Virtuální observatoř – hlavní „pozorovací“ nástroj astronoma 21. století

Petr Škoda
Astronomický ústav AVČR

MÚ Brno 9.10.2006, MFF UK Praha 11.10.2006

Astronomie 21. století

- Exponenciální nárůst objemu dat
  - Multiobject fibers, IFU
  - CCD mozaiky
  - Kontinuální expozice TDI
- Pozorování s velkými přístroji v servisním režimu (VLT, Subaru)
- Queue Scheduling (HET, SALT)
- Bez přítomnosti PI astronoma
- Komplikované zpracování dat = automatické pipeliny
- Robotické teleskopy (P60, Liverpool)

Teleskopy bez přítomnosti PI

- Klasický model PI – observing run se mění
- Úspory nákladů, efektivita – scheduler (SPICA)
- Keck , WYIN, VLT .... remote observing, RT
- Quick-look preview a eavesdropping
- Komplikované posouzení co je výsledkem
- pipeliny na gridech – automaticky do databáze
- Výsledek PI vidí až z DB na WWW
- Teleskop je databáze s velmi dlouhým přístupem“

Two degree field
2dF (AAT)

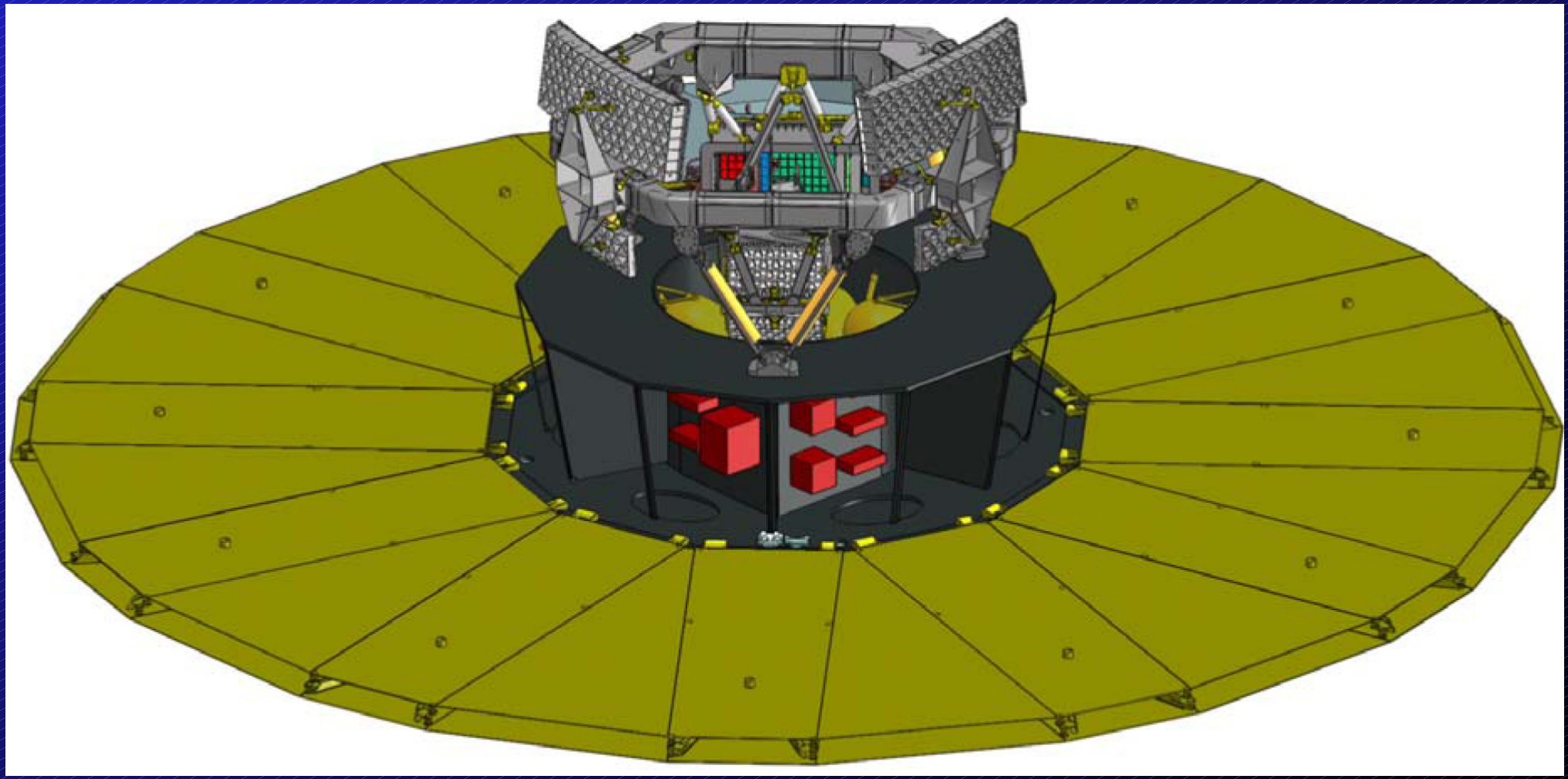
Robot
2 desky
400 vláken

2dF (AAT)

Družice

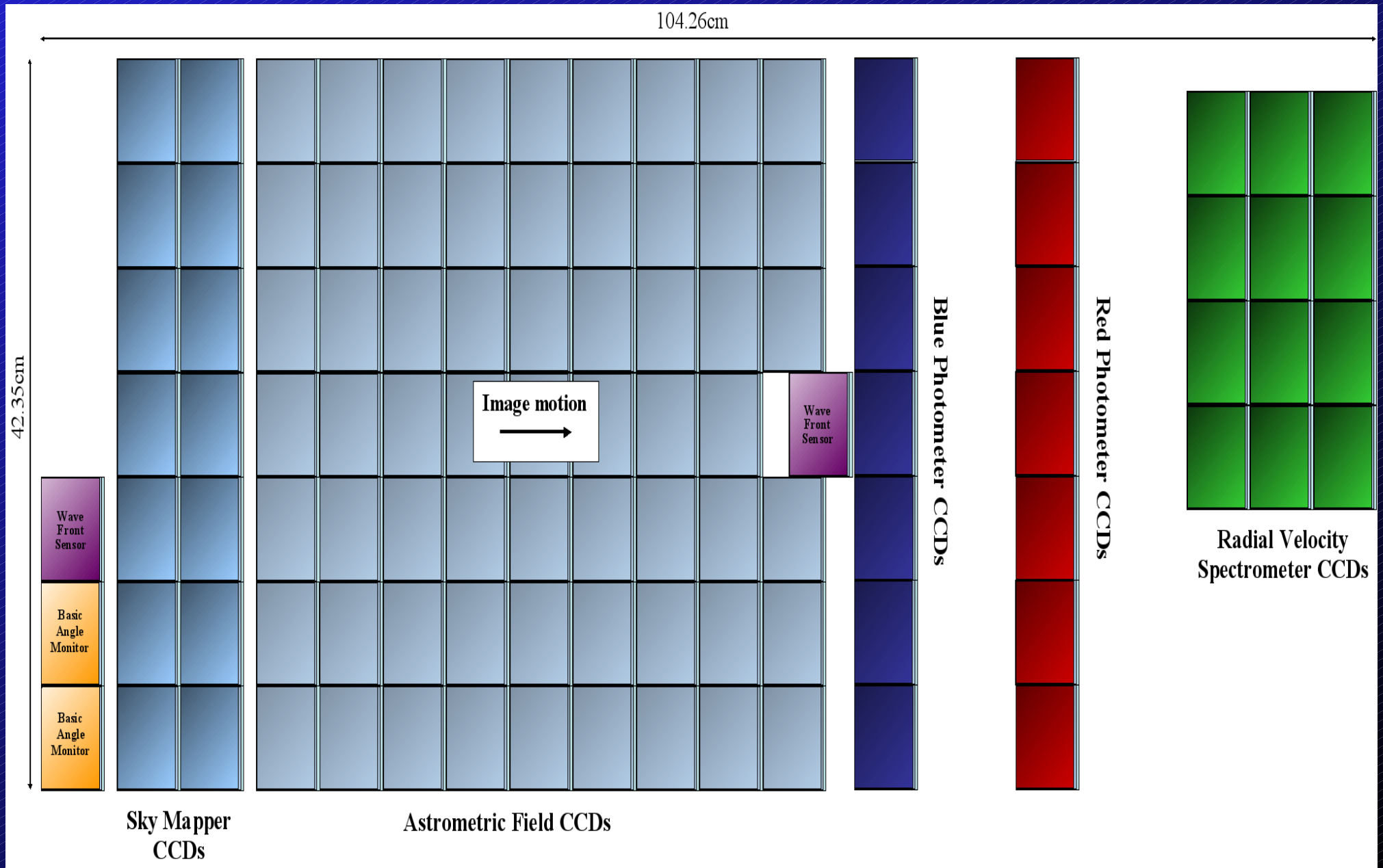
- Chandra
- XMM-Newton
- HST
- SOHO
- Hipparcos
- Rosat, FUSE, EUVE, IUE
- Mnoho jiných
- Velká datacentra – SW před startem, simulace

GAIA (2012)



GAIA CCDs

106 CCDs
938 Mpix
2800cm²

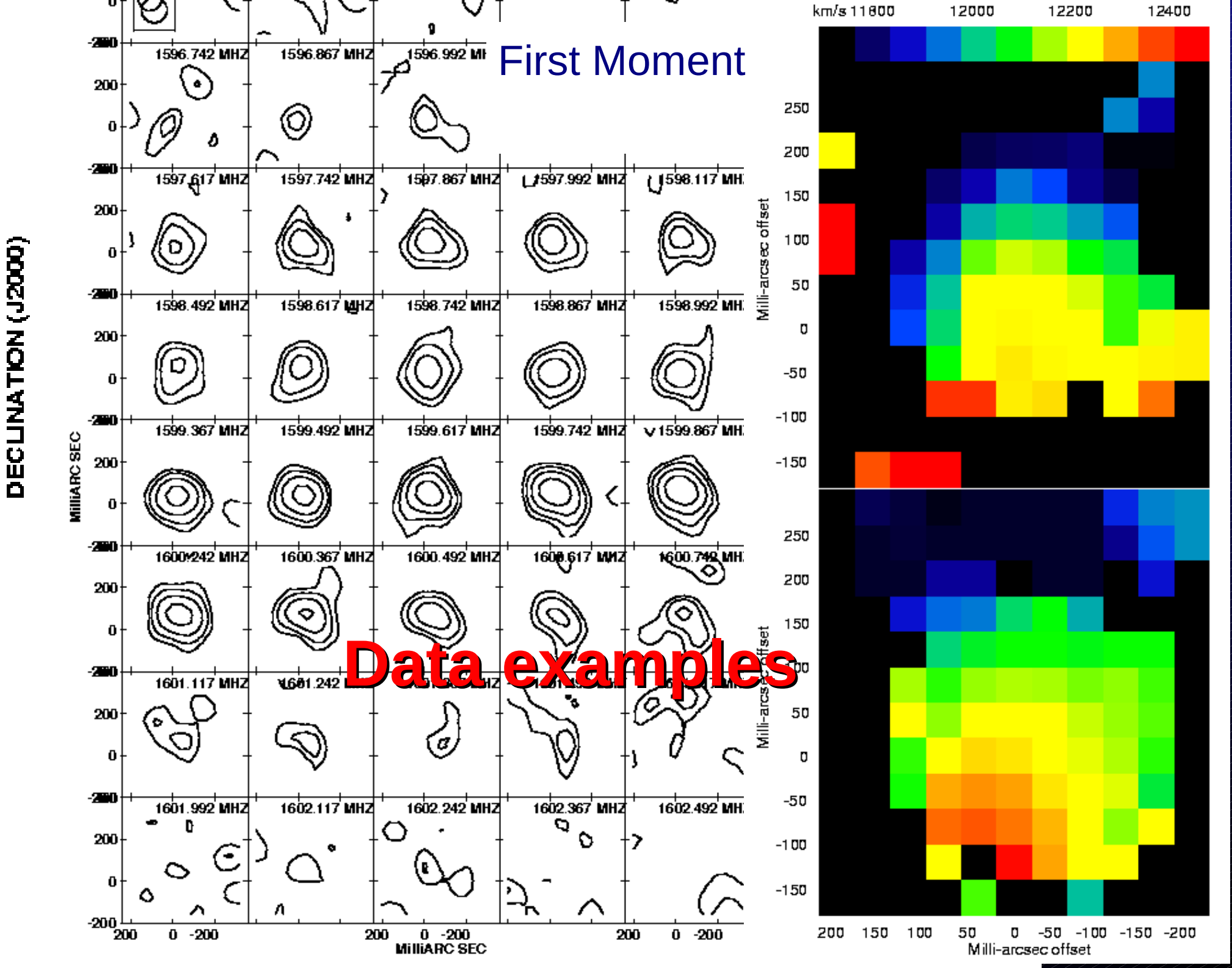


Nové přístroje na pointované pozorovaní

- MOS
  - vlákna (2dF, 6dF, Hydra, Octopus)
  - Mikrostěrbiny – vypálené laserem, MMD
- IFU (Gemini, JWT, VIMOS) – slitlety, mikročočky
- Hvězdné koronografy
- Optické Interferometry
- Ešeletové spektrografy a Fly-Eye kamery
- AO a LGS

Radioteleskopy

- Nejvíce dat – FITS, 3D
- Datacube
- Kontinuální toky
- Složitá redukce
- Klíčové pro strukturu vesmíru (HI)
- Speciální chipy - korelátory
- Nutno masivně paralelní clustery - FFT
- Přesný čas, synchronizace (VLBI)
- ALMA, SKA = datový oříšek


First Moment
Data examples
DECLINATION (J2000)
MilliARC SEC
MilliARC SEC
Milli-arcsec offset
Milli-arcsec offset
km/s 11800
12000
12200
12400
1596.742 MHZ
1596.867 MHZ
1596.992 MH
1597.617 MHZ
1597.742 MHZ
1597.867 MHZ
1597.992 MHZ
1598.117 MH
1598.492 MHZ
1598.617 MHZ
1598.742 MHZ
1598.867 MHZ
1598.992 MH
1599.367 MHZ
1599.492 MHZ
1599.617 MHZ
1599.742 MHZ
1599.867 MH
1600.242 MHZ
1600.367 MHZ
1600.492 MHZ
1600.617 MHZ
1600.742 MH
1601.117 MHZ
1601.242
1601.992 MHZ
1602.117 MHZ
1602.242 MHZ
1602.367 MHZ
1602.492 MH

Atacama Large Milimeter Array
ALMA

64 antén 12m
Chajnator 5000m
Chille
2008-2012

Square Kilometre Array

- **~ 1 km² collecting area** in an interferometer array

  sensitivity ~50 x EVLA (current largest radio array)

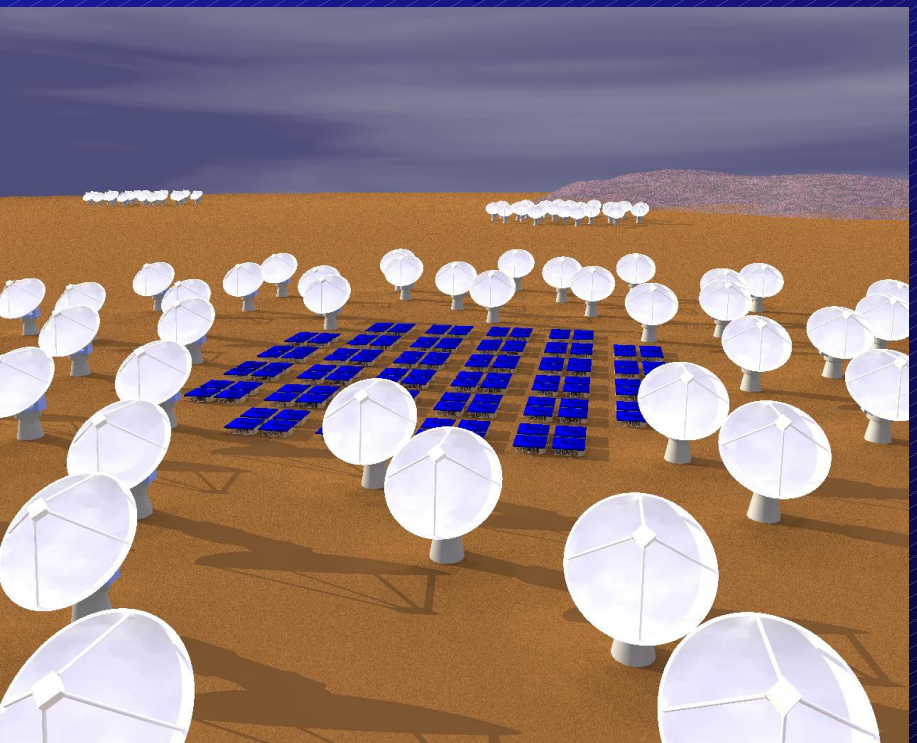
  survey speed >10000 x faster than EVLA

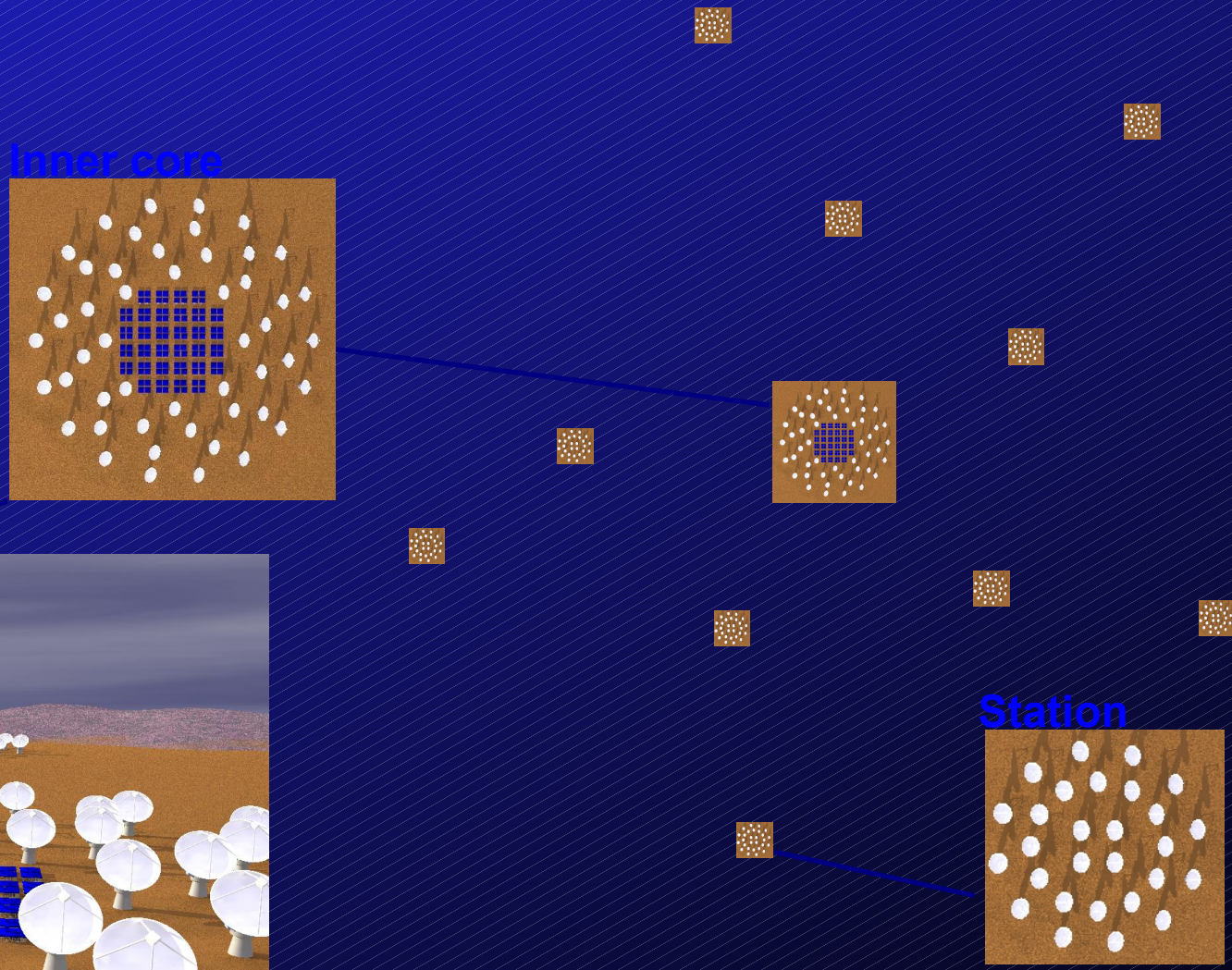
longest baselines

- wide frequency range: **0.1 – 25 GHz**
- configuration:

  >3000 km; 50% collecting area<5km
- wide field of view: **50 sq. degree at <1 GHz** (250 x moon)
- total cost 1 B€; operating costs 70 M€/year

SKA (2011-2018)





Wide-angle radio camera + radio "fish-eye lens"

Velké přehlídky oblohy

- Automatické pozorování (systematicky)
- On-line předzpracování – alerty SN
- Finání redukce komplikovaná = superpočítače a GRID (OmegaCam-Montage-Terapix)
- SW je také nástroj (30%-50% ceny projektu)
- Stomiliony objektů
- Velké databáze (stovky TB)

Palomar Observatory Sky Survey

- POSS-I (1950-57)
  - Cover the sky of $\delta > -30$
  - Blue (400nm) and Red (650nm)
  - 936 photographic plates
- POSS-II (1987-1999)
  - Finer grain and fast emulsions
    - 103aO -> IIIaJ, 103aE -> IIIaF
  - Install achromatic corrector
  - 897 plates

Southern Surveys

- UK Schmidt
  - SERC(J) (1974-87) 606 plates
  - AAO(R) (1989-) 606 plates
- ESO Schmidt
  - ESO(B) (1973-78)
  - ESO(R) (1973-88)

2MASS

2 * 1.3m telescopes
Arizona & Chile
1997-2001
J, H, K′
1.25, 1.65, 2.17 μm

471 10^6 point sources
Scale = 2"/pixel

1054 asteroids (2000)
12219 asteroids (2006)

DENIS

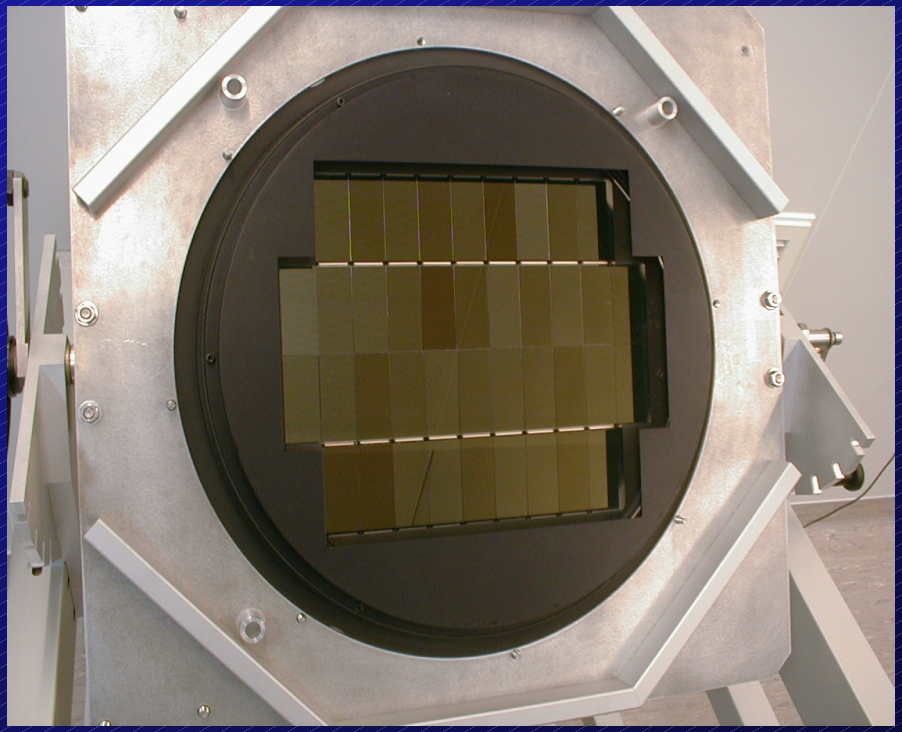
1m telescope
Chile
1995-2001
I, J, K′
0.82, 1.25, 2.16 μm

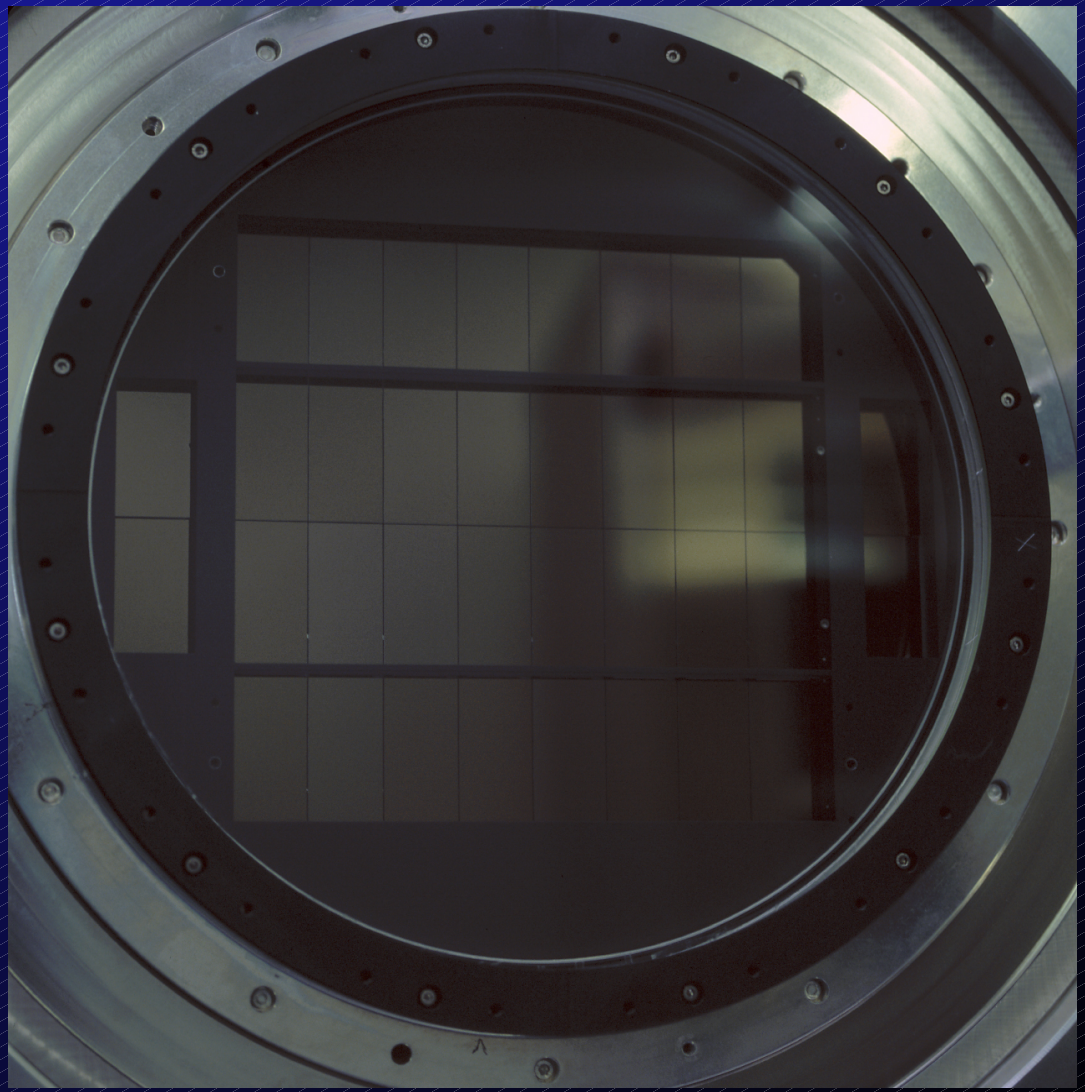
355 10^6 point sources
Scale = 1", 3" & 3"/pixel

767 asteroids (2001)
1931 asteroids (2004)

OMEGACAM (CFHT)

36 (40) CCD 4.6kx2k
770 MB na expozici
77 GB za noc
Montage - Terapix





Sloan digital sky survey = SDSS

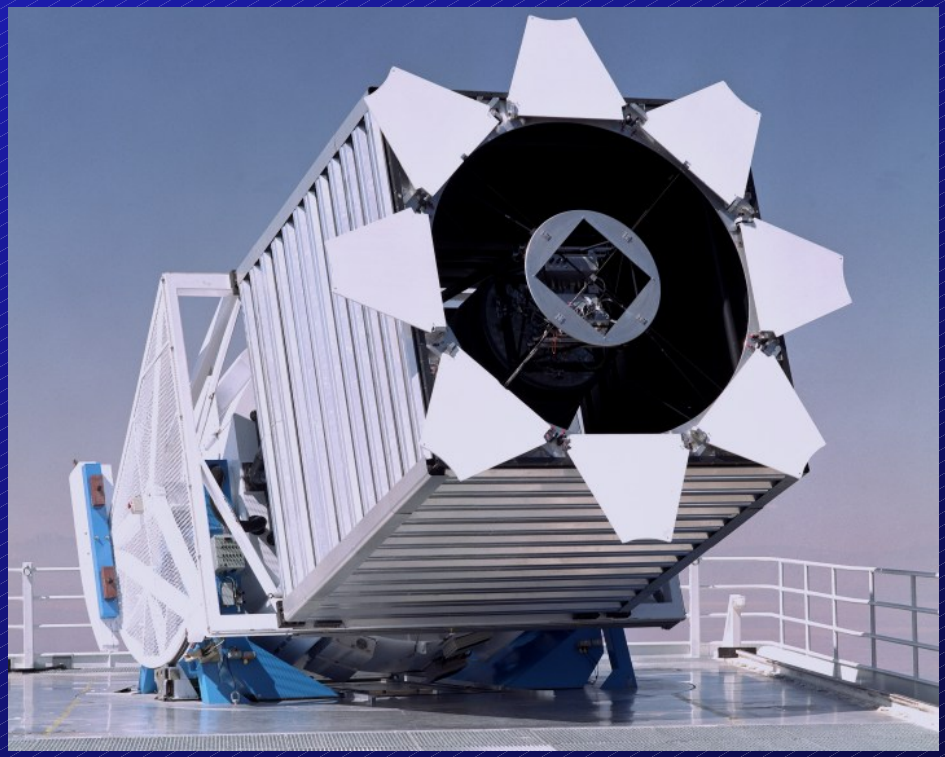
- Initial goals

- Imaging 10,000 square degree of northern sky down to 23mag in 5 optical band (3900-9200A)
  - 7×10^7 stars
  - 5×10^7 galaxies
  - 1×10^6 quasars
- Measure redshifts for 10^6 galaxies and 10^5 quasars
- Create largest, homogeneous, and high-quality catalog of galaxies and quasars

SDSS

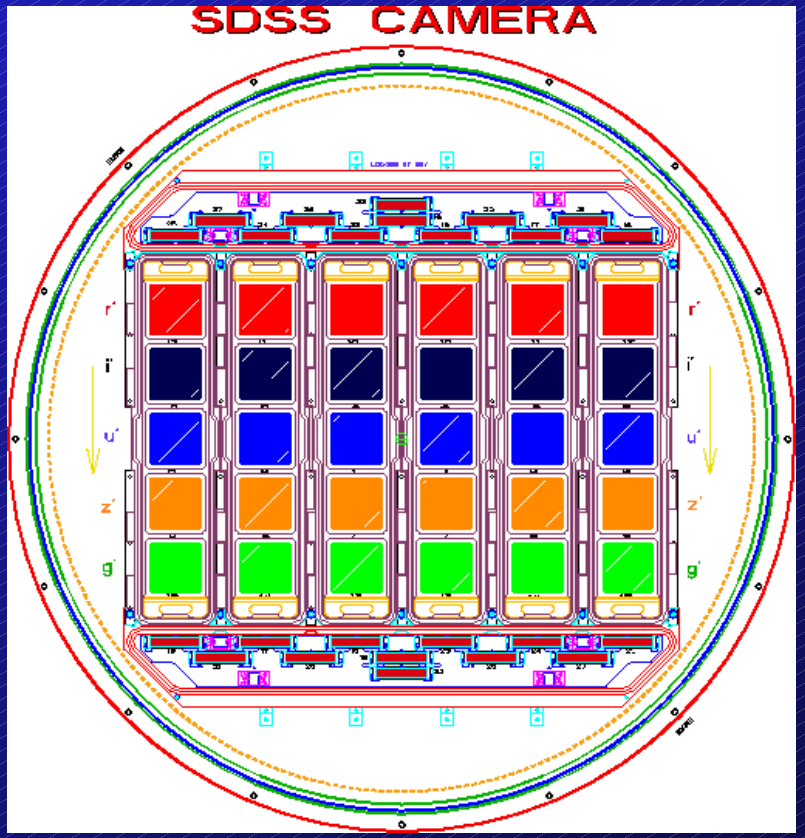
Apache point observatory – New Mexico

SDSS 2.5m teleskop

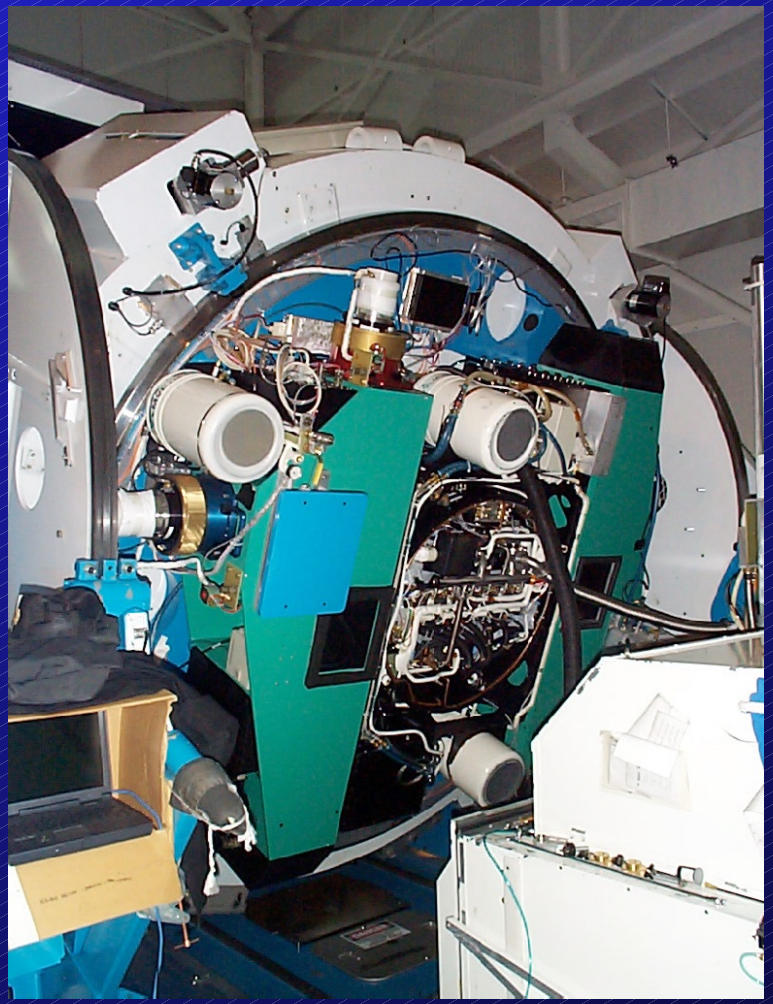


SDSS CCD

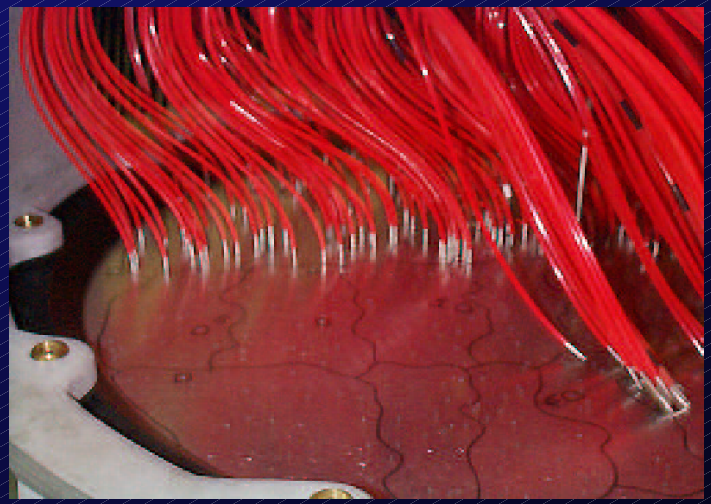
30x CCD 2kx2k



SDSS spektrograf



2 spektrografy 3800-9200 A
640 vláken
beamsplitter – červený a modrý
desky až 6-9 za noc (5000 objektů)



SDSS Data Release

release	Area deg^2	spectra	when
EDR:	462	54,000	6/2001
DR1:	2099	186,000	4/2003
DR2:	3324	367,000	3/2004
DR3:	5282	529,000	10/2004
DR4:	6670	850,000	7/2005
DR5:	8000	1,490,000	6/2006

Survey Plates

- End of SDSS-I
  - ~ 1310 plates
    ~ 6300 deg^2
  - 840,000 spectra total
  - 590,000 galaxies
  - 75,000 quasars
  - 110,000 stars

  - Diameter 32 degree
  - Radius 267Mpc
  - Volume = 0.02 Gpc^3

- End of LEGACY
  - ~ 1700 plates
    ~ 8200 deg^2
  - 1,090,000 spectra
  - 760,000 galaxies
  - 98,000 quasars
  - 140,000 stars

  - Diameter 70 degree
  - Radius 450Mpc
  - Volume = 0.09 Gpc^3

Data Archives

- Main page
  - http://www.sdss.org/dr5/index.html
  - Describe data products, instruments, and algorithms
- Data Archive Server
  - http://das.sdss.org/DR5-cgi-bin/DAS
  - Serve flat files (FITS format)
- Catalog Archive Server
  - http://cas.sdss.org/astrodr5/en/
  - Search tools for SDSS catalogs
- Casjobs
  - http://casjobs.sdss.org/casjobs/
  - Batch job server for SQL searches

SDSS DR5 Archiv

- Obrázky
  - 8000 deg sq
  - 215 milionů objektů
  - 9 TB obrázků
  - 1.8 TB katalog
  - u g r i z
    - 3551Å 4686Å 6165Å 7481Å 8931Å
    - 22.0 22.2 22.2 21.3 20.5mag

SDSS DR5 Archiv

- Spektra (60GB 2D -170GB z,měření)
  - 5740 sq. deg.
  - 3800-9200 A resolution 1800, SNR>4 g=20.2
  - 1,048,960 spectra, classified into
  - 674,749 Galaxies
  - 79,394 Quasars (redshift <2.3)
  - 11,217 Quasars (redshift >2.3)
  - 154,925 Stars
  - 60,808 M stars and later
  - 12,312 Unknown class

Spectrum Services for the VO - Microsoft Internet Explorer

Back Search Favorites File Edit View Favorites Tools

Address http://voservices.net/spectrum/search_list.aspx?search=cone&view=graph&page=o Go

NVO

Spectrum Services

home | docs | search | MySpectrum | collections | webservices | user

not logged in
login | register

National Virtual Observatory

Search Results

Found 12 objects. Displaying from 1 to 3

List mode Image mode

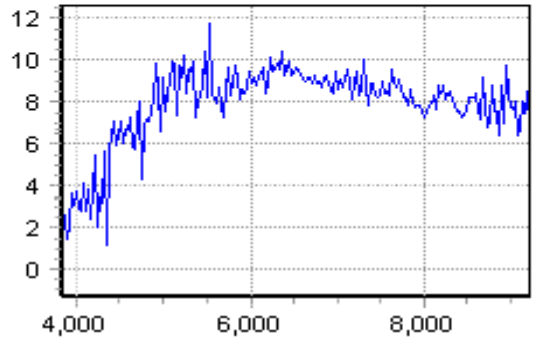
First Prev Next Last

1 . SDSS J115944.85+000000.00

ivo://jhu/sdss/dr4#80443408212033536 |
ivo://sdss/dr4/spec#80443408212033536 details

class: Galaxy , Z = 0.1009

ra = 179.936874 , dec = 0.941241

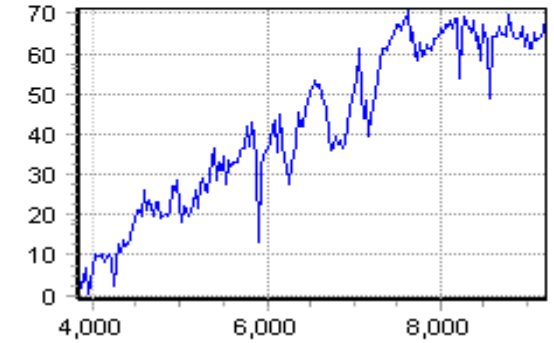


2 . SDSS J120008.29+016000.00

ivo://jhu/sdss/dr4#80443408262365184 |
ivo://sdss/dr4/spec#80443408262365184 details

class: Galaxy , Z = 0.0000

ra = 180.034561 , dec = 1.146855

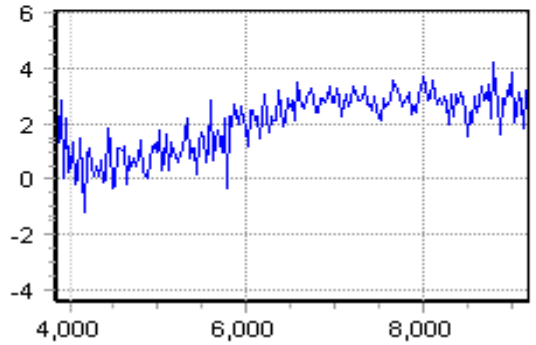


3 . SDSS J115923.80+000000.00

ivo://jhu/sdss/dr4#80443407863906304 |
ivo://sdss/dr4/spec#80443407863906304 details

class: Galaxy , Z = 0.4517

ra = 179.849167 , dec = 0.984768



Select All Clear All What do you want to do with the results? Download data

- Download data
- Save to MySpectra
- Plot on a graph
- Calculate composite
- Calculate synthetic magnitudes
- Fit continuum & lines

<< Results < Back Next > Finish >>

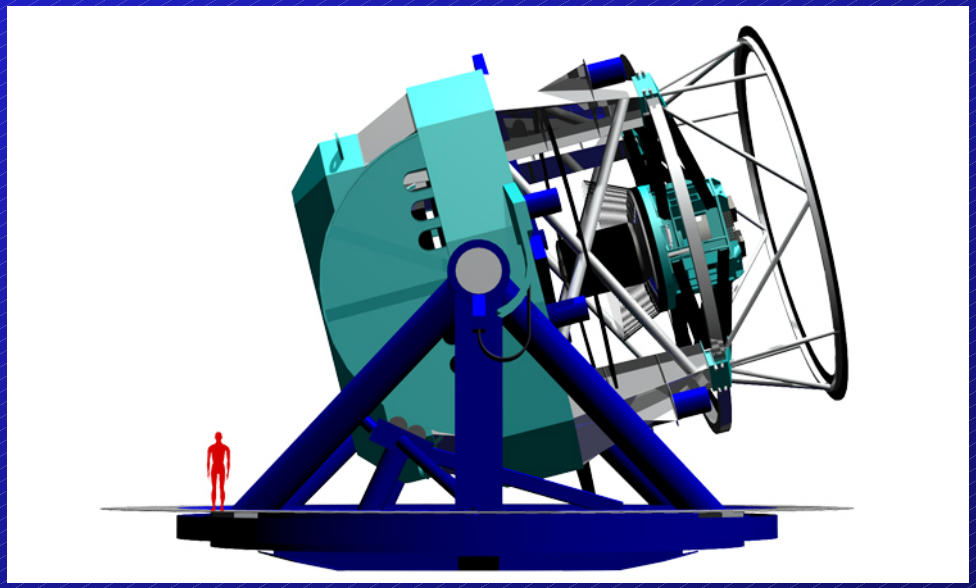
Internet

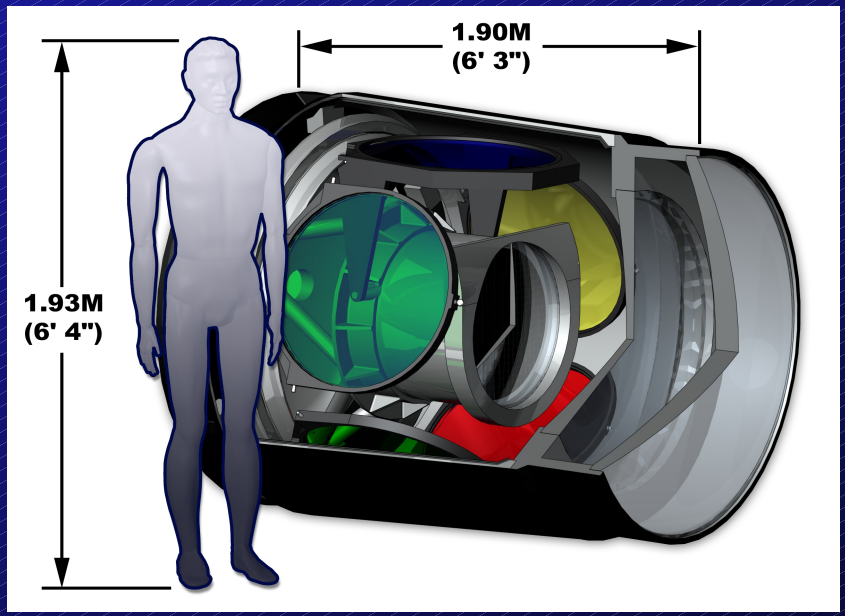
Specializované – Mikročočky

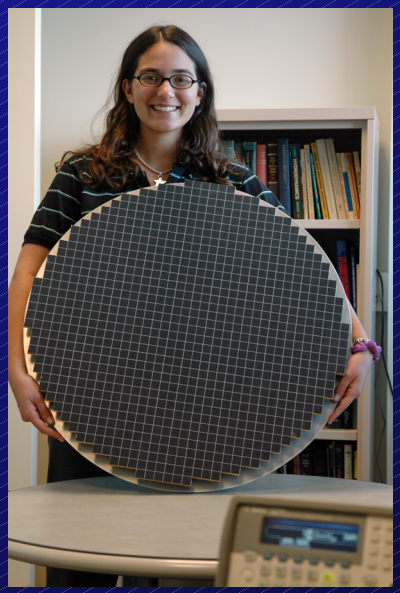
- MOA
  - NZ, Mt John Observatory, 4 CCD 2kx2k
- OGLE
- MACHO
- WASP (Sutherland, La Palma) – 8 kamer 2x2k
- KIDS
- Zpracování on-line statisíce objektů
- Mikročočky jen zlomek potenciálu – proměnné hvězdy a pod.

Large Synoptic Survey Telescope LSST

LSST (8.4m)





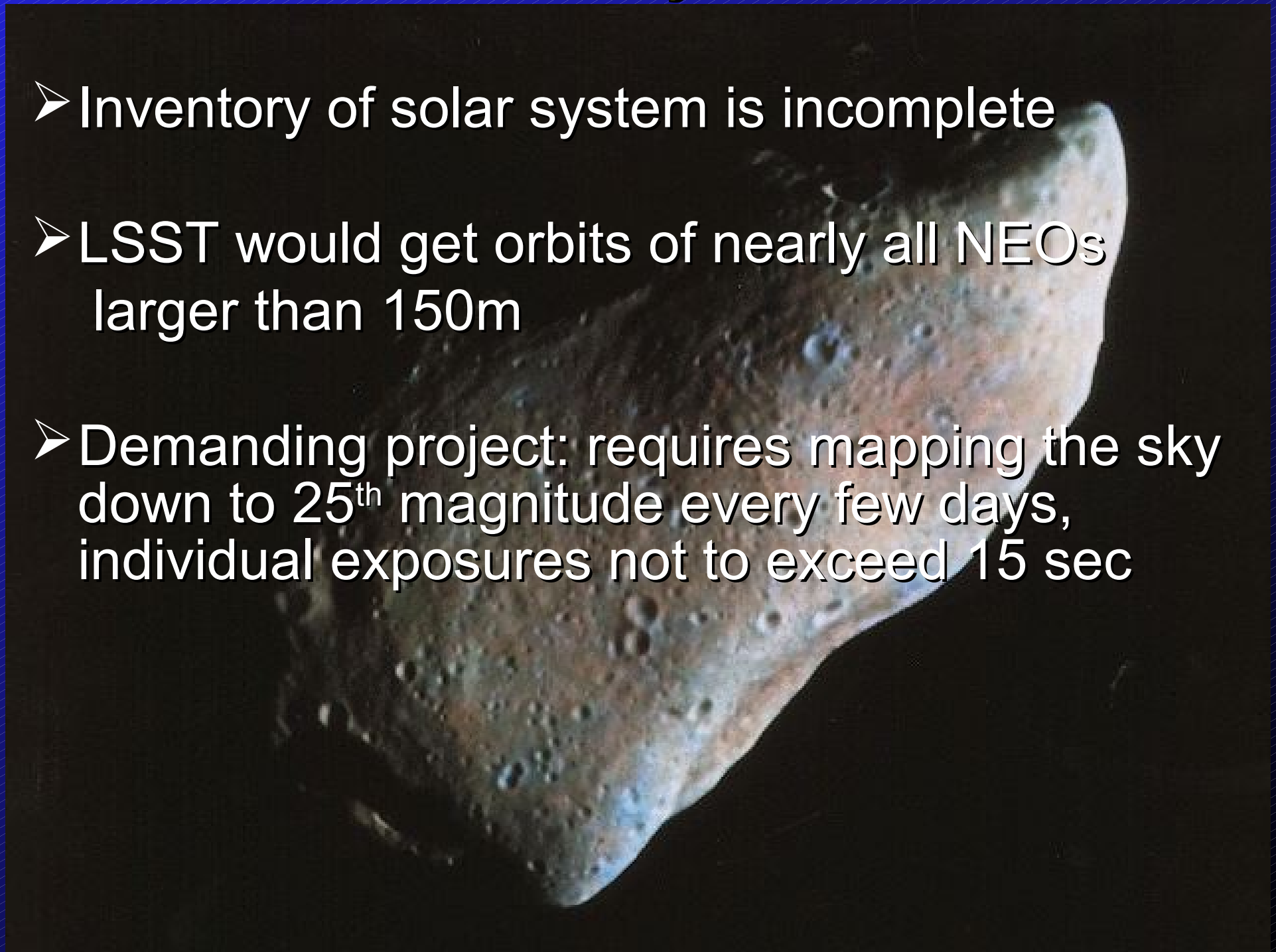


200 CCD 4kx4k,
32 kanálů (6400)
3.2 Gpix za 2 sec
64cm průměr
3.5 deg FOV
30 TB/noc
2 TFLOPS
detekce změn do 60sec

LSST survey of >20,000 sq deg

- 4 billion galaxies with redshifts
- Time domain:
  - 100,000 asteroids
  - 1 million supernovae
  - new phenomena

Near Earth Objects



- Inventory of solar system is incomplete
- LSST would get orbits of nearly all NEOs larger than 150m
- Demanding project: requires mapping the sky down to 25th magnitude every few days, individual exposures not to exceed 15 sec

LSST Survey

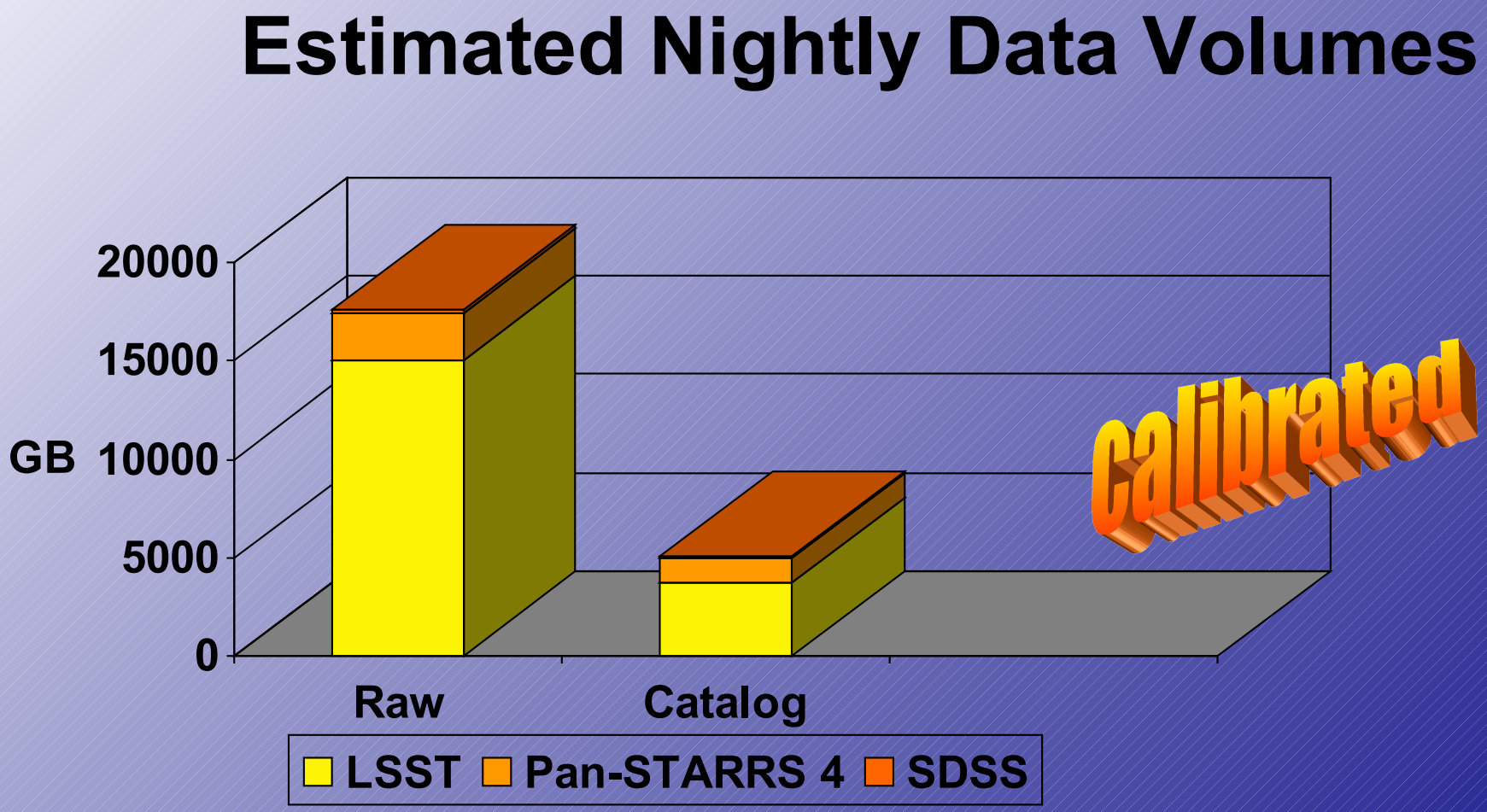
- 6-band Survey: u*grizy* 320–1050 nm
  NEO frequent revisits: grizy
- Sky area covered: >20,000 deg^2
  0.2 arcsec / pixel
- Each 10 sq.deg FOV revisited ~2000 times
- Limiting magnitude: 26.5 AB magnitude @10σ
  25 AB mag /visit = 2x15 seconds
- Photometry precision: 0.01 mag requirement,
  0.001 mag goal

LSST

- Processing pipeline generates 108TB of 32-bit floating point temporary image data, not archived

Calibrated images at 8 Gbps (36 TB/24 hours) +
Noise maps at 8 Gbps (36 TB/24 hours) +
Subtracted images at 8 Gbps (36 TB/24 hours) = 108TB/24 hours

Unprecedented Astronomy Data Volumes



VISTA

4m telescope

0.6 sq.deg. IR camera

16 2kx2k detectors

0.35” pixels

VST

2.6m telescope

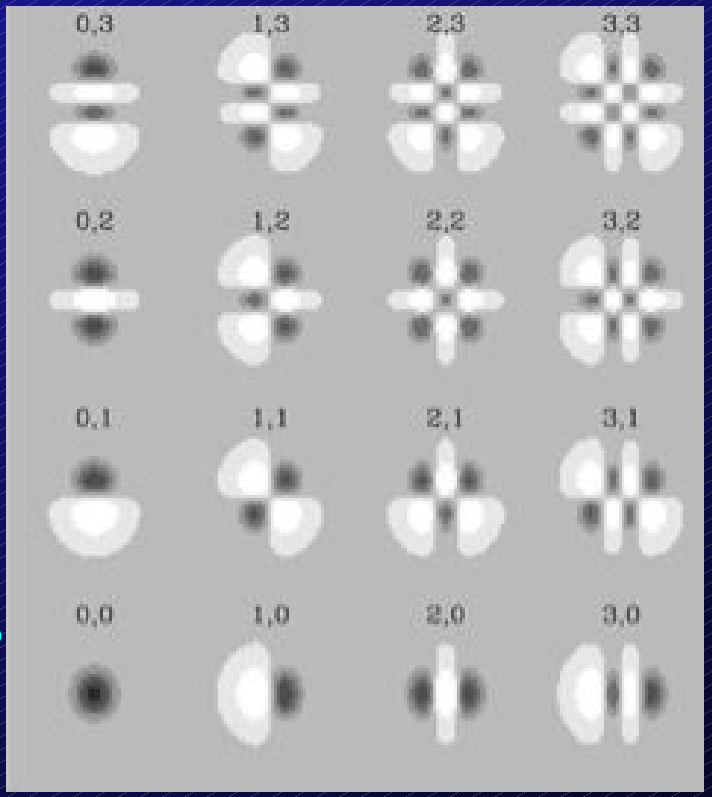
1 sq.deg. optical camera (OmegaCAM)

32 2kx4k detectors

0.21” pixels

Shapelets

- Gaussian x polynomials
  - Orthonormal basis: Gauss-hermite series
  - Nice transformation properties (little mixing) under
    - Translation
    - Rotation
    - Shear
    - Magnification
    - …
  - Reasonable approximations to PSF & galaxies (?
  - Closed-form expressions for convolutions

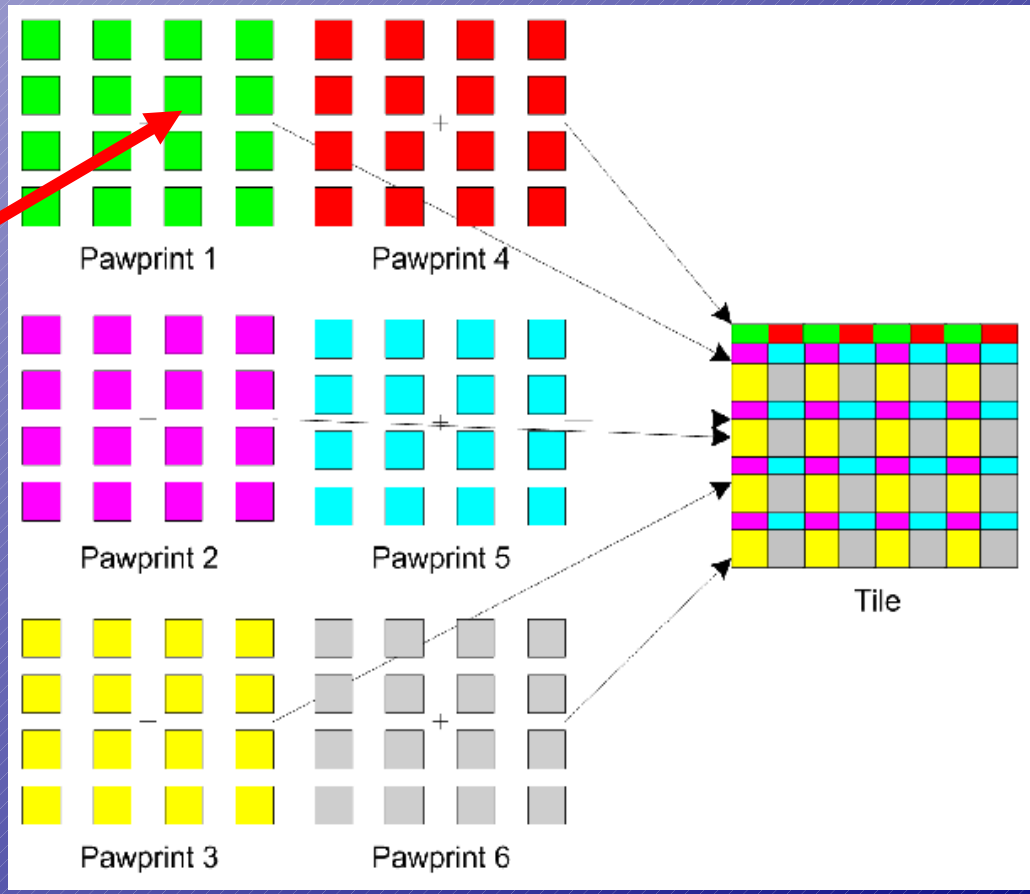


(Refregier 2003)

Visible and Infrared Survey Telescope for Astronomy VISTA

- 4-m class imaging survey telescope in Chile
- 2007
- 1.6 deg FoV
- 16 2kx2k CCD

Observing Mode

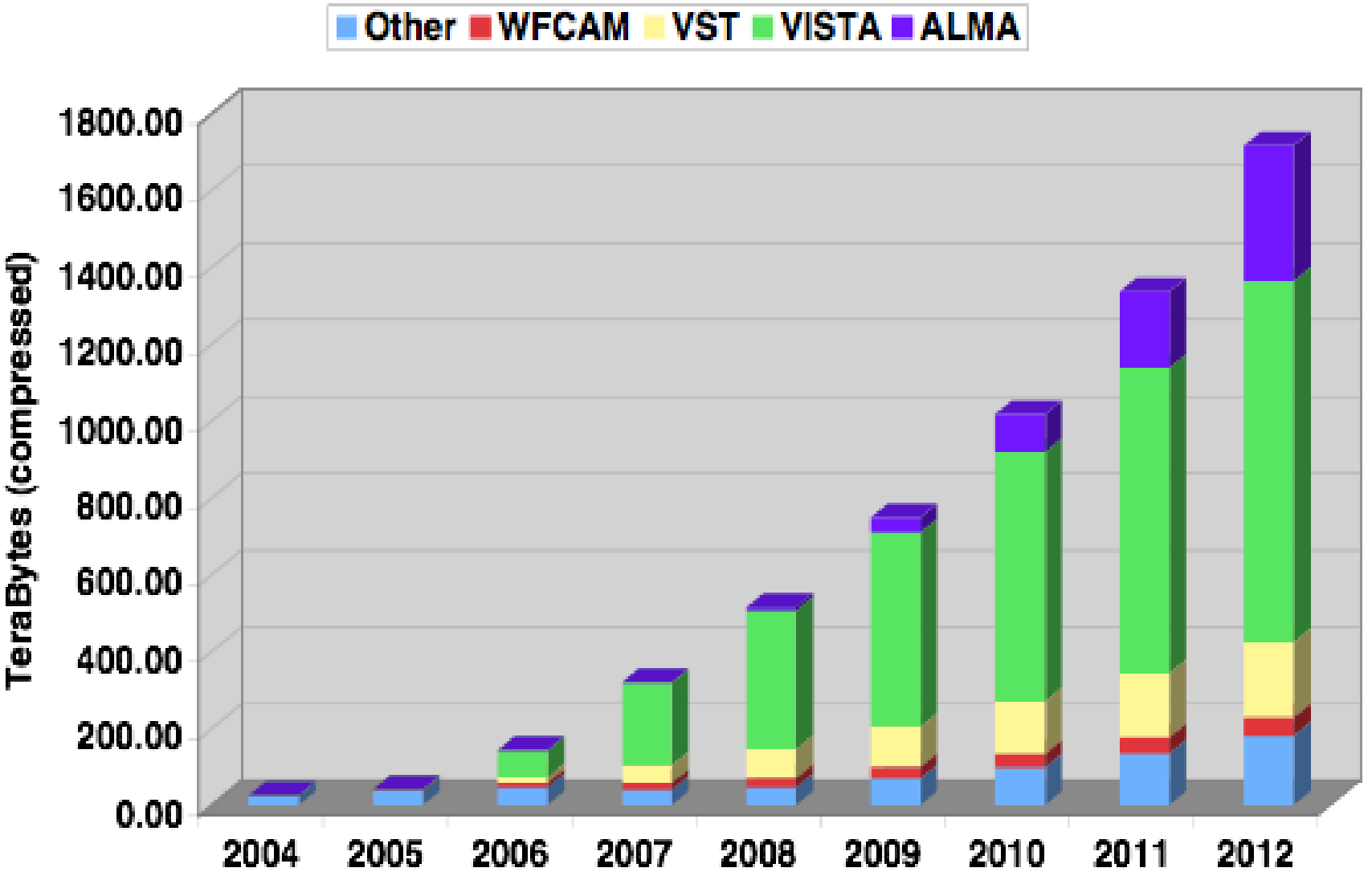


Evaluation of Montage

•Six stepped exposures fill a "Tile" with at least two exposures

•Automated pipeline processes each "pawprint",

The ESO Archive

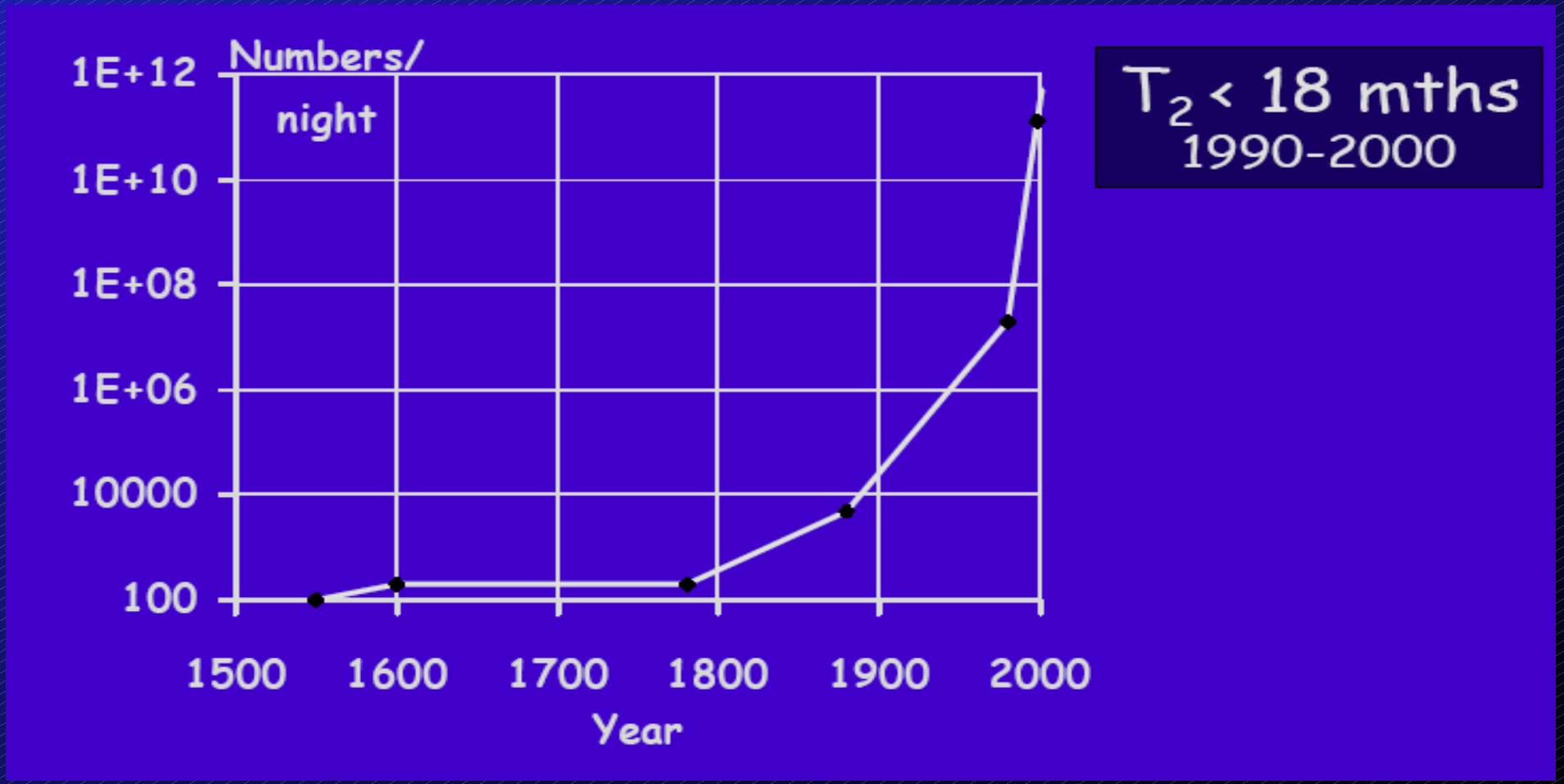


Teorie – složité modely

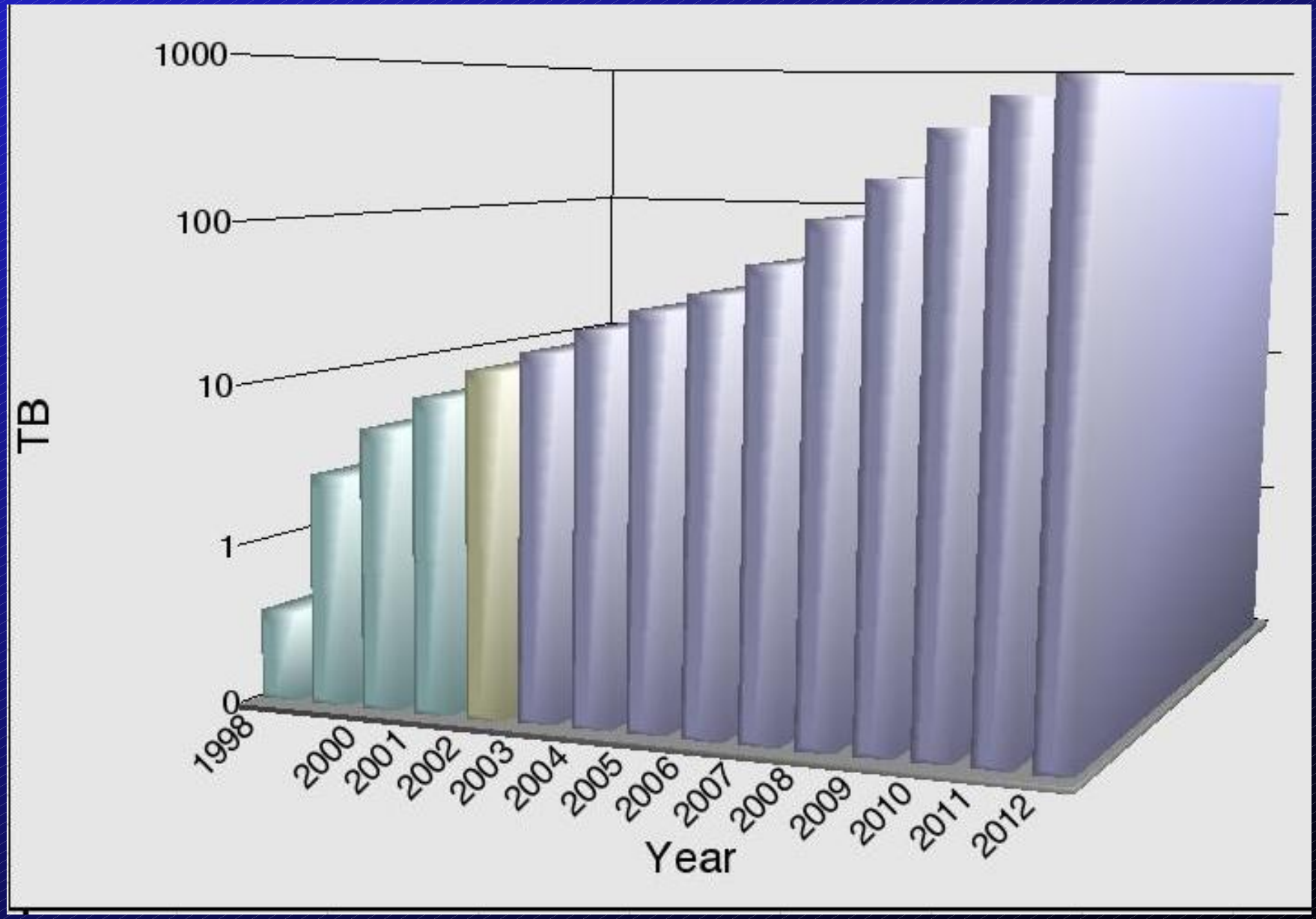
- 3D simulace
- Plná MHD
- Velké simulace – data v TB, velké databáze na vstupu (linelisty, sítě modelů)
- Turbulence ISM …
- N-částicové modely (celé galaxie, populace)
- Velkorozměrová struktura
- AI metody, NS, GA
- Vizualizace TB dat pomocí VR

Lavina dat

- Moorův zákon chipy – zdvojení 1.5 roku (1000/10 let)
- Data v astronomii – zdvojení < 1 rok !



Lavina dat


1000
100
10
1
0
TB
1998
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year

Éra digitálních dat

- Multispektrální data (nová okna)
- syntéza údajů z různých zdrojů
- digitální data -archivy (IUE ULDA)
- 90. léta = web různé služby skyview, telnet
- různé formáty, jednotky, protokoly, GUI
- literatura = SIMBAD, ADS
- Integrace archivů = MAST, ESO, ING

Demokratizace astronomie

- Digital divide (technologie ne, data ano)
- Data jealousy (pomine – psychologický efekt)
- Data pořízená a zpracovaná strojově – pocit že jsou nevlastní, proprietary period max rok
- Většina projektů-volné ihned
- Keck archiv – co veřejné (HIRES) je public
- Ale lavina dat
- Zdvojení každý rok (Moore 18měsíců)

Počátky VO

- idea VO konec 2000
- propojení archivů
- jednotné rozhraní, datový formát pro přenos
- mnoho dat – distribuované zpracování
- GRID - fyzika elementárních částic
- multispektrální výzkum: radio---gama
- Výstupy simulací v NCSA
- Data pro SDSS – hlavní výzkum

Virtual Observatory : Key Definitions

- "*The Virtual Observatory will be a system that allows astronomers to interrogate multiple data centers in a seamless and transparent way, which provides new powerful analysis and visualization tools within that system, and which gives data centers a standard framework for publishing and delivering services using their data*".
- Standardization of data and metadata, and of data exchange methods.
- Registry, listing available services and what can be done with them.

R.J.Hanisch, P.J.Quinn, in "IVOA – Guidelines for participation"

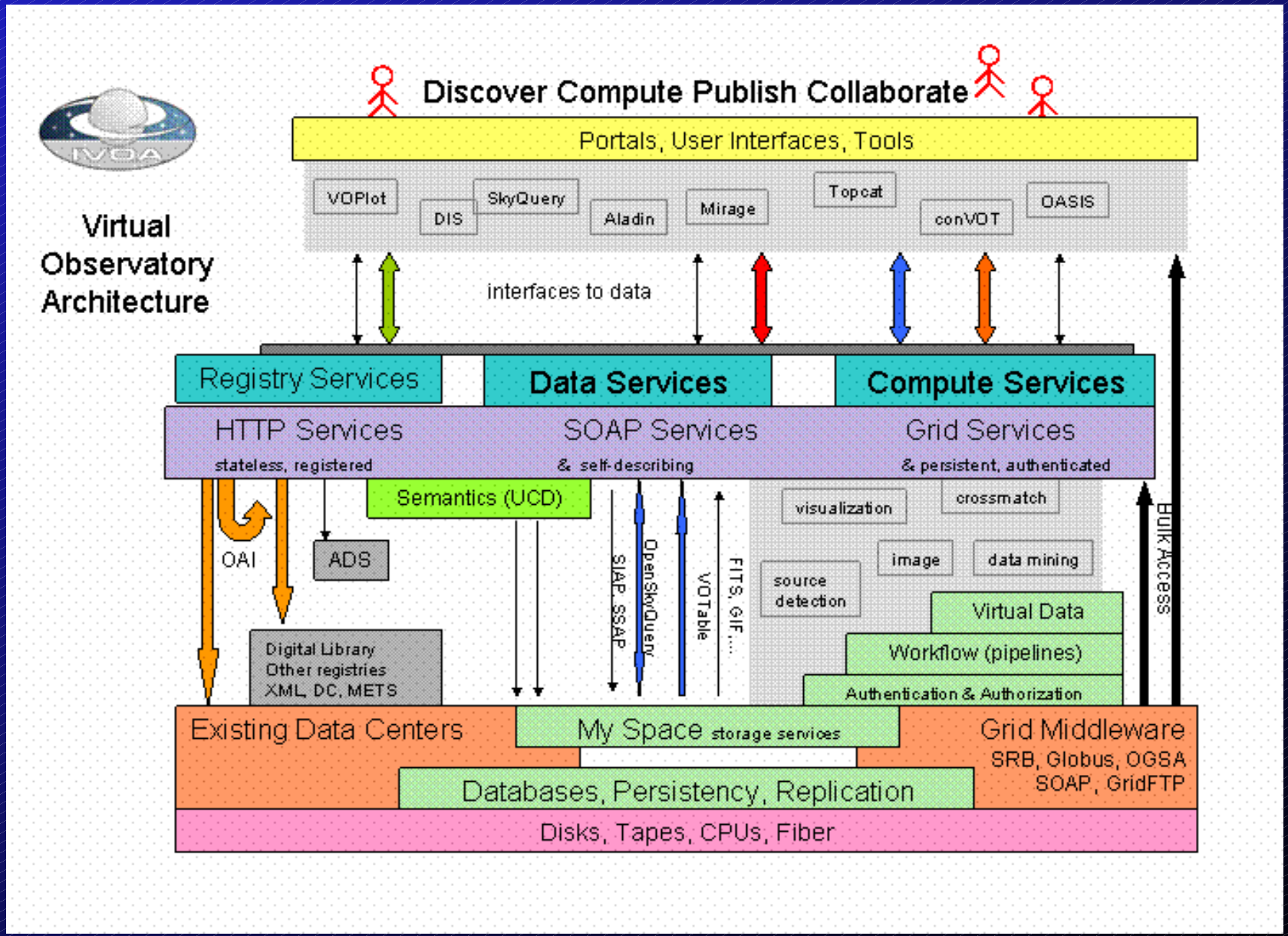
Principy VO

- Jednotný formát dat – VOTable, UCD
- transparentní přenos SOAP
- Web services (WS)
- VOregistry (jako DNS)
- MySpace (síťový home disk)
- protokoly (CGI services)
  - ConeSearch (hledání v kruhu na obloze)
  - SIAP (Simple Image Access Protocol)
  - SSAP(Simple Spectral Access Protocol)
  - SLAP(Simple Line Access Protocol)

Technologie VO (SDSS)

- SDSS = SkyServer
- Skynode, SkyPortal (distribuované query mezi SkyNody)
- OpenSkyQuery
- ADQL
- XMATCH, REGION
- VOSpace – cache(WS, database,http put get)
- přenos dat nelze, pomalý - zpracování na místě
- VOEvent (alerty)

Architektura VO

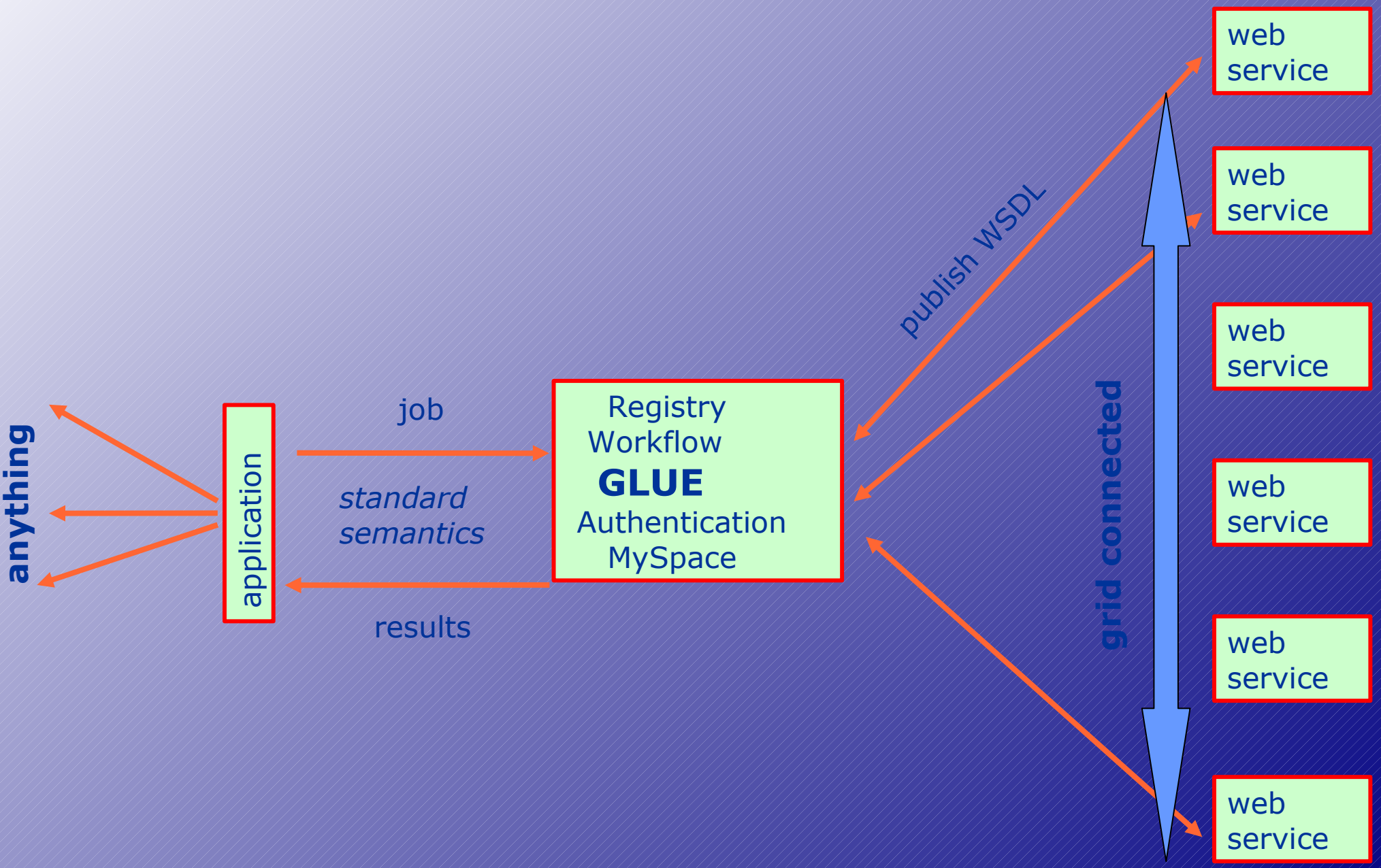


Grid : Key Definitions

- The **Grid** concept is "*coordinated resource sharing and problem solving in dynamic, multi-institutional virtual organizations*"
  - This sharing is, necessarily, highly controlled, with resource providers and consumers defining clearly and carefully just what is shared, who is allowed to share, and the conditions under which sharing occurs.
- A set of individuals and/or institutions defined by such sharing rules form what we call a **virtual organization** (VO ... VOrg)

Ian Foster, Carl Kesselmann, Steven Tuecke in "Anatomy of the Grid"

Virtual Observatory & Grid



Nástroje VO-enabled

- Aladin
- VOPlot
- VOSpec
- SpecView
- SPLAT
- ViSiVio
- VOSED
- Sextractor – WESIX (Web Enabled Source Identification with Cross Matching)

ESO Archive Query Form

ESO Archive Overview | Form INFO | FAQ | Archive Facility HOME | ESO HOME

The checkboxes on the right of the parameters a

SEARCH | ShowAll | ShowNone | Reset

Target | Resolved
RA | DEC
Search Box 00 10 00 | Input | RA
Output | Sexagesimal (h, deg)

M	More	Target Ra, Dec	Program ID	Ins
-		05:22:04.40 -67:58:56.4	074.D-0696(A)	EM
-		05:22:04.40 -67:58:56.4	074.D-0696(A)	EM
-		05:22:04.40 -67:58:56.4	074.D-0696(A)	EM
		05:22:14.41 -67:58:48.0	68.C-0019(A)	WF
		05:22:14.82 -67:58:43.0	68.C-0019(A)	WF
		05:22:14.91 -67:58:42.1	68.C-0019(A)	WF
		05:22:15.02 -67:58:55.7	68.C-0019(A)	WF
		05:22:15.07 -67:58:41.4	68.C-0019(A)	WF
		05:22:27.29 -67:58:07.0	68.C-0238(A)	FO

Request Marked Datasets | Reset

A total of 68 were found matching the provided criteria

Download result table from: export18381

Sky Map: the Aladin@CDS Java applet
interchange of data between ESO and Al
Further **help**.
You may also **convert** the VOTable and

Use tabular output even if only one row is retur
Use full-screen output even if more than one ro
Format results in plain text only (without HTML

Sort by: Nothing (Faster)

Aladin v3.0 multiview

Load... | Save... | Tools... | Print... | Help... | Undetach

Position J2000 05:21:59.98 -67:59:29.9 | Pixel full | Unknown

selec | dist | draw | tag | text | filter | rgb | grid | rtaln | cont | zoom | mglss | hist | prop | del

Simbad
ESO Archive
Instrumen
Your quer
MAMA.ALES

multiview | Zoom 2/3x | out

05:22:04.40	-67:58:56.4	EMMI.2004-11-21T07:12:45.503	074.D-0696(A)	EMMI/2.15	10
05:22:04.40	-67:58:56.4	EMMI.2004-11-21T07:15:16.650	074.D-0696(A)	EMMI/2.15	10
05:22:15.02	-67:58:55.7	WFI.2001-12-08T06:08:34.132	68.C-0019(A)	WFI	20
05:22:20.41	-67:59:12.1	WFI.2001-12-08T07:58:52.819	68.C-0019(A)	WFI	20
05:22:21.12	-67:59:05.9	WFI.2001-12-07T03:16:29.145	68.C-0019(A)	WFI	20

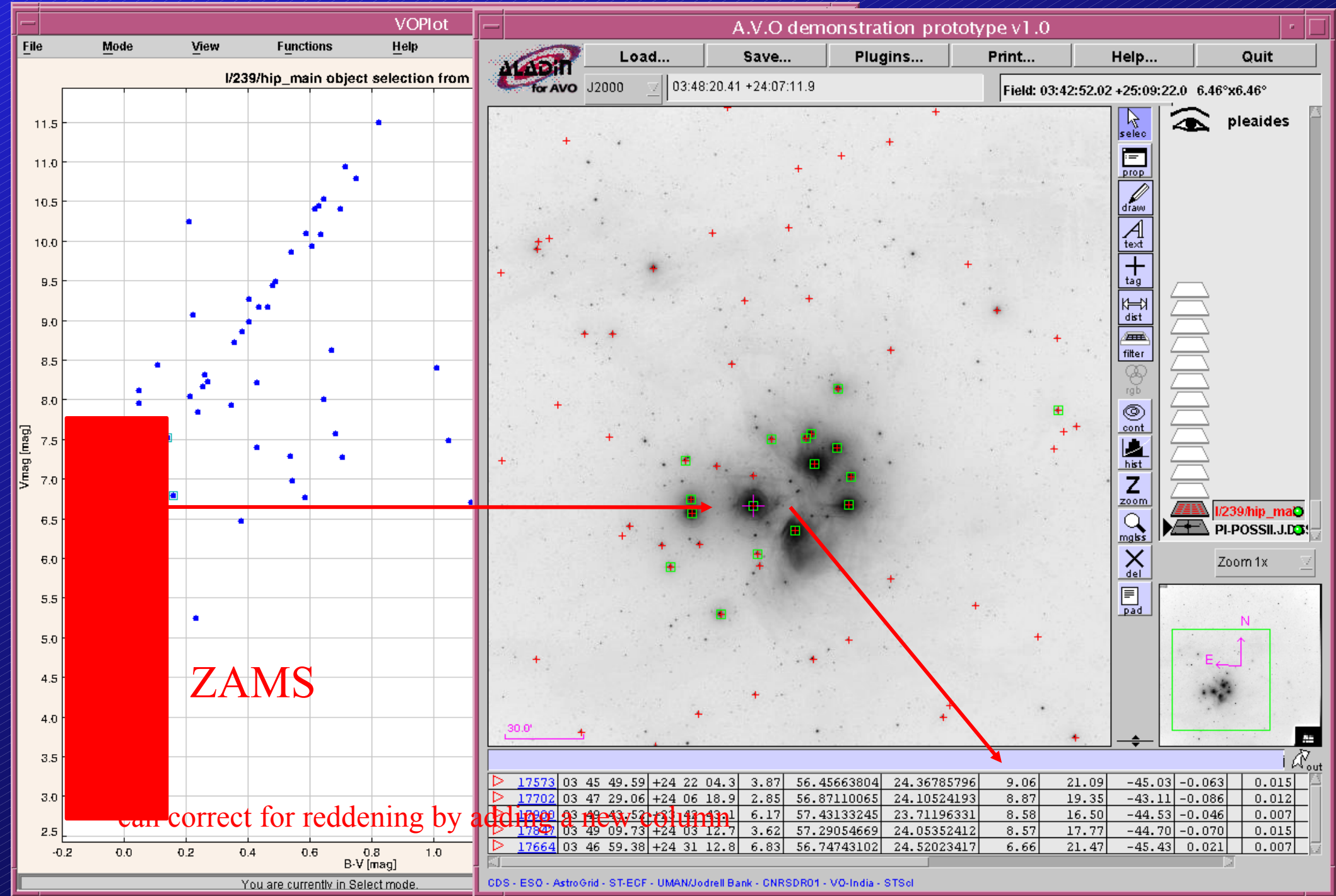
(c)1999-2005 ULP/CNRS - Centre de Données astronomiques de Strasbourg | 5 planes, 1 view, 35Mb

New

Complex queries by:

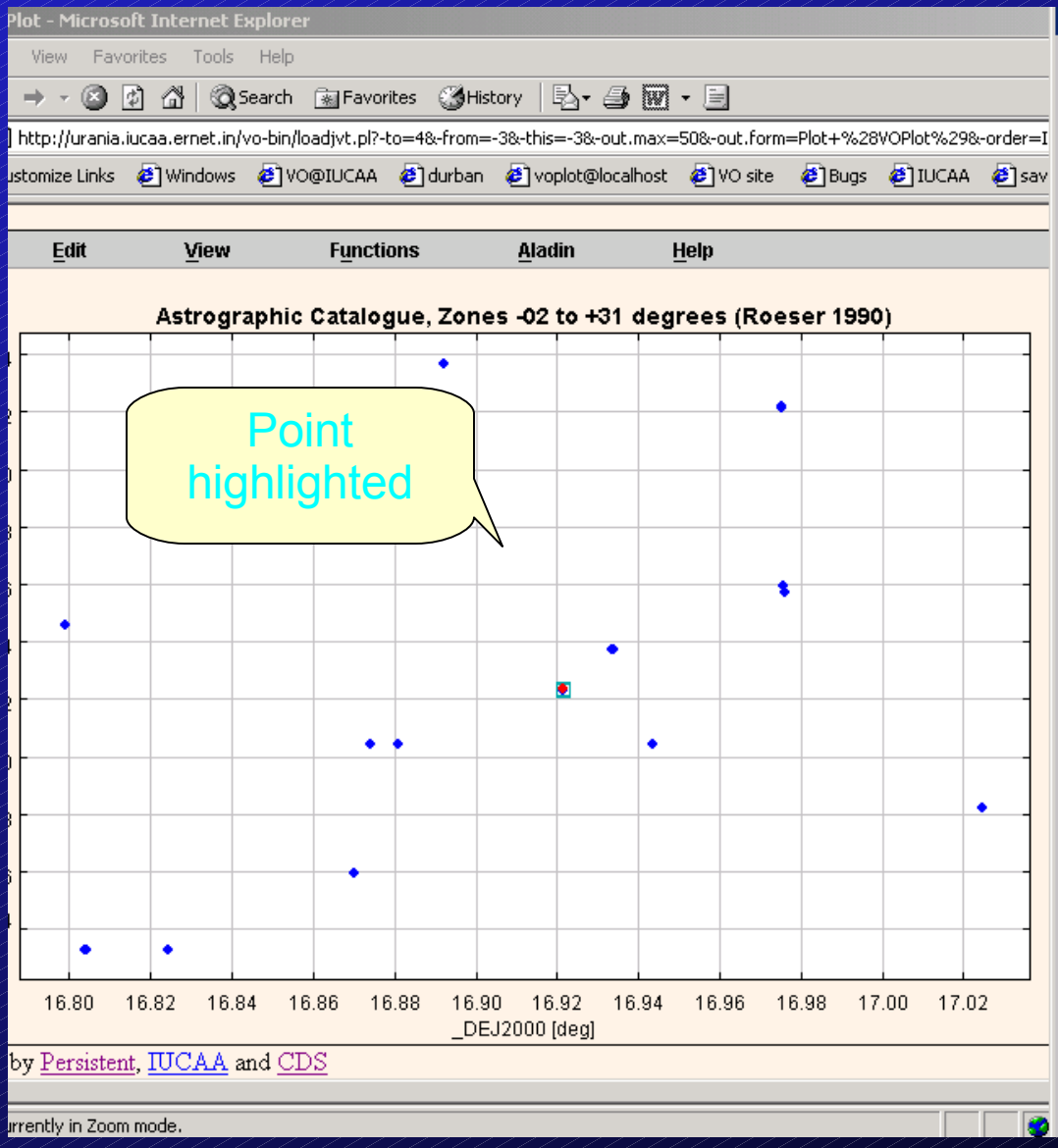
- Coordinates, target name
- Input lists
- Scheduling information
- Proposal information
- Instrument, obs category

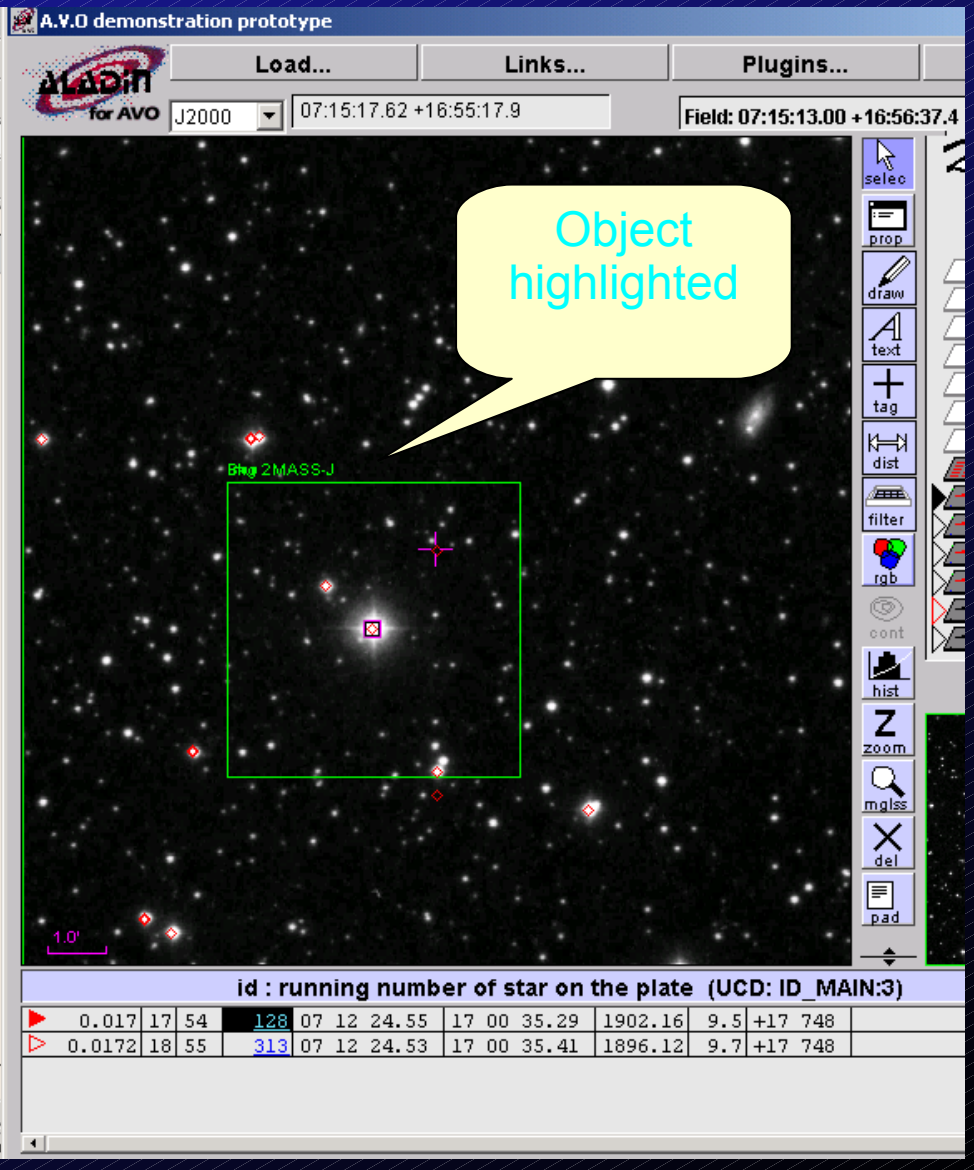
Colour-magnitude diagram



can correct for reddening by adding a new column

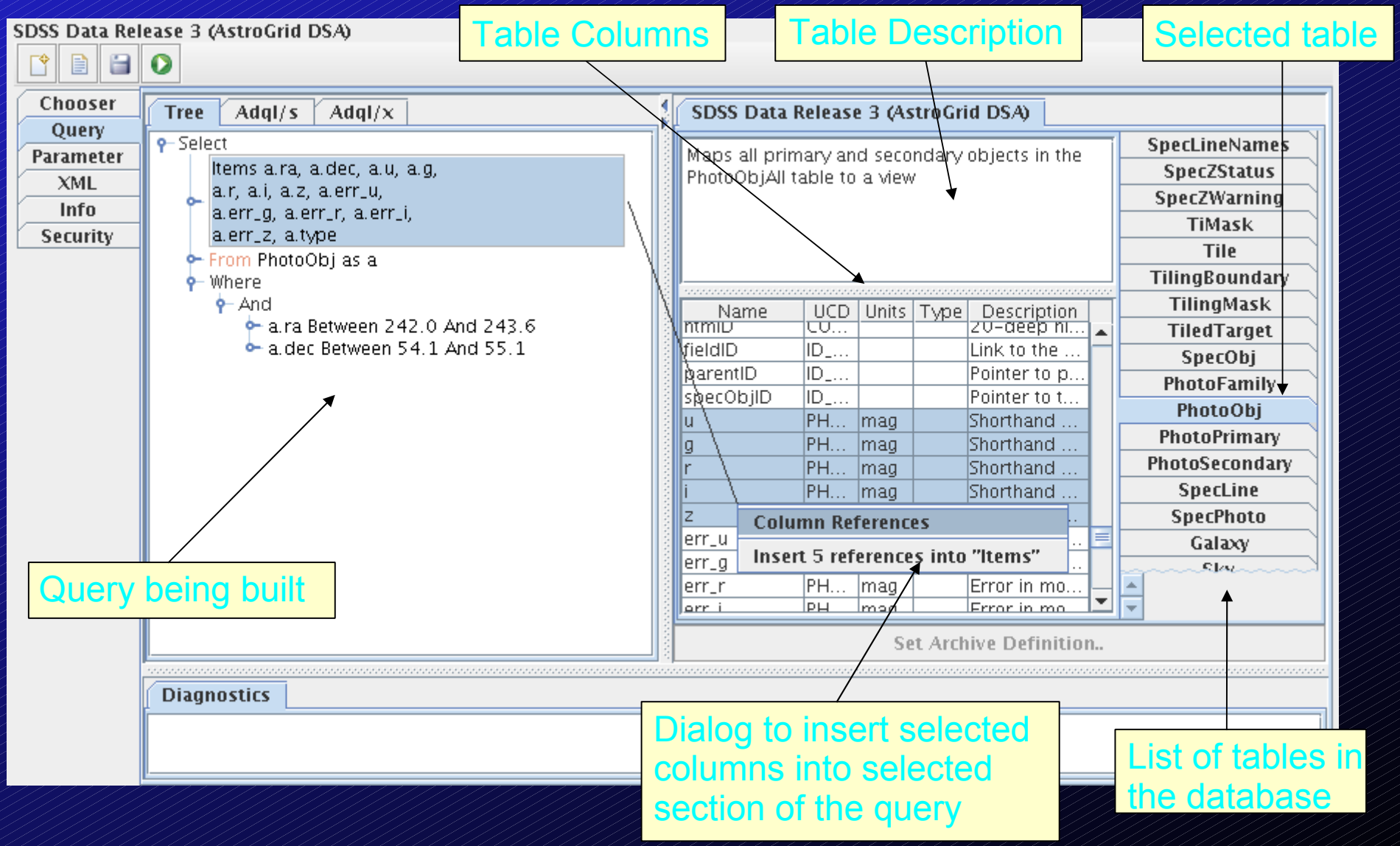
VOPlot-Aladin interoperability



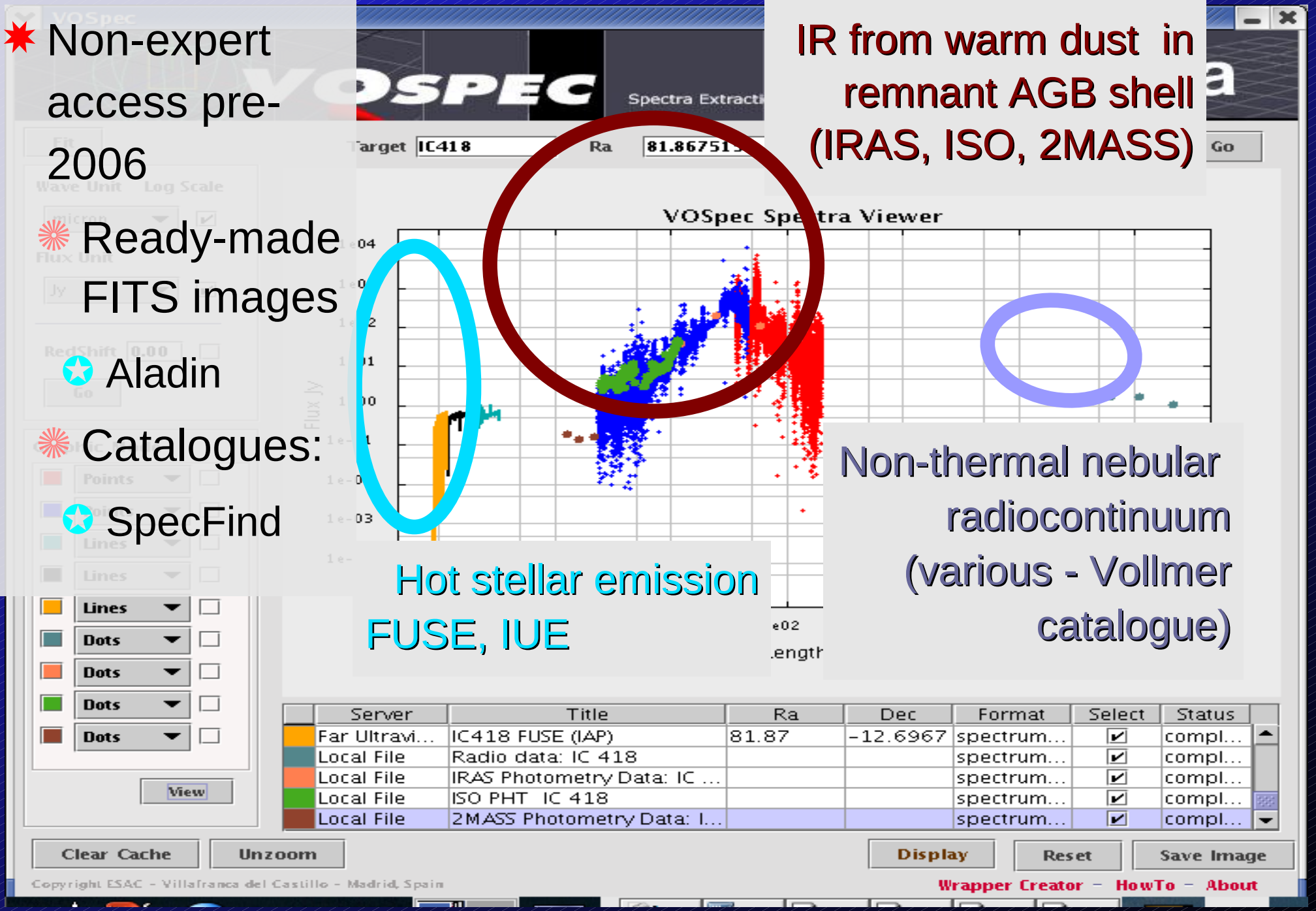


Building a query

AstroGrid Query Builder



- Non-expert access pre-2006
  - Ready-made FITS images
    - Aladin
  - Catalogues:
    - SpecFind



IR from warm dust in remnant AGB shell (IRAS, ISO, 2MASS)

Hot stellar emission FUSE, IUE

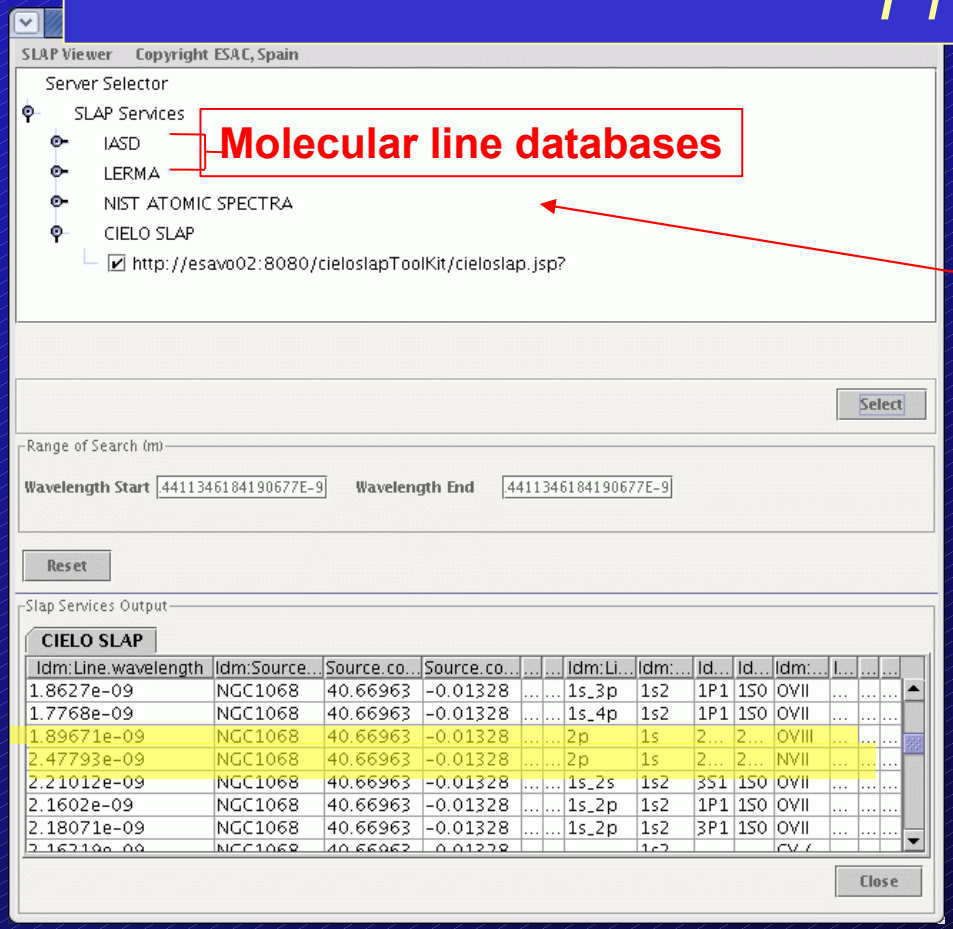
Non-thermal nebular radiocontinuum (various - Vollmer catalogue)

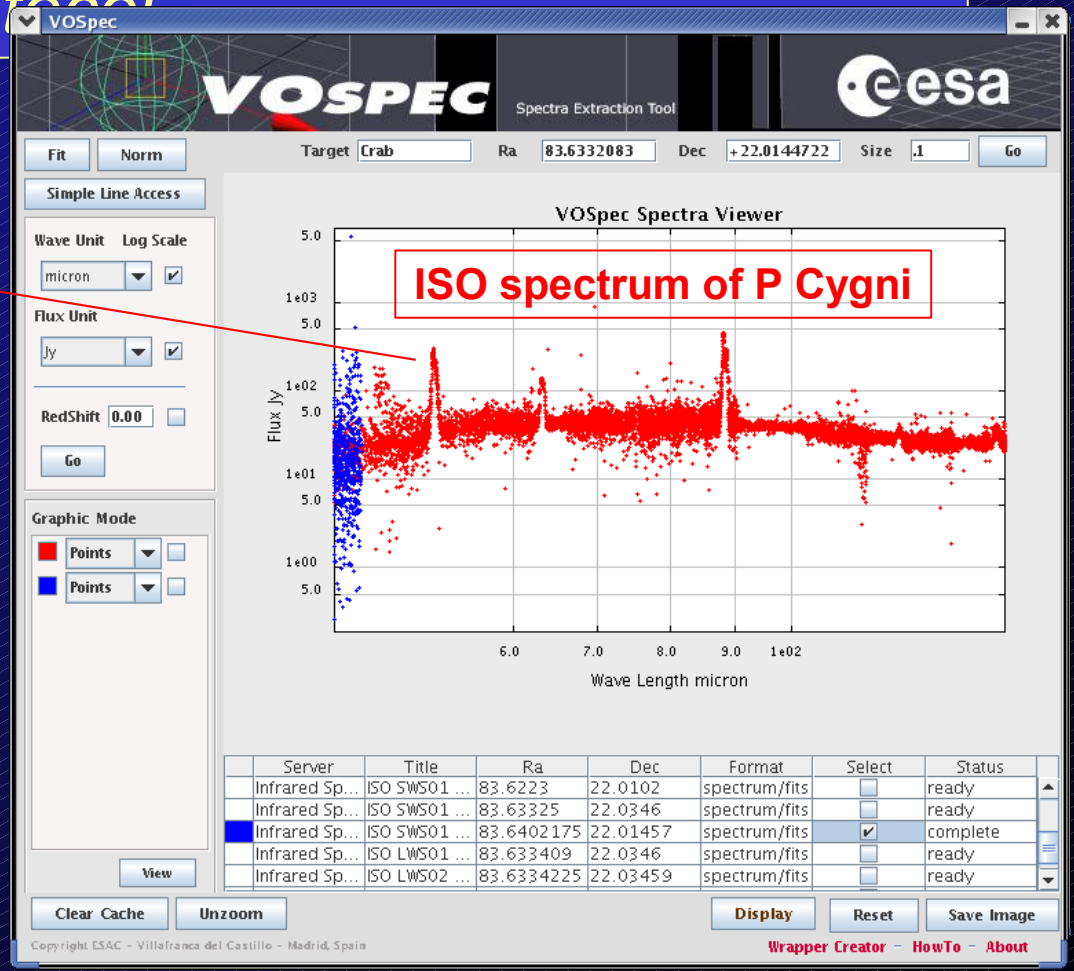
Teoretická VO (TVO)

- Metody VO (parametry v DB, SQL...) pro výzkum výsledků simulací, katalogy simulovaných objektů jako SDSS...
- Prohlížení simulačního prostoru podle různých os – parametrů, výřezy na oblasti...
- Virtuální vesmír (AstroGrid)
- Formování umělých galaxií, kulových hvězdokup – N částicové modely
- Srážky galaxií

CIELO VO implementation

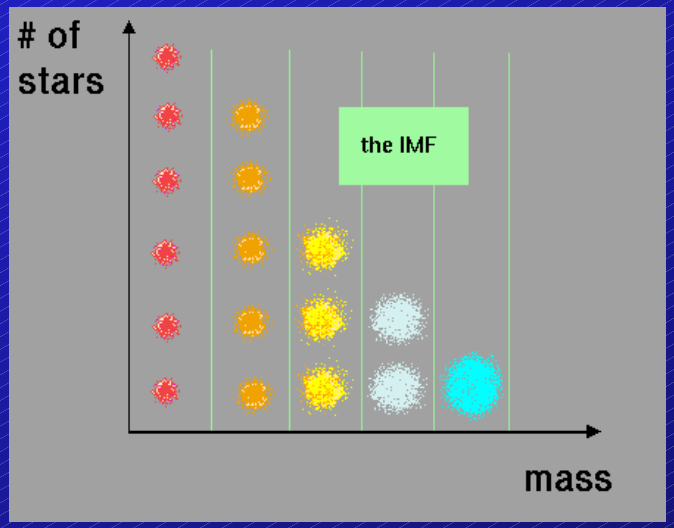
CIELO-AGN is the first astrophysical line catalogue compatible with the (draft) IVOA *Line Data Model* and accessible through the (draft) *Simple Line Access Protocol*

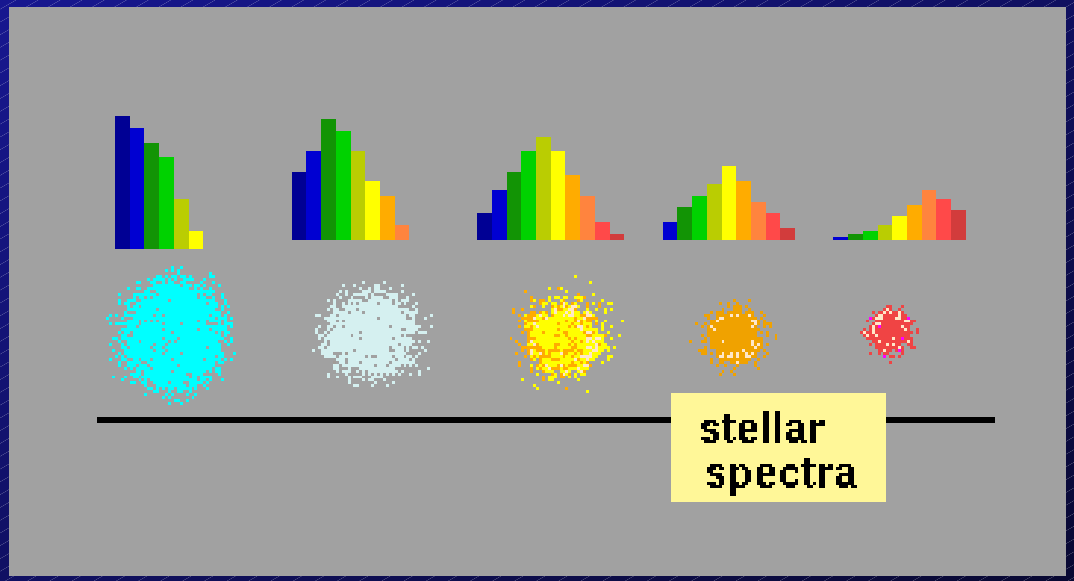


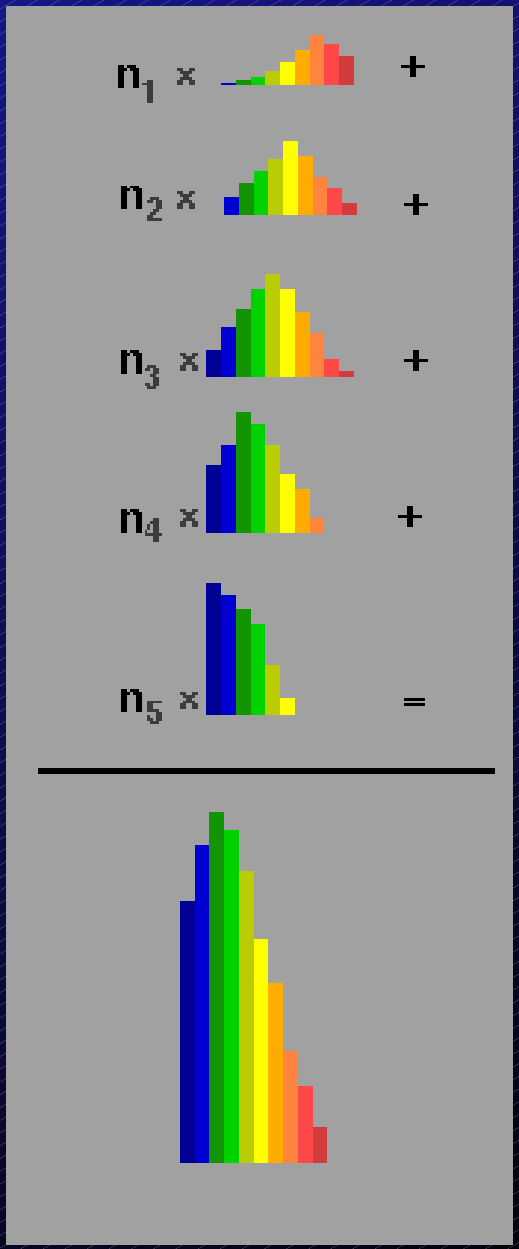


(IVOA Line Data Model, Dubernet, Cecchi et al., in preparation)
(Simple Line Access Protocol, Salgado et al., in preparation)

Stellar populations are modeled with synthesis models





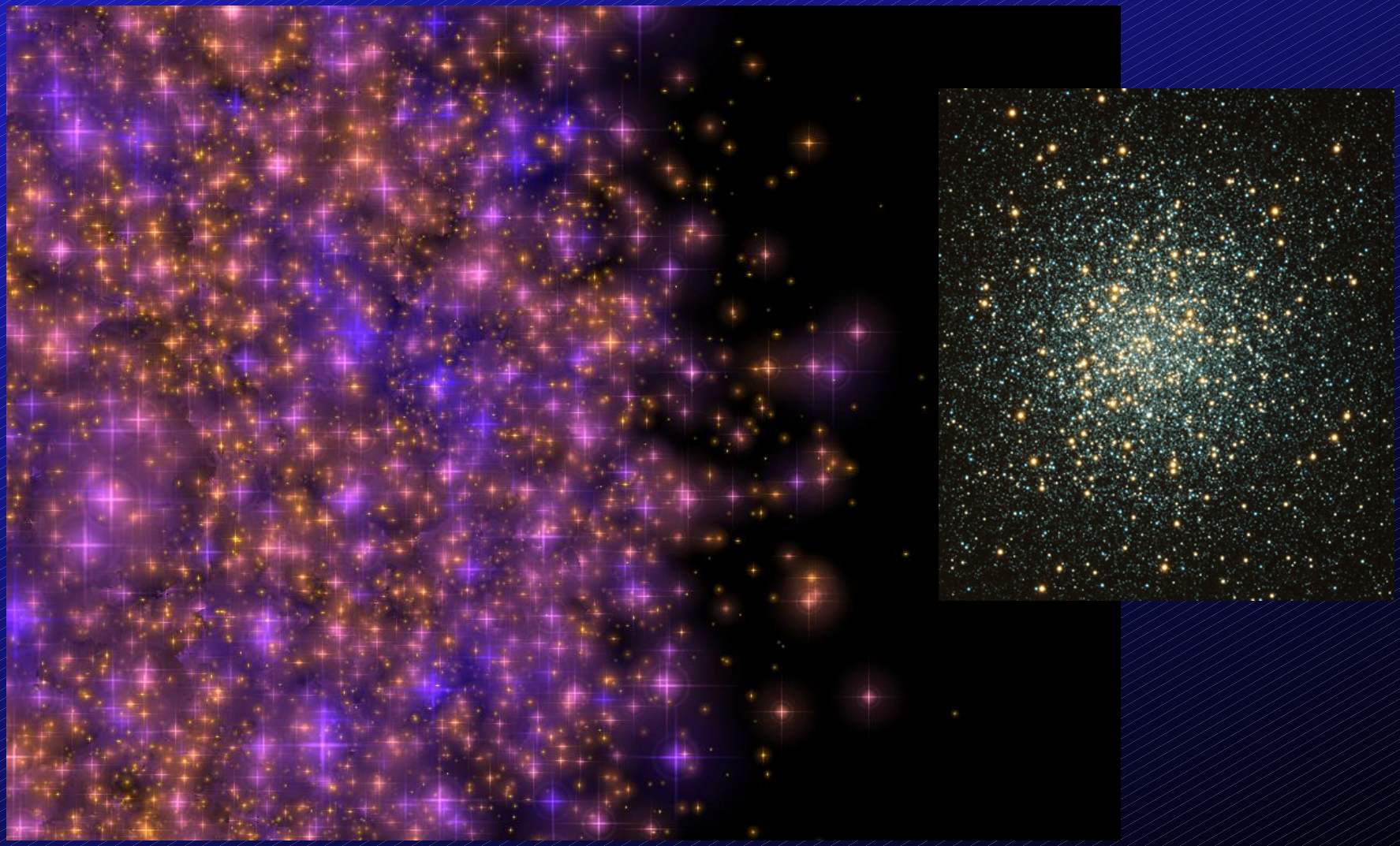


(Available as *Theoretical Simple Access Protocol* server at http://ov.inaoep.mx)

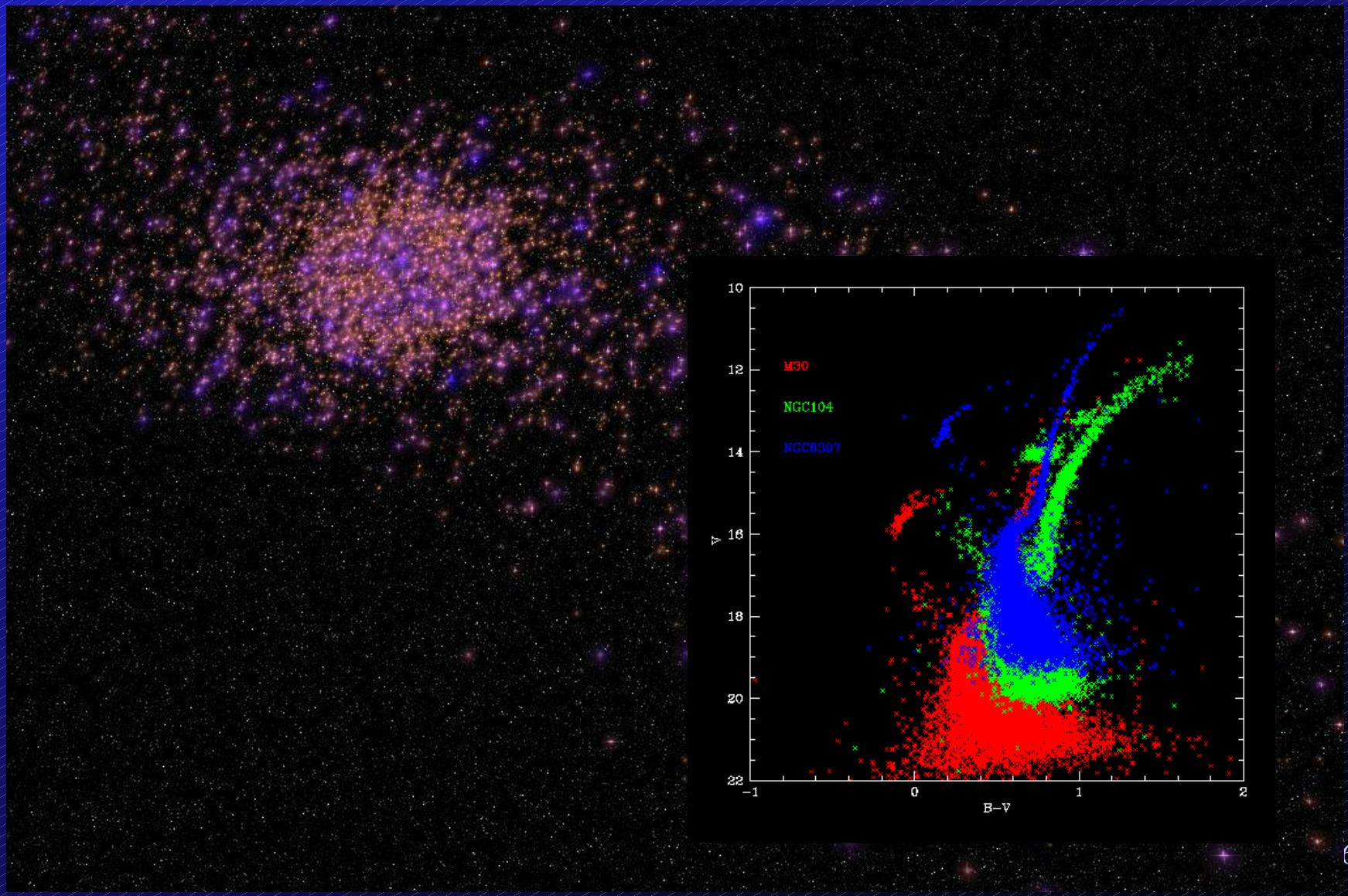
Virtuální dalekohled

- Výpočet na GRIDu (Superpočítači)
- Vizualizace dat ve 3D
- Konvoluce s PSF daného přístroje (přehlídky)
- Příslušné natočení , perspektiva
- Hledání vhodných podobností ve VO
  - Automaticky
  - Chi^2 match
  - NN analýza

N Body Simulations of Globular Cluster Evolution

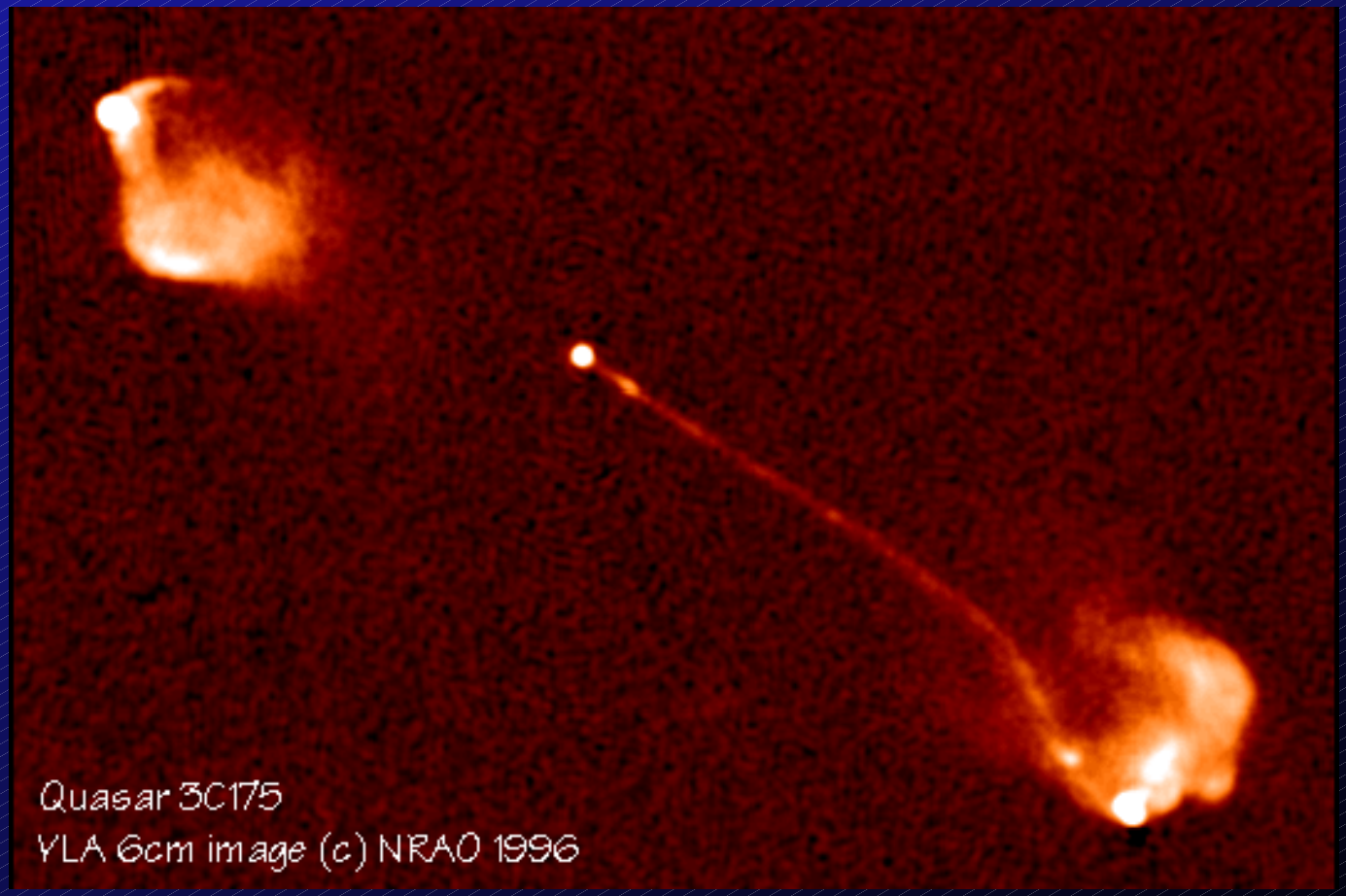


N Body Simulations of Globular Cluster Evolution

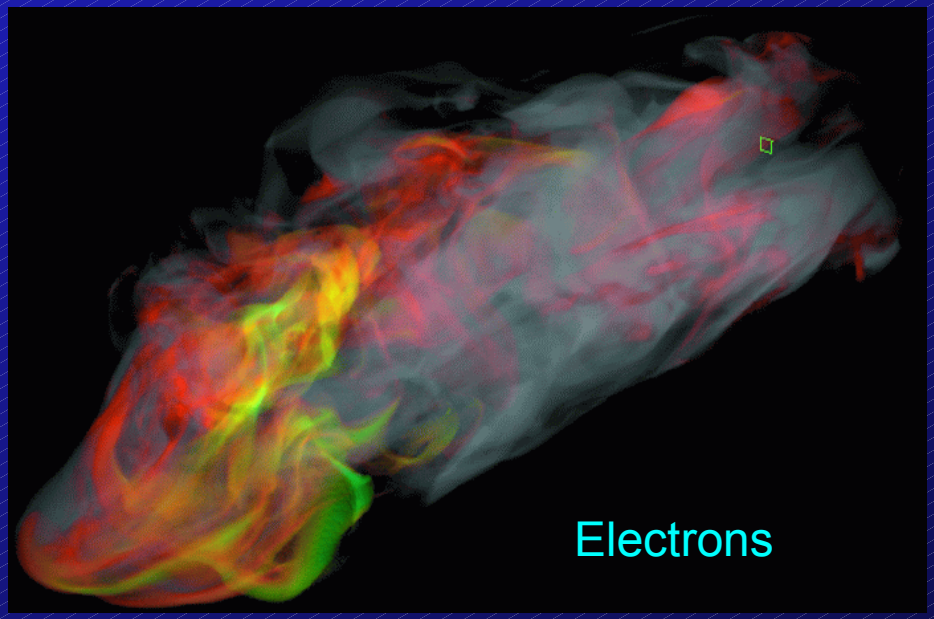


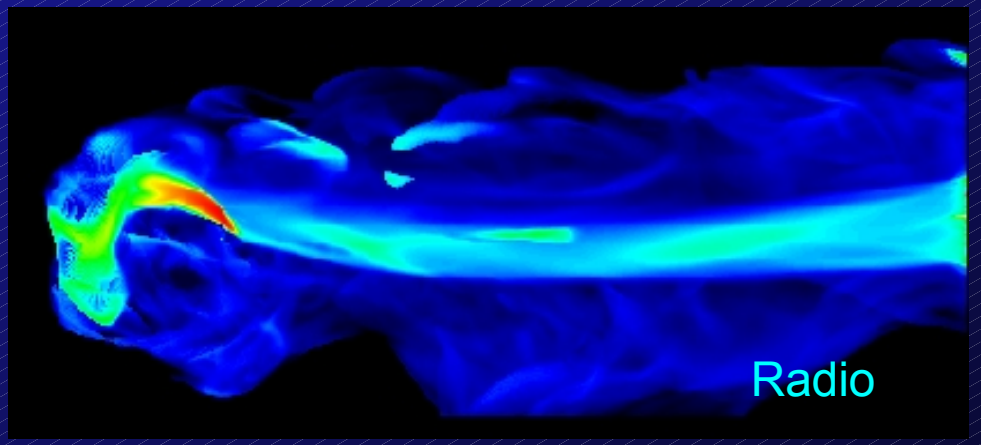
Collimated Outflows from AGN

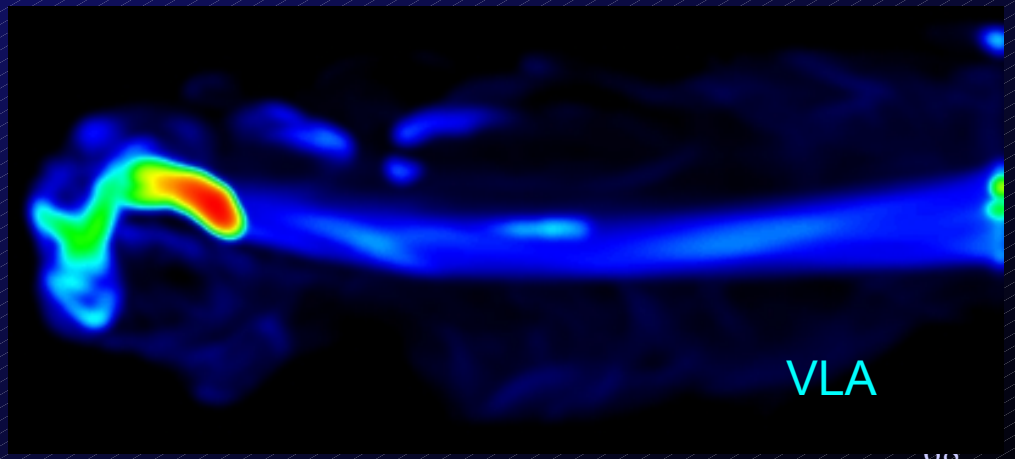
- 3C 175



MHD Simulations of Collimated Outflows from AGN – Virtual Telescope Observations

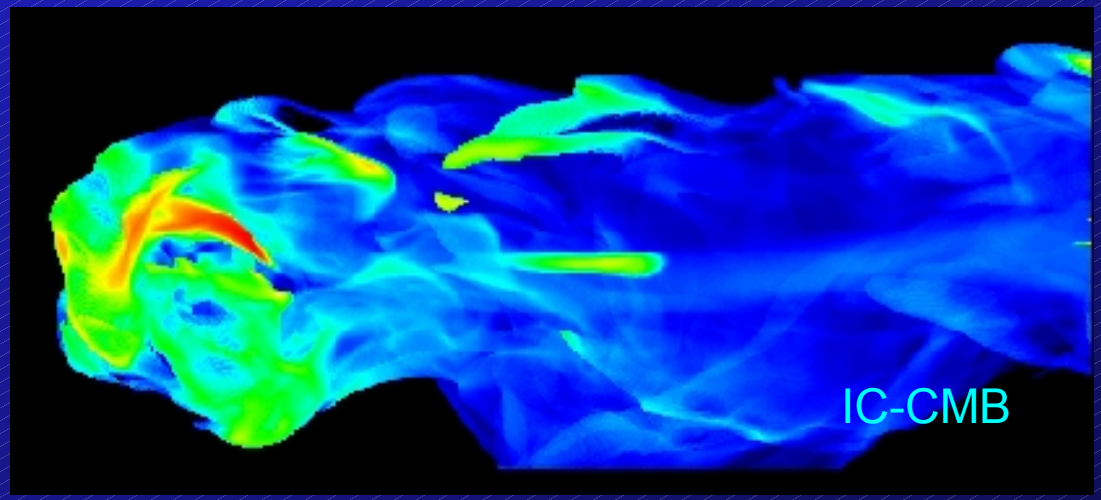


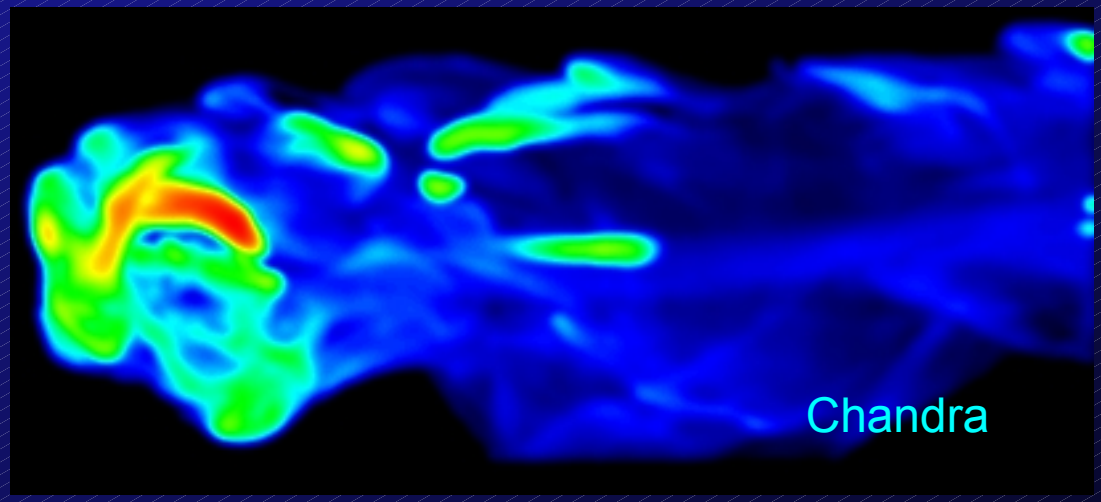


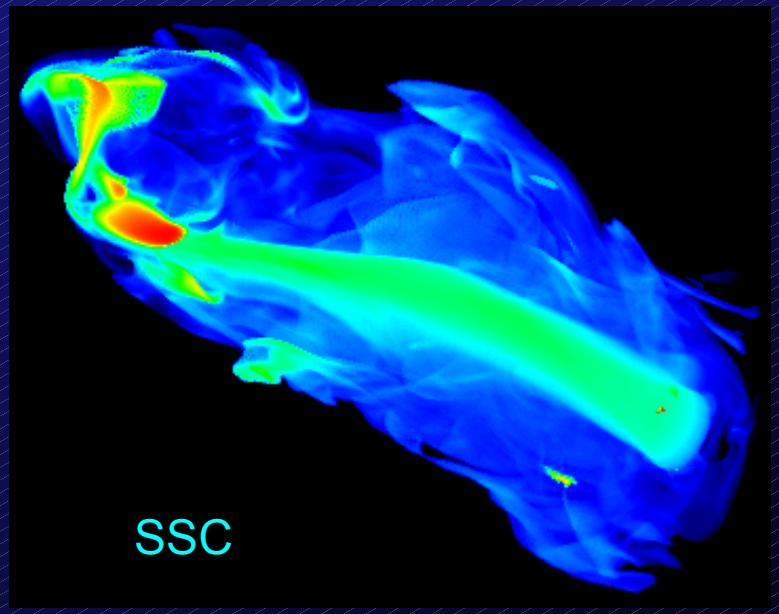


Compare with Radio Archives

MHD Simulations of Collimated Outflows from AGN – Virtual Telescope Observations







Compare with Chandra Archives

Věda především

- Nové objevy (publikace)
- Hledání vztahů
- Temná hmota …
- Granty na VO (Astrovirtel 2001)
- Hledání vzácných objektů (BD, Obscured QSO)
- Vývoj hvězd a galaxií, star formation regions
- Kulové hvězdokupy
- Upřesnění Hubblovy konst.

Ukázky aplikací

- Objevy hnědých trpaslíků (jako eps Ind)
- Přechod od AGB k PN (100 nových k 200 dosud známým pomocí VO)
- Světelné křivky pomocí AI
- SED (Spectrum Energy Distribution)
- Bolometrická jasnost
- Porovnání snímků (POSSI vs. POSSII) změny
- Modelování stelárních populací – spektra
- Sluneční oblasti – vlastnosti podle polohy

ImageComparer

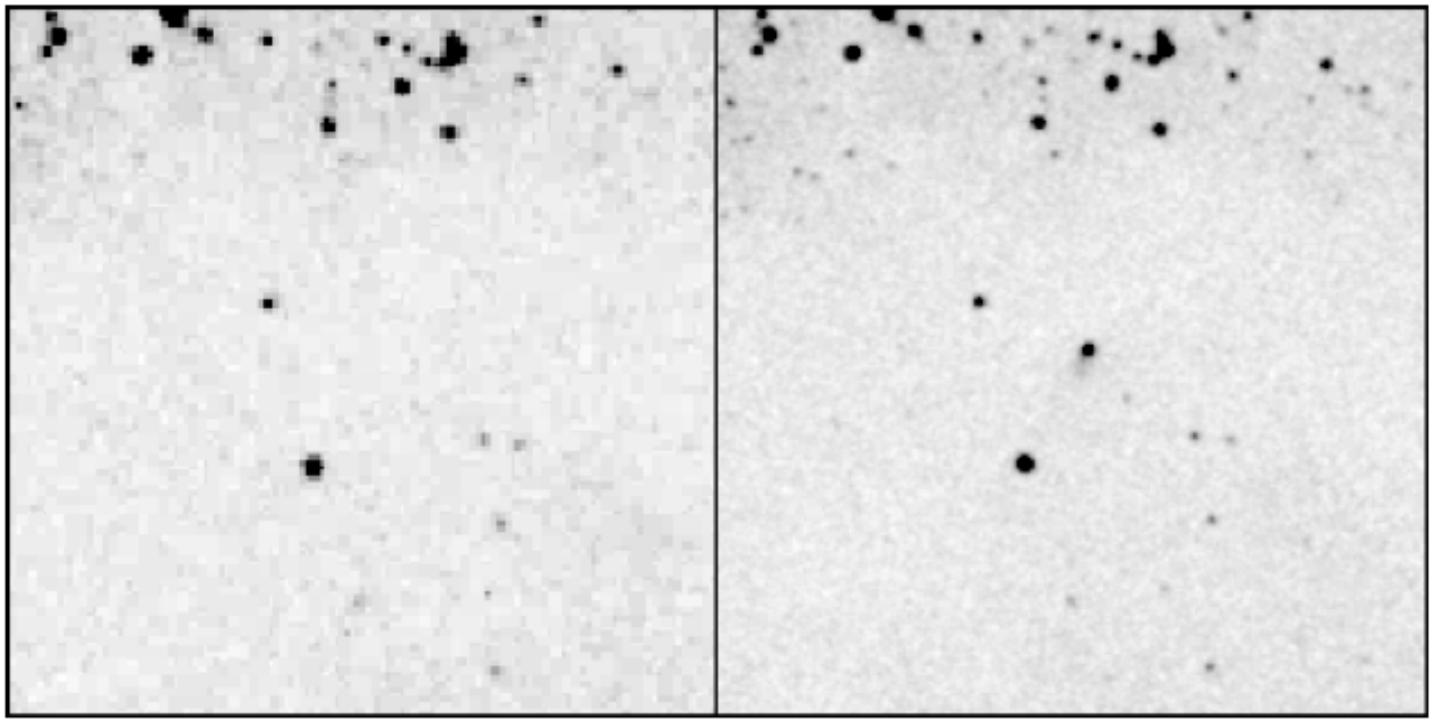
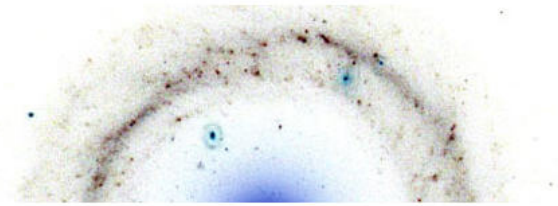


Fig. 3.— Red POSS-I and POSS-II images of Persson's Star. The left image was taken in October 1953, while the right image was taken in September 1991.

BDs discovered using VO

NVO
NATIONAL VIRTUAL OBSERVATORY



NSF

PROJECT

Standards
Software & Services
Publications
Prototypes

Internal
Logos

ABOUT NVO

What is the NVO?
Science Objectives

COMMUNITY

Discussion Lists
International VO
VOForum
Metadata (NCSA)
Other Links

PEOPLE

Contact Us
Personnel

Brown Dwarf Search Science Prototype: Real-Time Cross Matching of Large Catalogs

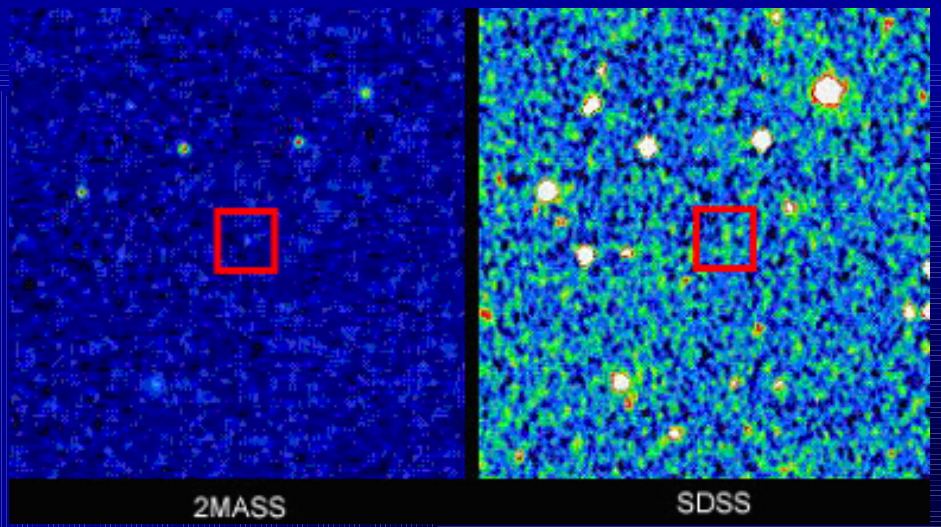
Scientific Motivation The search for brown dwarfs has been revolutionized by the latest deep sky surveys. A key attribute to discovering brown dwarfs is the federation of many surveys over different wavelengths. Such matching of catalogs is currently laborious and time consuming. This matching problem is generic to many areas of astrophysics.

Data Resources

- Sloan Digital Sky Survey (SDSS) Early Data Release (15 million objects)
- 2-Micron All Sky Survey (2MASS) 2nd Incremental Point Source Catalog (162 million objects)

What the VO Brings Today, doing the matching of these two large datasets is user-intensive and is replicated by many different users. Also, the correlation of these two datasets can take years of CPU time if not done correctly. The NVO brings two key aspects to

- **Filtering criteria:** z & J-only detections with *z- J > 2.75*
- *SDSS: 15M obj.*
- *2MASS: 160M obj.*
- *300000 objects in common.*



✓ *However, systematic searches using a VO methodology have not been performed so far.*

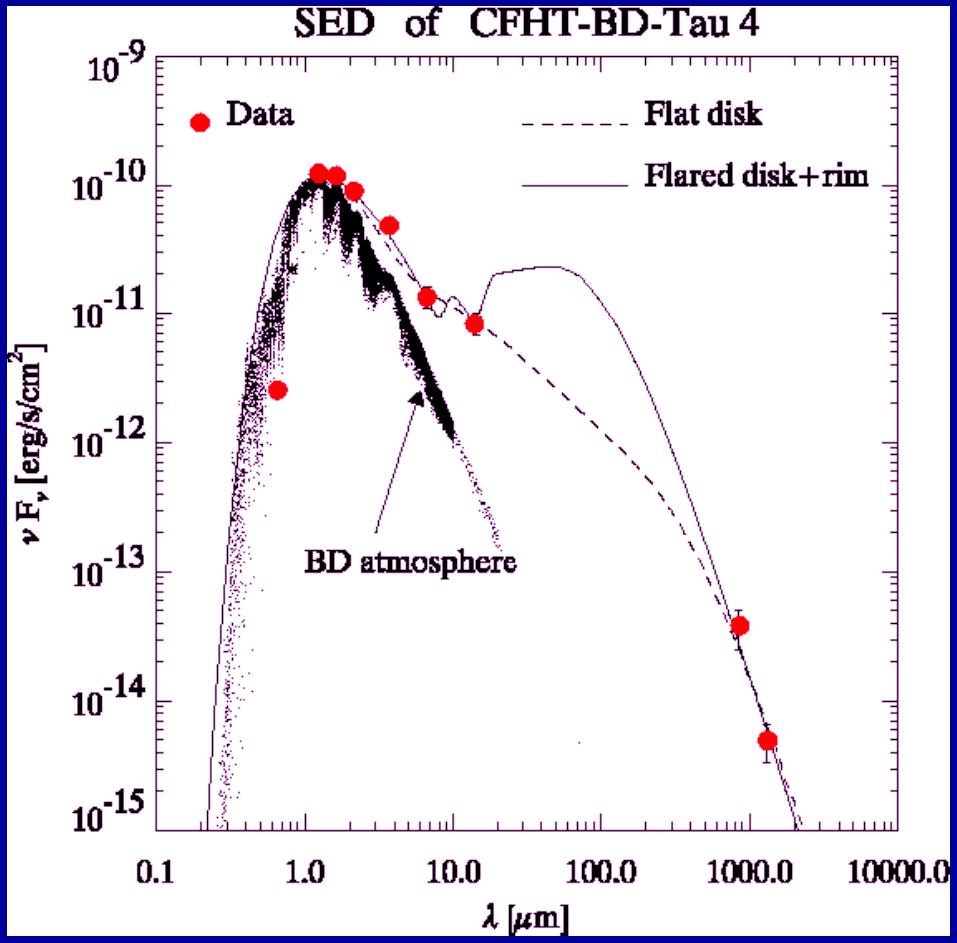
Discovering field BDs with 2MASS/DENIS

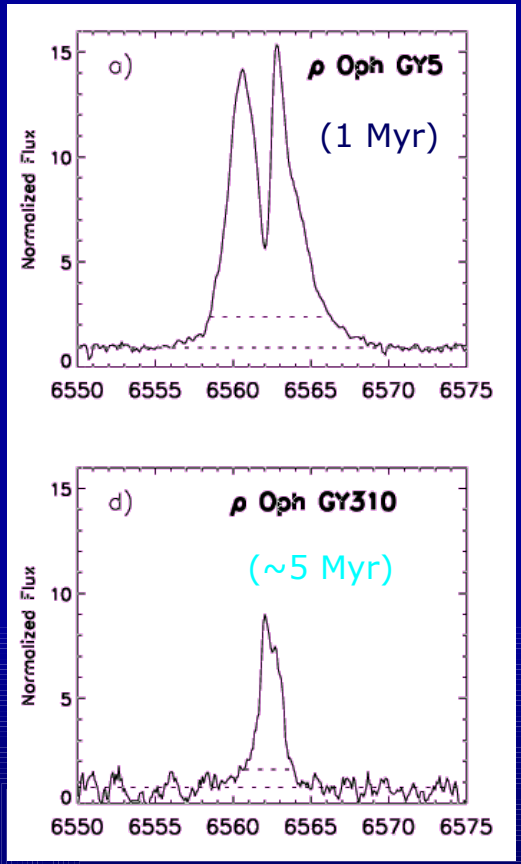
- Region surveyed:
  - ✓ RA: 300° – 360° / DEC: -10° / -34°
  - ✓ RA: 210° – 270° / DEC: -1° / -13°
- *10+8 potential candidates*
- Follow-up (IR imaging) already done. Analysis on-going.

Discovering field BDs with 2MASS/SDSS

- Region surveyed:
  - ✓ RA: 300° – 360° / DEC: 0° – 20°
- *Three potential candidates*, one of them already identified as BD (2004, AJ, 127, 3553)
- Follow-up (IR imaging) foreseen for the coming weeks.

The observational evidences



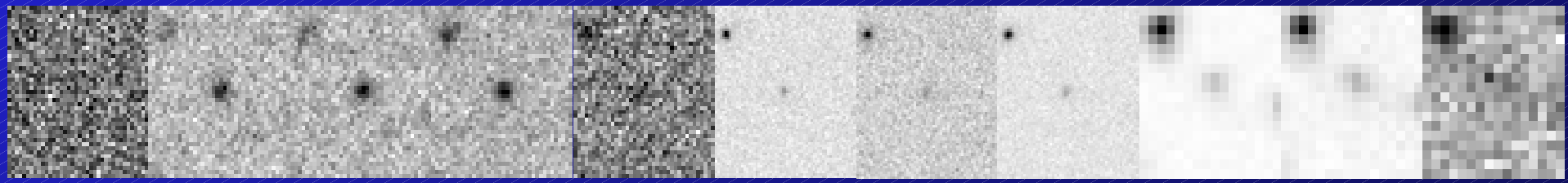


✓ A high percentage of BDs found in Star Forming Regions show IR excesses → Existence of disks.

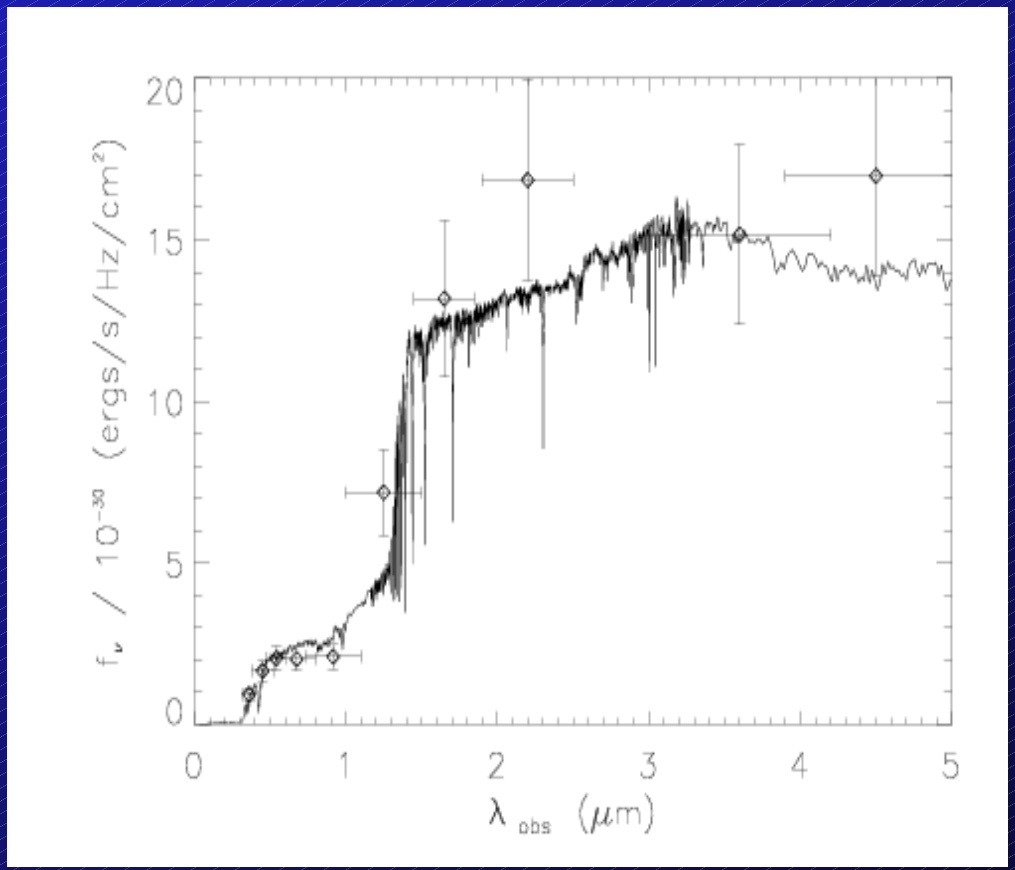
✓ Hα double peak → Indicator of accretion.

✓ Scenario compatible with a disk dissipation in a timescale similar to T Tauris.

Study Results



U B V R I J H Ks 3.6μm 4.5 μm 5.8 μm



zphot = 2.52

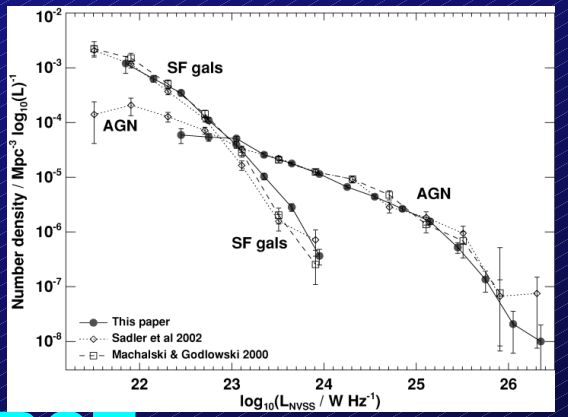
Age = 500 Myr

Stellar mass = 9.9e10^9 M_{sun}

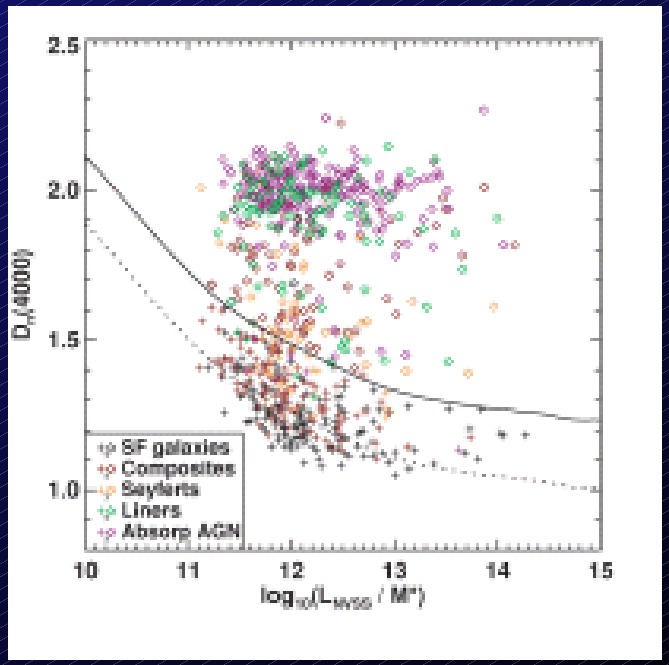
Reduced chi-sq = 1.04

SFR current = 0.79 M_{sun} yr^{-1}

NVO Science – Some Examples



- Radio-Loud AGN in the SDSS
  - Best et al. 2005
  - Cross Match SDSS DR2, NVSS, FIRST
  - SDSS Spectral Data
  - 2712 Radio Galaxies
  - Radio Emission Due to AGN vs Star Bursts



NVO Science – Some Examples

- Is There an AGN – Starburst Connection?
  - (Heckman et al.2006)
  - Does a Common Accretion Torus Produce Both?
  - Both Phenomena Produce X-rays
  - Cross Correlate 80,000 X-ray Sources with > 500,000 Galaxies (with z) From SDSS DR4
  - Look for Common Hosts
  - Look for Evolution with Redshift

NVO Science – Some Examples

- Detecting Embedded Intermediate Mass Stars
  - (Kerton et al. 2006)
  - Star of 5-10 Mo – At Boundary Between Solar Type and Very Massive Stars
    - Hence Crossover of Different Physical Processes
  - Young B Stars Buried in Molecular Clouds
  - Radio + mm Spectral Line Surveys + 2MASS, IRAS
  - Data Cube Analysis (x-y-λ)

NVO Science – Some Examples

- Merging Galaxies
  - (Allam et al. 2006)
  - Galaxy Mergers: Create Starbursts, Form Central CD's in Clusters, Feed AGN, Produce ULIRGS….
  - Optical (SDSS) Surveys Bias toward High SFR
  - IR Traces Mass Distribution (Red Stars)
  - Search 2MASS XSC (1.6M Galaxies)
    - Expect ~ 30,000 Merging Pairs
  - Do Multi Wavelength Followup

IVOA


Aus-VO
EURO VO
China-VO
vo-i
Astro Grid
CVO
RVO
SVO
NVO
NATIONAL VIRTUAL OBSERVATORY
IVOA
VObs.it
ArVO
Armenian Virtual Observatory
JVO
JAPANESE VIRTUAL OBSERVATORY
HVO
GAVO
VIRTUAL OBSERVATORY
France

Výhrady k VO

- Zaměřené na technologie a SW
- Kvalita dat – garbage in - garbage out
- Astronomové chtějí vědu především
- Kdo vlastní data – co s daty v PP při dotazu PI?
- Lidé se nebudou chtít lacino vzdát – data platidlo, prestiž, konkurenční výhoda
- Jak dát kredit ? Komu ?
- Kdo je autor článku ?????

What is a VO compliant archive?

- The VO needs data ⇒ astronomical data centres lie at its foundation
- The VO cannot (and does not) dictate how to manage an archive
- The VO requires data centres to have a "VO-layer" to:
  - ✓ "translate" any locally defined parameter to the standard (IVOA compliant) ones (e.g., RA can be called in many different ways)
  - ✓ hide any observatory/telescope/instrument specific detail and work in astronomical units: e.g., *wavelength range/band* (not grism or filter name), *spectral resolution, field of view, limiting magnitude* ⇒ provide the right meta-data (data about data)
- The VO will work at best with high level "science-ready" data ⇒ data centres should make an effort to provide such data

Je báječné být u nové revoluce v astronomii
Zúčastnit se můžete i VY!

Stačí jen Internet a rychlé PC
Veškerý SW i data jsou ZDARMA!

Můžeme být plnohotnotnými partnery po vstupu do ESO (EURO-VO)

Zapojení ČR – CZVO

- Nabídka zapojení do EURO-VO
- Projekt EU FP6
- Právě začíná
- Pomoc expertů vytvořit VO-compat archivy
- Zapojení – návrh
  - Národní portál – shrnutí zdrojů dat
  - Aplikace se zaměřením na stelární astronomii
  - Teoretické modely do TVO
  - ??????? co dál ???????

The Data Avalanche

Immense amounts of data are being produced by large telescopes using large area detectors.

Terabytes of data are now available, and Petabytes will soon be available from frequent all sky imaging.

Vast databases are also being produced through simulations.

Wavelength Coverage, Resolution

The data spans the electromagnetic spectrum from the radio to the gamma-ray region.

Obtaining, analysing and interpreting the data in different wavebands and at different resolutions involves highly specialised instruments and techniques.

The astronomer needs new holistic tools for using this wealth of data.

The Digital Divide in Astronomy-

Immense databases, electronic archives of scientific periodicals are available free.

The latest research is available through preprints.

Virtual Observatory tools will make all this highly accessible and usable.

But-

Many astronomers lack the bandwidth, expertise and the environment to make use of these riches…

There is resistance to the use of new concepts and tools…

There are reservations about exposing data…