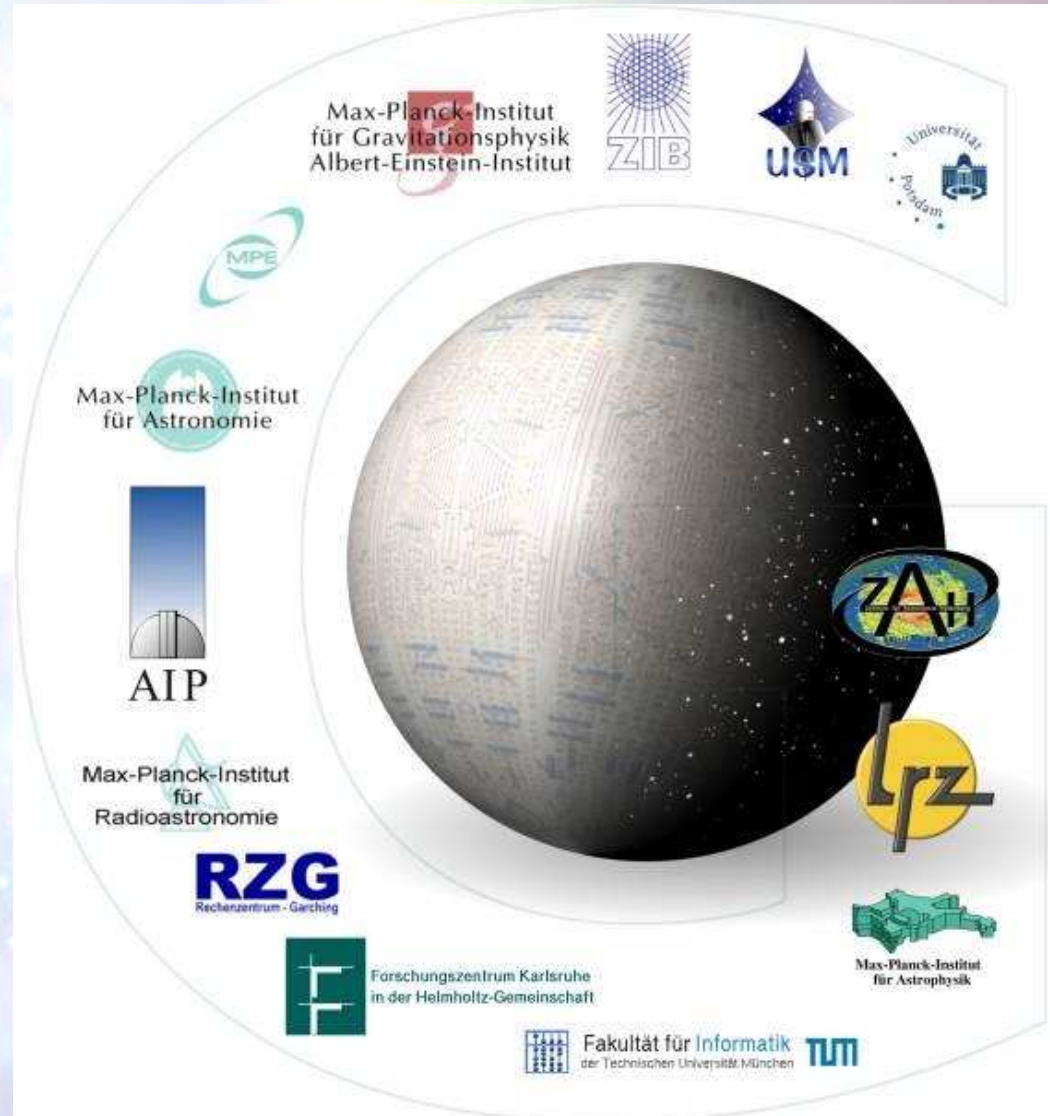
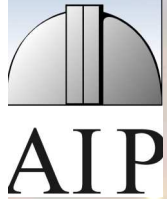
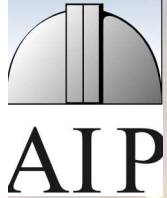


Astronomie + Grid = AstroGrid



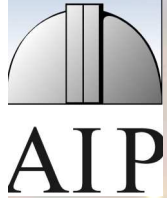
Astronomie + Grid = AstroGrid



Harry Enke
Astrophysikalisches Institut Potsdam

AstroGrid-D
WissGrid

Übersicht



- ◆ **Geschichte**
 - **Anfänge der modernen Astronomie**
- ◆ **Instrumente**
- ◆ **Surveys**
 - **Virtual Observatory + RT/Grid**
- ◆ **Simulationen**
- ◆ **Warum e-Astronomy? (VO+Grid+VRE)**
 - **Datenchallenge**
- ◆ **IT - Infrastruktur Entwicklungen**
 - **Virtual Observatory Tools**
 - **AstroGrid-D Architektur und Tools**
 - **Neue Hard+Software-Konzepte**

Frühzeit der Astronomie:

Empirische Wissenschaft

- ◆ Ordnung am Himmel durch
 - Beobachtung von Konstellationen
 - Bewegungen der Wandelsterne (Planeten)
 - Verknüpfung mit jahreszeitlichen Ereignissen
- ◆ Erfassung von Beobachtungen in Tabellen
- ◆ Geometrische Erklärungsmodelle von Bewegungen am Himmel
- ◆ Ideologische (naturphilosophische und religiöse) Erkenntnis-Bremsen

Astronomie: Geschichte



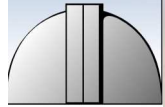
Cassiopeia sedens in siliquastro collocata e. cui⁹ sedi-
lis & ipsi⁹ cassiopeie pedes positi in ipsa circinductio-
ne circuli qui arcticos vocat. effigies autē corpis ad
estiuū circulū pertinet: ique capite & dextera manu
tangit. hęc ppe mediū dividit circul⁹is lacteus ap-
pellat. prime cephei signū collocatū. hęc occidens cū scorpione ca-
pite: cū sedili resupino ferri pspicit. Exoritur autē cū sagittario. hui⁹
i capite stella ostēdit vna. In vtroq; humero vna. In mamilla de-
stra dara vna. In lūbis magna vna. In sinistro femore duas. In
genu vna. In pede ipsi⁹ dextro. i. In qdrato quo sella doctinat. i.
In vtroq; singulę dari⁹ ceteris lucētas. hęc igit ē oio stellar. xiiij.



Andromeda ppe cassiopeia supra caput persei baci
intervallo distidēte pspicit collocata: manib⁹ otueris
vinca vt antiquis historijs ē traditū: cui⁹ caput cō-
pegasi vtri coniungit. Eadē eni stella vt vmbilicus
pegasi & andromede caput appellat. hui⁹ medum
pect⁹ & manū sinistra circul⁹ estiuū dividit. Occidit autē cū pisce
de duobus fecido: quē andromede subiectū brachio supra dext⁹
mus. Exoriete libra & scorpione capite pualq; reliquo corpe pue-
nit ad terrā. Exoritur autē cū piscis⁹ & ariete. hęc vt supra diximus
habet i capite stellā dare lucēte vna. In vtroq; humero vna. In
cubito dextro vna. In ipsa manu vnam. In sinistro cubito vel in



2 der 48 Ptolemäischen Sternbilder, aus „Poeticon astronomicon“
(1. Jh. BC, Hyginus)
Ratdolt'sche Ausgabe, Holzschnitte, 1482



AIP

Ablösung des Ptolemäischen Weltbildes:

- ◆ Beobachtung und Tabellen von Tycho Brahe
(Anhänger des Ptolemäischen Weltbilds)
- ◆ Kopernikanische Wende (1543)
Heliozentrische Sicht
- ◆ Keplersche Gesetze
- ◆ Galieische Beobachtungen mit
Fernrohr
- ◆ Newtonsche Physik

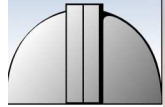


Bedeutende historische Sterntabellen

- * ca **150**, *Almagest* - enthält die letzte bekannte Stern-Tabelle der Antike, von Ptolemäus, **1028 Sterne**
- * **1627**, *Rudolphinische Tabellen* - erste mittelalterliche Stern-Tabelle, basiert auf Messungen v. Tycho Brahe, **1005 Sterne**
- * **1690**, *Prodromus Astronomiae* - von Johannes Hevelius für sein Firmamentum Sobiescanum, **1564 Sterne**
- * **1725**, *Britannic Catalogue* - John Flamsteed für seinen Atlas Coelestis, Position von mehr als **3,000 Sternen** bei 10" Genauigkeit
- * **1903**, *Bonner Durchmusterung* - von Friedrich Wilhelm Argelander et al., **ca 360,000 Sterne**
(tabellarische scheinbare Magnitudines und Positionen)

Theorie und Beobachtung ergänzen sich

- ◆ Newton / Flamstedt (Mondposition)
- ◆ Einsteinsche Relativitätstheorie:
 - Perihel-Drehung des Merkur
 - Ablenkung des Lichtes durch die Sonnenmasse
 - (Eddington)
 - Schwarze Löcher
 - Schwarzschild, Kerr, Wheeler
 - Ausdehnung des Universums
 - Hubble
- ◆ Kernphysik : Erklärung des nuklearen Zyklus der Sterne
 - Bethe-Weizsäcker-Zyklus



AIP

Anfänge der modernen Astronomie:

ab 1900: Photographie als Basis für optische Beobachtungen

ab 1800: Spektroskopie (Herschel)

Infrarot und Ultraviolett-Strahlung

1930: Radio-Astronomie (Karl Guthe-Jansky)

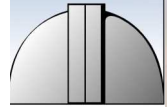
1964 Cosmic Microwave Background (Penzias/Wilson)

◆ 1962: Röntgenstrahlen-Astronomie

R. Giacconci

◆ 1958: Gamma-Strahlen-Astronomie

I. Hayakawa, P. Morrison



AIP Traditionelle Arbeitsweise

- Einzelbeobachtungen,
- Individuelle Teleskopzeit
- 1 Spektralbereich
- Theorie und Beobachtung
- Einzelauswertung

Daten: ~ Gigabyte

- Photoplatten, Tabellen, Diagramme, Publikationen
- Einzelarbeitsplatz/Workstation
- Originaldaten nicht mit Publikationen verknüpft

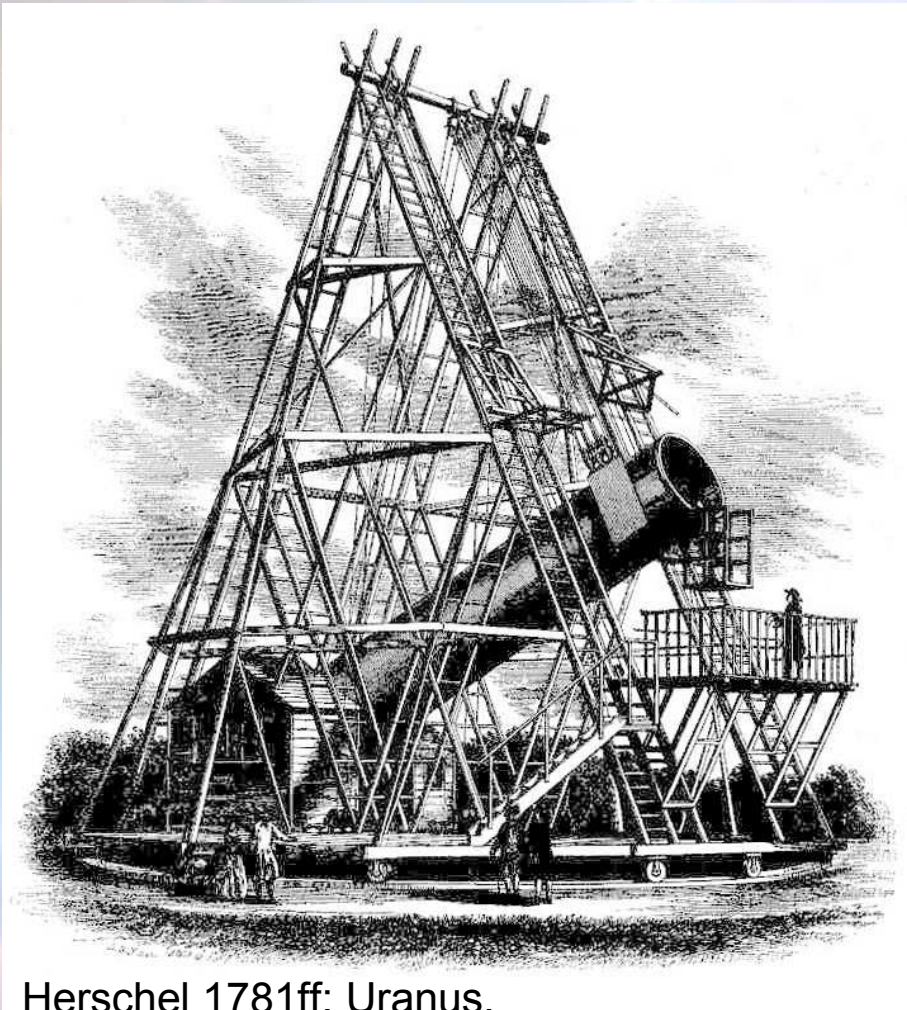
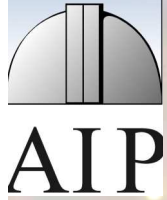
Moderne Arbeitsweise

- Surveys, Satelliten, robot. Teleskope
- Kollaborationen (Multinational)
- Daten aus vielen Spektralbereichen
- Theorie, Simulation, Beobachtung
- Daten-Pipelines

Daten: ~ Petabyte

- digitalisierte Daten
- Datenbanken
- Netzwerke von Datenservern, Rechnern
- Originaldaten und Publikationen verknüpft

Astronomie: Instrumente

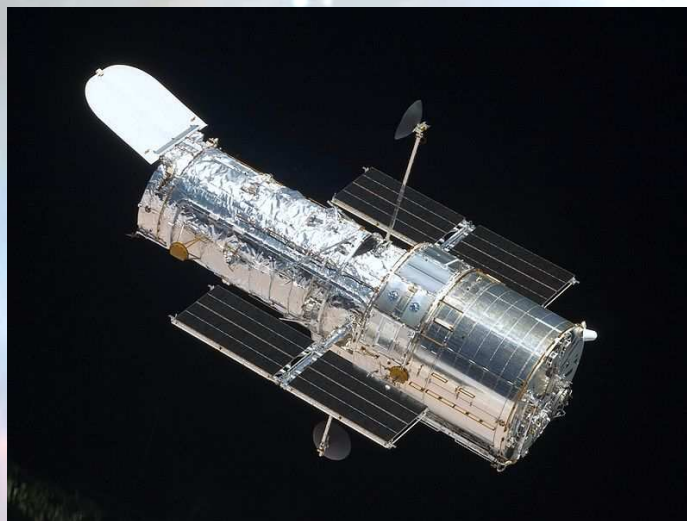
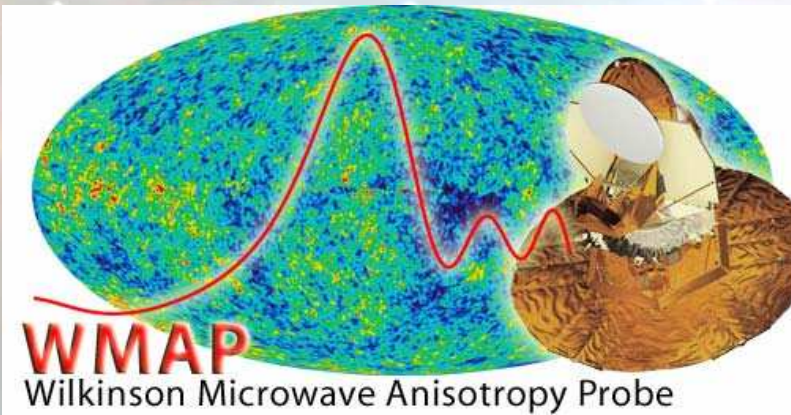
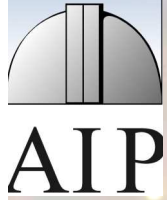


Herschel 1781ff: Uranus,
Uranus-Monde Oberon, Titania
Saturn-Monde Mimas, Enceladus

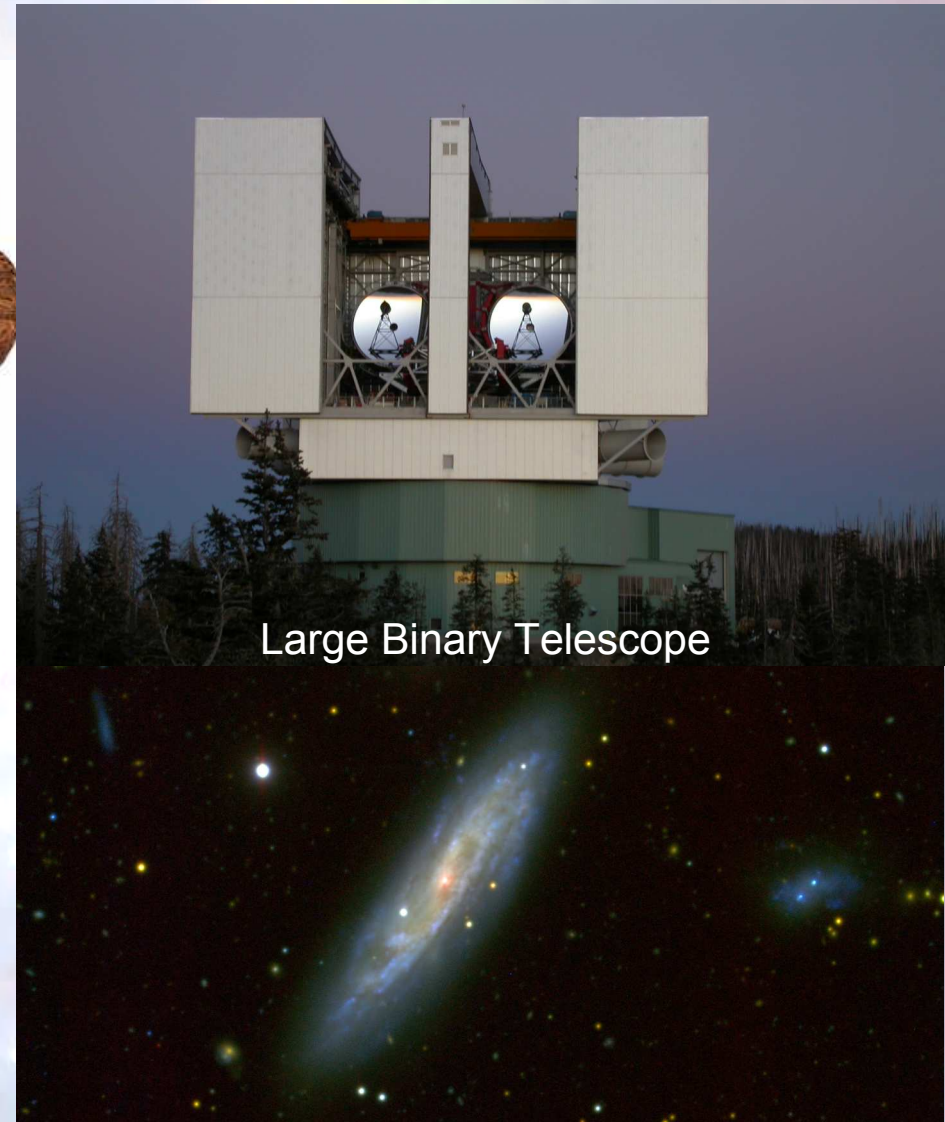


Hubble 1929: Rotverschiebung,
Ausdehnung des Universums

Astronomie: Instrumente

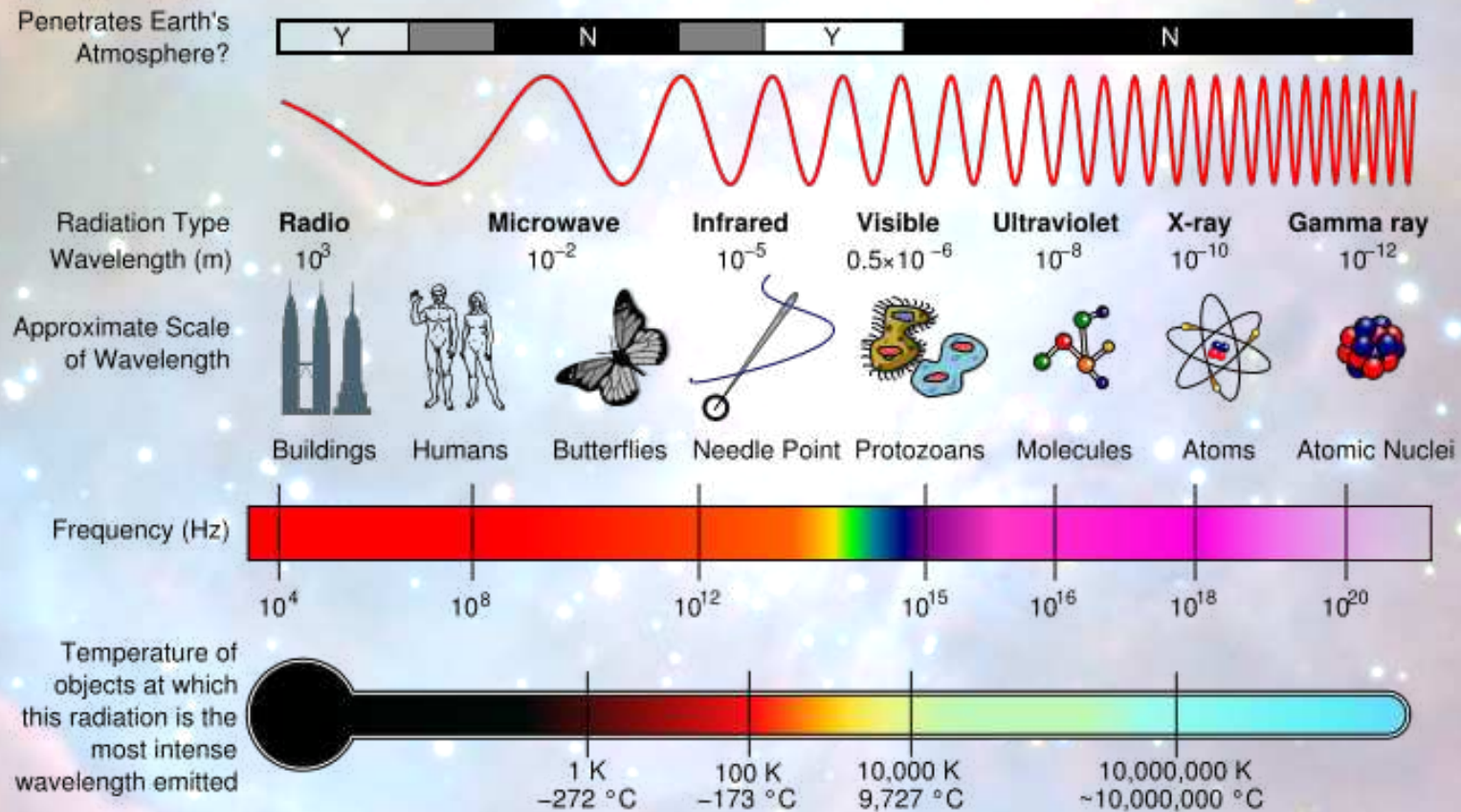


Hubble Space Telescope



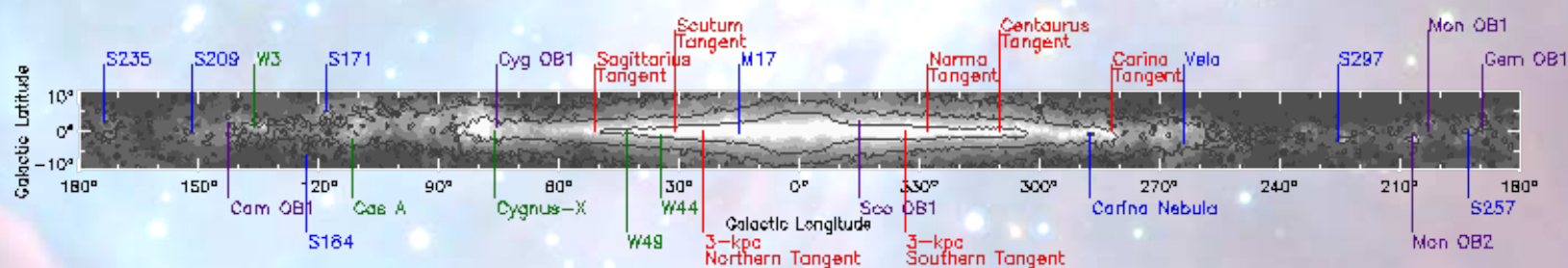
Large Binary Telescope

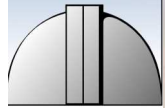
Nutzung des gesamten elektromagnetischen Spektrums



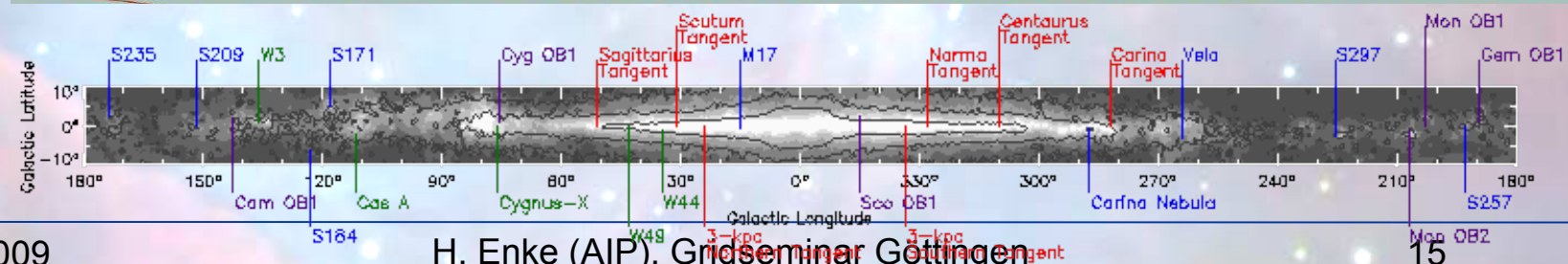
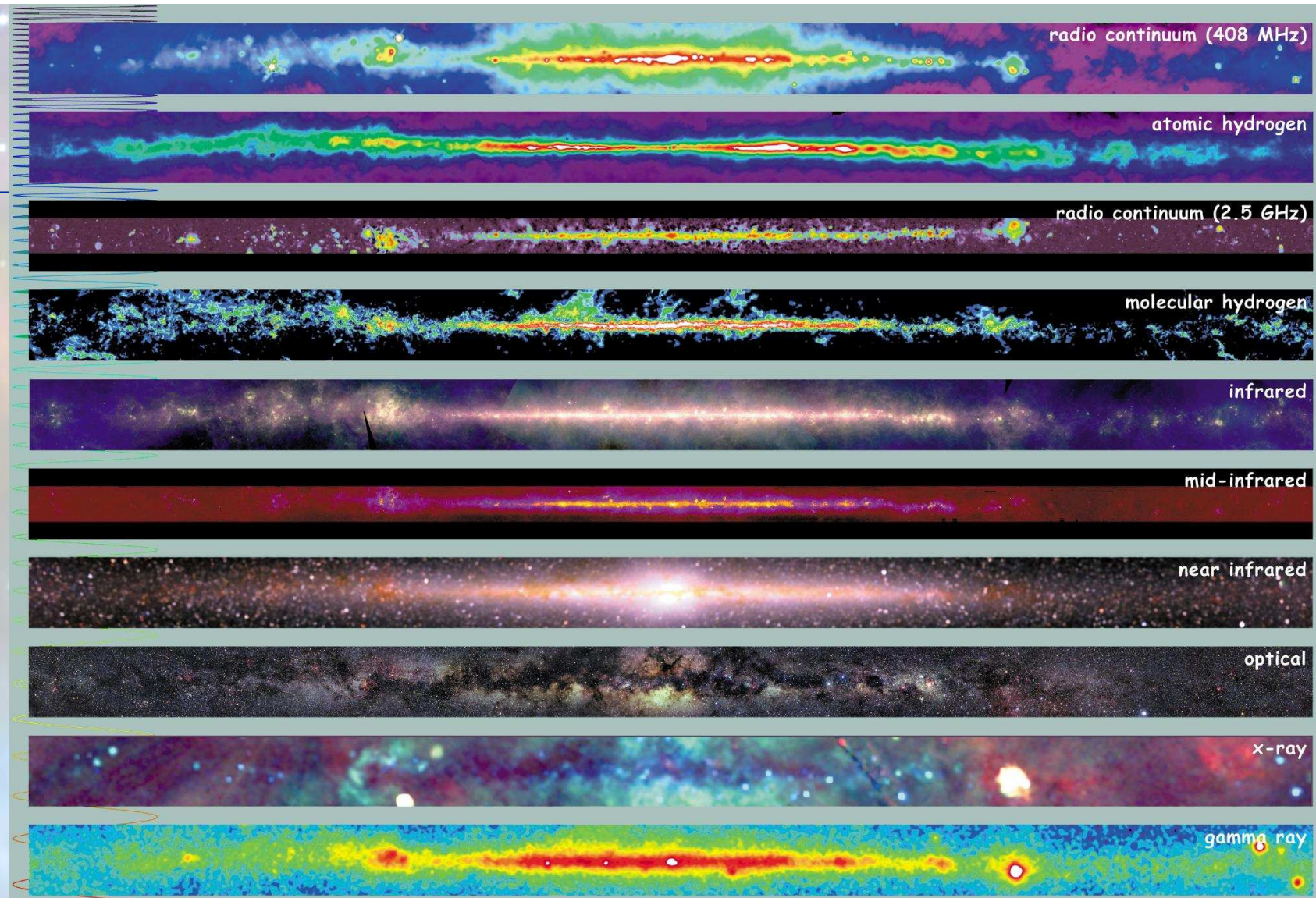
■ Eine digitale Galaxis

- ◆ Sternkataloge
- ◆ Interstellares Medium und Staub
- ◆ Vergleich mit theoretischen Modellen (Simulationen)

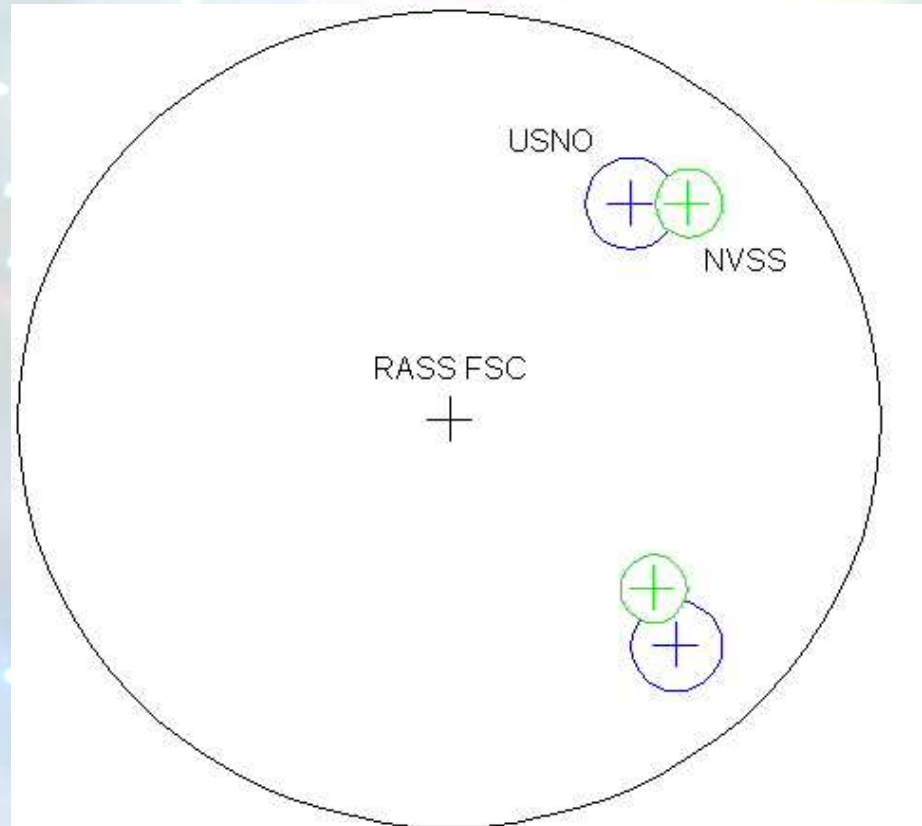
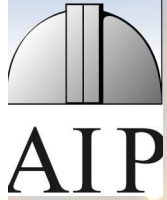




AIP



Das Identifikationsproblem



Astronomische Surveys

Jahr	Survey	Daten	Inhalt
1994	Digitized Sky Survey	~73 Gigabyte	Digitalisierte Photoplatten
2001	Catalog of DSS	~16 Gigabyte	89 Mio. Objekte
1997-2001	2 Micron All Sky Survey(2MASS)	~200 Gigabyte	300 Mio. Punktquellen und 1 Mio. ausgedehnte Quellen
2000-2006	Sloan Digital Sky Survey	~10 Terabyte	100 Mio. Objekte + 1 Mio. Spektren
ab 2014	LSST	30 Terabyte / Nacht	

Beispiel: Robotische Teleskope

HTN: The Heterogeneous Telescope Network

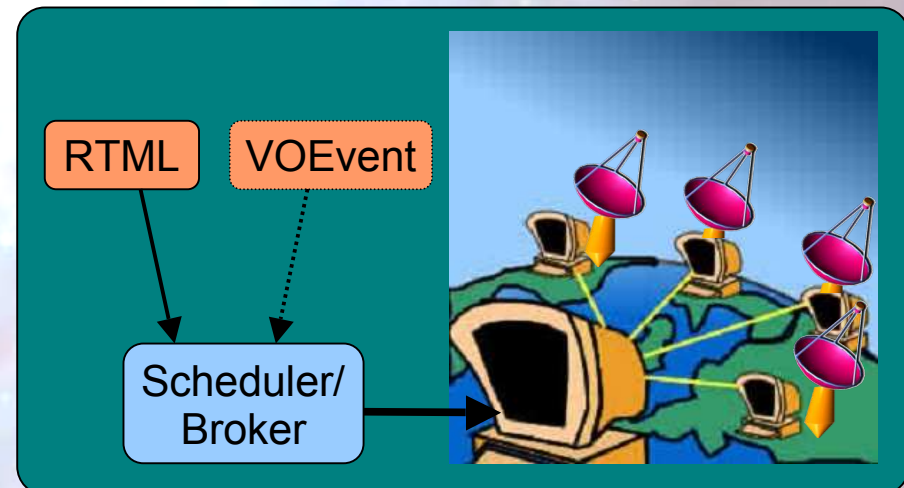


RTML

(Remote Telescope Markup Language, Hessman 2006)

- RTML beschreibt:
- Beobachtung (Target, Randbedingungen, Status, Referenz zu VOEvent)
- Schedule
- Teleskope (Ort, Status, Geräte-Charakteristiken)
- Wetterberichte
- ...

- VOEvent (Standard der IVOA)
- VOEvent beschreibt:
 - Ereignisse (what, where/when, how, who, etc.)
- Komplementär zu RTML, Anwendung für Scheduler / Brokers und Teleskope



Teleskope als Datenquelle: Monitoring mit StellarIS (AGD)

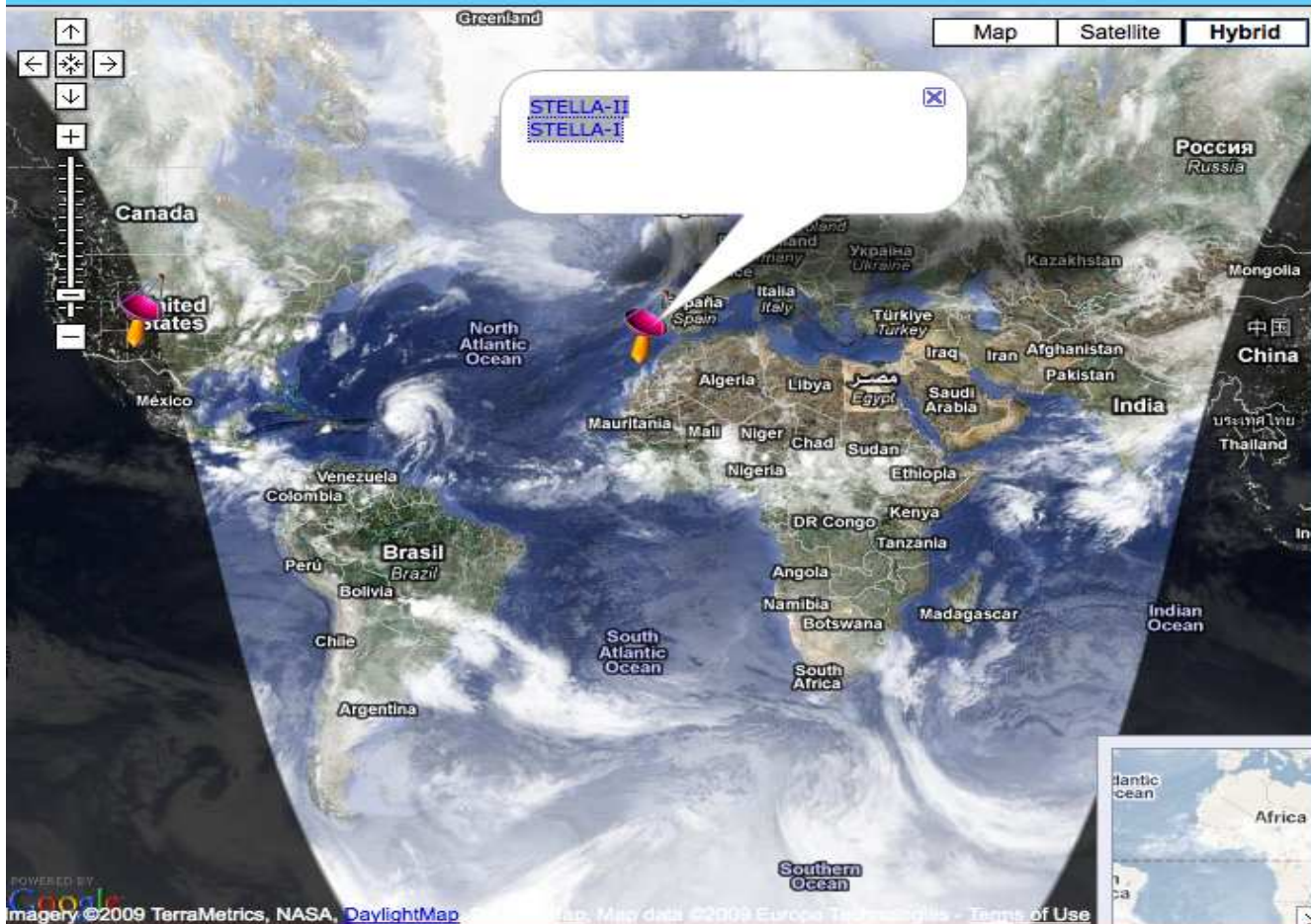


AstroGrid-D Map

Computers Telescopes

[Timeline](#) [Internal](#)

(c) M. Höggqvist (ZIB) & F. Breiting (AIP)



STELLA-I (28.30, -16.51)

Details

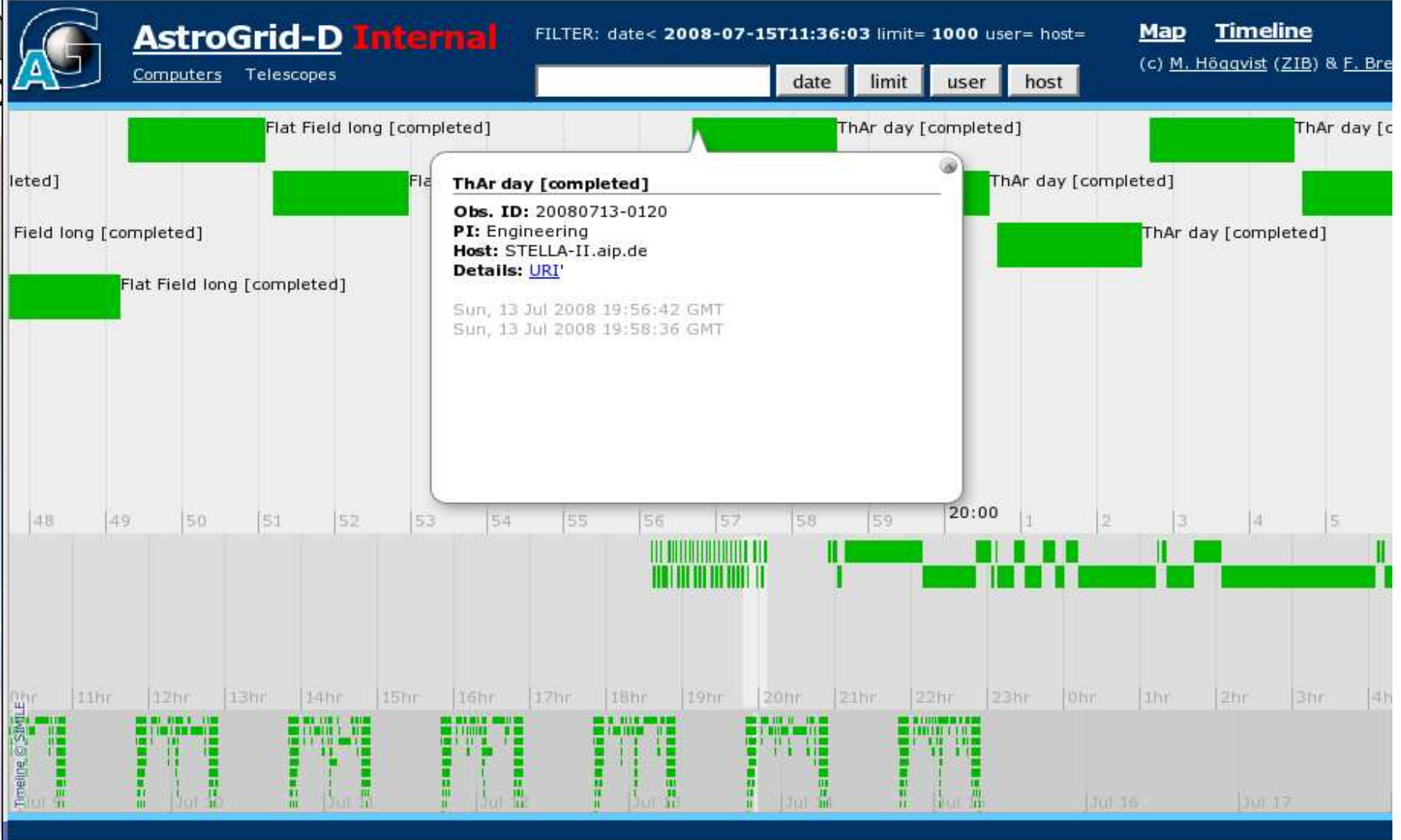
FilterType

- Johnson_U
- Johnson_B
- Johnson_V
- Cousins_R
- Cousins_I
- Sloan_u
- Sloan_g
- Sloan_r
- Sloan_i
- Sloan_z
- Stroemgren_u
- Stroemgren_v
- Stroemgren_b
- Stroemgren_y
- Halp

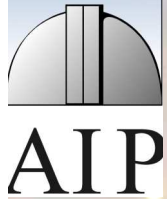
einschließlich:

- Terminator
- Wetter
- Status Information
- Instrumentelle Ausstattung

Beobachtungen als Grid-Job: AGD Monitoring mit StellarIS



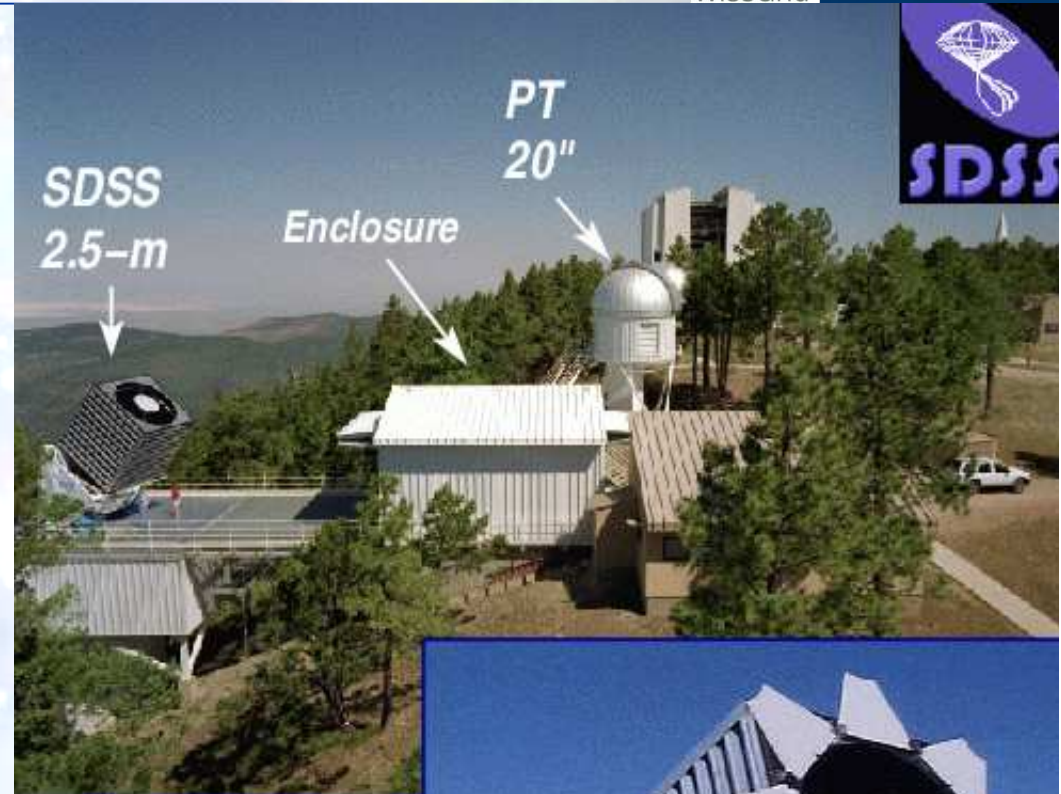
Beispiel: Sloan Digital Sky Survey



SDSS benutzt ein
speziell dafür
entwickeltes 2.5-m
Telescope

Aufgaben:

- Abbilden
- Spektroskopie



**Apache Point
Observatory**

New Mexico, USA

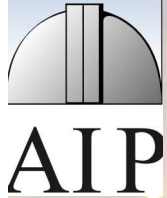
Lat. $32^{\circ}46'49.3''$ N

Long. $105^{\circ}49'13.5''$ W

Elev. 2788 m



Der Sloan Digital Sky Survey



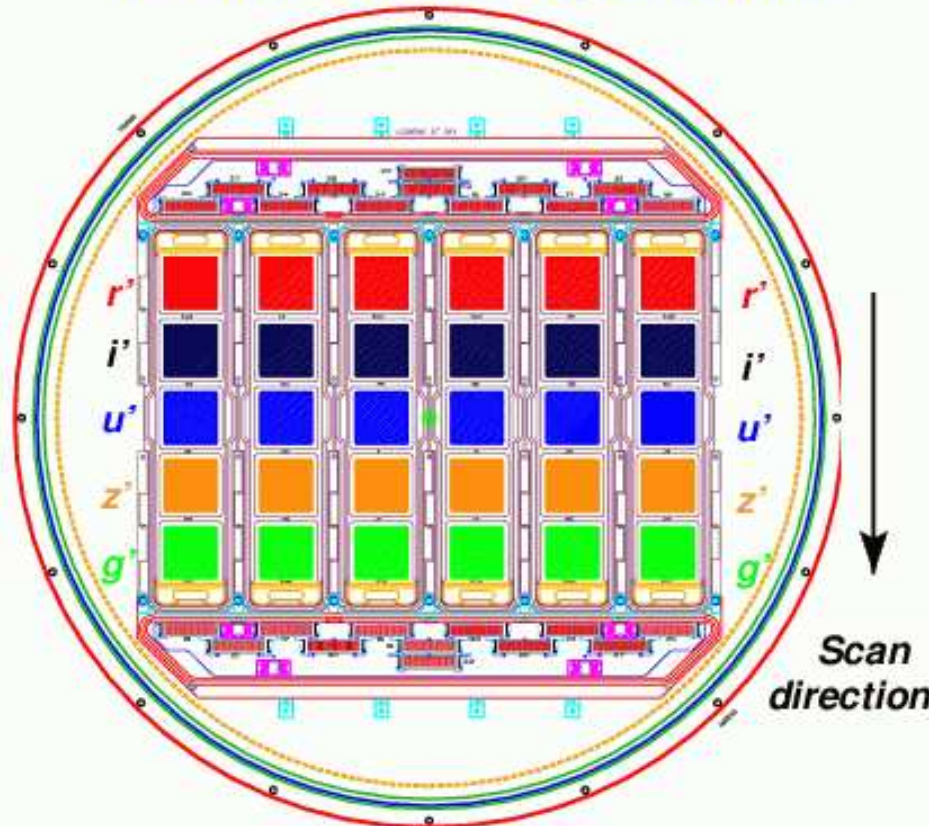
SDSS Camera

6x5 2K Tek/SITe chips

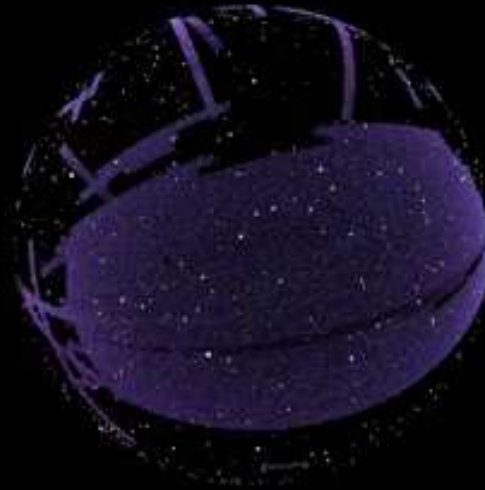
Sidereal scanning rate

15' / sec = 54 sec exposure time

- 30 2048x2048 photometric chips
 - 22 2048x400 astrometric chips
 - 2 2048x400 focus monitor chips
- 0.4" / pixel

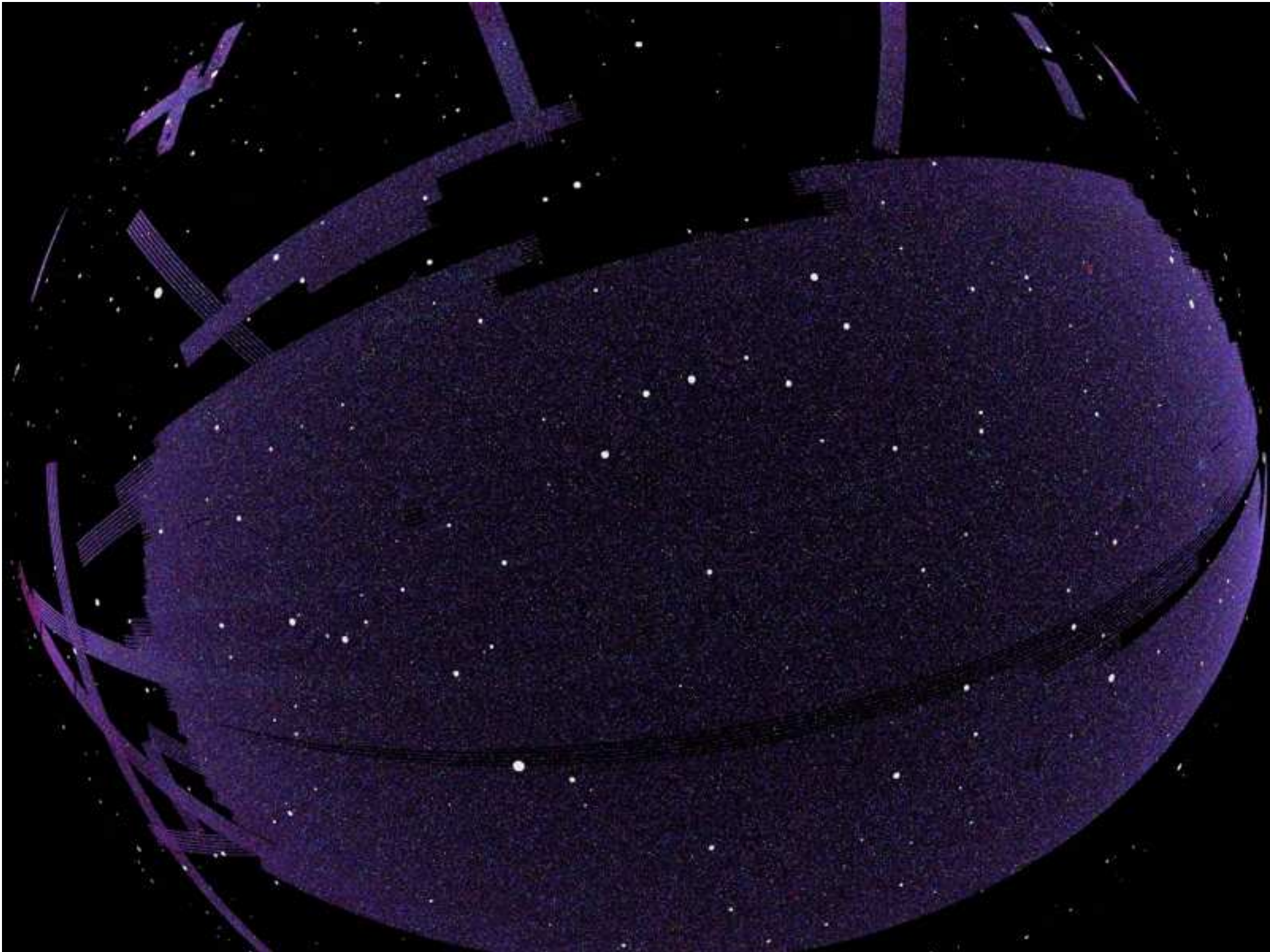


data: S l o a n D i g i t a l S k y S u r v e y
and t h e B r i g h t S t a r C a t a l o g



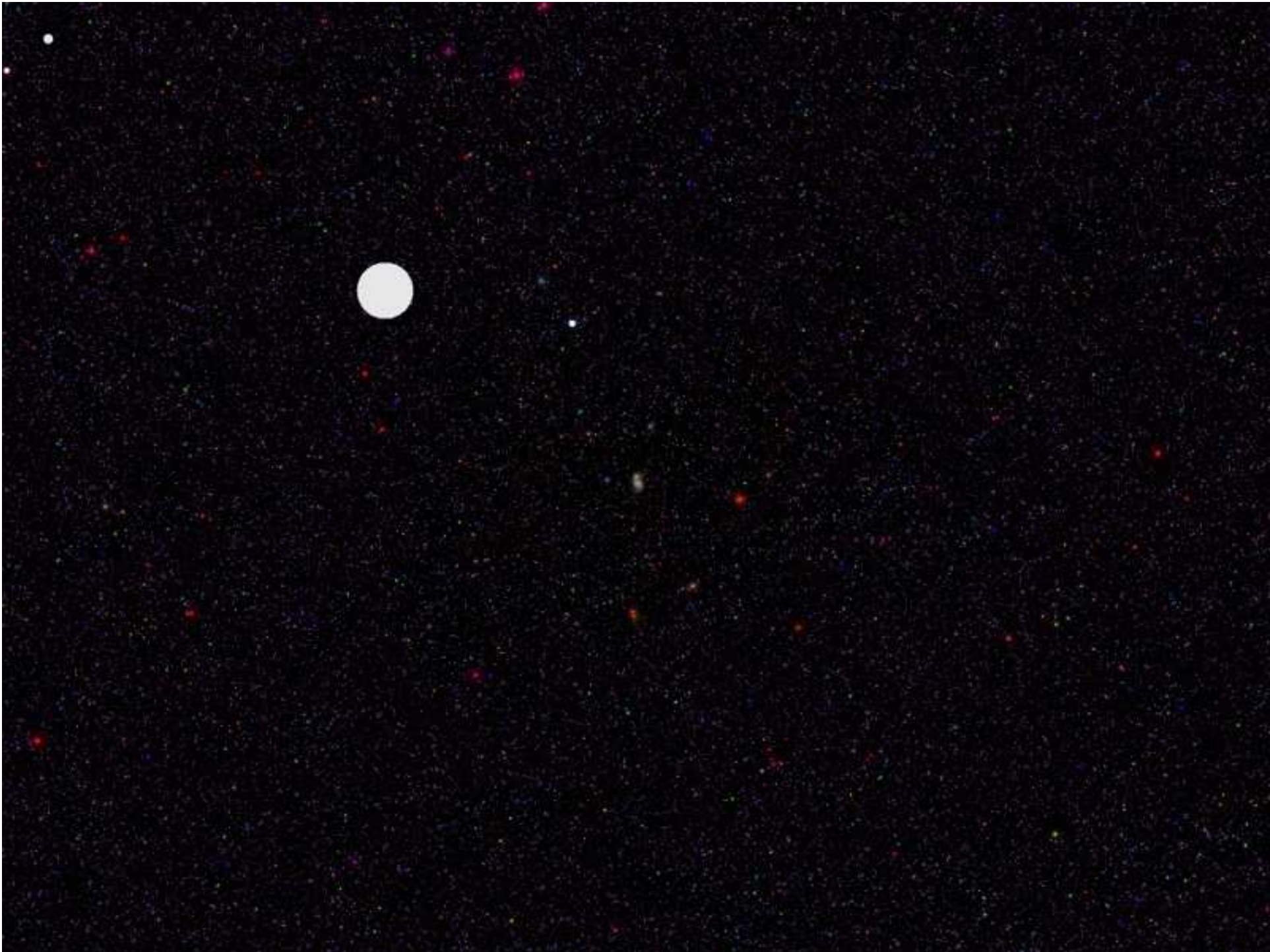
visualization: D a v i d W . H o g g (NYU)
with help from B l a n t o n , F i n k b e i n e r ,
P a d m a n a b h a n , S c h l e g e l , W h e r r y

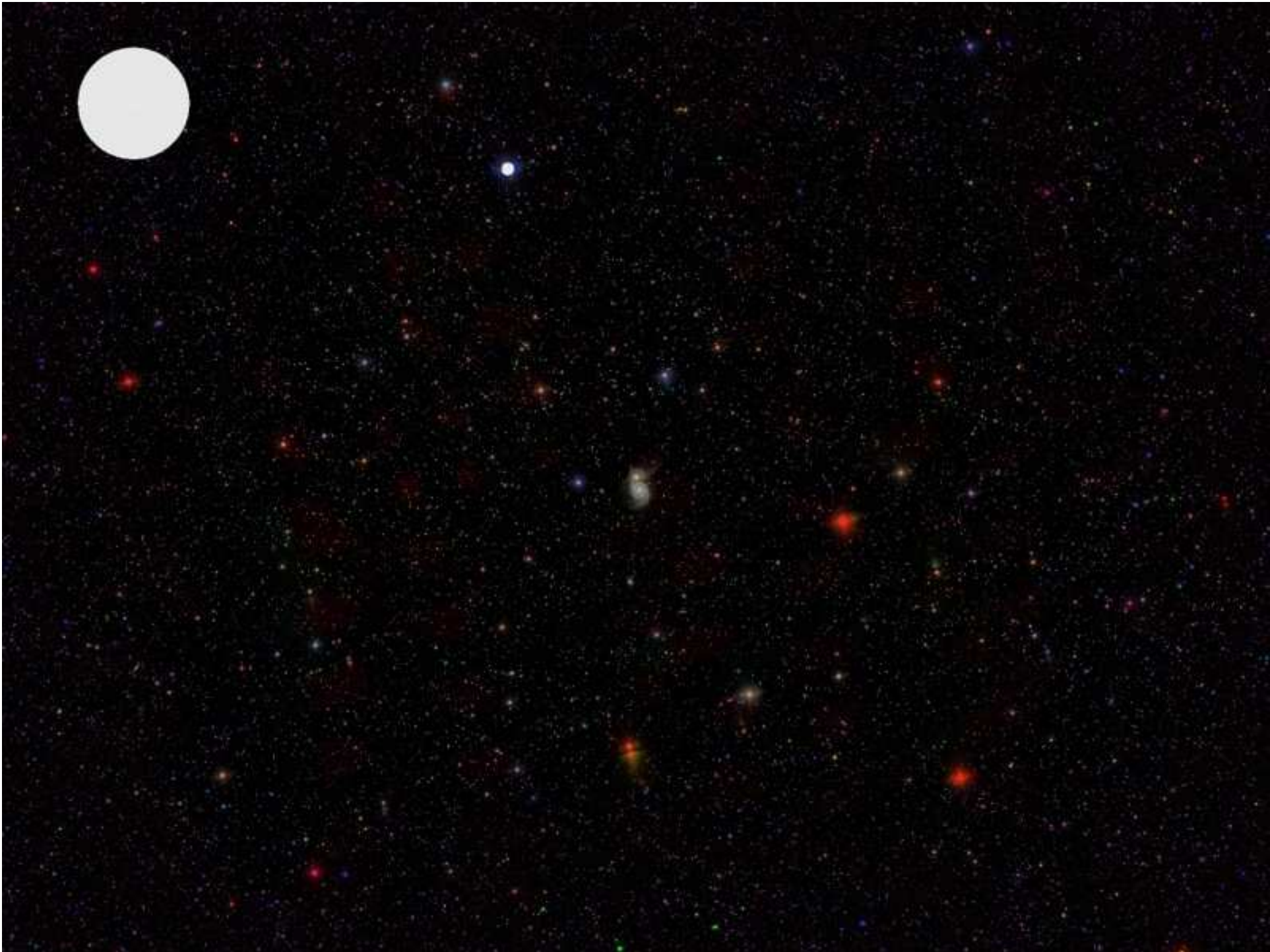


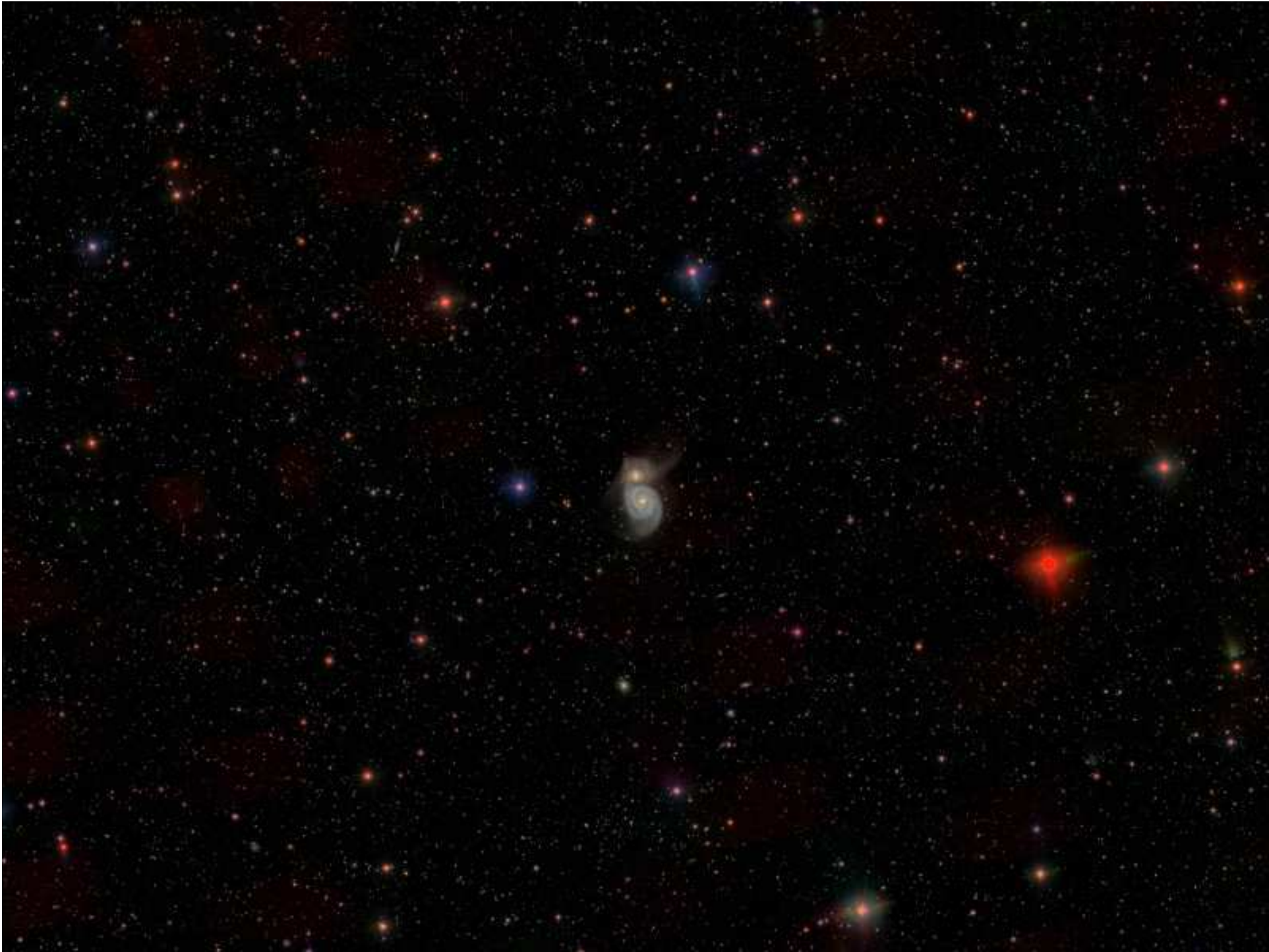










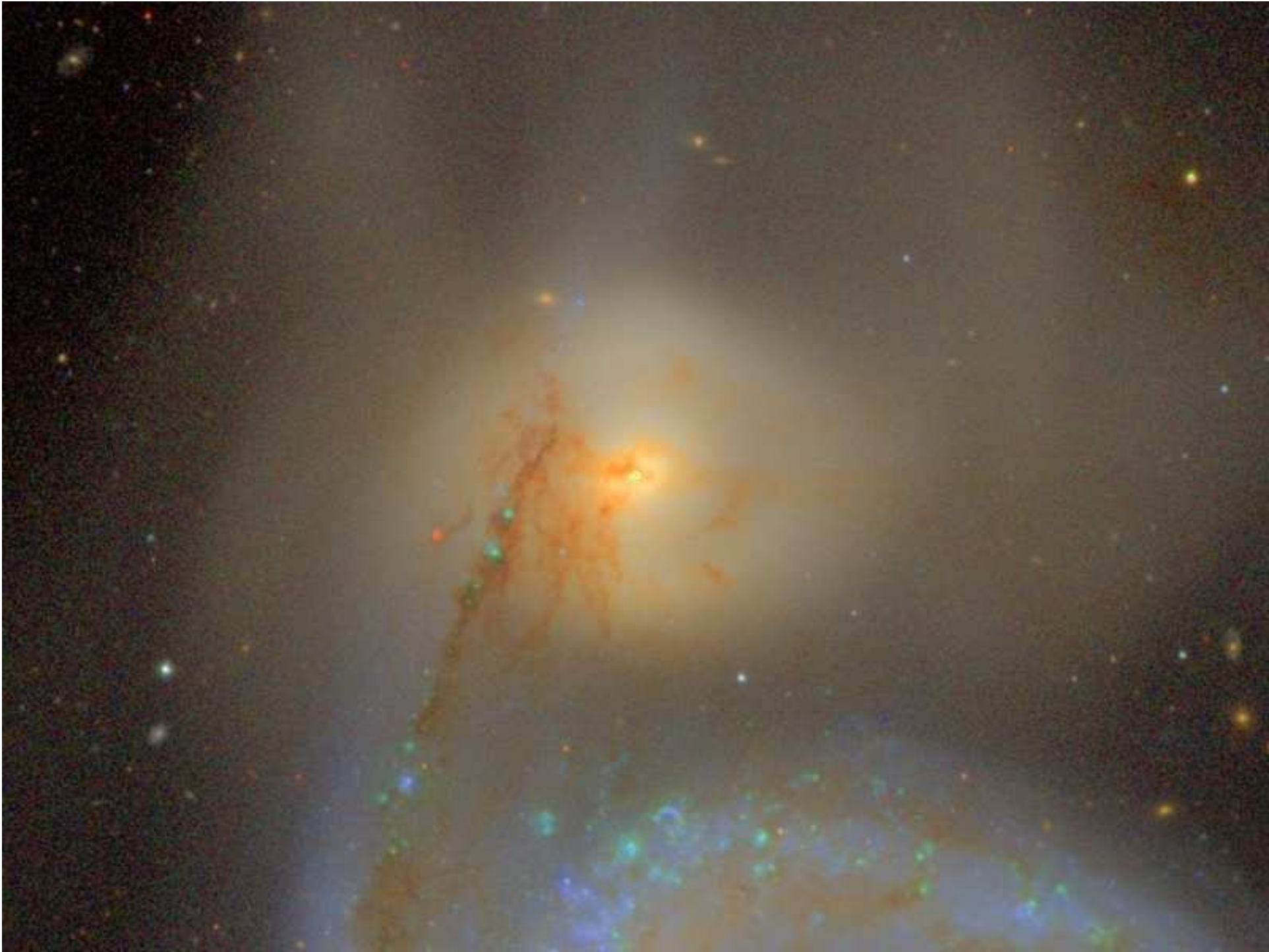












Beispiel: Sloan Digital Sky Survey



- Ursprüngliche Durchmusterung wurde am 15.5.2008 beendet.
- Final data release (DR7) am 31.10.2008
- Final data archive im Aufbau
 - ◆ Publikationen: Bibliothek der U. Chicago
 - ◆ Digitales Archiv an der Johns Hopkins University
 - ◆ Spiegel bei FNAL+JHU+ Potsdam
- Archiv enthält über 100TB an Daten
 - ◆ Alle Rohdaten
 - ◆ Alle reduzierten/kalibrierten Daten
 - ◆ Alle Versionen der Datenbank (>18TB)
 - ◆ Komplettes email-Archiv und technische Zeichnungen
 - ◆ Software code repository
 - ◆ Telescope sensor stream, IR fisheye camera, etc



Öffentliche Nutzung des SkyServer



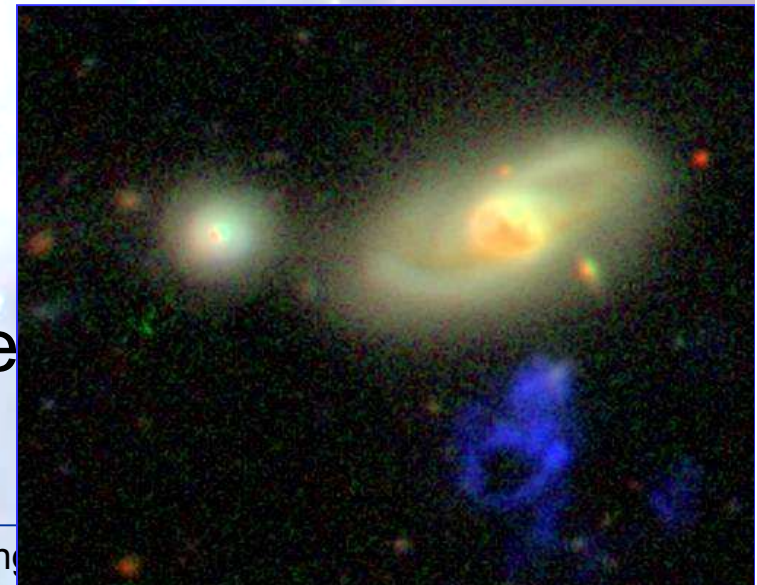
- Prototyp für Veröffentlichung wiss. Daten
 - ◆ 650 Millionen web hits in 8 Jahren
 - ◆ 1.000.000 verschiedene Nutzer (vgl 15.000 professionelle Astronomen)
 - ◆ >100TB an Rohdaten
 - ◆ alles folgt einem Potenzgesetz
- Interaktive Workbench
 - ◆ Casjobs/MyDB
 - ◆ Eigene Datenbank für ~ 2.500 Power User, keine Zeitbeschränkung
 - ◆ Datenspeicherung beim Server, link zur Hauptdatenbank
 - ◆ Tools für einfache Datenanalyse (plots, etc)



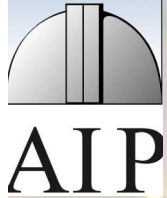
Galaxy Zoo



- Baut auf den SkyServer auf (C. Lintott et al)
- mehr als 40 Millionen visuelle Klassifikationen von Galaxien durch die Öffentlichkeit
- Enormes Presseecho (CNN, Times, Washington Post, BBC)
- 200,000 Teilnehmer, Blogs, Gedichte,
- Entdeckung eines ungewöhnlichen Himmelsobjekts durch eine Lehrerin in Holland
 - ◆ Folgebeobachtung mit Hubble, VLBA, GALEX
- Neue Art, wissenschaftliche Daten zu nutzen



Exponentielle (Daten)Welt

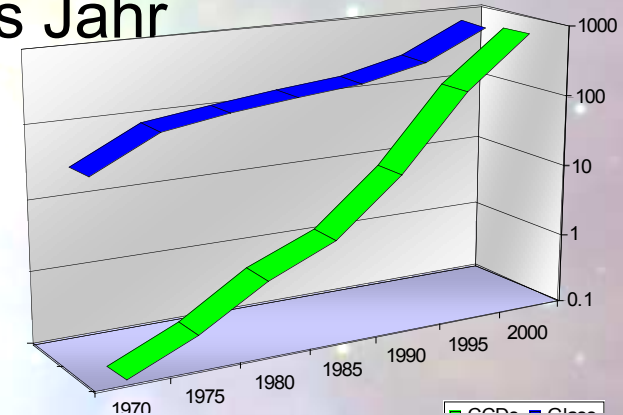


■ Datenvolumen verdoppelt sich jedes Jahr

- ◆ größere Teleskope
- ◆ größere, billigere CCDs
- ◆ CCD-Mosaik
- ◆ Simulationen
- ◆ Storage Challenge auf der SC08

□ Platz 1 und Platz 3 Anwendungen aus der Astronomie

- Es wird zunehmend schwierig, Daten zu extrahieren
- 20% der Datenserverkapazität in der Welt bei den "Big 5"
 - ◆ Google, Microsoft, Yahoo, Amazon, eBay
- Es geht nicht nur um wissenschaftliche Daten

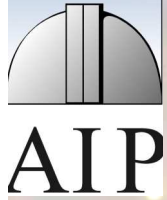


Warum ist Astronomie "special"?

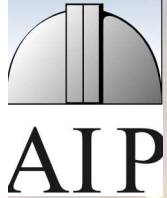


- Hohe Attraktivität für die Öffentlichkeit
- kein kommerzieller Wert
 - ◆ keine Rechte, freier Zugang für alle
 - ◆ ideal um mit Algorithmen zu experimentieren
- Real und wohl dokumentiert
 - ◆ Multidimensional
 - ◆ räumlich, zeitlich
- Divers und verteilt
 - ◆ Viele verschiedene Instrumente an vielen verschiedenen Orten zu vielen verschiedenen Zeiten
- There is a lot of it (petabytes)

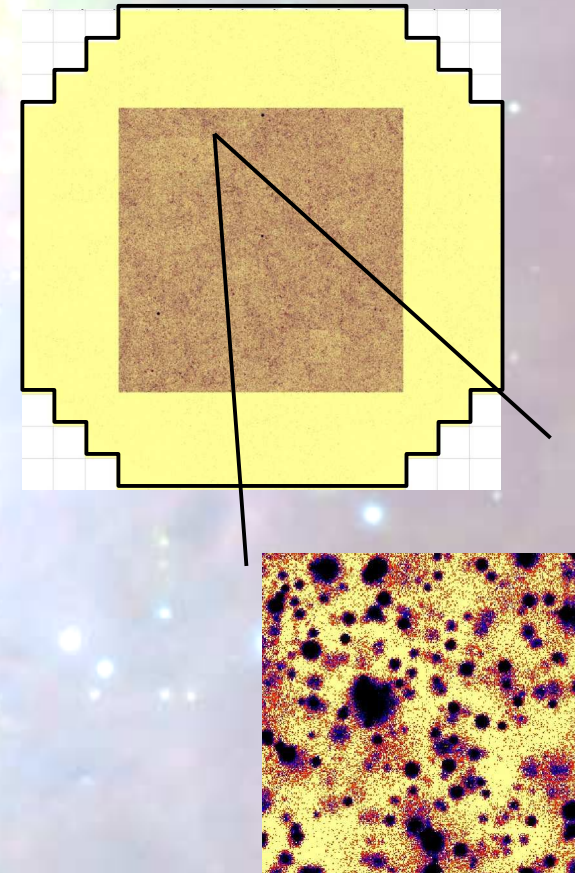
LSST



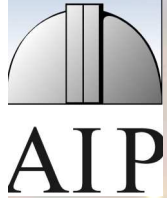
LSST Survey



- 8.4m-Teleskope (LBT-Spiegel)
- Gesichtsfeld von 3.5° (f/1.2)
- 3.2 GPix-Kamera
 - ◆ 2 x 15 sec Belichtungen
 - ◆ Himmelsabdeckung: $> 20,000 \text{ deg}^2$, 0.2 arcsec / pixel
- 10 Jahre Laufzeit
 - ◆ jede Woche ein kompletter SDSS
 - ◆ bis zu 2000 Epochen
- „Beobachtung“
 - ◆ Datenbankabfrage
 - ◆ Verteilte Datenreduktion → Grid



Massiv parallele Astrophysik



- Galaktische Struktur einschließlich der lokalen Gruppe
- Seltene, sich bewegende Objekte
- Gamma Ray Bursts & Supernova bis zu hohen Rotverschiebungen
- Gravitationslinsen (stark, schwach, mikro)
- Physik der dunklen Materie
- Dunkle Energie
- Variable Sterne/Galaxien: Akkretionsprozesse
- Optische Ausbrüche bis zur 25 mag: unbekanntes Gebiet!
- 5-Farben photometrischer Survey bis 27^m : repräsentatives Volumen des Kosmos
- Sonnensystem: NEO, Kometen, ...



AIP



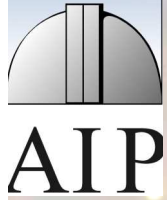
5.11.2

LOFAR: das modernste Radioteleskop der Welt



5.11.200

LOFAR: das modernste Radioteleskop der Welt



5.11.2009

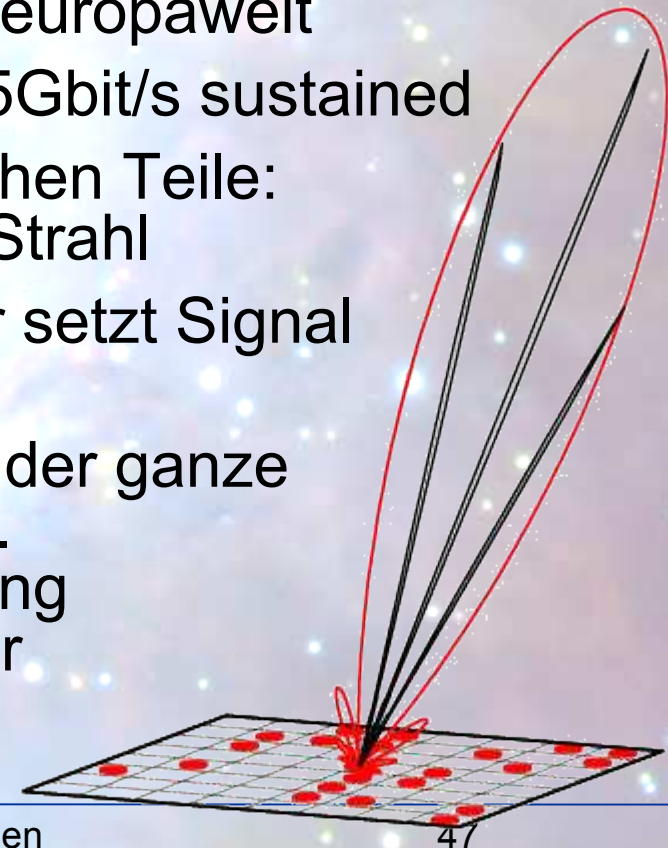
H. Enke (AIP), Gridseminar Göttingen

46

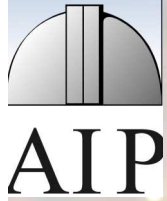
Low Frequency Array (LOFAR)



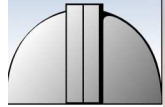
- Teleskop so groß wie die Niederlande + Teile Europas
- Frequenzbereich 30-80, 120-240 MHz
- Basislinie: 2.5-100 km to 1000 km
- ~ 45 Stationen europaweit
- Jede Station ~5Gbit/s sustained
- Keine beweglichen Teile: elektronischer Strahl
- Supercomputer setzt Signal zusammen
- Im Prinzip wird der ganze Himmel erfasst. Computerleistung limitiert Zahl der Sichtlinien



LOFAR: Wide Area Sensor Network



LOFAR: Software Telescope



AIP

Central Processing Facility:

Streaming data:

- ◆ Input: ~ 320 Gbit/s
- ◆ Internal width correlator: ~20 TBit/s
- ◆ Storage I/O: ~25Gbit/s (= 250 TByte/day)
- ◆ Final data products 1-3 TByte/day

Computing:

- ◆ Correlation: ~15 Tflop/sec
- ◆ Preprocessing and filtering: ~ 5Tflop/sec
- ◆ Offline processing: 5-10 Tflop/sec
- ◆ Control, Scheduling, Visualisation: 2 Tflop/sec

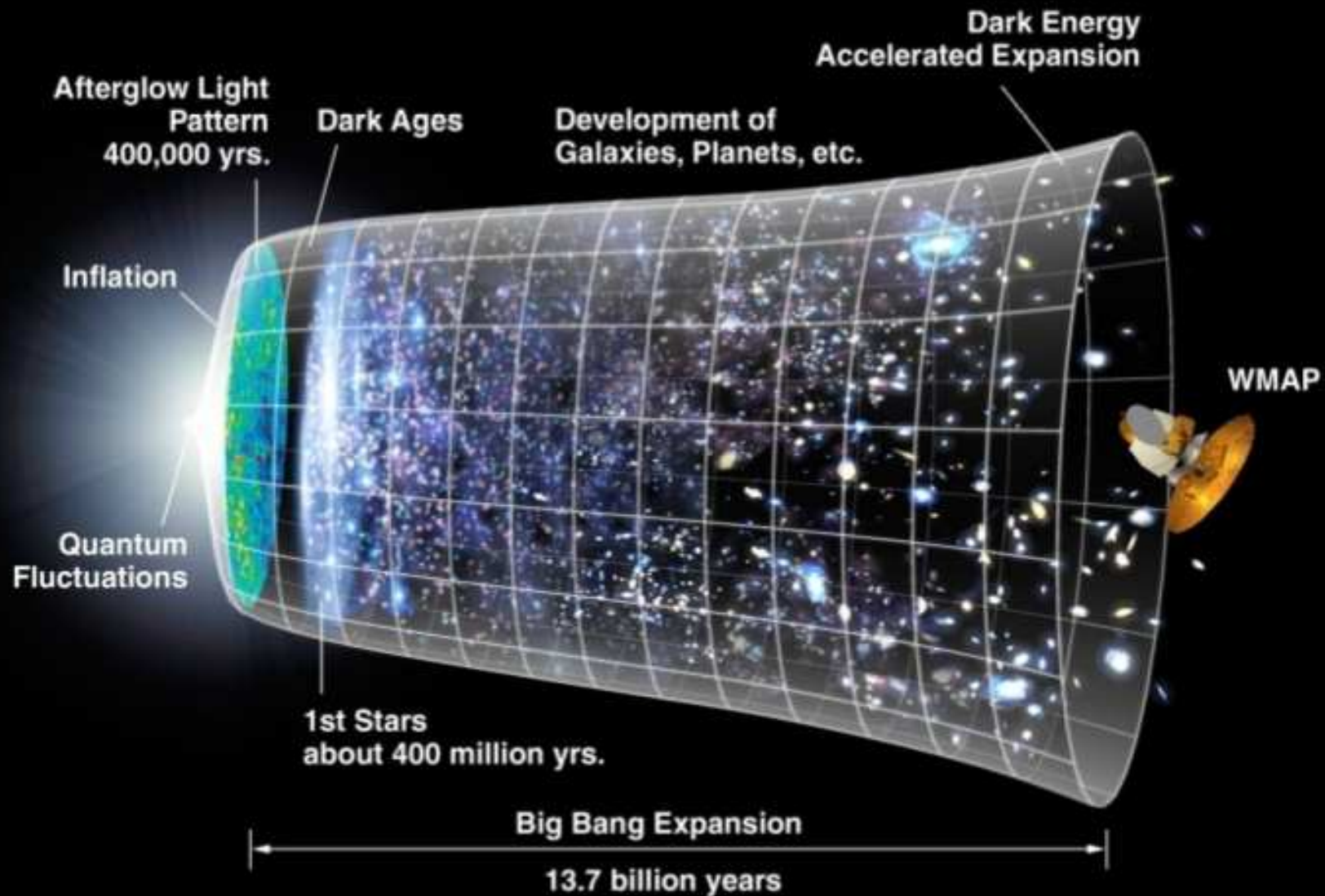


Astronomie: Kosmologie

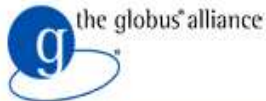
Sicht der Entwicklung des Universum



AIP



Astronomie: Simulationen



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[Contact Us](#)

[Home](#) [Globus Alliance](#) [Globus Toolkit](#) [Grid Software](#) [Grid Solutions](#) [dev.globus](#)

Website Email Lists Search:

- 10.22.2009 **Important information on Globus events and plans** [Learn more...](#)
- 07.13.2009 **CoG JGlobus 1.7.0 Release** [Learn more...](#)
- 07.13.2009 **Spider, the world's biggest Lustre file system at ORNL's LCF is accessible via GridFTP** [Learn more...](#)
- 07.10.2009 **KnowARC Project Brings Grids to Debian** [Learn more...](#)
- 06.09.2009 **Nimbus in the news** [Learn more...](#)

[XML](#) [What's this?](#)

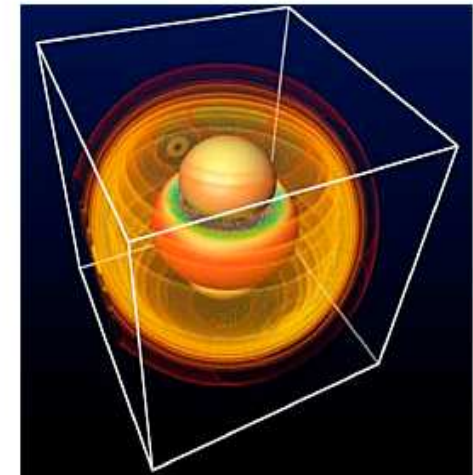
[Archive of Globus Alliance news](#)

Welcome to Globus®

The **Globus Alliance** is a community of organizations and individuals developing fundamental technologies behind the "Grid," which lets people share computing power, databases, instruments, and other on-line tools securely across corporate, institutional, and geographic boundaries without sacrificing local autonomy. [Learn more...](#)

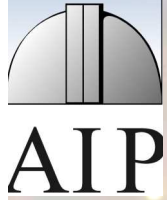
The **Globus Toolkit** is an open source software toolkit used for building Grid systems and applications. It is being developed by the Globus Alliance and many others all over the world. A growing number of projects and companies are using the Globus Toolkit to unlock the potential of grids for their cause. [Learn more...](#)

The Globus Alliance is an active member in the community of **Grid Software** developers. [Learn more...](#) As partners in e-Science and e-Business projects, we've built **Grid Solutions** for a variety of challenges that come up when people share resources. [Learn more...](#)



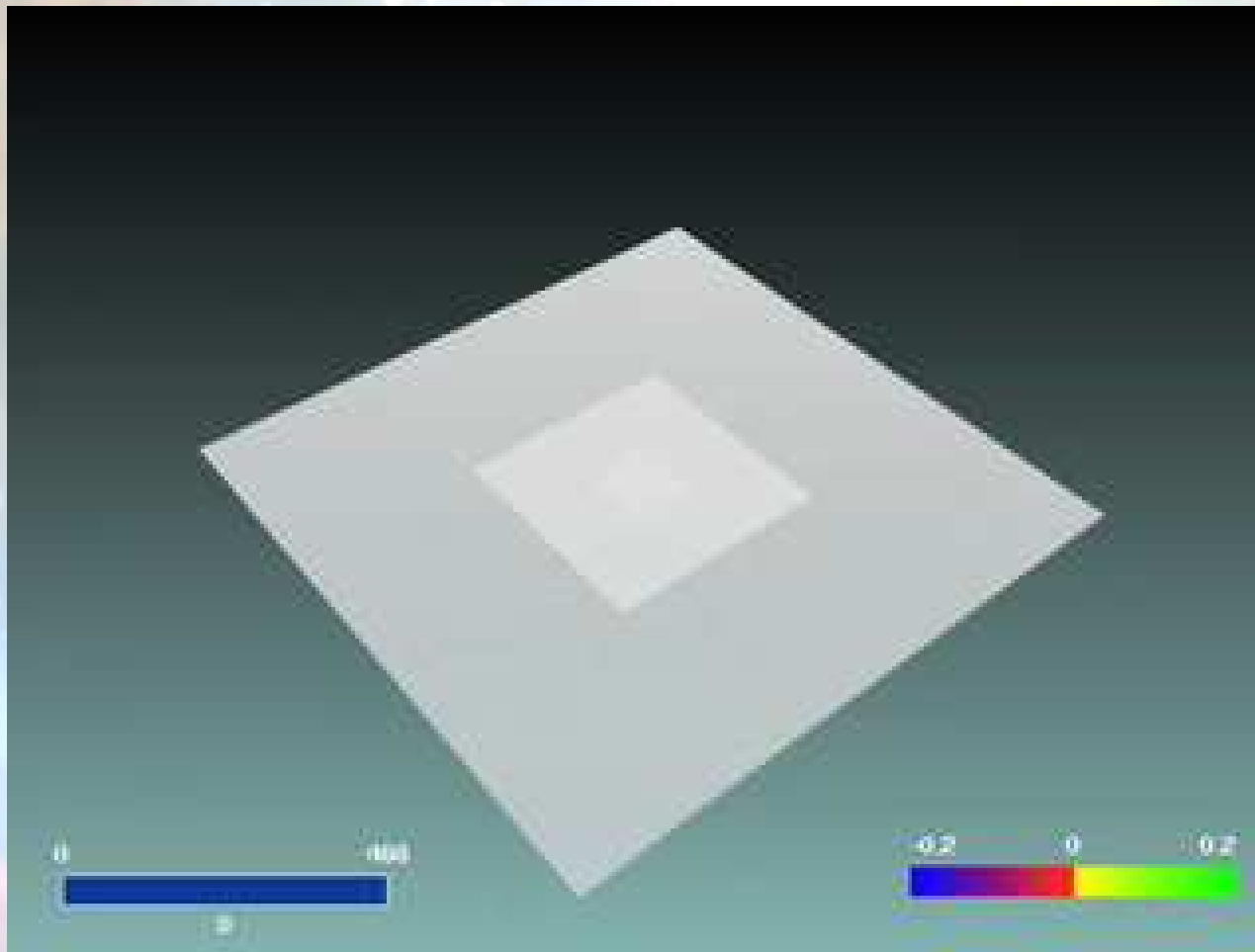
Physicists used the Globus Toolkit and MPICH-G2 to harness the power of multiple supercomputers to simulate the gravitational effects of black hole collisions. The team, which included researchers from Argonne National Laboratory, the University of Chicago, Northern Illinois University, and the Max Planck Institute for Gravitational Physics in Germany, was awarded a prestigious [Gordon Bell prize](#) for its work. Image courtesy of [Max Planck Institute for Gravitational Physics](#).

Astronomie: Simulationen



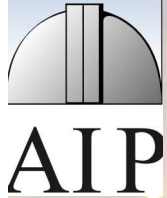
AIP

Black Hole Collision



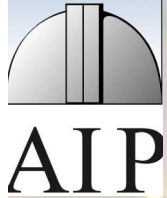
AEI

GAVO: **German Astrophysical Virtual Observatory**



www.g-vo.org

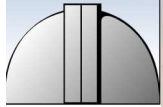
GAVO: **German Astrophysical Virtual Observatory**



- IVOA: International initiative for Astrophysical standards
 - ◆ Data description
 - ◆ Protocols
 - ◆ Data publication methods
- German “Virtual Observatory” project
- main German Astrophysical research institutes are partners
- Areas:
 - ◆ Data publication (observational and theoretical)
 - ◆ Standard development for theory
 - ◆ Collaboration in research projects
 - ◆ Tutorials, training

www.g-vo.org

GAVO examples



AIP

- Millennium Database:
 - ◆ Identification of Dark matter halos from a cosmological simulation
 - ◆ Results stored in database
 - ◆ Access via SQL and VO tools
- GAVO Data center
 - ◆ publication of numerous Astrophysical datasets
 - ◆ individual search interfaces
 - ◆ registry and connection to VO tools

Virgo - Millennium Database

Documentation
CREDITS/Acknowledgments
Registration
News
Databases
millimil (context)

```
select *  
from millimil..DeLucia2006a  
where snapnum=63  
and maj_b between -26 and -18  
and x between 10 and 20  
and y between 10 and 20  
and z between 10 and 20
```

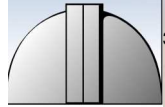
Query (stream)
Query (browser)
Help

Maximum number of rows to return to the query form: 10

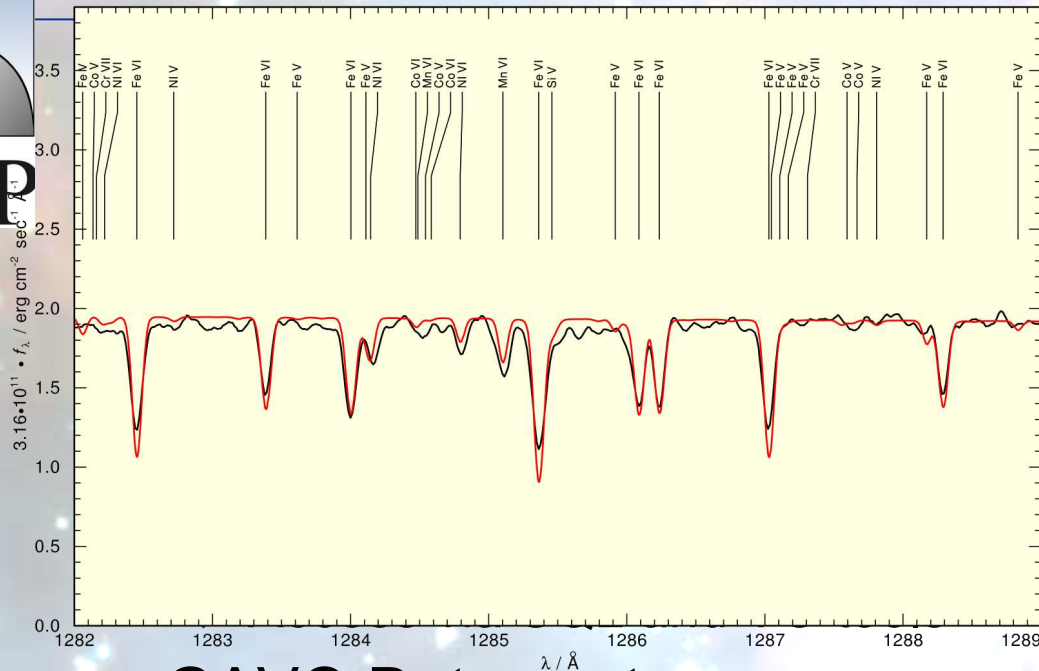
Demo queries: click a button and the query will show in the query window.
Holding the mouse over the button will give a short explanation of the goal of the query. These queries are also available on this page.

Mainly Halos: H.1 H.2 H.3 H.4 H.5 HF.1 HF.2 HF.3
Mainly Galaxies: G.1 G.2 G.3 G.4 G.5 G.6 HG.1 HG.2 GF.2

GAVO examples



AIP



■ GAVO Data center

- ◆ publication of numerous Astrophysical datasets
- ◆ individual search interfaces
- ◆ registry and connection to VO tools

Services available here

By subject | By title

Astrometry

- [APFS HIP Simple Query](#)
- [APFS Simple Query Form](#)
- [Computation of GAST, GMST, and ERA](#)
- [PPMX query](#)

Astrophotography

- [HDAP -- Heidelberg Digitized Astronomical Plates](#)

Catalogs

- [P] [2Mass Query](#)
- [ADQL Query](#)
- [P] [Candidates for geometric lensing](#)
- [PPMX query](#)
- [P] [USNO-B query](#)

Computer Simulation

- [The Infinite Lightcurve, Images](#)
- [The Scrolling Infinite Lightcurve](#)

Dark matter

- [Liverpool Quasar Lens Monitoring](#)

Data extraction

- [Dexter for your data](#)

Ephemerides

- [APFS HIP Simple Query](#)
- [APFS Simple Query Form](#)

Galaxies: halos

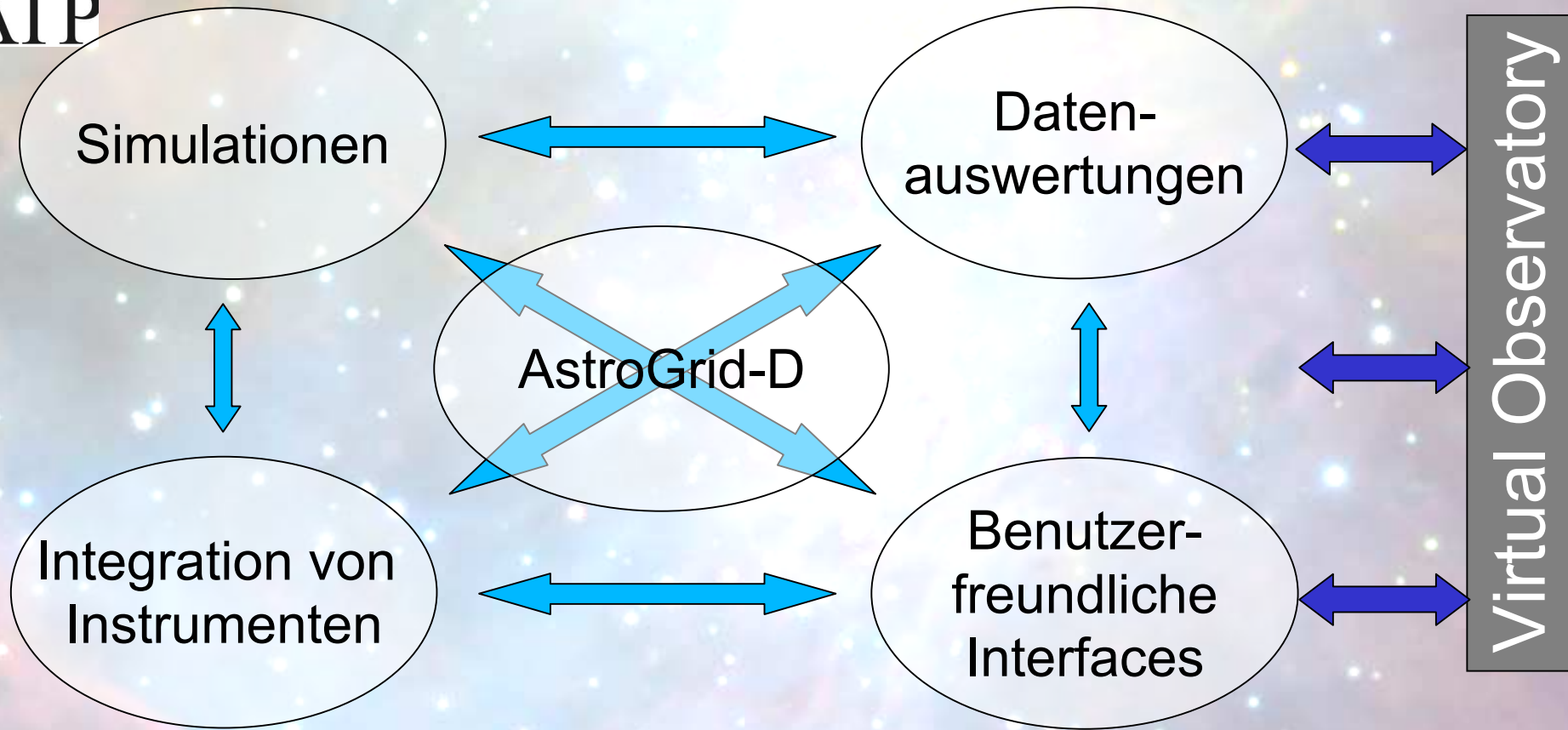
- [Liverpool Quasar Lens Monitoring](#)

Geodesy

- [Computation of GAST, GMST, and ERA](#)

Gravitational lensing

AstroGrid-D: Aufgaben

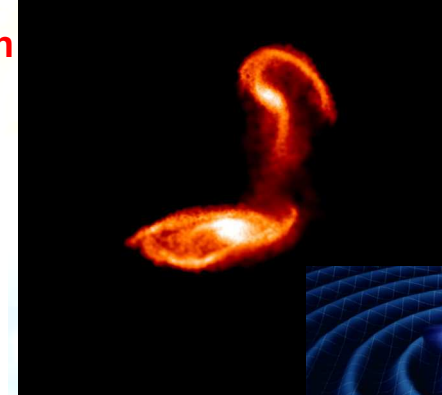


AstroGrid-D: Aufgaben

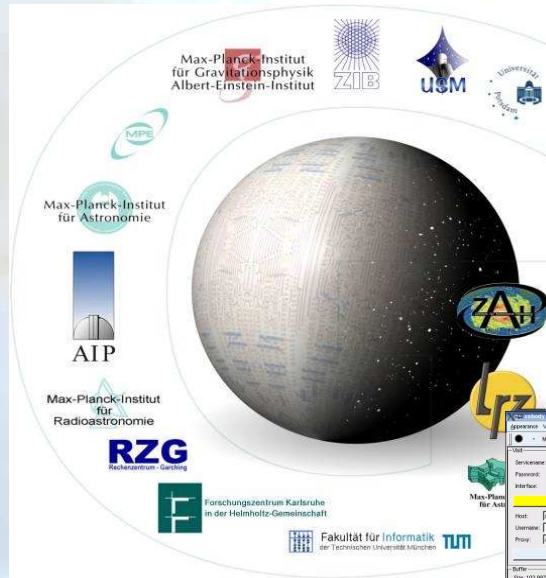
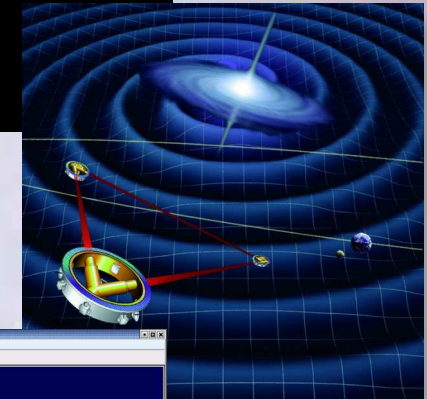


sanssouci.aip.de

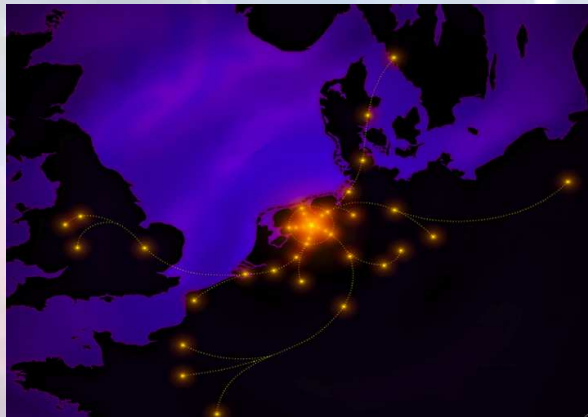
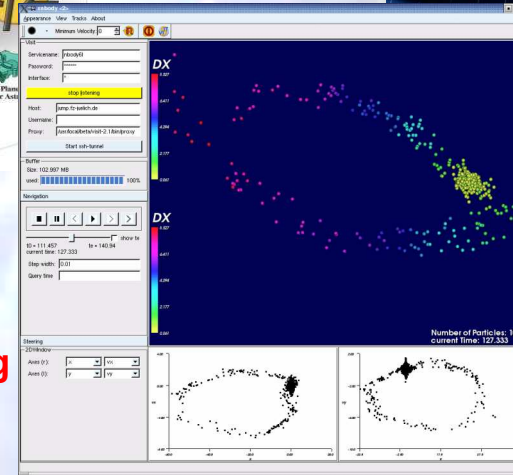
**Galaxien-Kollision
Postprocessing**



LISA



**X-NBODY6++
Visualisierung**



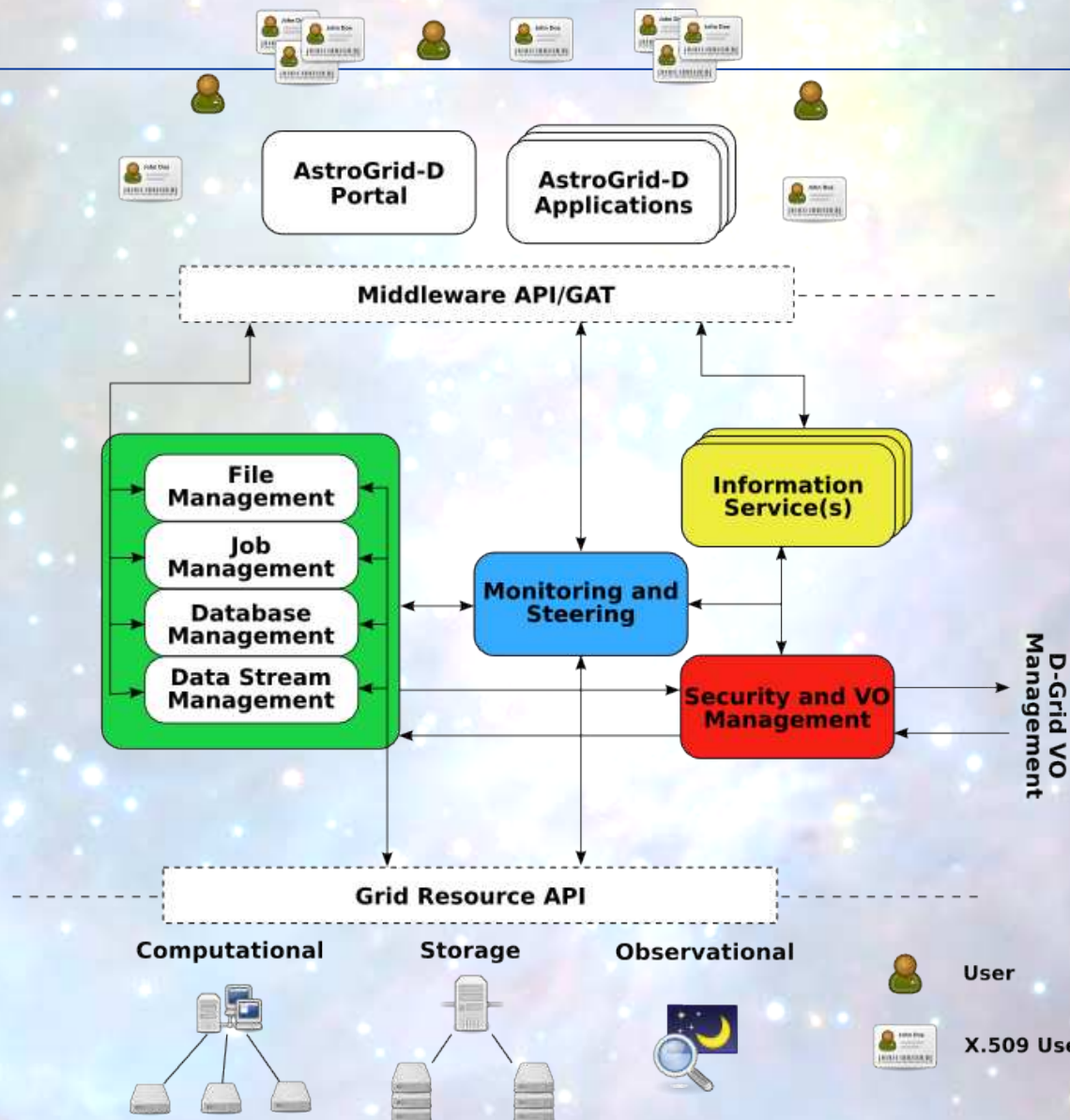
LOFAR



Globus Middleware

- Extensions
 - Information Server Stellaris (RDF based)
 - GAT Interface to gLite and Unicore
 - Virtual Organisations Management
 - Metascheduler GridWay
 - Robotic Telescope Package
- AddOn Web-Interfaces
 - Timeline
 - Job Monitoring
 - Resource Maps
- Data Management
 - DataStream Managment
 - ADM

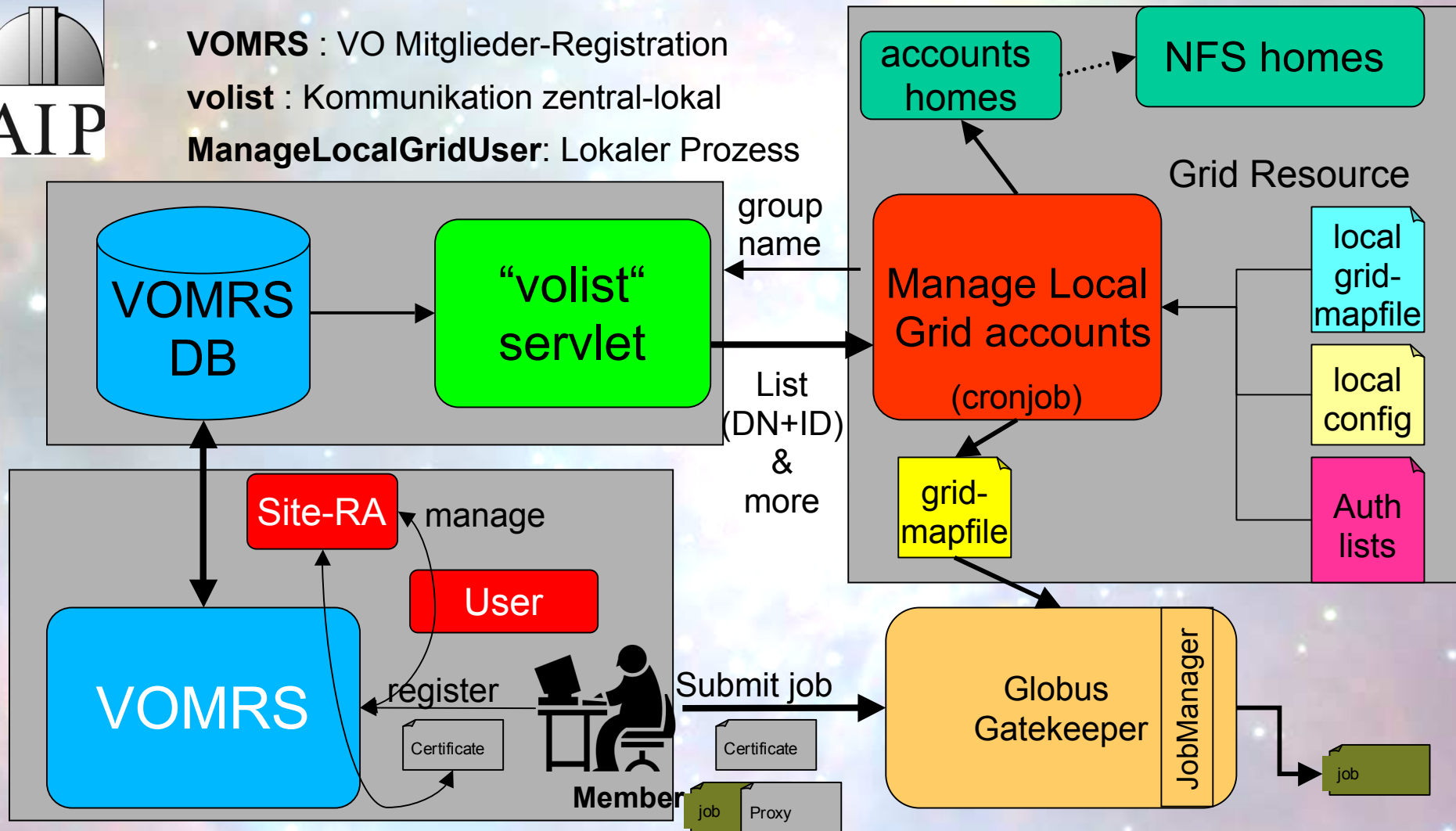
AstroGrid-D Architektur



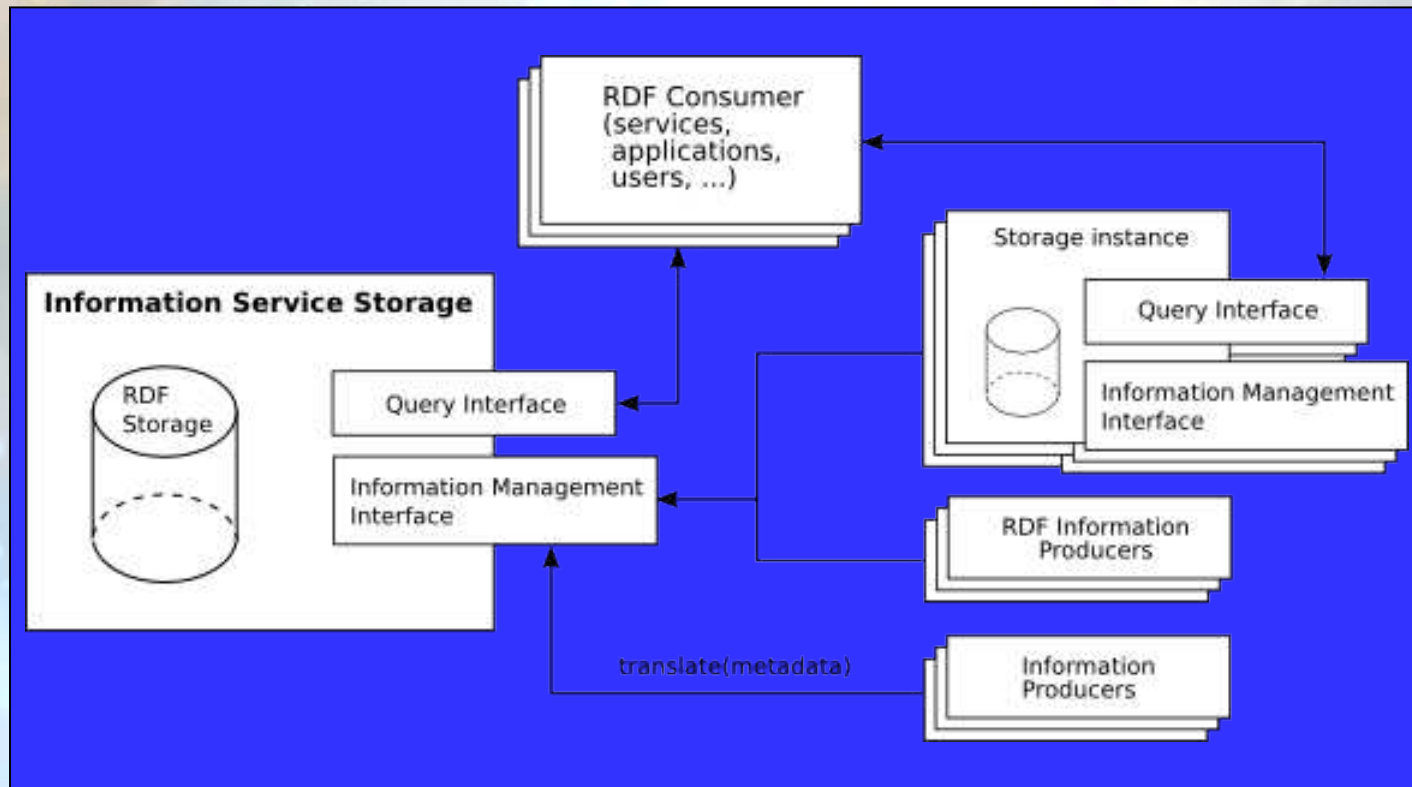
Grid Account Management



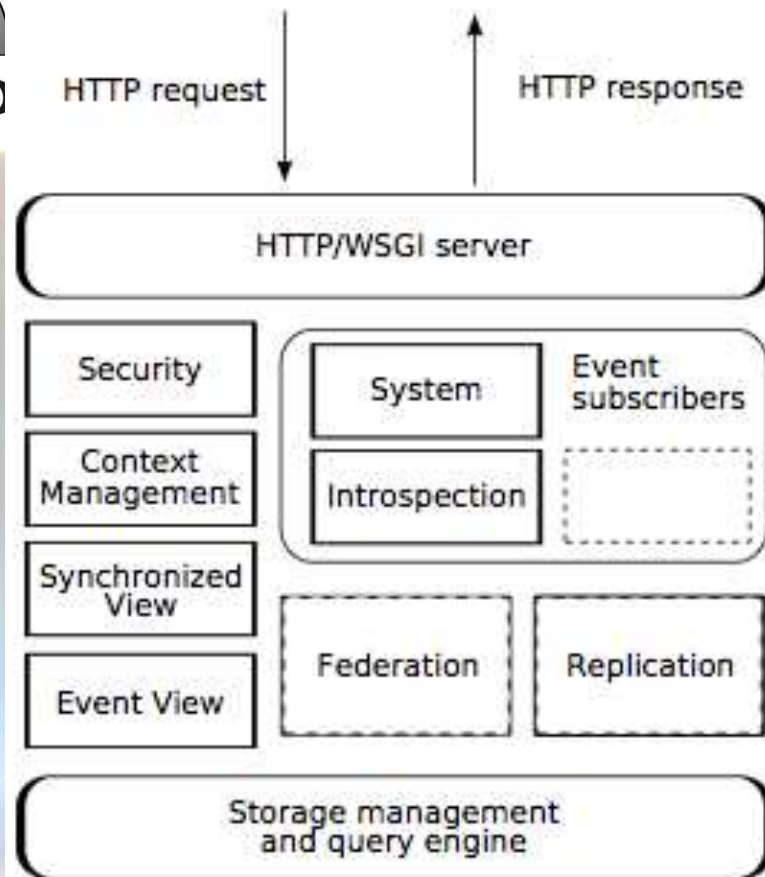
VOMRS : VO Mitglieder-Registration
volist : Kommunikation zentral-lokal
ManageLocalGridUser: Lokaler Prozess



Structure of Information Service



AstroGrid-D Stellaris: Interface



Request-Handler:

Security:

Handles authentication and authorization (ACL, VOMRS, X509)

Context Management:

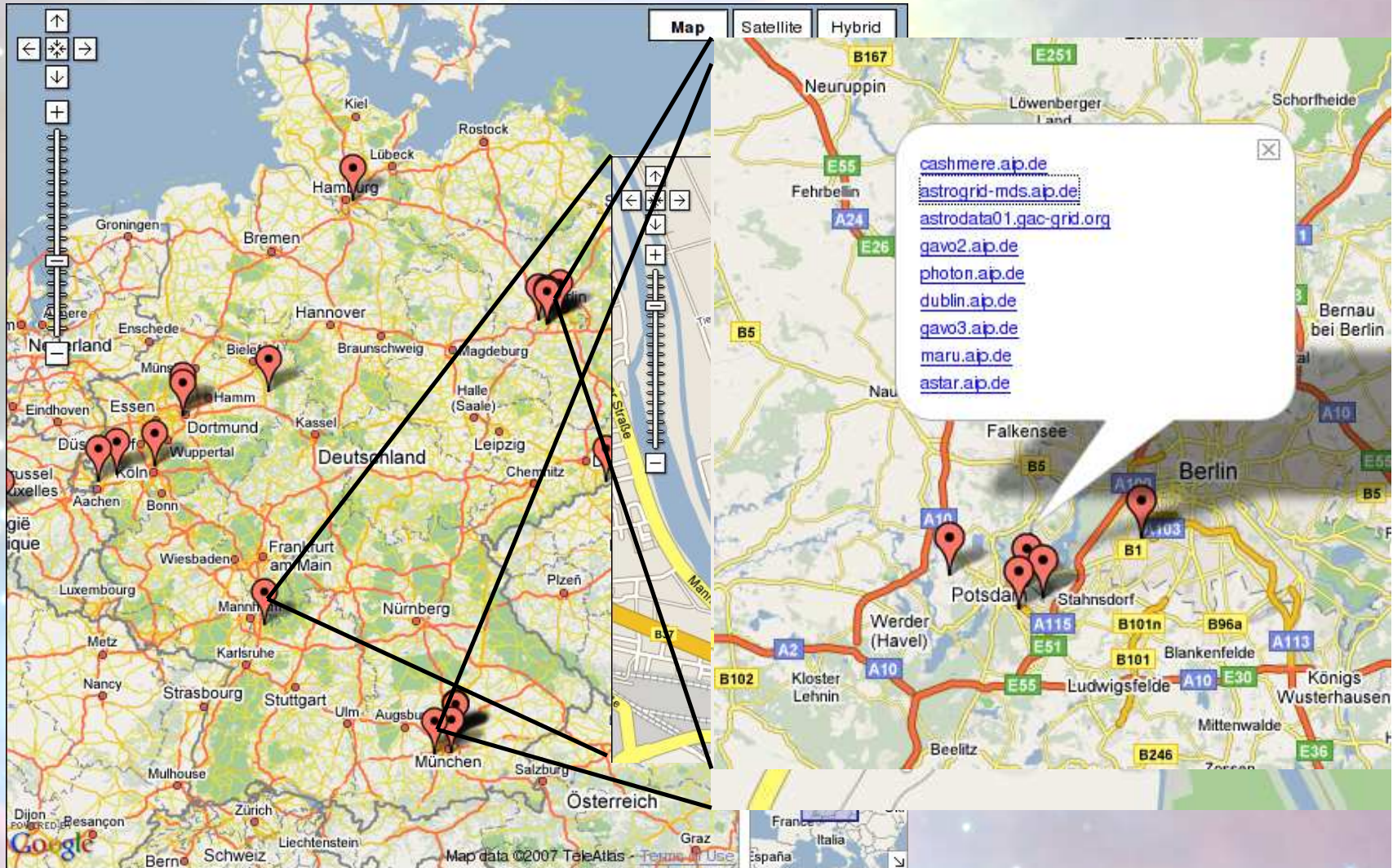
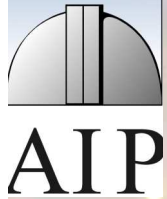
internal interface for commands:

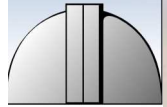
create / retrieve / update / delete query

■ Informations-Service des AstroGrid-D

- ◆ Integration der Metadaten (Grid-Ressourcen, -Jobs, -Daten, wissenschaftliche Daten)
- ◆ Basiert auf RDF/SPARQL des W3C
- ◆ Gewährleistet persistente Datenhaltung und bietet ein flexibles Query-Interface
- ◆ Die Prototyp-Implementation wird benutzt von
 - UseCases für Metadaten
 - der GridResourceMap
 - der TimeLine (Job-Monitoring)

Stellaris: Ressourcemonitoring

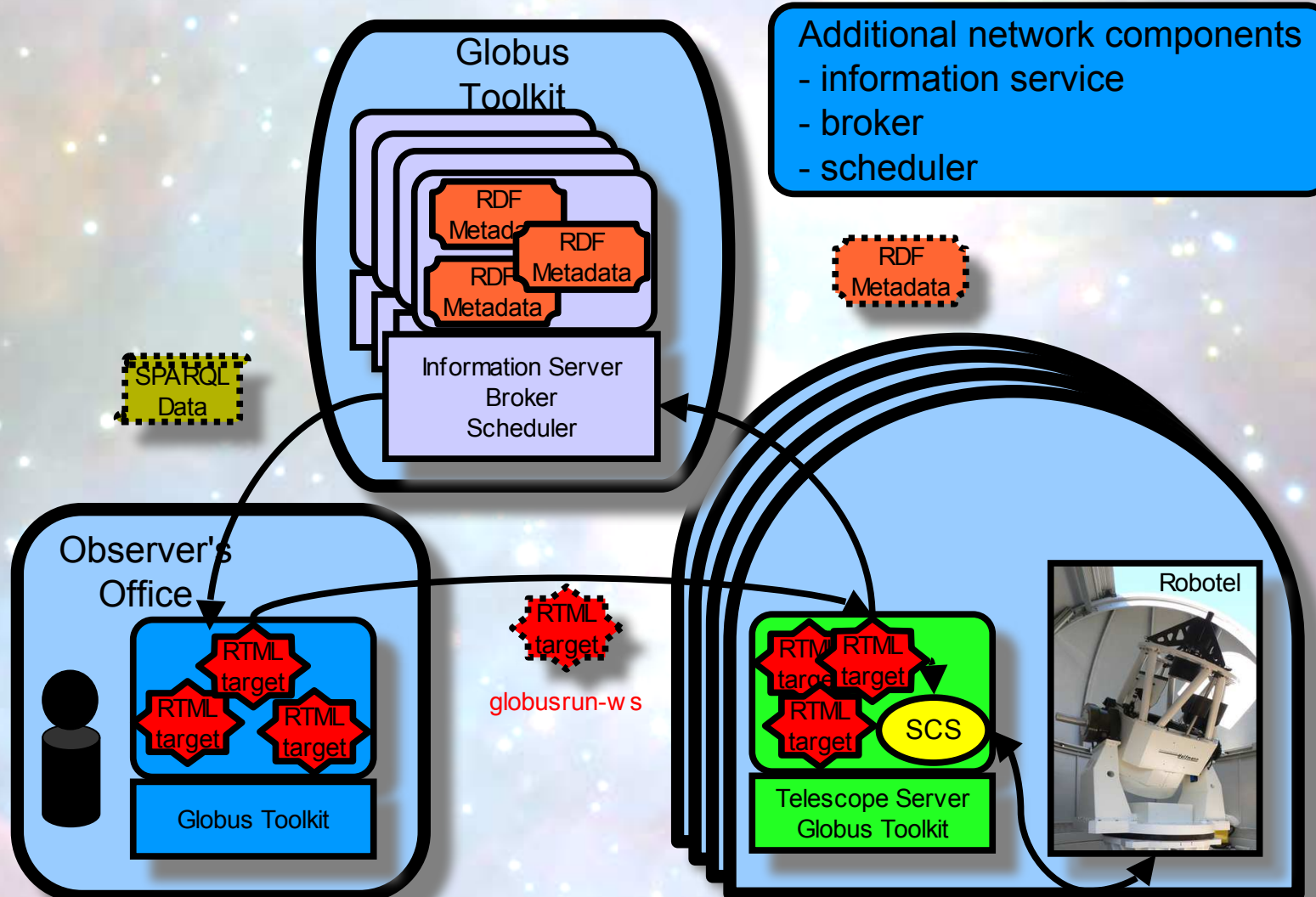
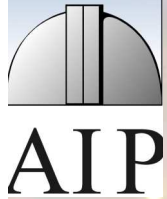




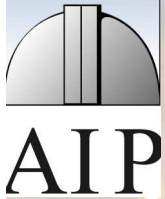
AIP

- Implementierte UseCases in AstroGrid-D Zentren/Instituten:
 - ◆ Dynamo (AIP)
 - ◆ Clusterfinder (MPE)
 - ◆ ProC (Workflow-Engine) (MPA)
 - ◆ NBODY6++ (ZAH)
 - ◆ Robotische Teleskope (AIP)
 - ◆ Cactus (AEI)
 - ◆ Geo600 (AEI)

RT:Grid Architecture: Summary



Collaborative Grid-Infrastructure for specialized Hardware



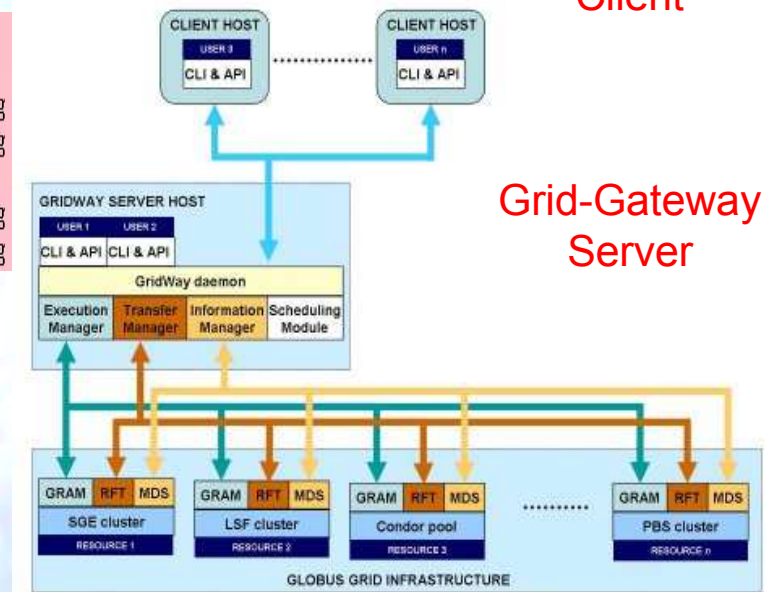
AstroGrid-D currently offers: software to access the grid:

- Web Portal to access the grid for common applications
- Gridway / Grid-Gateway for classical job submission
- *First International Link to MAO Kiev, Ukraine*

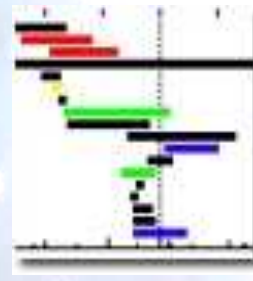
```
spurzem@hydra:~$ gwhost
```

HID	PRIO	OS	ARCH	MHZ	%CPU	MEM(F/T)	DISK(F/T)	N(U/F/T)	LRMS	HOSTNAME
0	1	Linux2.6.16.33-	x86_64	2411	200	3076/7939	197805/220515	0/2/2	Fork	astrodata04.gac-grid.org
1	1	Linux2.6.11.4-2	x86_64	3200	300	866/3974	67177/79742	0/3/4	Fork	titan.ari.uni-heidelberg
2	1	Linux2.4.27-2-3	x86	996	99	6/502	7150/19366	0/1/2	Fork	buran.aei.mpg.de
3	1	Linux2.6.9-42.0	x86_64	2411	98	1399/7970	289588/311777	0/1/2	Fork	astrodata05.gac-grid.org
4	1			0	0	0/0	0/0	0/0/0		astrodata07.gac-grid.org

Client



Grid-Gateway Server



• Data Processing Pipelines e.g. for Dome A... (new project) Courtesy of R. Spurzem

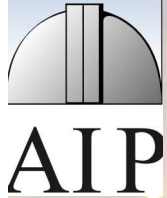
Information Systems

Gridmap

Grid Timeline

Astrogrid-D Resources

Globus-Helper-Package



- Globus 4 Source-Installation
 - ◆ Konfigurations-Anleitung
 - ◆ Umfangreiche Hilfe-Seiten
 - ◆ MPICH-Globus Nutzung
 - ◆ Erweiterung von Globus-MDS durch Ganglia
- Scripts für die lokale Administration
 - ◆ Standardisierte Konfiguration
 - für Suse, Redhat, Scientific Linux
 - ◆ RA und Zertifikats-Verwaltung
- Security-Erweiterung durch Monitoring von offenen Middleware Ports
- Regelmässiger Test der Middleware-Services durch Test-Applikation

Grid-Job-Monitoring mit StellarIS:



AstroGrid-D Timeline

date <2008-07-03 limit=500 host=

[Map](#) [Internal](#)

[Computers](#) [Telescopes](#)

date

limit

host

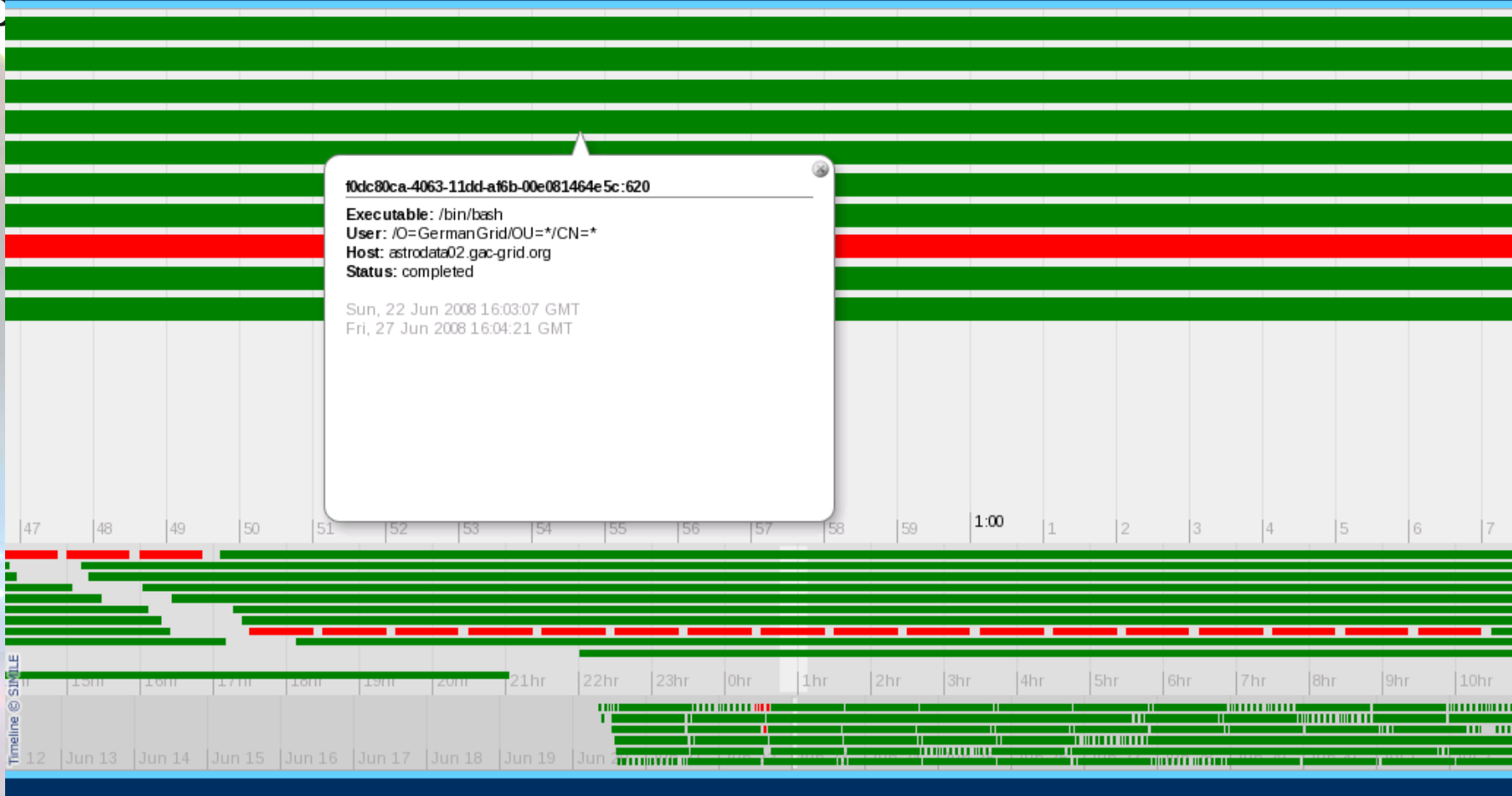
(c) M. Höggvist (ZIB) & F. Breitling

AIP

10dc80ca-4063-11dd-a16b-00e081464e5c:620

Executable: /bin/bash
User: /O=GermanGrid/OU=*/CN=*\nHost: astrodata02.gac-grid.org\nStatus: completed

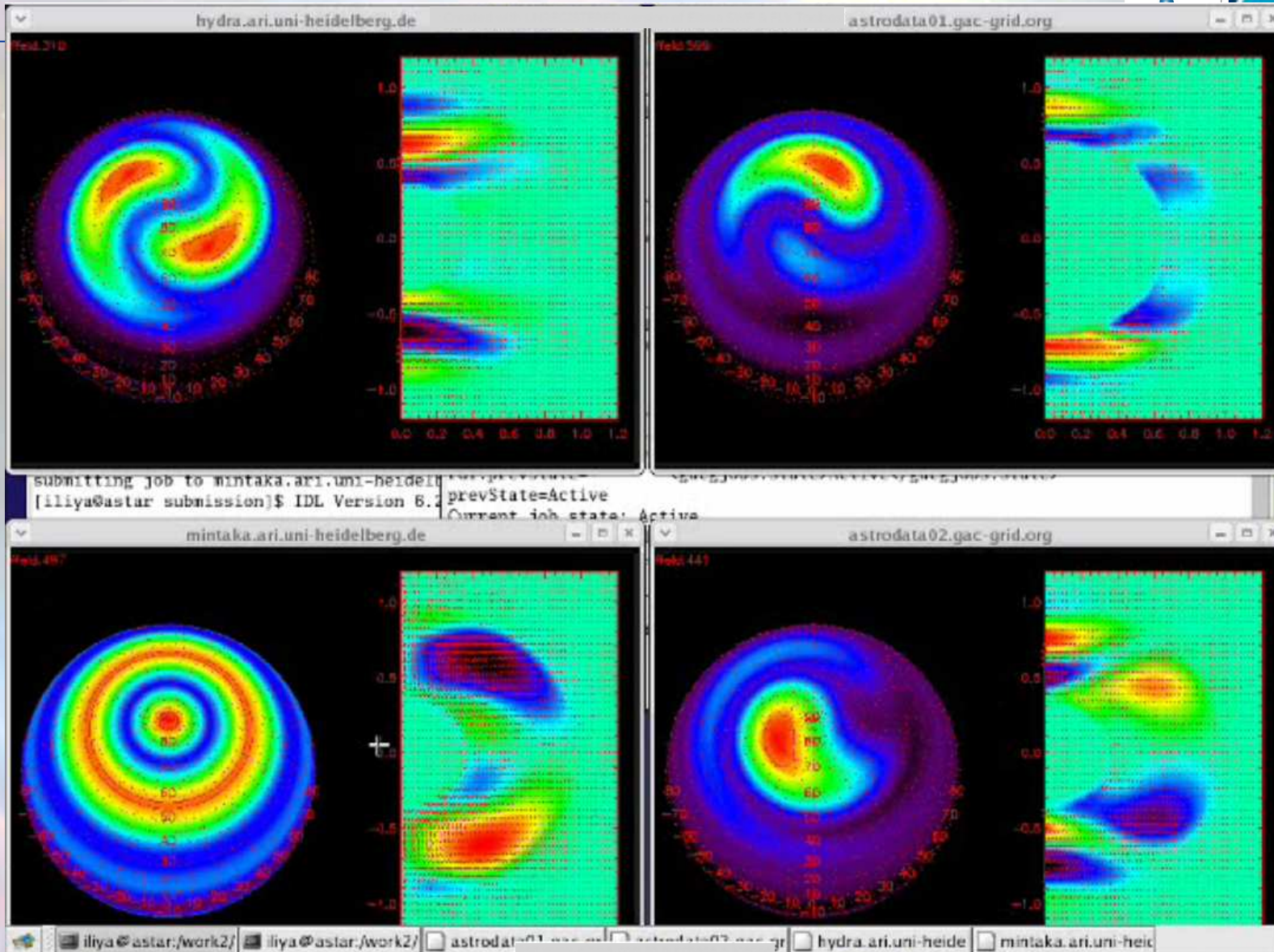
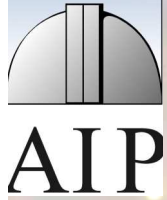
Sun, 22 Jun 2008 16:03:07 GMT
Fri, 27 Jun 2008 16:04:21 GMT

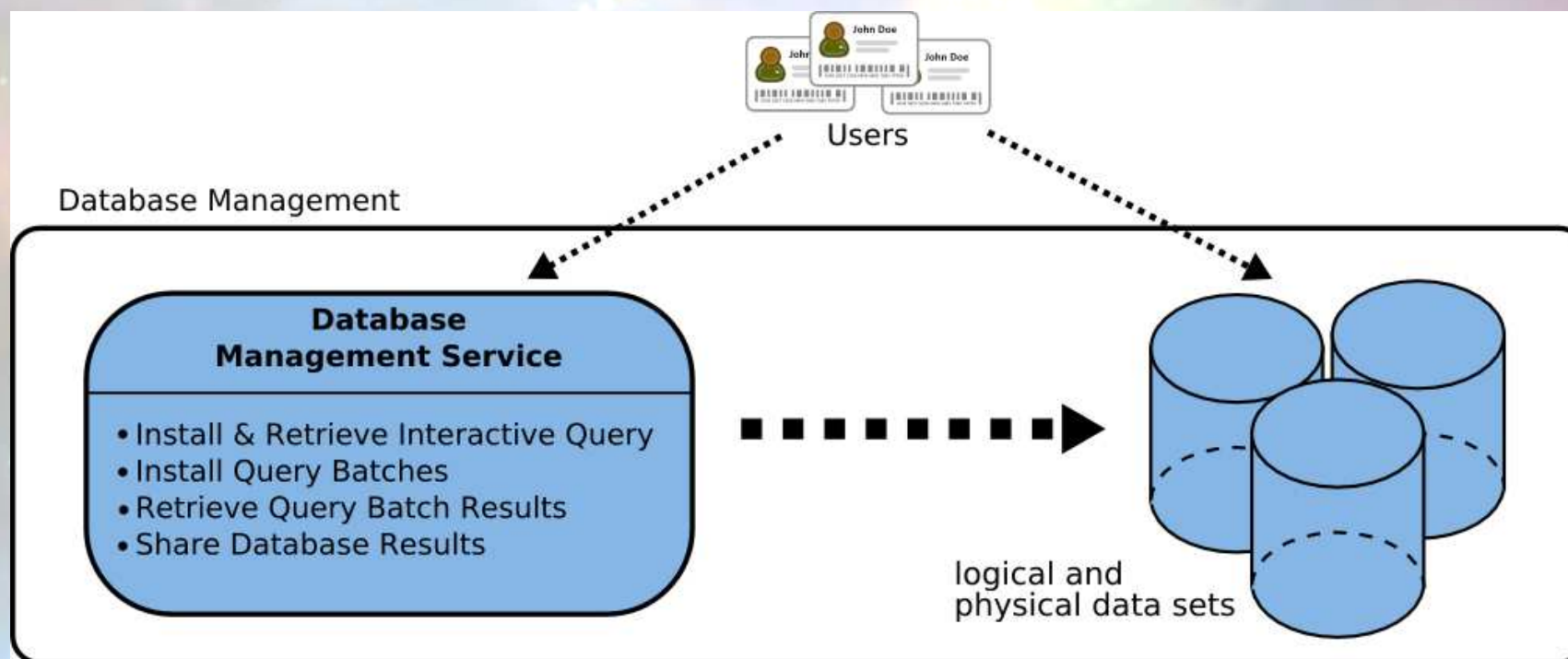


Job-Monitoring mit Globus

- ◆ Globus Kommando zur Anzeige des Job-Status
globusrun-ws -status -j job.epr
- ◆ Shell-Wrapper speichert im Informations-Service
 - Job-Status Informationen
 - StageIn, Active, StageOut, Done, Failed, Error
 - Erweiterbares Template
- ◆ Status Abfrage:
 - Timeline des Jobs (Webinterface)
 - Anzeige in der GridRessourceMap (Webinterface)
 - SPARQL Queries (Kommandozeile)

AstroGrid-D: Demo

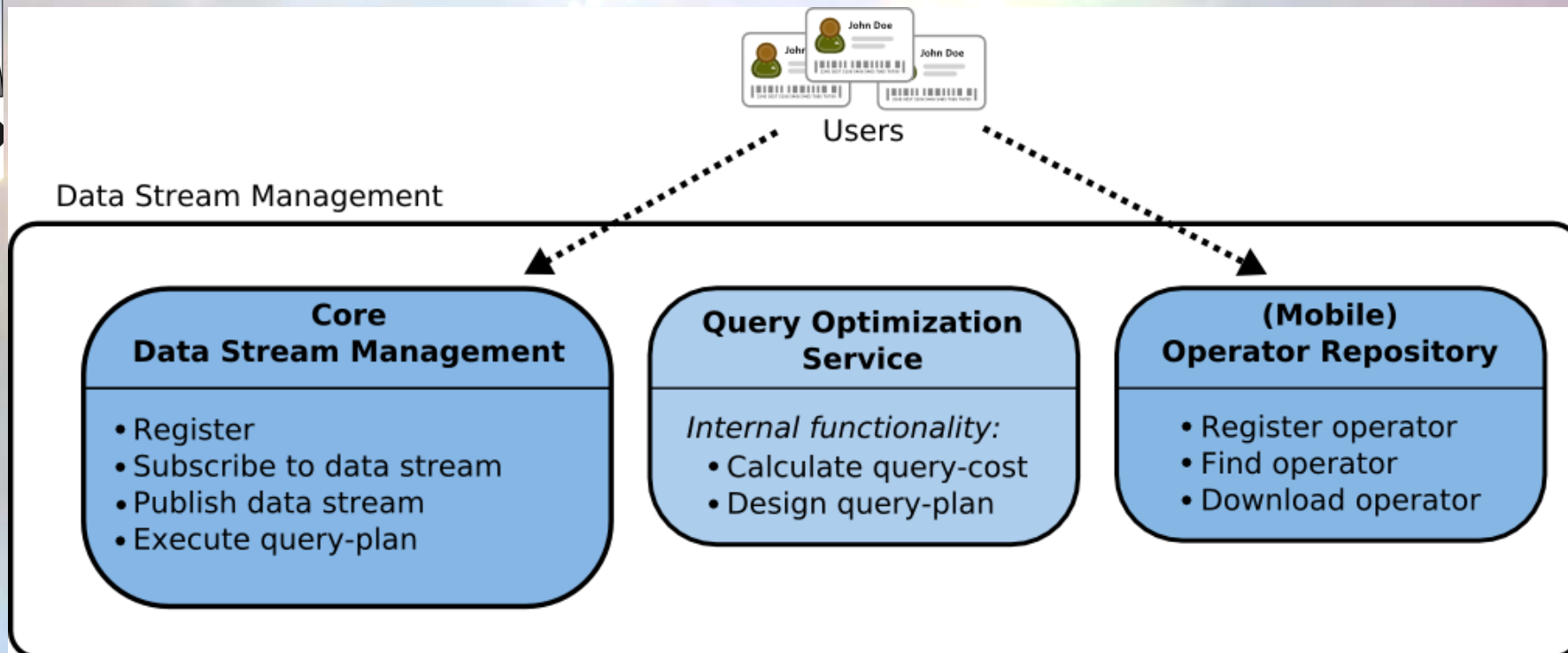




- Zugriff auf große wissenschaftliche Datensätze
- Gemeinsame Nutzung von Datensätzen in der astronomischen Community

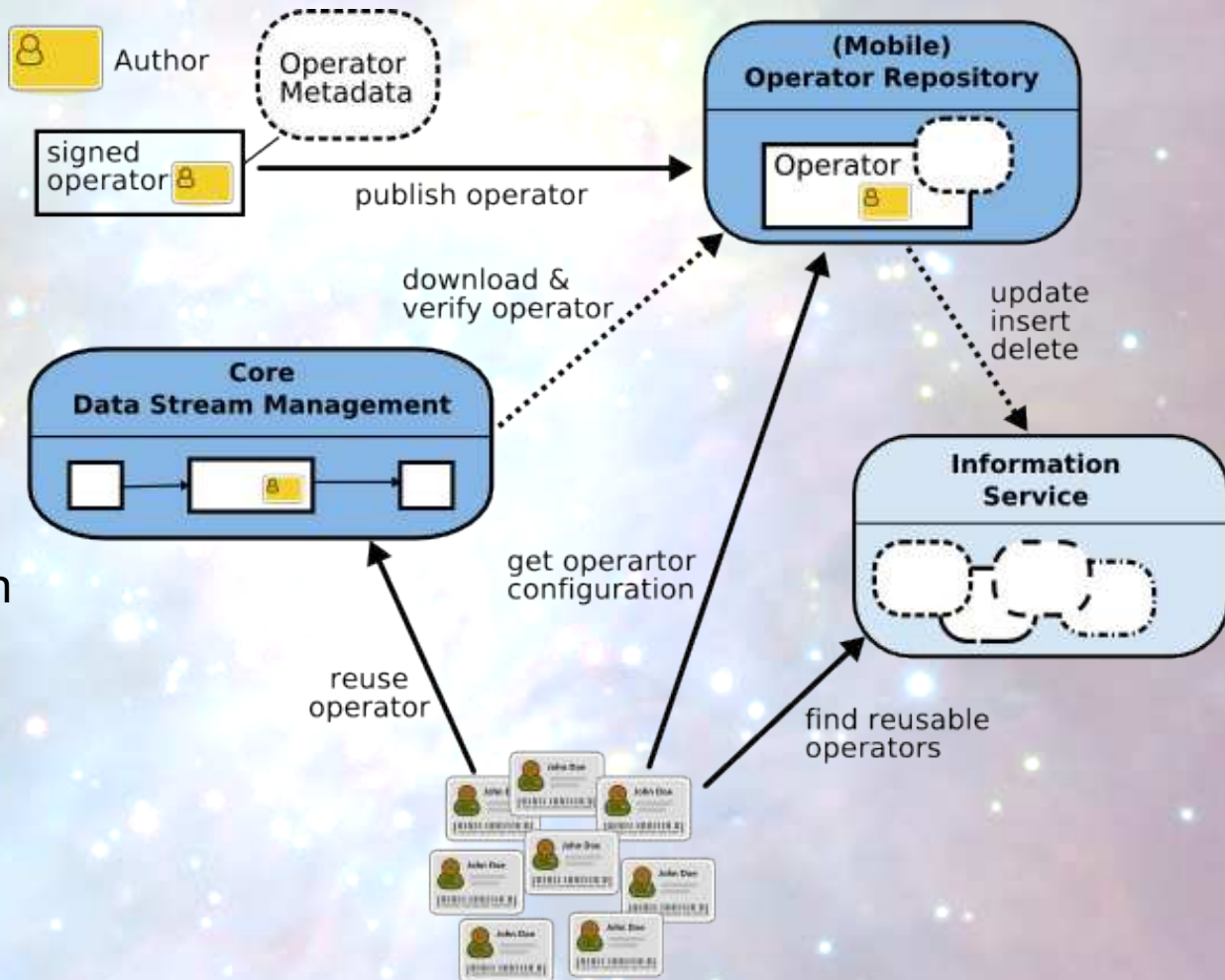
OGSA-DAI

- ◆ Etablierte Middleware-Komponente
- ◆ Aktiv an der Standardisierung beteiligt
- ◆ Zertifikats-basierter Datenzugriff
- ◆ 3rd party Transfer über Grid-FTP



- Publish/Subscribe Verfahren für Datenströme
- Wiederverwendung existierender Informationsflüsse (Data Stream Sharing)
- Pipelining, frühe Filterung
- Manuelle Optimierung

Mobiler Code / Function Provider



- Gemeinsame Nutzung von Operatoren unter Kooperationspartnern
- Dynamisches Laden von Operatoren zur Laufzeit
- Die Applikation wird zu den Daten transportiert
- Information Service unterstützt die Suche nach wiederverwendbaren Operatoren

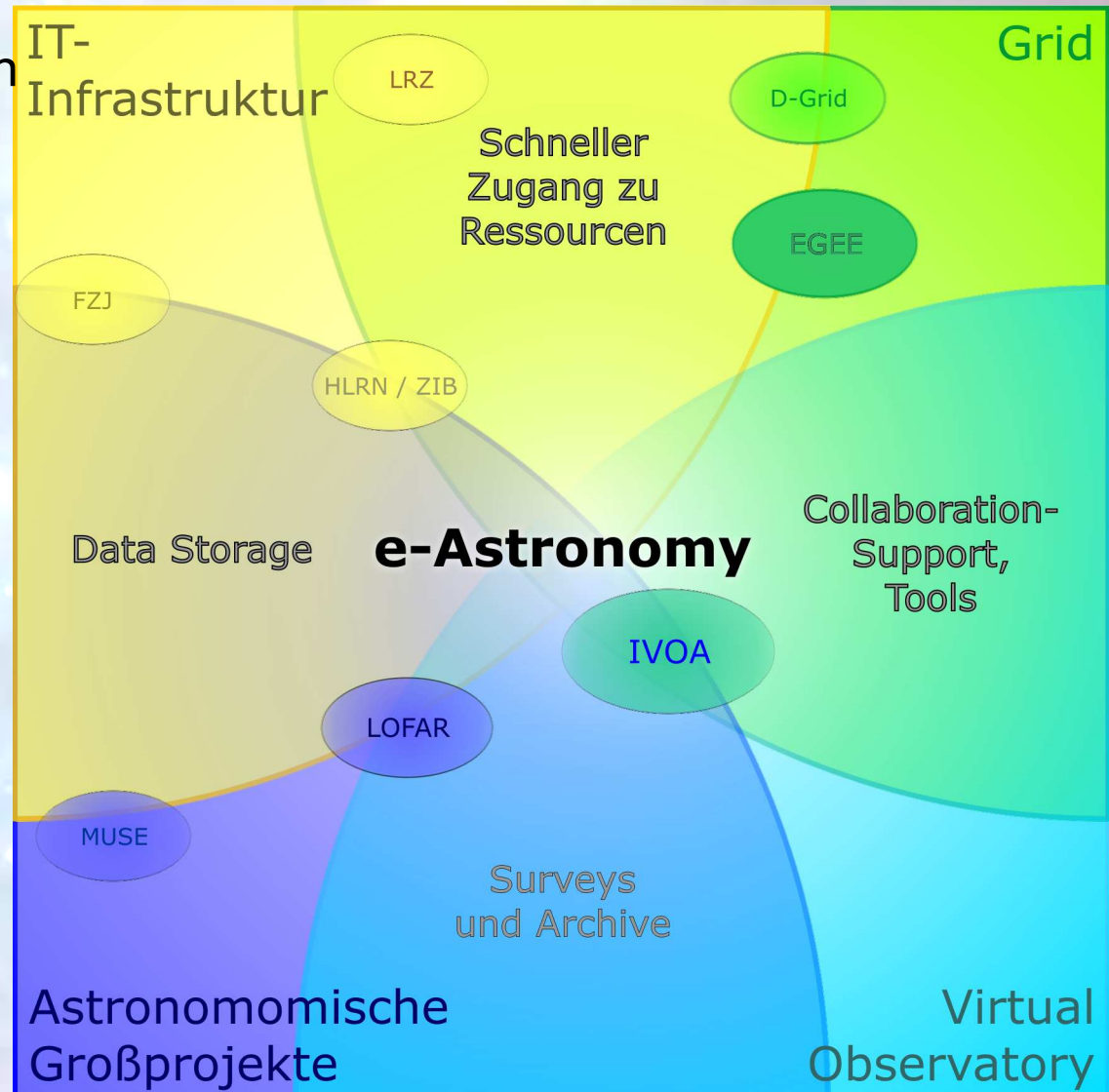
VDZ: e-Astronomy

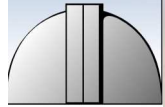


Struktur der angestrebten internationalen kollaborativen Forschungsumgebung für die Astronomie

Das **Grid** ermöglicht den sicheren und barrierefreien Zugriff auf benötigte IT-Ressourcen

Das **Virtuelle Observatorium** Erarbeitet Standards und Protokolle für den Datenzugriff





Basis Komponenten

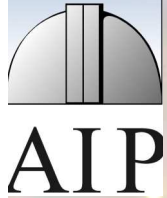
- ◆ Hardware / Storage
- ◆ Middleware für shared resources
- ◆ Support für Virtual Environments
- ◆ Expertise



Hardware :

- astrodata.astrogrid-d.org: (linux)
100 TB RAID
- almagest.aip.de : (Windows+Linux)
700 TB RAID
- Tape Storage @ ZIB:
ca. 250 TB
- 10 GB Connection to ZIB:
 - ◆ funded, operational soon
- Clusters @ AIP
 - ◆ 700 cores

VDZ: Almagest / Graywulf



almagest.astrogrid-d.org

Configuration Info

Network	(Update: 19-Aug-2009)
Power (APC)	(Update: 19-Aug-2009)
IPMI	(Update: 19-Aug-2009)

Select a Hardware-Interface

You selected apc002. It is displayed in a separate window.

RAID APC IPMI SM
Intel

----- ----- ----- -----

Show

- araid001
- araid002
- araid003
- araid004
- araid005
- araid006
- araid007
- araid008
- araid009
- araid010
- araid011
- araid012
- araid013
- araid014
- araid015
- araid016
- araid017

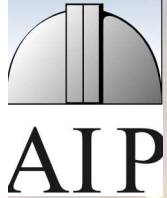


Hardware - Configuration

- 3 Tiers with different tasks
- Tier 3 shows 21 Servers
- 144-port Infiniband-Switch, aggregated bandwidth ~5.6 TBit/s on backplane
- 2 x 10GBit/sec uplink to Institute backbone via dedicated router

	CPU/Cores	RAM	RAID	Qty.
Tier 1	(4Px4C) 16	128	1 x 15	1
Tier 2	(4Px4C) 16	64	3 x 15	2
Tier 3	(2Px4C) 8	16	2 x 15	21
Total	(54P) 216C	592	735	24

VDZ: Middleware



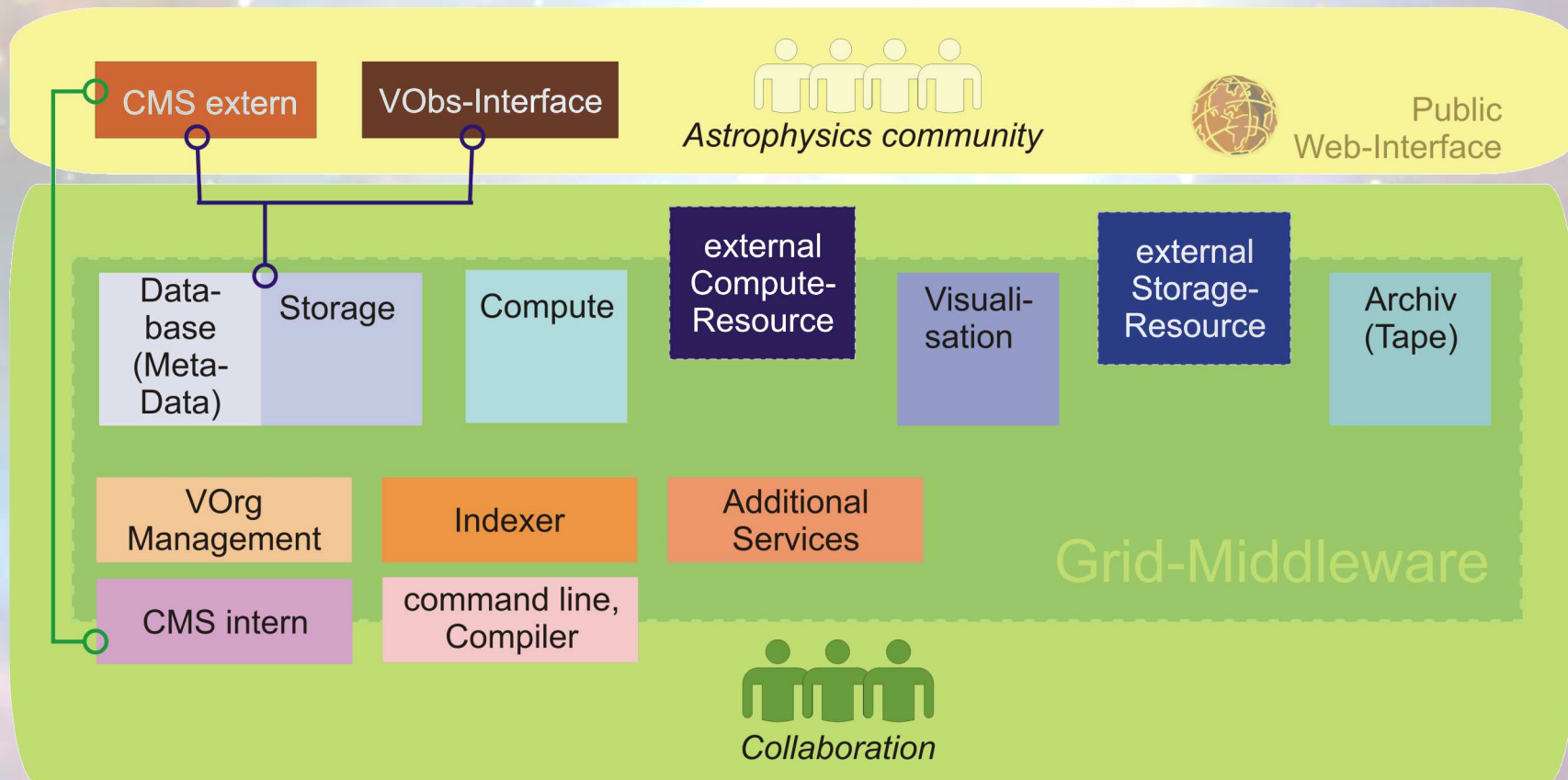
Middleware (installed or planned):

- astrodata.astrogrid-d.org: (linux)
 - globus 4.x, AstroGrid-D software
 - dCache, OGSA/DAI, adm
 - XtreemFS

Data collections/archives with VO interface

- almagest.aip.de : (Windows+Linux)
 - globus 4.x, Astrogrid-D Software,
 - gLite interface, XtreemFS
 - MSSQL, SkyServer,
 - SDSS mirror,
 - Solar Science Data Archives (LOFAR)
 - Simulation Data Archives

Elements of a Collaborative Research Environment (Example: Simulation Postprocessing)



VDZ: Virtual Research Environments



Dedicated for use by collaboration

- machine (16 Cores (2.4 Intel), 128GB Memory)
- planned for up to 100TB storage
- SAS RAIDs, Infiniband connect

Content Management System for project with

- public site + intranet site

Additional webservers, mailing list

ssh, grid + hpn-ssh interfaces available

compiler, idl

under development: database for

registering simulations + postprocessing work

planned:

other support tools (e.g. metadata generation, visualisation)

VDZ: Virtual Research Environments



CLUES
Constrained Local Universe Simulations

CLUES-Project | People | Simulations | Talks | Articles | **Image Gallery** | Movies

» Image Gallery Search

Image Gallery

This page provides some pictures created from our cosmological simulations. More details on these simulations are given in the [Simulations](#) section. The images are organized by the components on which they mainly focus: dark matter, gas or stars. Please also visit [Movies](#) for our animations.


Copyright note:
You may use the pictures for illustration purposes in talks and for posters, but we ask you to give proper credit to the artist(s)/institution.

[Sitemap](#) Last Published: Fri, 28 Aug 2009 14:09:50

VDZ: Virtual Research Environments



Intranet



CLUES-Intranet | Project-Info | Simulations | Help

» Project-Info » Erebos » Tools UK Search

- Erebos
- Almagest
- Tools
- Storage
- Access
- Registrants

erebos tools:

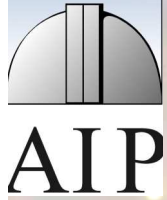
The setting of environment variables, making these tools available to the user, is done with scripts, which are located in `/opt/env`

On erebos.aip.de you find the following tools:

- Intel Cluster Suite (currently Version 11.0)
`$>source /opt/env/ict.sh`
sets everything, including path and license-server, for **ifort** and **icc**
- GCC 4.3.3
`$>source /opt/env/gcc-433.sh`
sets everything for **gfortran** and **gcc-4.3.3**
- IDL 7.0
`$>source /opt/env/idl_env`
makes **idl** available at the shell-prompt

Additionally, there is a script `/opt/env/idl_run` which you can copy and adapt to your needs.

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Astronomie + Grid + Virtual Observatory

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E-Astronomy