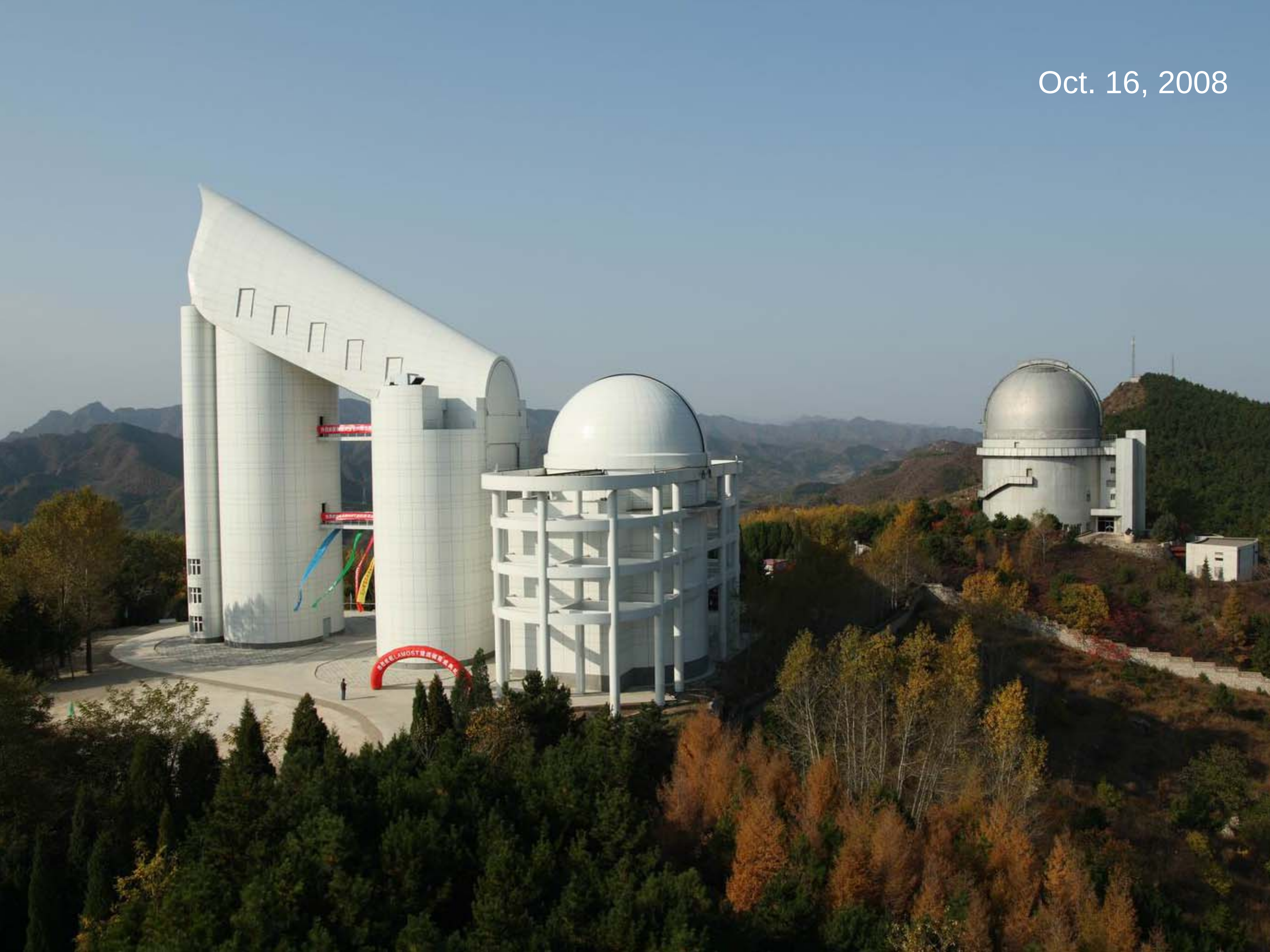
A VO-driven Astronomical Data Grid in China

Chenzhou CUI
Boliang HE, Yang YANG, Yongheng ZHAO

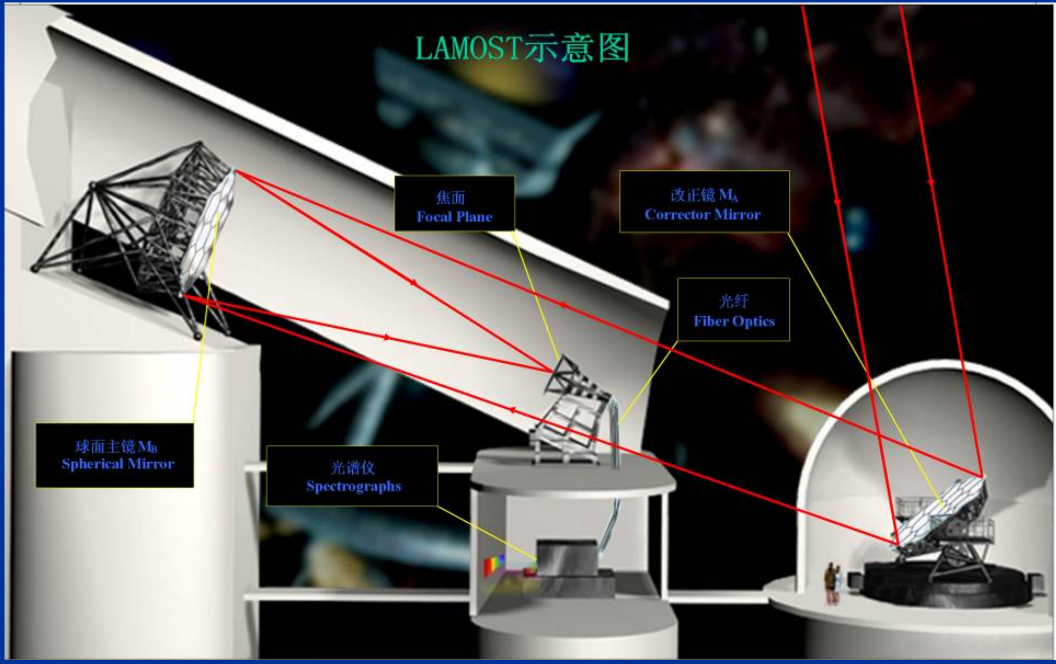
China-VO, National Astronomical Observatories, CAS

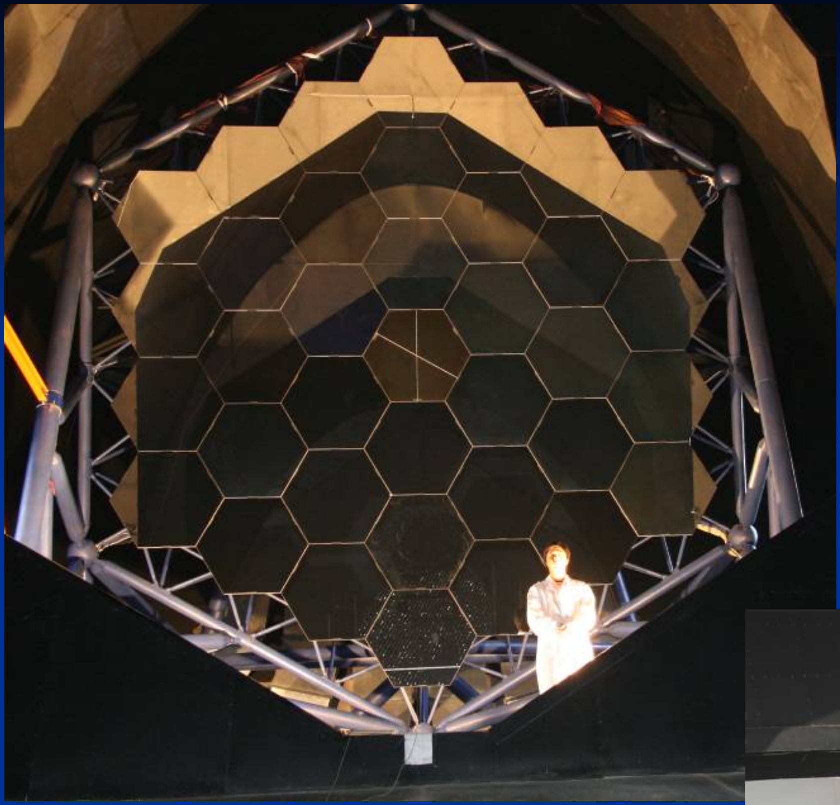

Oct. 16, 2008

LAMOST

Large Sky Area Multi-Object Fiber Spectroscopic Telescope

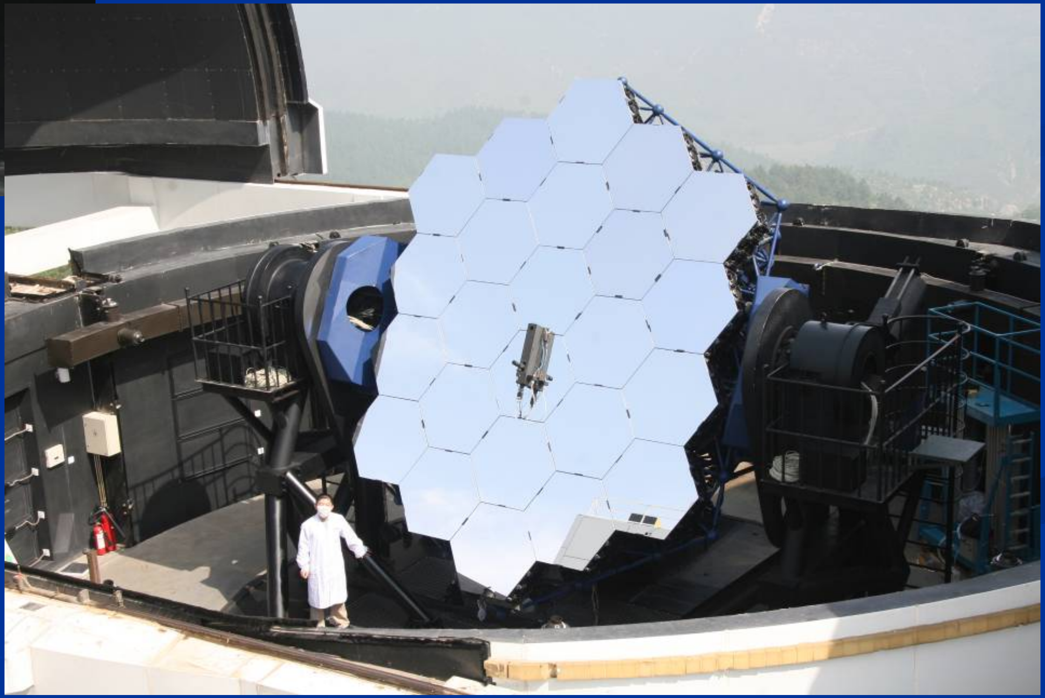
- Started in 1997
- First light for engineering in August 2008
- Hardware construction finished in June 2009
- Under calibration and commission currently





MB: 37 sub-mirrors

MA: 24 sub-mirrors

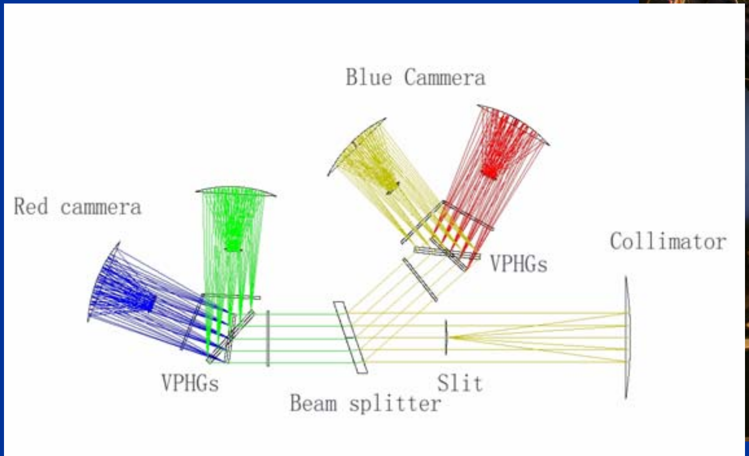


Characteristics of LAMOST

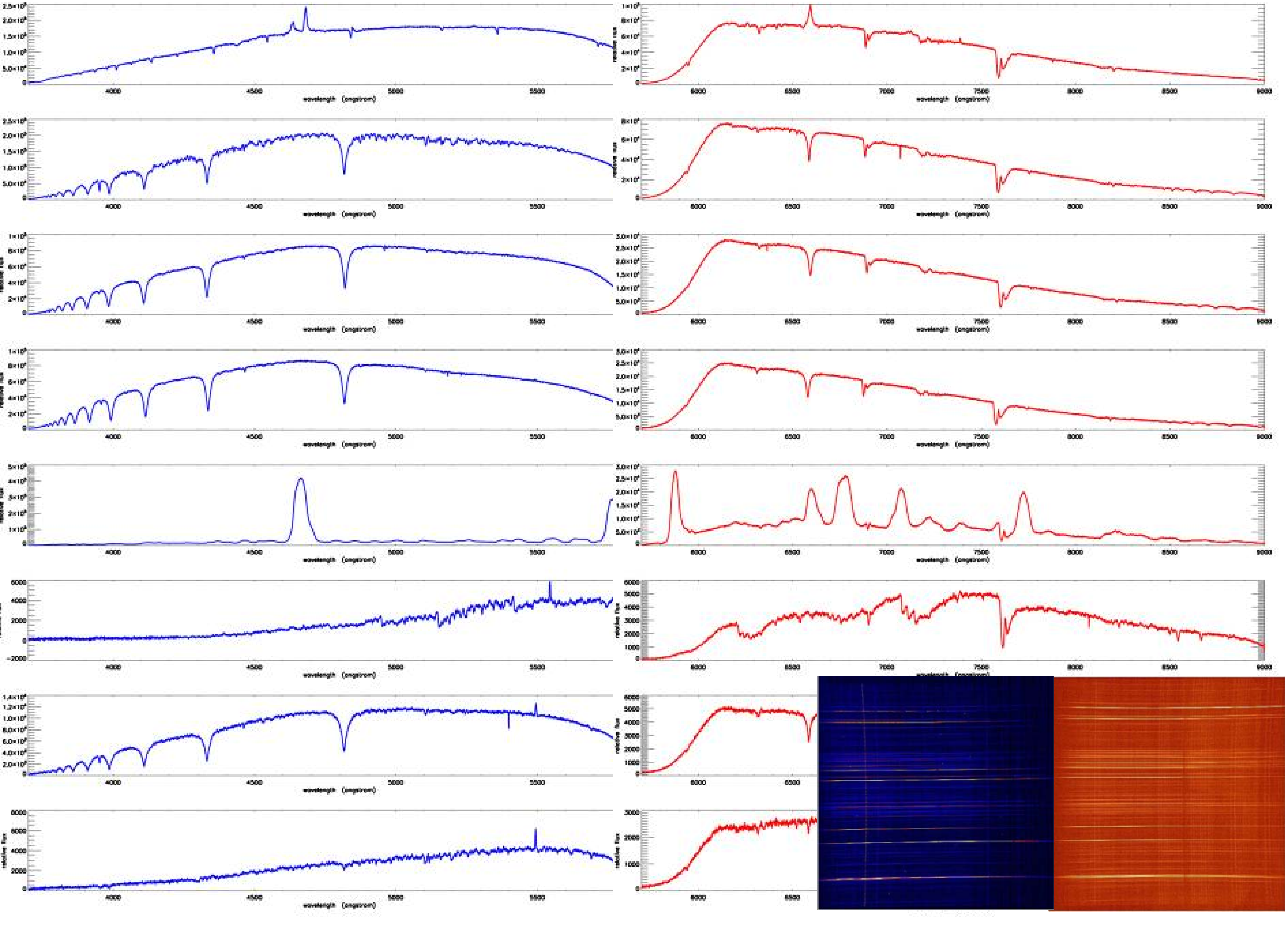
- **Effective aperture** **3.6-4.9 meter**
- **FOV** **5° (1.75m linear)**
- **Number of optical fiber** **4000**
- **Observing sky area** **$-10° \leq \delta \leq +90°$**
- **Spectral resolution** **1-0.25nm**
- **Survey capability** **taking spectral resolution 1nm, integration time 1.5 hours, magnitude limit: 20.5^m**
- **Size of fiber** **3.30 arcsec (320 macro linear)**
- **Site seeing: ~2 arcsec**

Instruments

- 4000 Fibers (130km)
- 4000 Fiber positioning units
- 16 Spectrographs
  - 250 fibers per spectrograph
- 32 4k x 4k CCD Cameras



R_L = 1000/2000
R_M= 5000/10000



wavelength (angstrom)
relative flux

Spectroscopic Surveys

- Key projects include
  - extra-Galactic
  - Milky Way
  - cross-identification

- SWG for the Milky Way study
- SWG for extragalactic survey

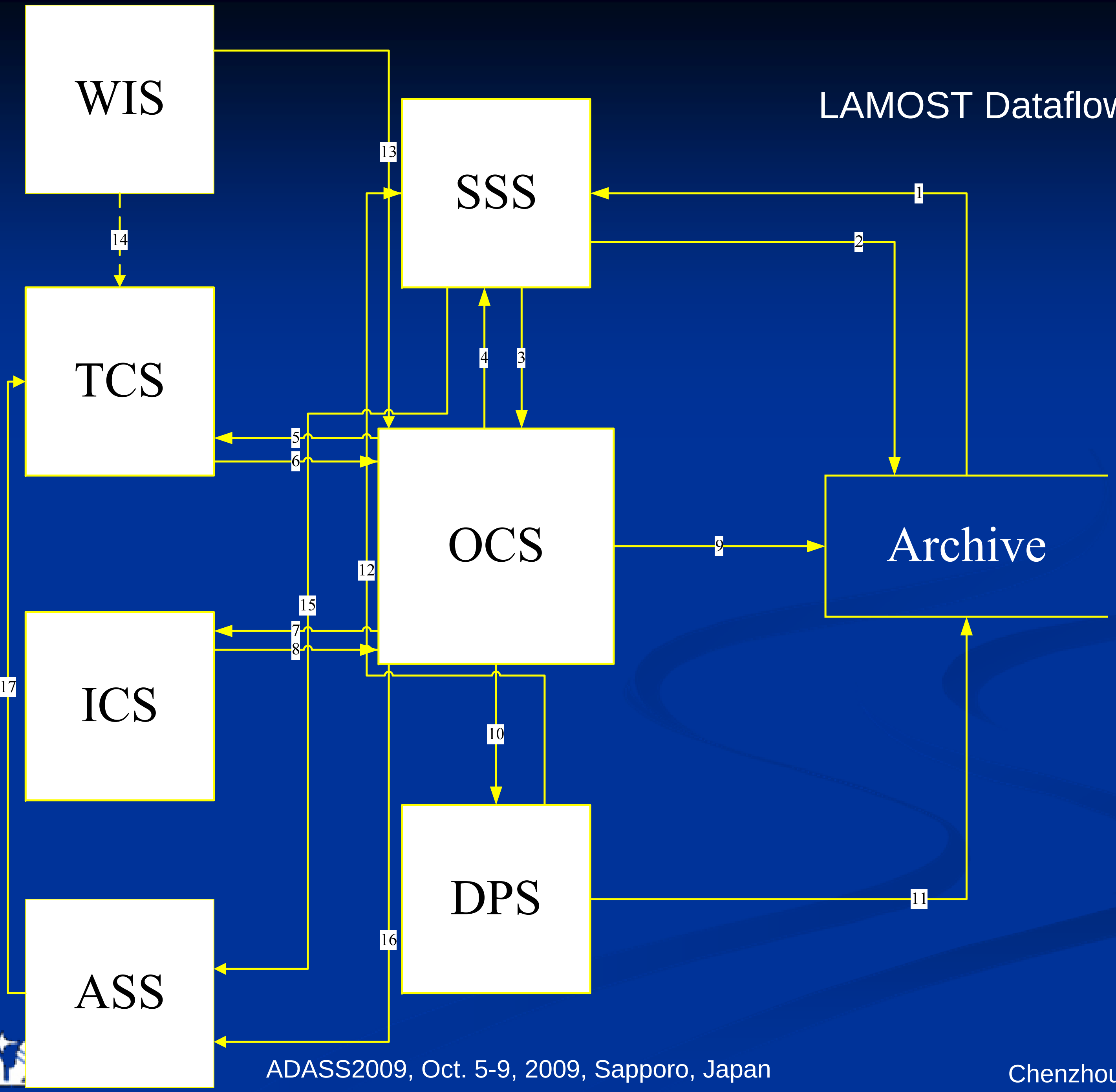
LAMOST Obs. Mode and Data Size

- 4000 / 250 => 16 spectroscopes => red & blue parts =>32 CCD cameras => 4K*4K pixels => 16 bits color deep
- For each sky area, 3 times exposure, 30 minutes each. 5 sky area (plate) can be observed for a night (7.5~9 hours)
- Scientific data per night:
  - 4K*4K*2*32*5*3= 15.36 (GB)
- All the collected data is about 20 GB/night
- 20*200= 4,000 GB per year (ideal condition)
- 4*5 year = 20 TB for the LAMOST 5 years life period
- The whole archive is about 50 to 60TB

Data Products

- Level 1: 2-D multi-fiber spectrum images (private)
- Level 2: 1-D spectra (to the public 18 months later)
- Level 3: Catalogs (to the public 24 months later) and value-added products

LAMOST Dataflow



Undergoing projects in China

The way to standardization and collectivization

- VO: the latest stage of along term trend towards standardization and collectivization in astronomy
  - The first key step was the development of "facility class instrumentation".
  - The next step was the standardization of data formats - FITS, NDF, etc.
  - Rapidly following on this was the production of "facility class" data reduction software - IRAF, MIDAS, Starlink, AIPS etc.
  - The VO is the next step in that process - standardizing data access methods, data exchange formats, and metadata.
  - Finally, a logical next step is the standardization of *data analysis* tools.

-- Andy Lawrence: Drowning in Data : VO to the rescue

We are at the starting point >>>

Requirements for astro-informatics are appearing

Starting from the simplest and the basic …

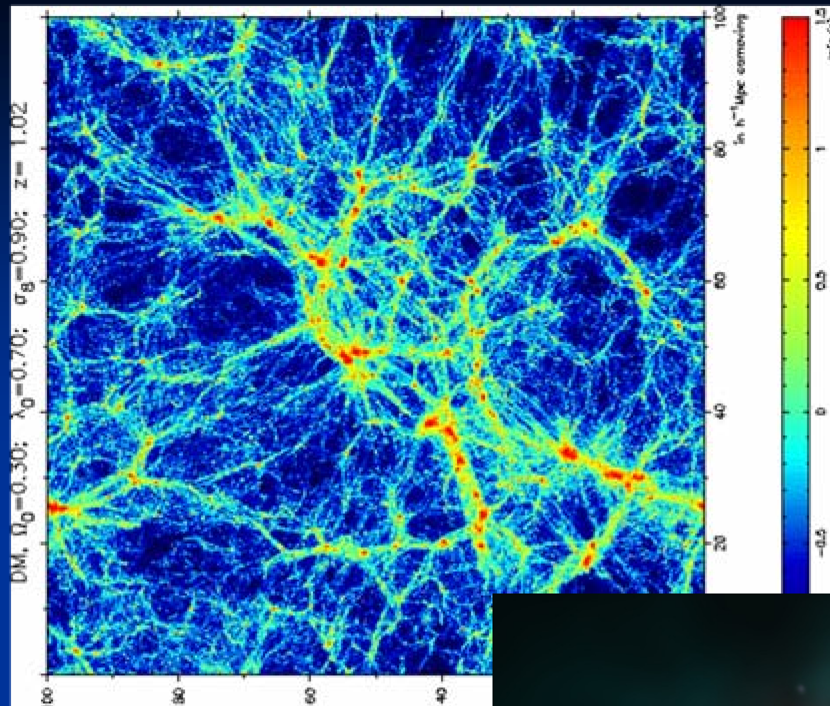
"facility class instrumentation" in China

- Modern observational projects
  - LAMOST, 21CMA, CSTAR, AST3, etc.
- Infrastructures for:
  - Storage
  - Data access
  - Computing
  - Preservation
  - User support

CAS SDB for Astronomy

- A sub-project of Chinese Academy of Sciences Scientific Database system
- Budget: 1.4 m RMB
- Period: 2009 to 2010
- Involved observatories: NAOC, SHAO, PMO (Nanjing)
- Datasets: LAMOST/CSTAR/BATC, SHAO numeral simulations, PMO radio archives

Cosmology simulation

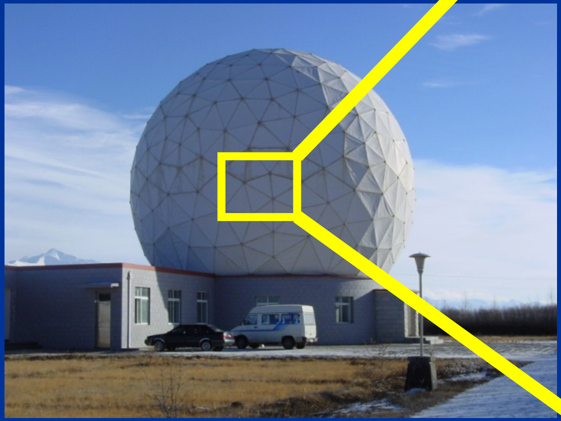


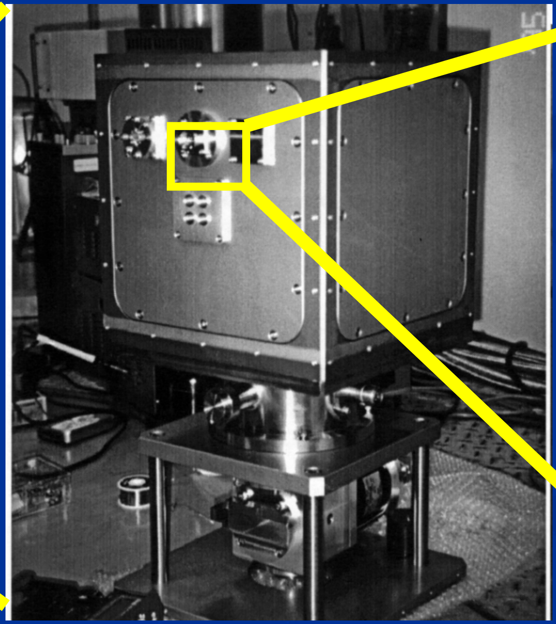
~100TB

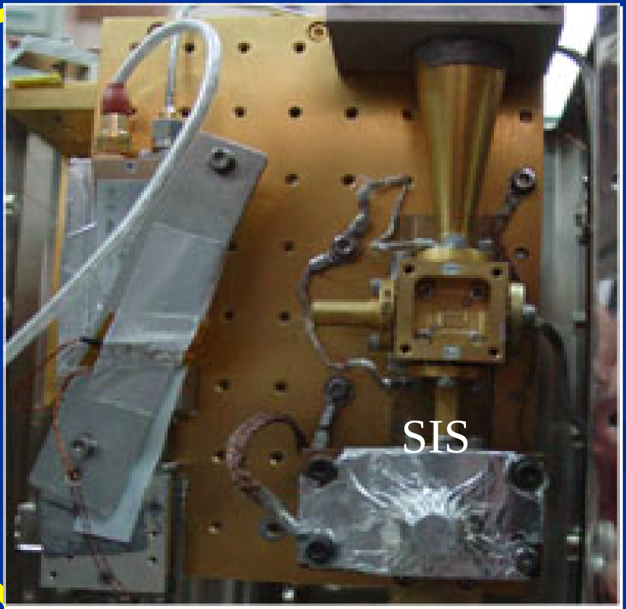
Y.P. Jing, et.al
Shanghai Astronomical Observatory

Qinghai Radio Telescope

Diameter: 13.7m
Working band: 3 mm
Data rate: ~1MB/s, ~230K spectra/yr

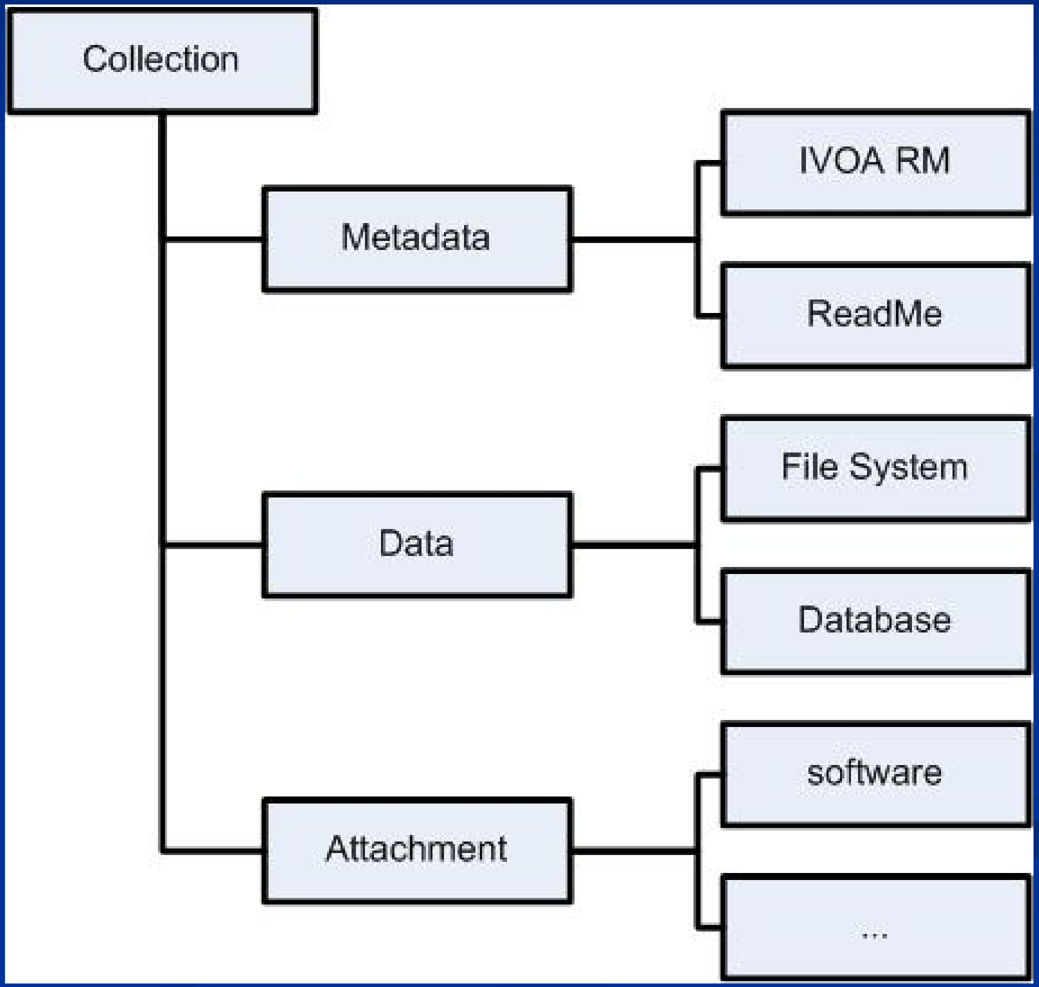




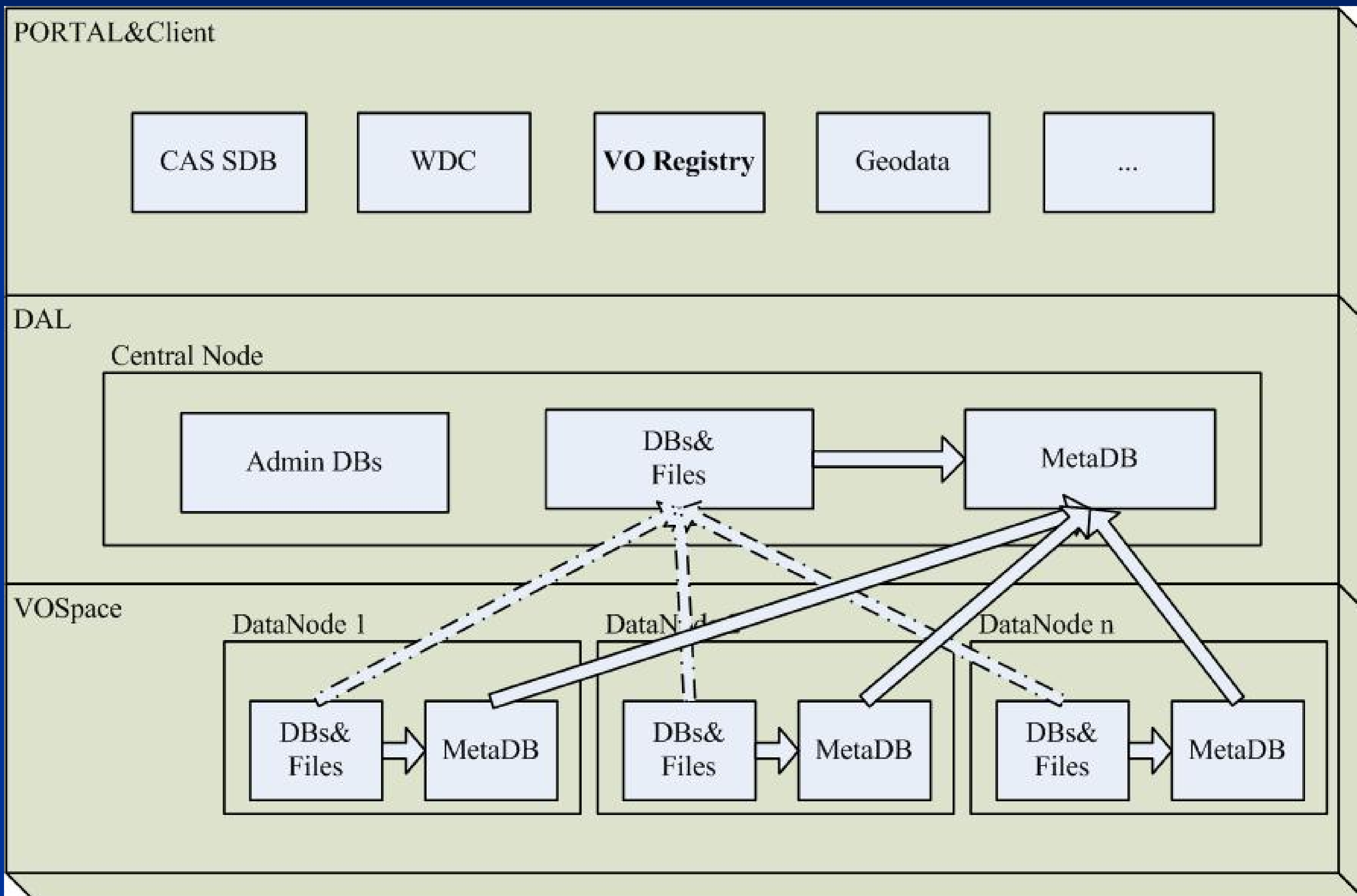


Simple Dataset Model

- A dataset
  - Metadata
  - Data
  - Attachment

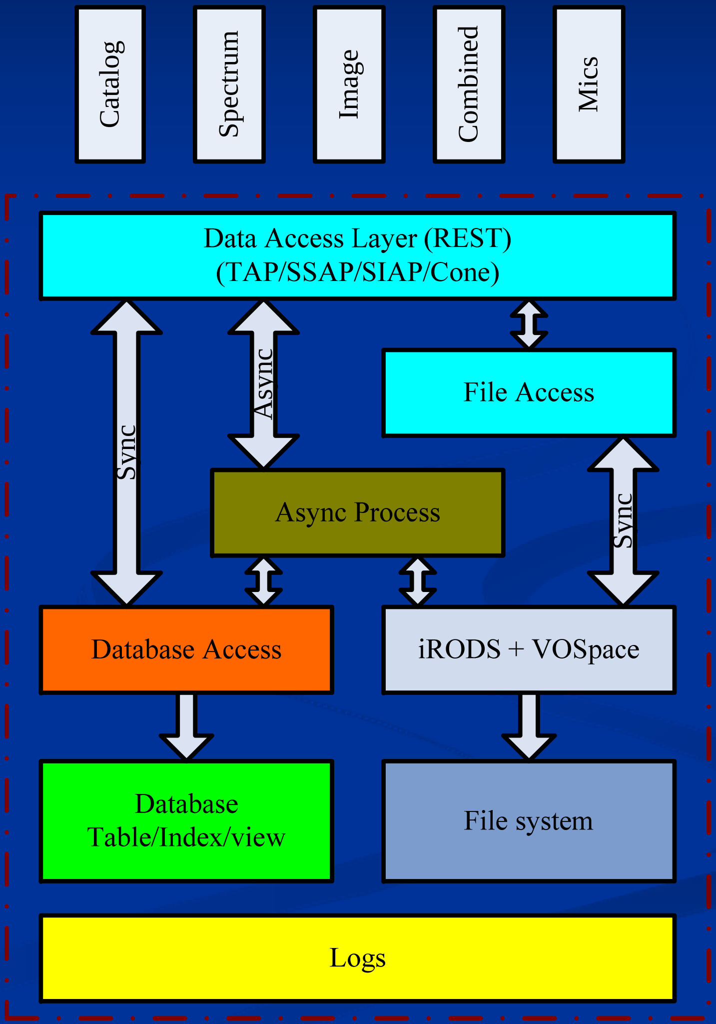


Architecture



Components

- Basic data access service
  - Catalogs
  - Files
- Online service
  - Spectrum view
  - Image view
  - Cross match
  - Footprint
  - SAMP
  - etc.
- Tools
  - CLI



20 years

20 years later,

Another world-class astronomical datacenter appears?...

Sincerely looking for your:

Collaborations and suggestions

Thank you!