miller III, James F. Rose, Michael S. Swam, Christine Heller-Boyer, John Schultz (STScI)

With the introduction of the OPUS CORBA mode, a limited subset of OPUS Applications Programming Interface (OAPI) functionality was cast into CORBA IDL so that both OPUS applications and the Java-based OPUS pipeline managers were able to use the same CORBA infrastructure to access information on blackboards. The primary motivation for doing so was to improve scalability, but moving to distributed object architecture also freed the managers from running strictly on a supported platform with access to a common file system. It also reduced the amount of duplicate code that otherwise would be required in a multi-programming language environment.

Exposing even more of the OAPI through CORBA interfaces would benefit OPUS applications in similar ways. Those applications not developed in C++ could use CORBA to interact with OPUS facilities directly, providing that a CORBA binding exists for the programming language of choice. Other applications might benefit from running outside of the traditional file system-based OPUS environment like the Java managers and, in particular, on platforms not supported by OPUS. The enhancements to OPUS discussed in this paper will illustrate how this generality was achieved, and present two examples on how to construct OPUS internal pollers in Java and Python.

P7.10   The COBRA/CARMA Correlator Data Processing System

Steve Scott, Rick Hobbs, Andy Beard, Paul Daniel (Caltech/OVRO) Colby Kraybill, Mel Wright (University of California Berkeley) Erik Leitch (University of Chicago) David Mehringer, Ray Plante, (University of Illinois) N. S. Amarnath, Marc Pound, Kevin Rauch, Peter Teuben (University of Maryland)

The COBRA (Caltech Owens Valley Broadband Reprogrammable Array) correlator is an FPGA based spectrometer with 16 MHz resolution and 4 GHz total bandwidth that will be commissioned on the Caltech Millimeter Array in September, 2002. The processing system described here includes collection of correlation function and total power data from the underlying software systems and then the synchronization and processing that are done to produce calibrated visibilities. The processing steps include passband gain correction, system temperature and flux scaling, blanking and flagging, atmospheric delay correction, and apodization and decimation. CORBA is used to move data from the 5 hardware based computers to the pipeline computer. Within a computer, computational steps are implemented as separate processes using shared memory for communication. At any step along the pipeline the data may be graphically inspected remotely using a CORBA based tool, the CARMA Data Viewer. This same architecture will be applied to the CARMA wideband correlator (8 stations, 8 GHz bandwidth) and the CARMA spectral correlator (15 stations, 4 GHz bandwidth) scheduled for 2003 and 2004.

See accompanying posters by Plante et al and Pound et al.

P7.11   CARMA Data Storage, Archiving, Pipeline Processing, and the Quest for a Data Format

Ray Plante (NCSA/University of Illinois) Marc Pound (University of Maryland) David Mehringer (NCSA/University of Illinois) Steve Scott, Andy Beard, Paul Daniel, Rick Hobbs (Caltech/OVRO) Colby Kraybill, Mel Wright (University of California Berkeley) Erik Leitch (University of Chicago) N. S. Amarnath, Kevin Rauch, Peter Teuben (University of Maryland)

In 2005, the BIMA and OVRO mm-wave interferometers will be merged into a new array, the Combined Array for Research in Millimeter-wave Astronomy (CARMA). Each existing array has its own visibility data format, storage facility, and tradition of data analysis software. The choice for CARMA was to use one of a number of an existing formats or devise a format that combined the best of each. Furthermore, it had to address three important considerations. First, the CARMA data format must satisfy the sometimes orthogonal needs of both astronomers and engineers. Second, forcing all users to adopt a single off-line reduction package is not practical; thus, multiple end-user formats are necessary. Finally, CARMA is on a strict schedule to first light; thus, any solution must meet the restrictions of an accelerated software development cycle and take advantage of code reuse as much as possible. We describe our solution in which the pipelined data passes through two forms: a low-level database-based format oriented toward engineers and a high-level dataset-based form oriented toward scientists.

The BIMA Data Archive at NCSA has been operating in production mode for a

decade and will be reused for CARMA with enhanced search capabilities. The integrated BIMA Image Pipeline developed at NCSA will be used to produced calibrated visibility data and images for end-users. We describe the data flow from the CARMA telescope correlator to delivery to astronomers over the web and show current examples of pipeline-processed images of BIMA observations.

P7.12 CARMA Software Development

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Combining the existing BIMA and OVRO mm interferometers, and adding a new third sub-array in a combined CARMA mm interferometer will not only bring up new challenges in hardware, but also in software. Both arrays have their own mature operations software, developed over the last decade. For CARMA, the situation is not as simple as choosing one over the other. It is further complicated by the fact that the software developers are dispersed among 5 institutions and 4 time zones. Such multi-institution development requires frequent communication, local oversight, and reliable code management tools.

Timeline has forced us to carefully balance using existing software, with wrappers bound to a new, more object oriented approach, and rewriting from scratch. New hardware, such as the correlator, has already resulted in new software, but we also anticipate re-using a fair fraction of the existing telescope software.

This poster will summarize our ideas on how we plan to do this, as well as outline what we call the CARMA Software Toolkit and the associated Software Engineering aspects.

See also accompanying posters by Scott et al. and Plante et al.

P7.13 Refactoring DIRT

N.S. Amarnath, M.W. Pound, M.G. Wolfire (University of Maryland)

The Dust InfraRed ToolBox (DIRT - a part of the Web Infrared ToolShed, or WITS, located at http://dustem.astro.umd.edu) is a Java applet for modeling astrophysical processes in circumstellar shells around young and evolved stars.

DIRT has been used by the astrophysical community for the past 4 years. DIRT uses results from a number of numerical models of astrophysical processes, and has an awt based user interface. DIRT has been refactored to decouple data representation from plotting and curve fitting. This makes it easier to a) add new kinds of astrophysical models b) use the plotter in other applications c) migrate the user interface to Swing components d) modify the user interface to add functionality (for example, SIRTF tools).

DIRT is now an extension of two generic libraries, one of which manages data representation and caching, and the second of which manages plotting and curve fitting. This project is an example of refactoring with no impact on user interface, so the existing user community was not affected.

P7.14 COS Calibration Process

Stephane Beland, Steven Penton, Erik Wilkinson

COS has two distinct ultraviolet channels covering the spectral range from 1150 to 3200 . The NUV channel covers the range from 1700 to 3200 and uses the Hubble Space Telescope s STIS spare MAMA. The FUV channel uses a micro channel plate detector with a cross-delay line readout system to cover the range from 1150 to 1900 . Due to the analog nature of the readout electronics of the FUV detector, this system is sensitive to temperature variations and has non-uniform pixel size across its sensitive area. We present a step-by-step description of the calibration process required to transform raw data from the COS into fully corrected and calibrated spectra ready for scientific analysis. Initial simulated raw COS data is used to demonstrate the calibration process.

P7.15 Systems Integration Testing of OPUS and the New DADS

Lisa E. Sherbert, Lauretta Nagel (STScI)

The Data Archive and Distribution System (DADS) will be entering the IDR (Ingest Distribution Redesign) era soon and more major functions will be shifting from the VMS platforms to various Unix platforms. As the first phase, Distribution, is delivered to testing, interfaces with OPUS and OTFR (On The Fly Reprocessing) will change. We will give an overview of the OPUS/DADS/OTFR supersystem, circa Fall 2002, and identify interface changes that will impact the operators and archive users.

P7.16 Supporting The Observatory Mission-Critical Data Flow

Benoit Pirenne (ESO)

ESO s model for operating the VLT (and several other telescopes) was developed following the space missions model: a well defined, regularly spaced and repeating set of cycles comprising phase-I and phase-II community proposal submission steps, scheduling (long and mid-term), observing, archival, quality control and finally distribution of the observations to the PIs. The above steps are almost all taking place at the headquarter of the Observatory for cost and logistics reasons. This modus operandi is the most logical one for a service mode -oriented observatory.

In this contribution, the VLT operations three year experience is given with particular emphasis on how the headquarters operations management support structure developed and stabilized. A number of metrics to assess the performance of the support operation is provided.

ENABLING TECHNOLOGIES

P8.1　Efficient Distribution of Computational Load on a Bewoulf-Like Cluster

Luca Fini, Marcell Carbillet (Osservatorio Astrofisico di Arcetri)

The CAOS Application Builder is a Graphical Programming Environment which allows the building of complex simulation applications for Adaptive Optics systems, by putting together elementary blocks [1,2,3]. The resulting simulation programs are often very heavy in computational needs and could be profitably run on bewoulf-like clusters, provided the computational load can be efficiently distributed on the CPU s. In the paper we describe a project to provide the CAOS Application Builder with software tools which allow the user to optimize the distribution of blocks on a multi cpu machine and show a few preliminary results.

[1] L.Fini, et. al. in ADASS-X ASP Conference Series, Vol. 238, 2001. F. R. Harnden Jr., F. A. Primini, and H. E. Payne, eds. pp. 253-256
[2] M.Carbillet, et. al. in ADASS-X ASP Conference Series, Vol. 238, 2001. F. R. Harnden Jr., F. A. Primini, and H. E. Payne, eds. pp. 349-352.
[3] S.Correia, et. al. in ADASS-X ASP Conference Series, Vol. 238, 2001. F. R. Harnden Jr., F. A. Primini, and H. E. Payne, eds. pp. 404-407

P8.2　Source code management and software distribution using Open Source technologies

Martin Bly (Rutherford Appleton Lab, UK) Alasdair Allan (University of Exeter, UK) Tim Jenness (Joint Astronomy Center, HI)

The Starlink Software Collection (SSC) runs on three separate platforms and contains approximately 130 separate software items, totalling over 6 million lines of code. Distribution of such large software systems and installation at multiple remote sites has always been problematic due to the complex web of inter-dependences such systems invariably generate.

The rise of the Open Source movement has brought standard tools into common use to cope with such large and complex tasks. The Redhat Package Manager (RPM) software is one such which is available for many platforms. We have shown it is possible to automate the distribution and installation of the Starlink Software using RPM. We anticipate that this will vastly simplify installation and package management for System Administrators who must support the SSC in production data processing environments.

P8.3 SIRTF Mosaicker

David Makovoz, Khan Iffat

We present a software system for image coaddition/mosaicking that is being developed for the SIRTF mission. SIRTF mosaicker features the use of the drizzle interpolation technique, robust outlier detection based on spatial and temporal filtering, and fast direct plane-to-plane coordinate transformation. It is designed to interface with other tools developed at SSC, such as pointing refinement and overlap consistency, which will improve the quality of the mosaic images.

P8.4 MacOSX for Astronomy

F. Pierfederici, N. Pirzkal, R. Hook

MacOSX is the new version of the Unix based Macintosh operating system. It features a sleek, high performance, display PDF user interface, sitting on top of a standard BSD UNIX subsystem. Consequently, this OS empowers users with a broad range of applications previously non available on a single system such as Microsoft Office and Adobe Photoshop, as well as legacy X11-based scientific tools and packages (IRAF, SuperMongo, MIDAS, and Skycat). This combination of a modern GUI layered on top of a familiar UNIX environment paves the way for new, more flexible and powerful astronomical tools being developed while assuring compatibility with already existing, older programs. In this paper, we outline the strengths of the MacOSX platform in a scientific environment, Astronomy in particular, and point to the numerous astronomical software packages available for this platform; most notably the SciSoft collection.

P8.5 The Fasti Project

C. Baffa, V. Biliotti, A. Checcucci (INAF - Osservatorio di Arcetri) V. Gavrioussev (IRA - CNR) S. Gennari, E. Giani, F. Lisi (INAF - Osservatorio di Arcetri) G. Marcucci (Firenze University) M. Sozzi (IRA - CNR)

Fasti is a controller architecture originally developed for fast infrared astronomical array detectors, and intended to be powerful and extendible. It is suitable to be used with both DRO and CCD detector and it is also well suited for very fast optical detectors, as those used in Adaptive Optics. In the framework of LBT project, a L^3CCD version is in development.

P8.6 The USNO-B Catalog

David Monet, Stephen Levine (USNO Flagstaff)

The USNO-B catalog presents positions, proper motions, magnitudes in various optical passbands, and star/galaxy estimators for 1,036,366,767 objects derived from 3,633,655,848 separate observations. The data were obtained from scans of 7,435 Schmidt plates taken for the various sky surveys during the last 50 years. A brief dis-

cussion of various will be presented, but the actual data are available from www.nofs.navy.mil and other sites after September 2002.

P8.7   Infrared-Array-Camera Images from the Space Infrared Telescope Facility

Russ Laher, Jason Surace, Heidi Brandenburg, Mehrdad Moshir

The Infrared Array Camera (IRAC), one of the science instruments on NASAs soon-to-be-launched Space Infrared Telescope Facility (SIRTF), has four simultaneous-imaging, focal-plane-array detectors with optical filters covering different near-infrared spectral regions: 3.6, 4.5, 5.8 and 8.0 m. IRAC digital images of the celestial sky will be computer-processed in several stages of a production pipeline for instrument-artifact removal and scaling to absolute intensity units. Ancillary uncertainty and pixel-condition-flag images will also be generated for each processed IRAC image. Special processing of calibration data will be done prior to applying it in the production processing. Telescope-pointing data will be separately processed and used to assign a sky position and orientation to each image. Time-sequences of images will be processed to create pixel maps of unwanted latent-image artifacts. Images overlapping the same sky region will be co-added to mitigate noise, put together to form sky mosaics much larger than IRAC s footprint on the sky, and further processed to yield intensity point-source information on the celestial objects that are imaged. Pixel maps of outliers in the image data will also be generated. Reduced data from IRAC s four infrared will be merged to facilitate scientific analysis. The data processing will be done at the SIRTF Science Center, first in real time and then in subsequent processing episodes to further refine the data products. Selected versions of the data products will be archived and made accessible to astronomers worldwide

Author Index