



中国科学院国家天文台

NATIONAL ASTRONOMICAL OBSERVATORIES, CHINESE ACADEMY OF SCIENCES

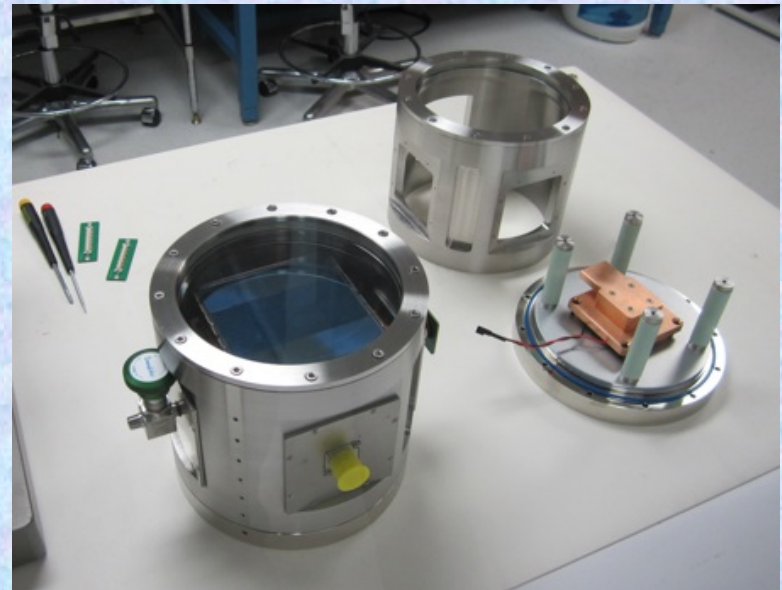
Antarctic Survey Telescope x 3 (AST3) Realtime Pipeline & Database System

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NAOC

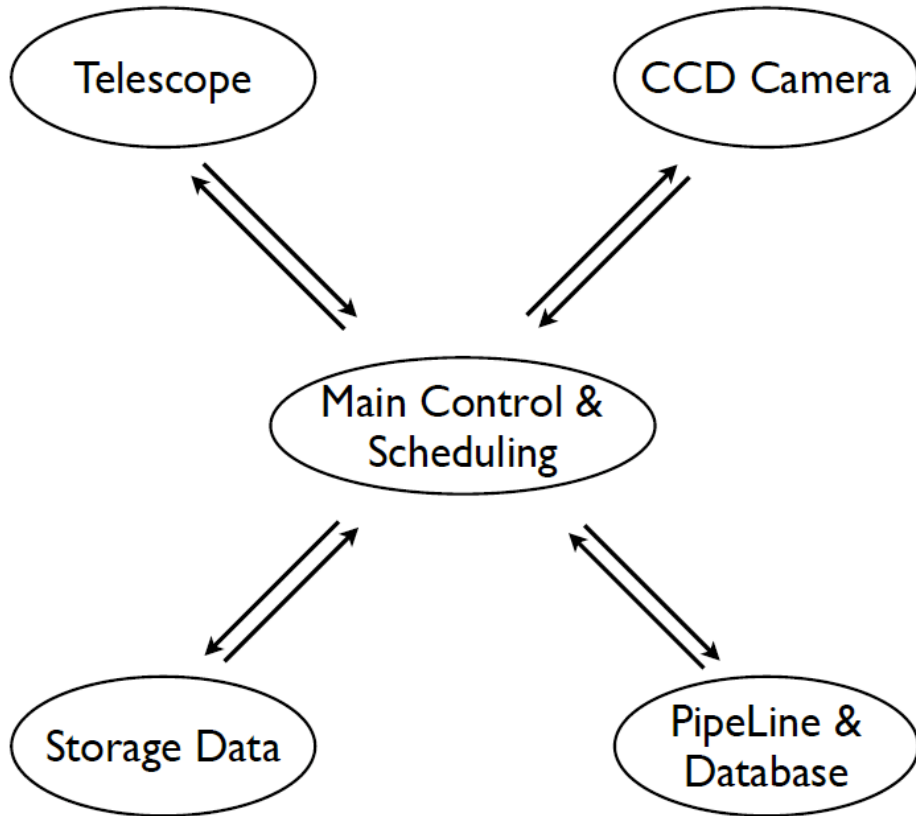
On behalf of Collaborations at NAOC, TJNU, TJU

Antarctic Survey Telescope x 3 (AST3) Survey

- Three 50/68cm modified Schmidt Telescopes (NIAOT)
- CCD Camera (STA 1600-FT)
10k x 10k, 9 micron/pixel , Plate Scale: 1 arcsec/pixel
FOV: $\sim 2.93 \times 1.47 \sim 4.3$ square degree



AST3 Survey Control and Data System



Survey Area Selection

Survey Scheduling

Data Acquisition and Storage

Real-time Pipeline

Database (onsite & in Beijing)

Onsite Real-time Data Processing

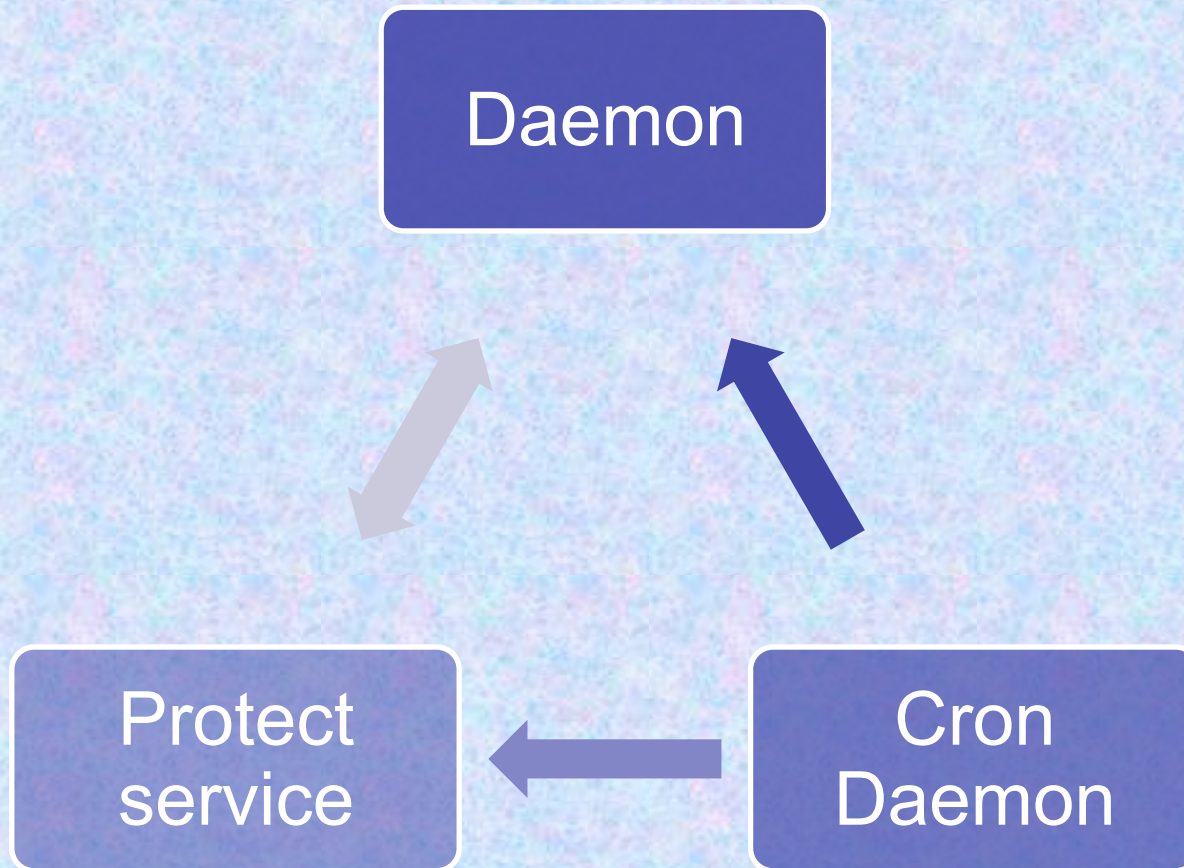
Requirements

- Fast
- Stable
- Fully automatic with configuration
- Automatic recover from error/crash

Real-time Pipeline System

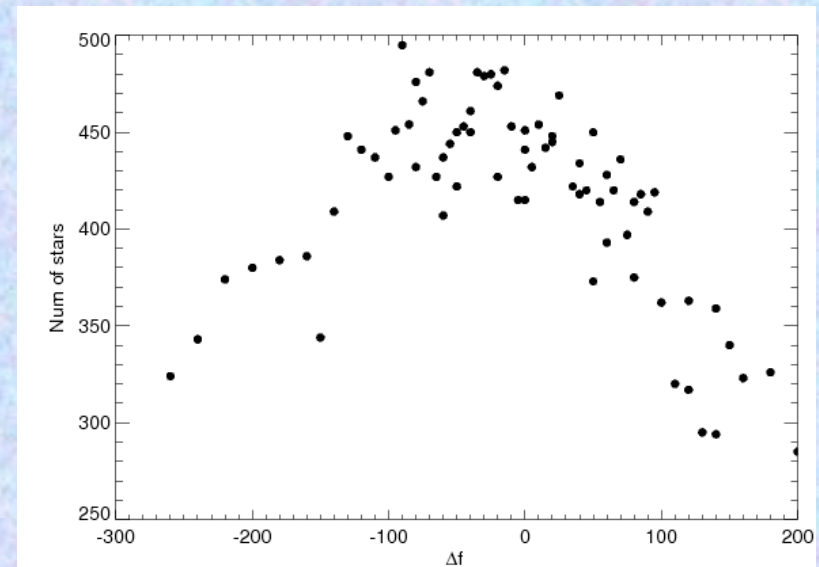
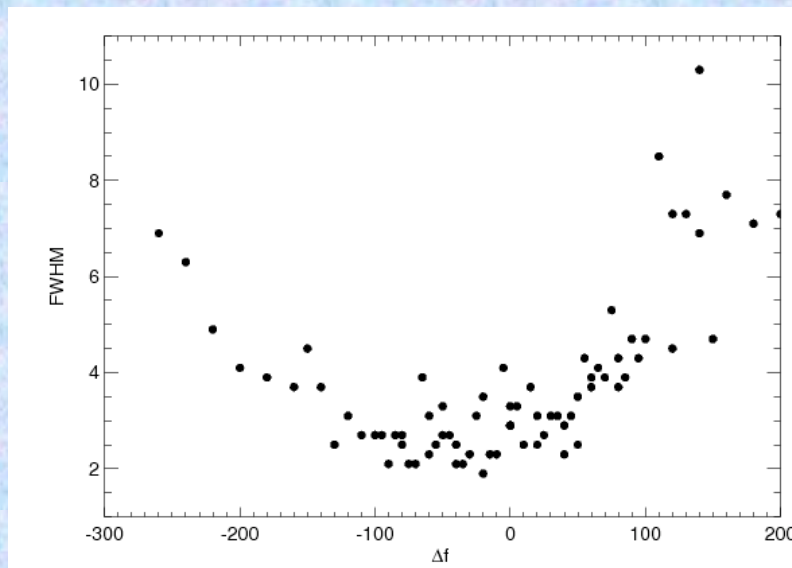
1. Daemon running on background
 - Detect new image
 - Start & manage pipeline
2. Mini-pipeline
3. Real-time pipeline

Daemon Cross Protection



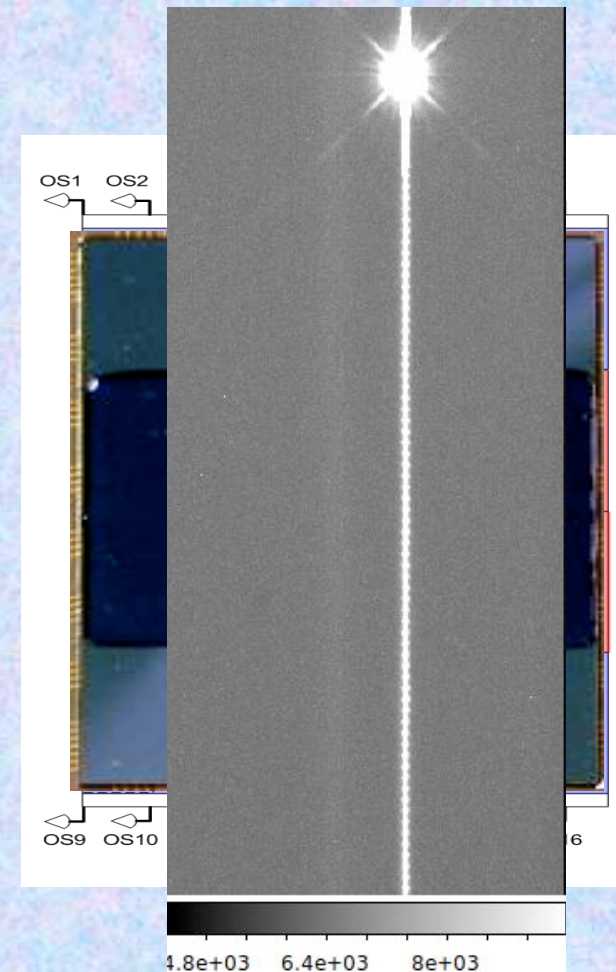
Mini-Pipeline -- Focusing

- Focus may change at low temp
- Monitor and adjust focus during Obs



Mini-Pipeline -- Trailing

- No shutter
- Frame transfer:
0.43sec, 2640 lines
→ 0.16 ms exp. at each pix
Enough S/N for bright stars
high frequency sampling
- seeing



α Ori, 0.4^m 1sec

Real-time Pipeline

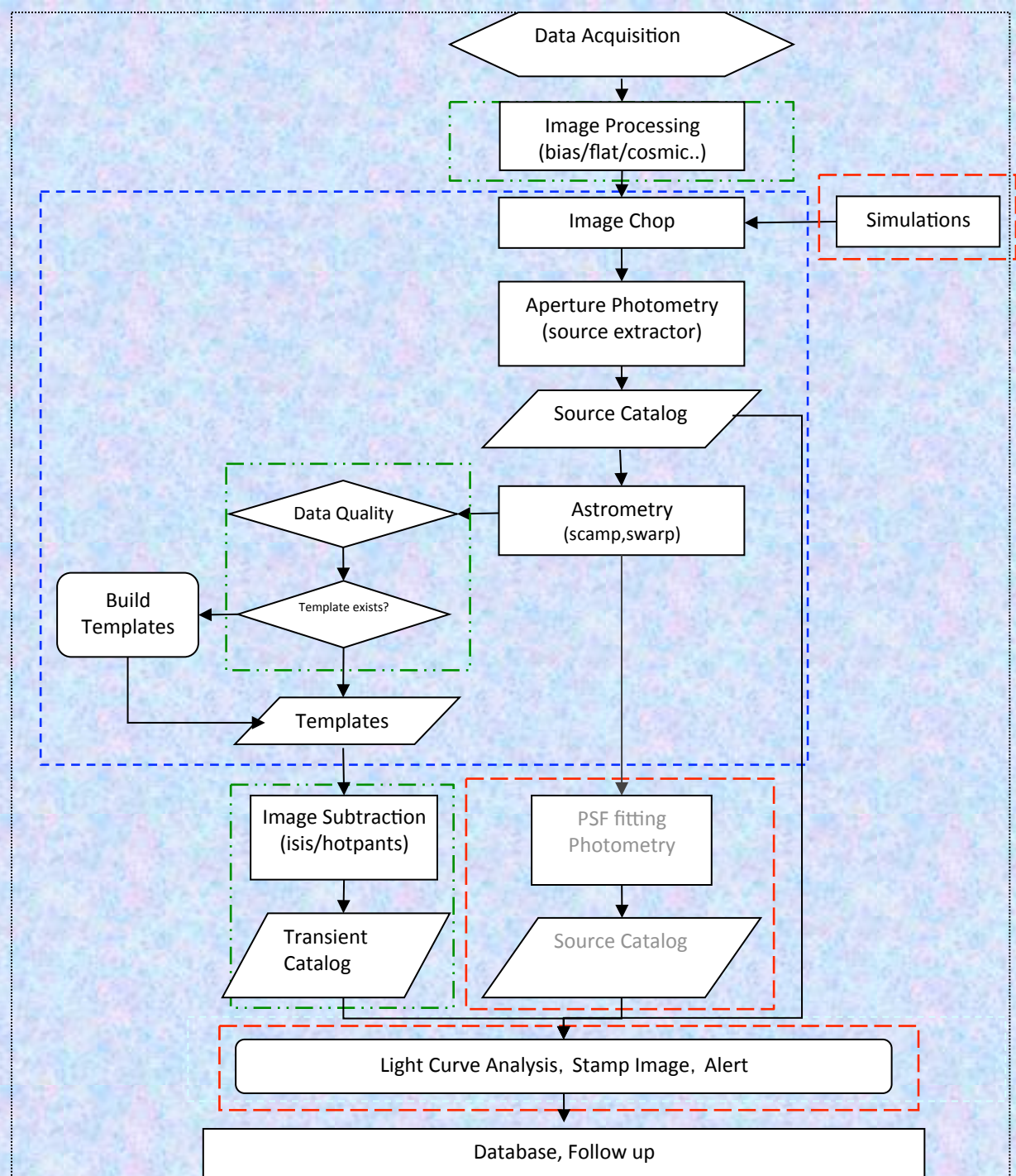
Open source software + programming

- Image Reduction
Flat, Bias, cosmic ray.....
- Photometry & Astrometry
x, y, mag ... (by **SExtractor**)
(x, y) \rightarrow (ra, dec) (by **SCAMP**)
- Template Mosaics
registration, coadding (by **SWarp**)
- Image Subtraction (by **HOTPANTS**)
- Transients Detection & Classification

Test, Test, Test, ...

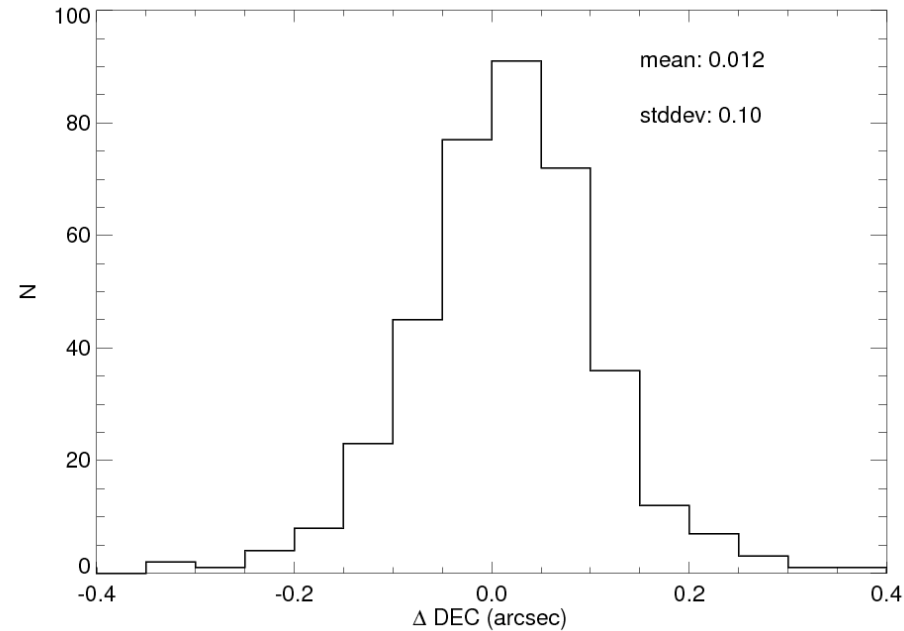
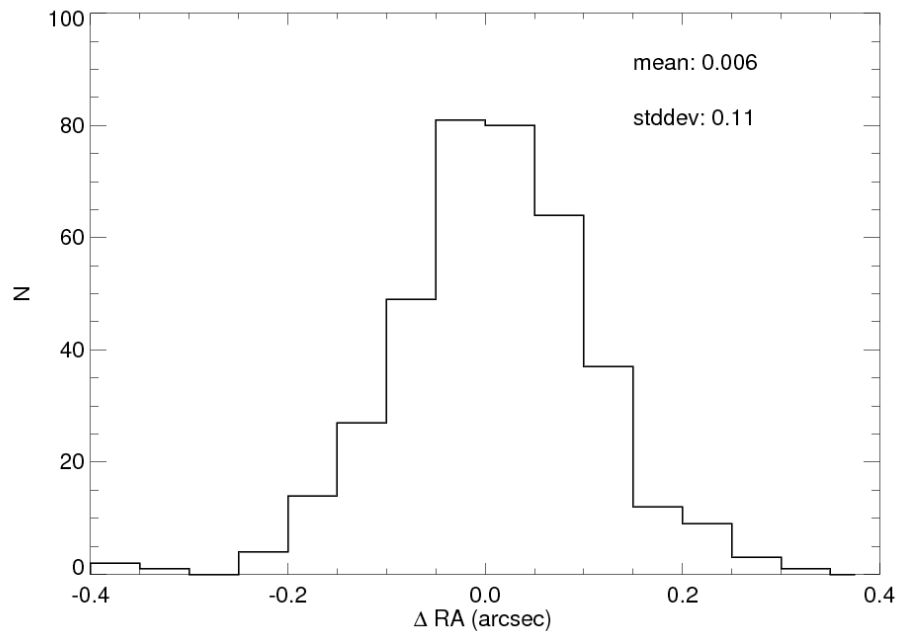
Pipeline Flow Chart

- Aperture photometry
=> all sources
- Image subtraction
photometry
=> transients



Real-time Pipeline – Astrometry

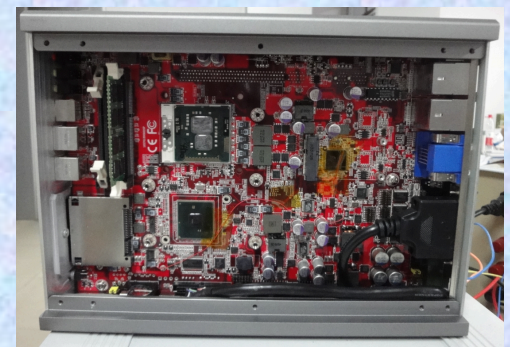
Coordinate calibration accuracy to **0.2''** on submiages



- Images: BATC, 2K*2K, 1.7''/pix
- calibrated by SCAMP with PPMX (accuracy $\sim 0.07''$)

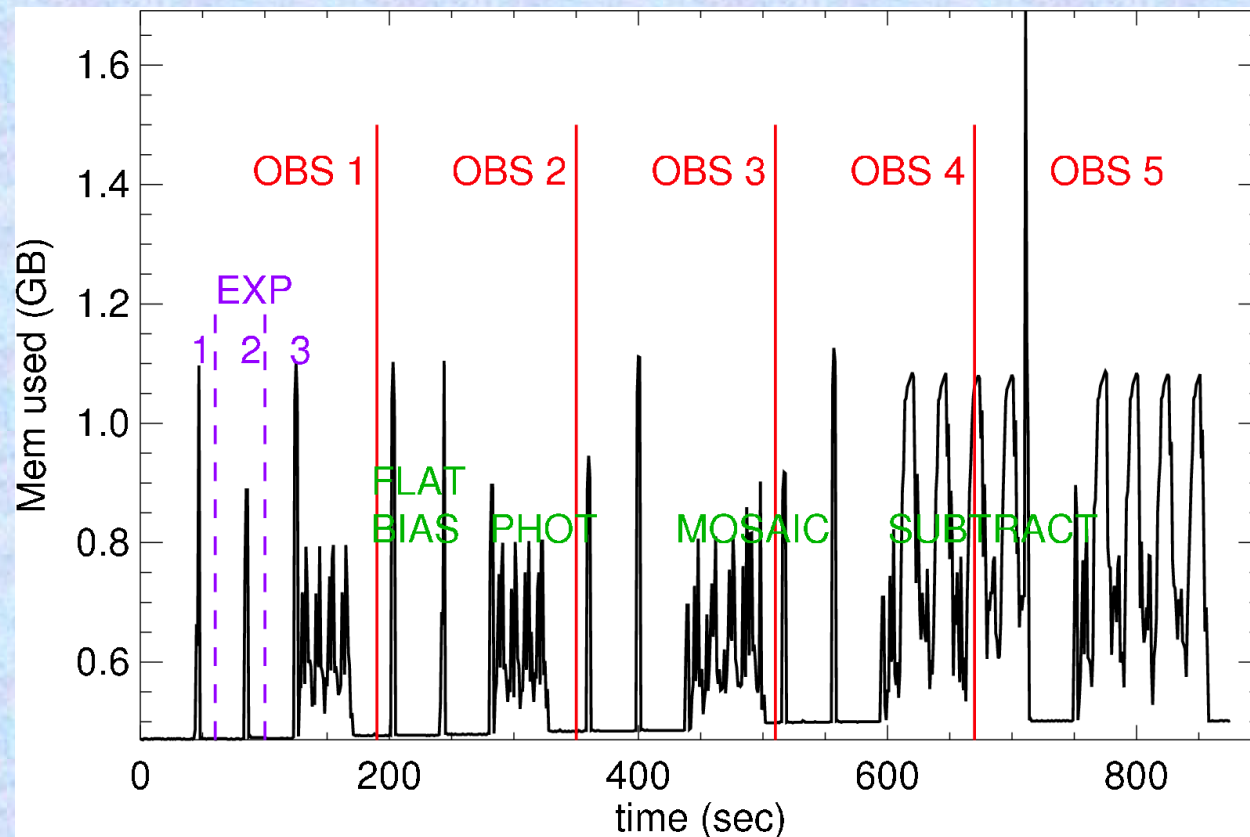
Real-time Pipeline – Performance Test

- 10K*5K simulated image, based on Guide Star Catalog 2.2, 8*2 subimages
- Intel® i7-620M and Intel® HM55
2 cores / 4 threads, 2660MHz, 4M Cache, TDP 35W
- 8GB Memory
- Ubuntu 10.04 64bit



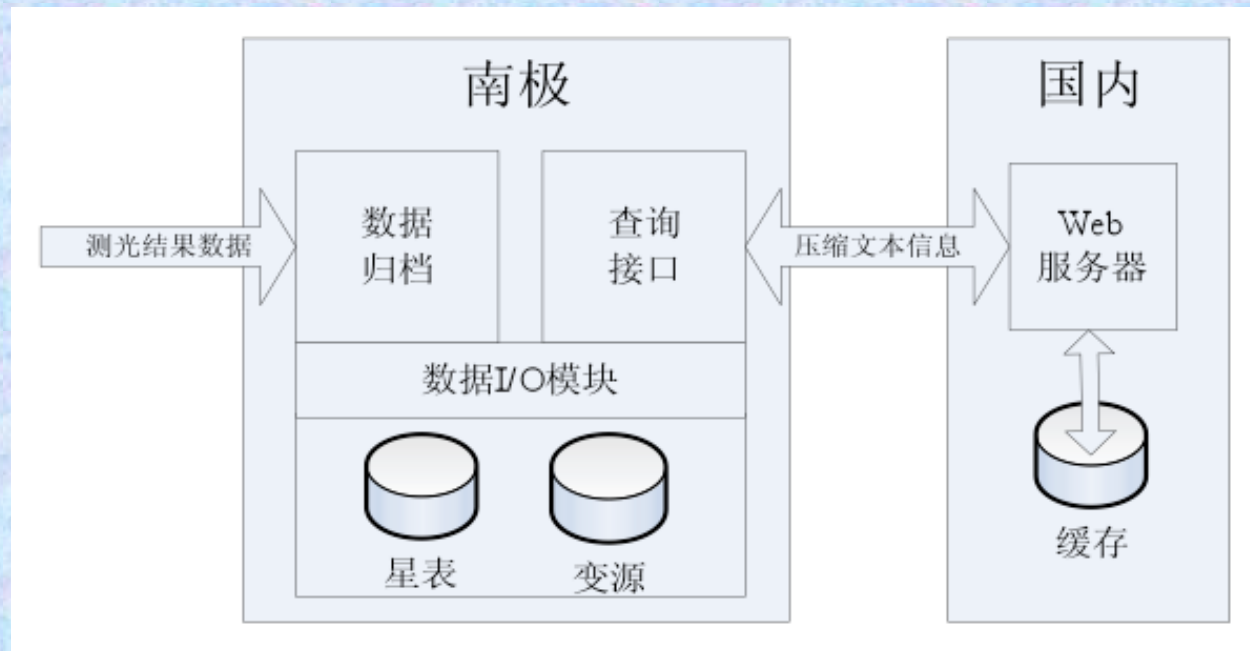
Real-time Pipeline – Performance Test

Function	Combine 3-exposure	Photometry & Astrometry	Template Mosaic	Subtraction	Total
Time (sec)	33.1	9.7	5.8	57.0	105.6



Database for Real-time Photometry Results

- Database at Dome A, server in China
- Low bandwidth: OpenPorts (80MB/day ?) allows us to retrieve light catalogs
- Light, open-source database: MYSQL



Database for Real-time Photometry Results

- **Observation information:**
time, airmass, temp, sky, FWHM...
Monitor the running status
- **All sources:**
catalogs by SExtractor
position, brightness, shape...
- **Variable sources:**
light curves
classification

Database for Real-time Photometry Results

- All sources requirements:

i~20:

star 3200/deg² ,b~60°

(Allen's Astrophysical Quantities)

galaxies 2100/deg² (Yasuda et al. 2001)

total ~ 5.3K/deg² * 4.3deg² ~ 23K /field

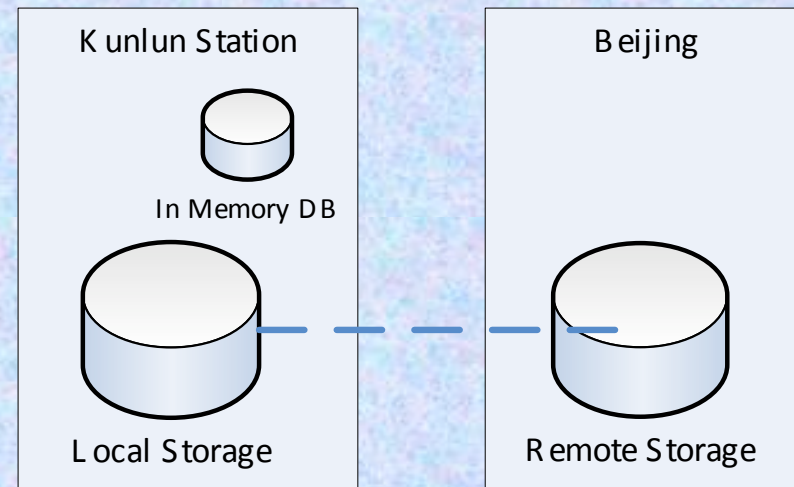
500 fields ~ 11.5M sources

110d, 3min/field → 79K images ~ 1.8G records

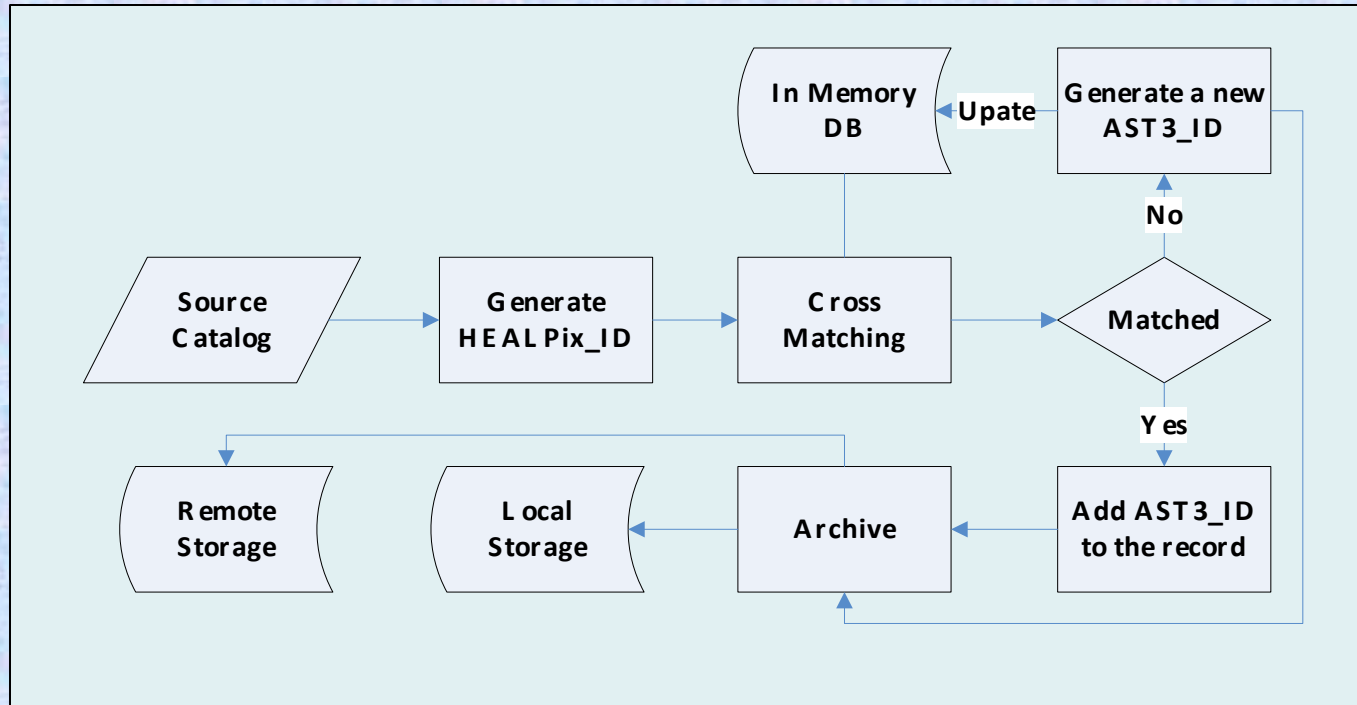
30entries/record → > 200 GB

Database for Real-time Photometry Results

- Unique source index (coordinate-based)
 - **AST3_ID**: Identify the same object from different catalogs.
 - In memory DB
 - Index data only (RA, Dec, AST3_ID...)
 - Used to calculate AST3_ID
 - Local: AST3_ID based database
 - Complete catalogs with AST3_ID
 - Beijing: AST3_ID based database
 - Reduced catalog with AST3-ID



Database for Real-time Photometry Results



11M sources ~1GB memory

23K/field ~40sec

Present & Future

- 3rd Nov 2011
departed from Tianjin, taking computers with
pipeline system installed



Present & Future

- Jan 2012
install telescope, Plato-A, computers...
- Late March 2012
start obs.
Check & adjust pointing, focus...
update pipeline system
database in Beijing: monitor running status,
access interactively...
- April 2013
get all data (~10TB) back
re-process, archive & release data

Hope supports of VO
&
Thanks!