AST3 in 2015

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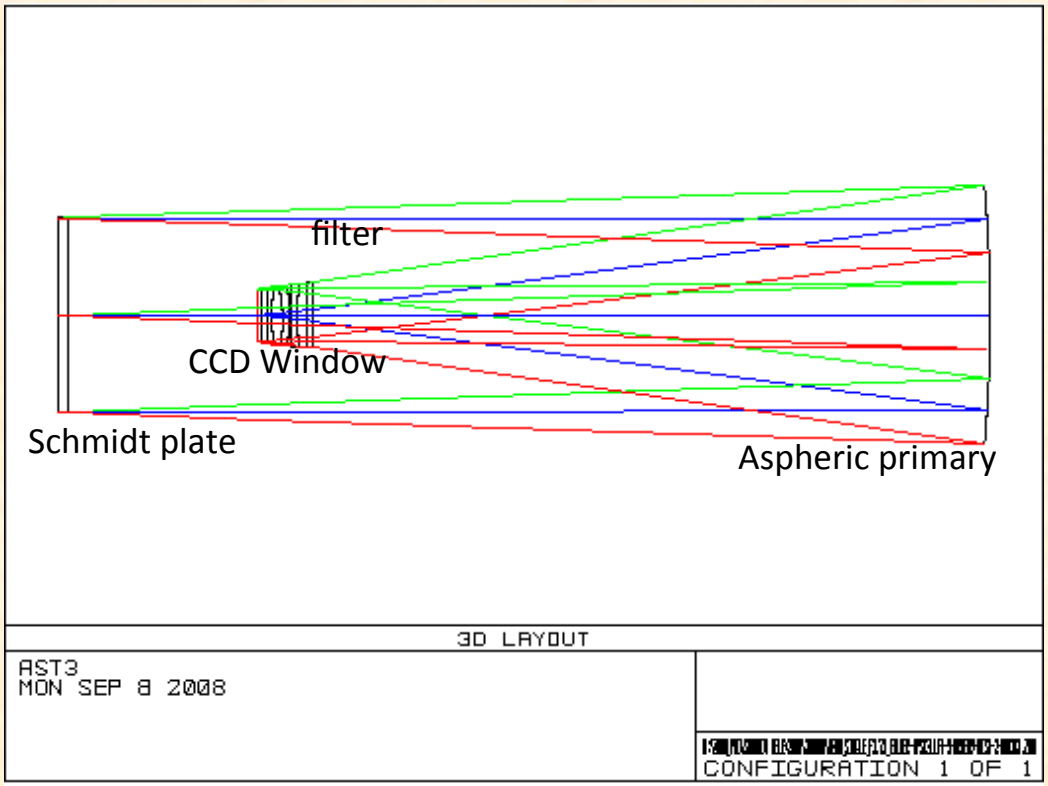
Outline

1. AST3 basics
2. AST3 in 2013/2014
3. AST3 in 2015

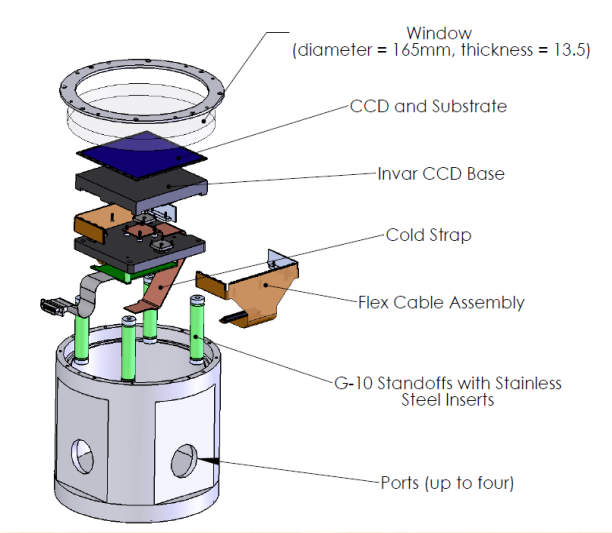
Antactic Survey Telescope x 3 (AST3)

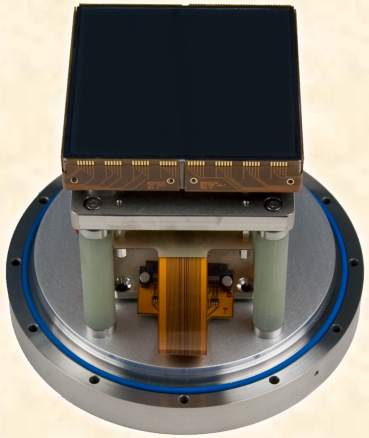
- Three 50/68cm modified Schmidt Telescopes (NIAOT);
  - spherical corrector
  - short tube (optical length 2.4m)
  - aberration correction
  - atmosphere dispersion corrector (ADC)
- Filters: g, r, i

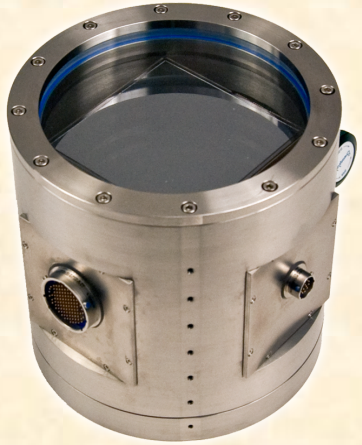


AST3 CCD Camera

- CCD camera (STA1600-FT)
  - 10k x 10k
  - 9 micron/pixel
- Plate Scale: 1”/pixel

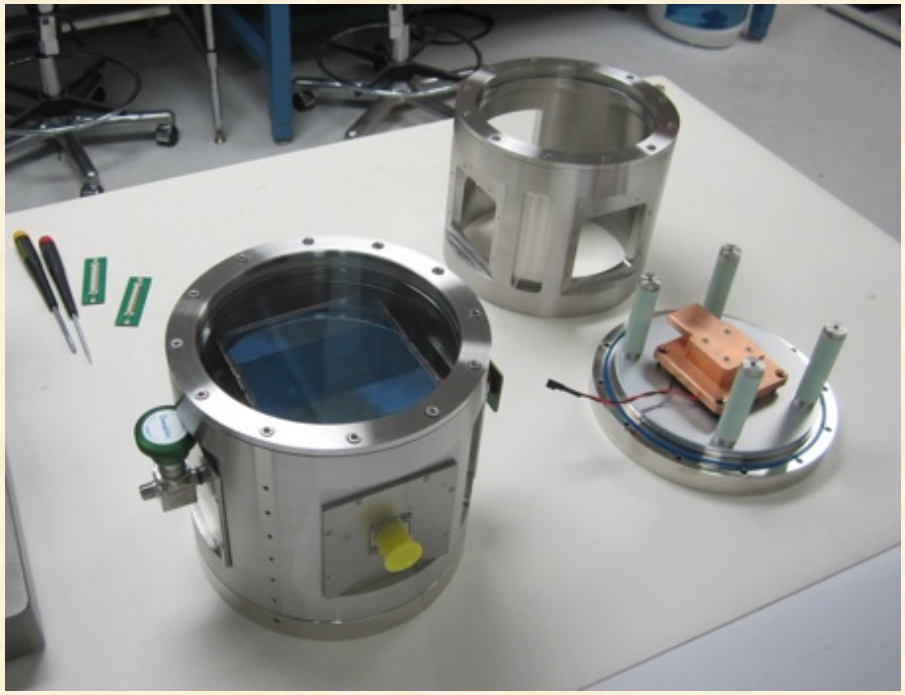


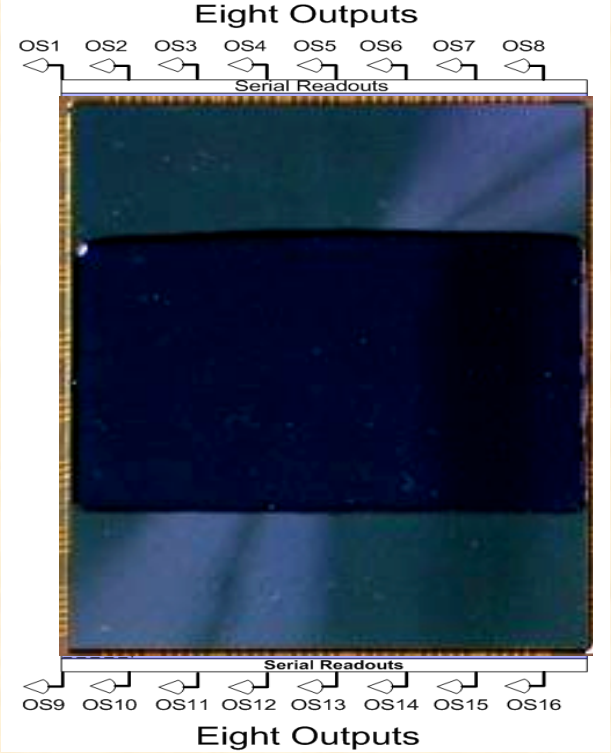




AST3 CCD Camera

- No shutter, to avoid mechanical failure
- Operated in Frame Transfer mode， 10k x 5k
- FOV: ～4.3 sq. degree
- 16 readout channels for fast readout





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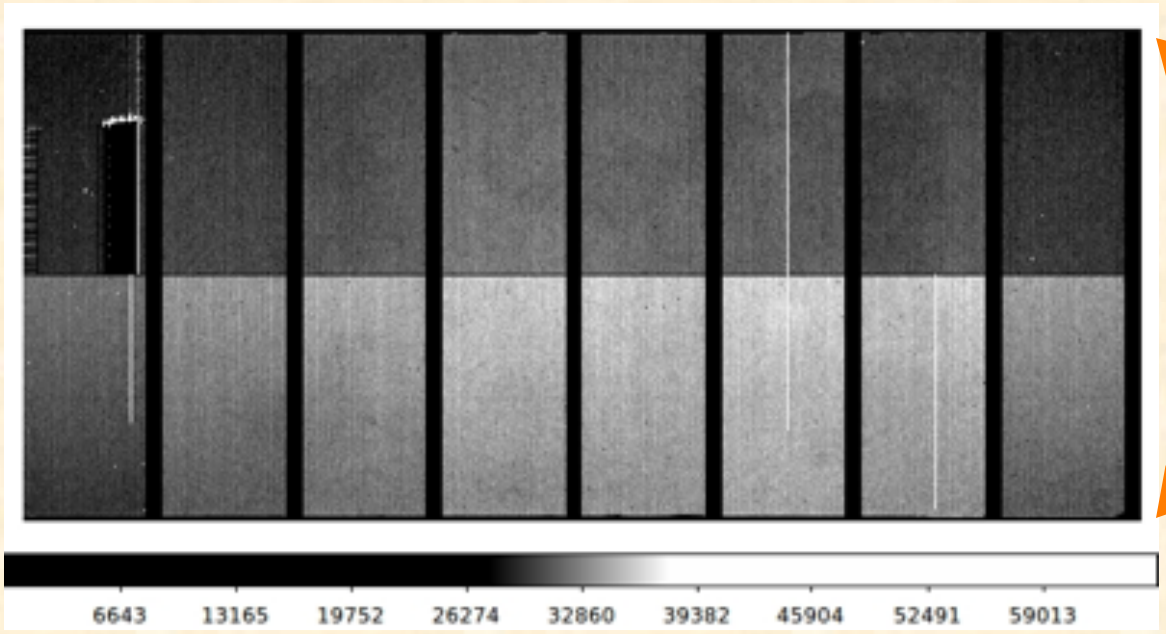
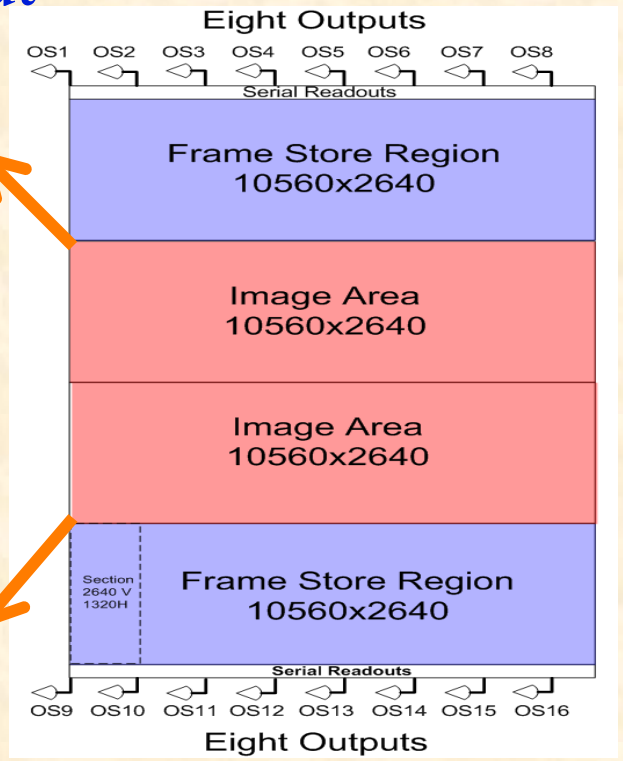
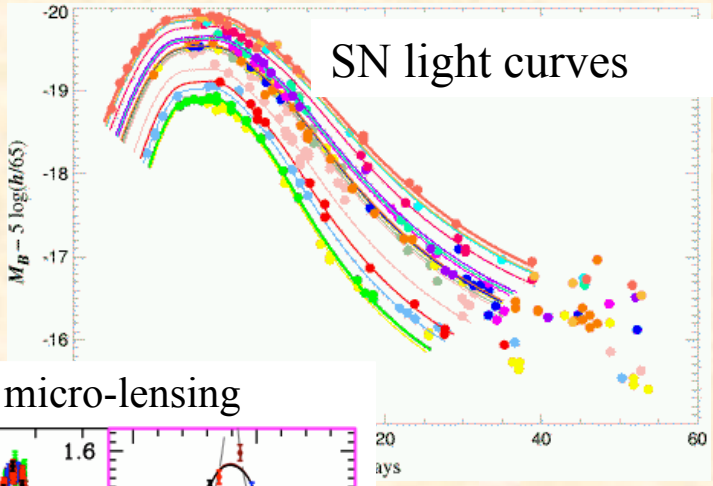


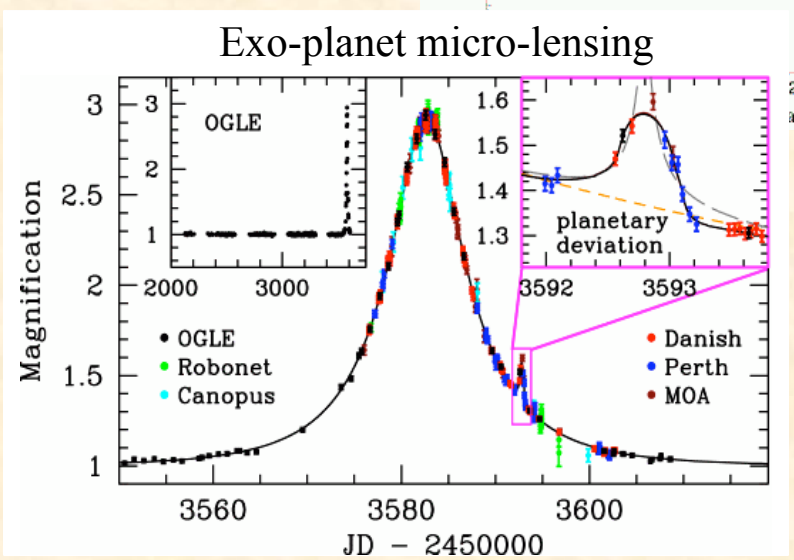


- Overscan: 180 columns/channel, 20 lines

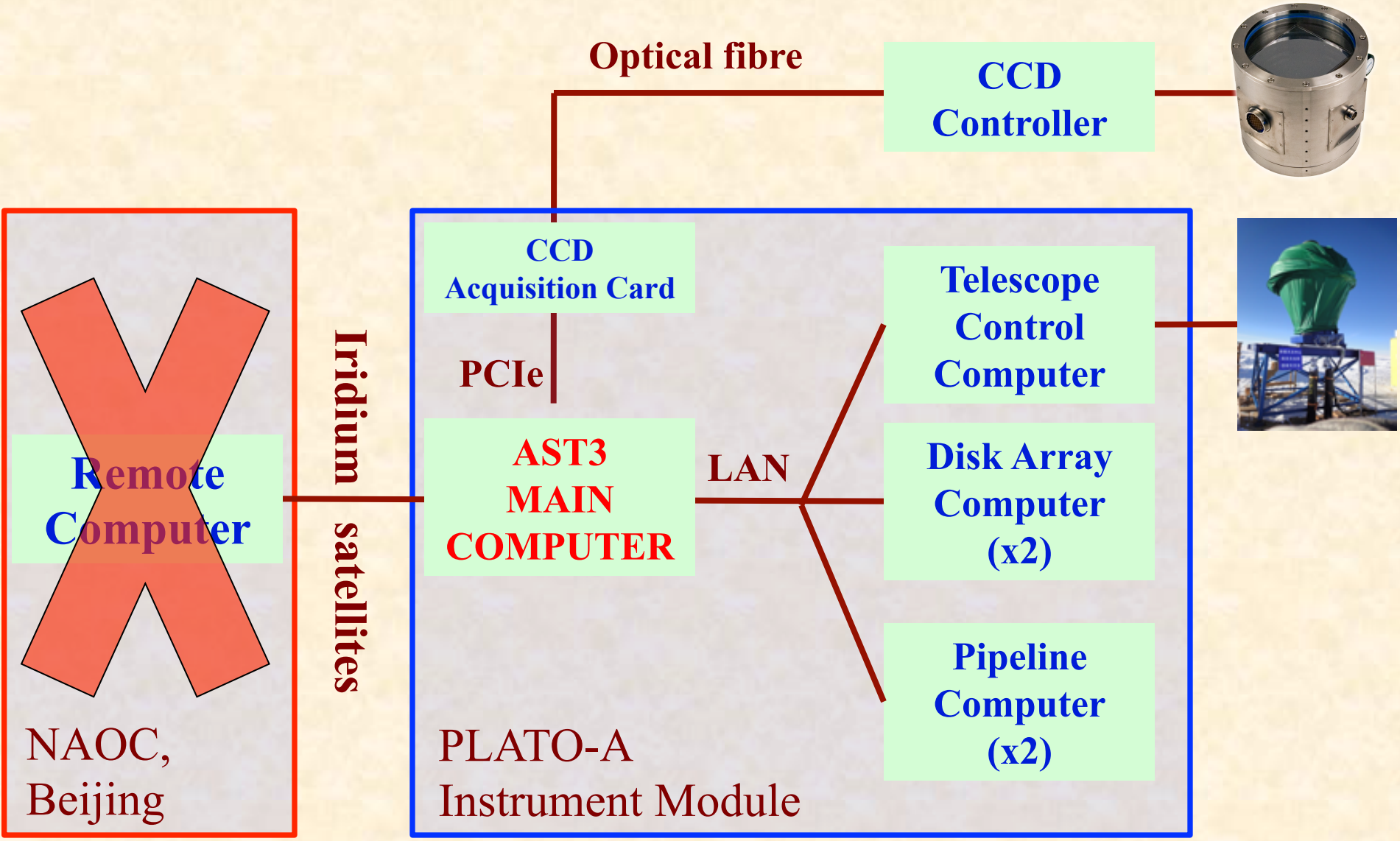
AST3 Sciences--- Time domain astronomy

- Supernova
  - Very early discovery
  - Uniform, multi-color light-curve
- Exoplanets
  - Transients
  - Micro-lensing
- Variable stars
- Quasar, AGN
- Gamma-ray bursts
- LMC,SMC
  - Nova
  - Micro-lensing
- …





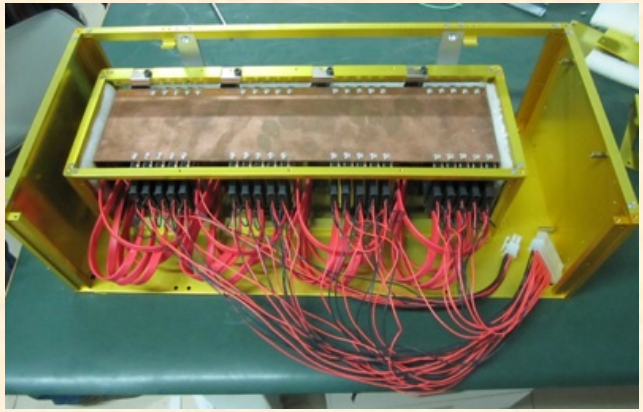
AST3 Operation -- unattended, fully automatic



AST3 Control, Operation and Data (COD) System

for low temperature, low air pressure, unattended operation

1. Customized computer systems
2. Customized data storage system
3. Lots of redundancies (every possible spot)
4. Complicated survey software
   (to ensure fully automatic operation)
   - Survey control (telescope, CCD, data…)
   - Survey scheduling (obs. efficiency)
   - Real-time Pipeline and database
     (bandwidth too low to transfer images)
   - Transient alert
   - Logs of everything



Hardware Redundancy

to reduce single-point failure

- Data Storage (computer+disk array) x 2
- Pipeline computer x 2
- Multiple power control PDU

For 2013 improvments:

- Main Computer x 2
- Power supply x 2
- CCD Fiber-optic Communication x 2
- Computer network (2 Ethernet cards, 1 USB wireless card)

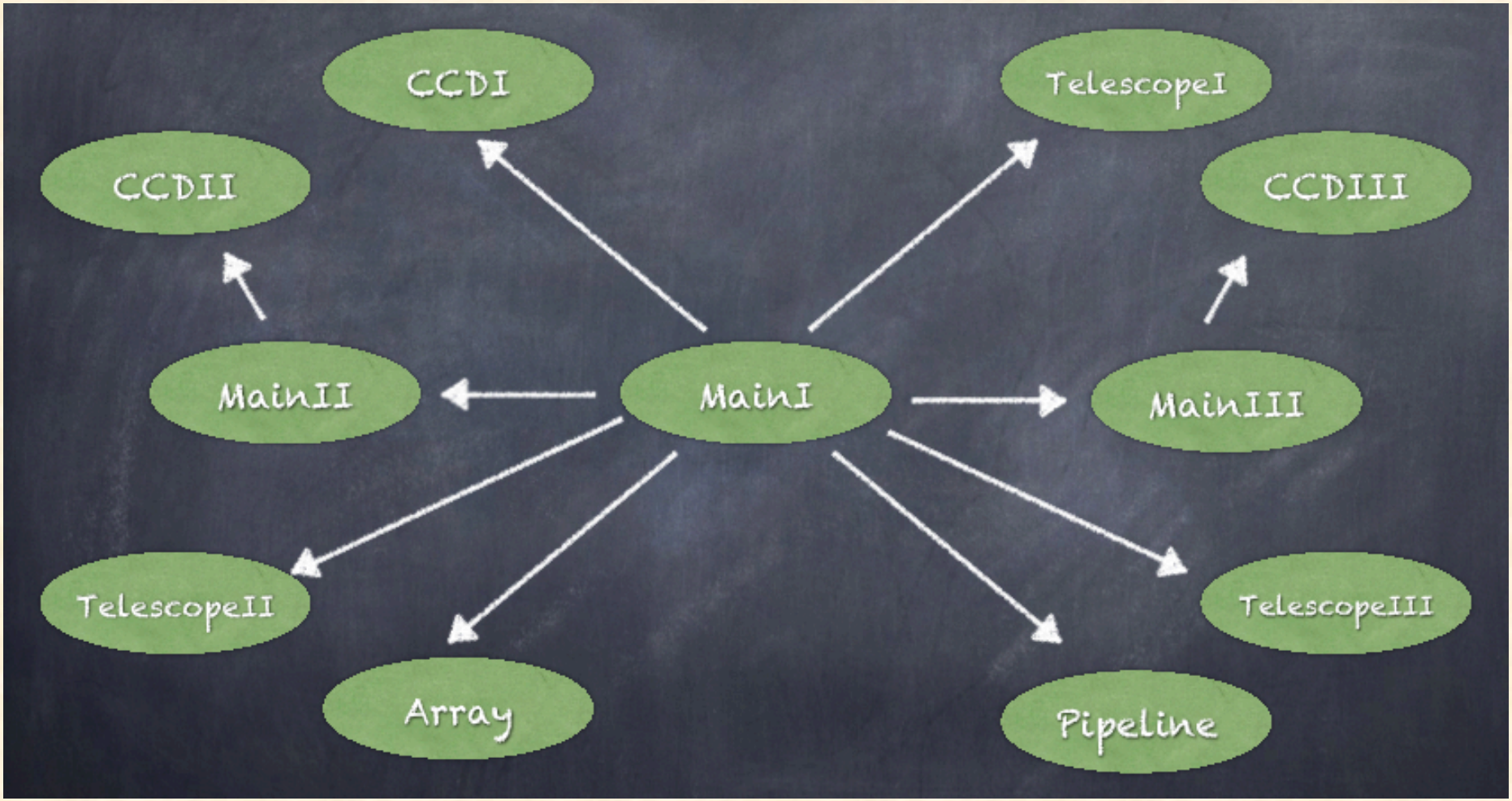
AST3 Software

AST3SUITE

- Related softwares: ast3(STA), tcc(NIAOT), strategy.py(NAOC).
- **Daemons**: long-term running processes that provide various of services, start after system booting, including ast3strategyd, ast3grabd, ast3arrayd, ast3filed, ast3seriald, ast3logd.
- **Basic command**: client programs that user's run them to execute a single task, including ast3strategy, ccd, telescope, ast3sendfile, ast3serial, ast3log.
- **Scripts**: glue basic commands together to complete observation, including ast3skysurvey.

Main Array Pipe Main + Array

AST3 Software

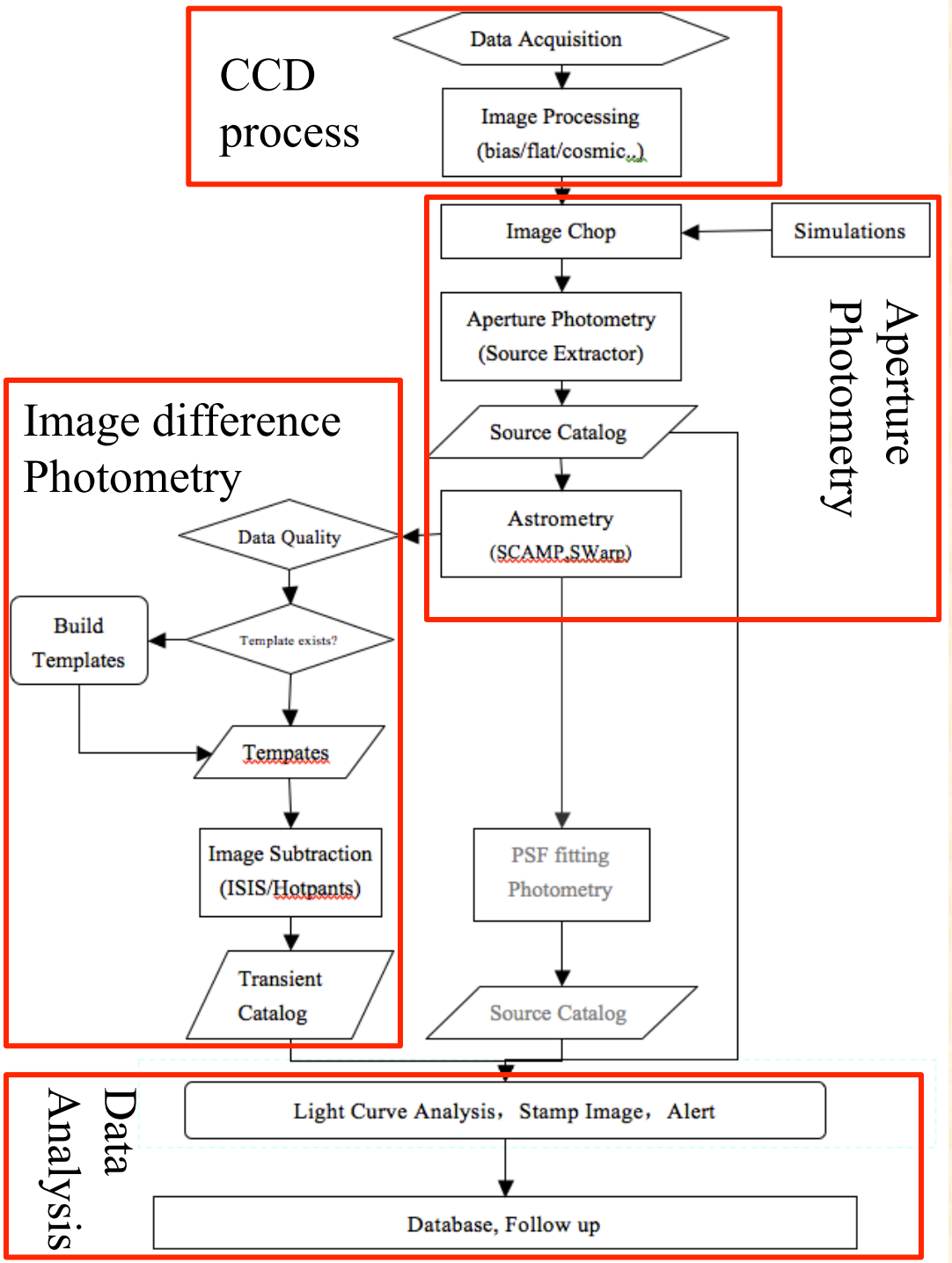


AST3SUITE for 3 telescopes

Photometry Pipeline

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

- Built on OpenSource softwares
- Optimization（e.g. parallelizing）
- Detailed tests to ensure accuracy and reliability



AST3 in 2013/2014

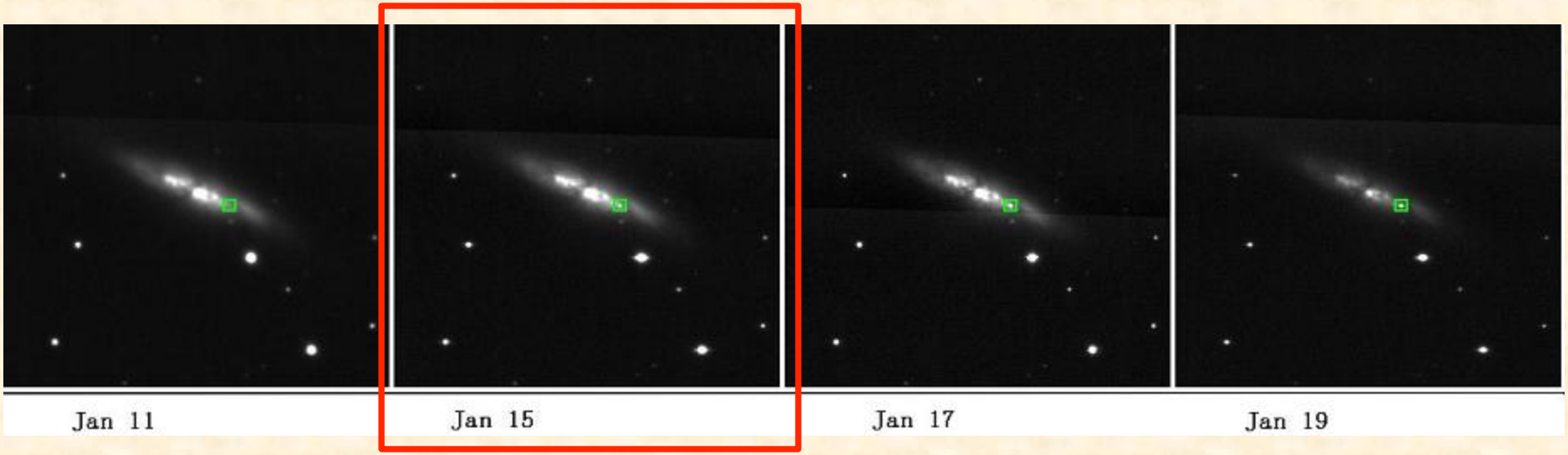
Intensive tests of AST3-2 at Mohe (5 months last winter)

Lattitude: 52°N
T: -30°C~-40°C
(in winter)

AST3-2 Mohe Test – SN Survey

Test of Automatic Photometry Pipeline with real data:
(both aperture photometry and image subtraction)

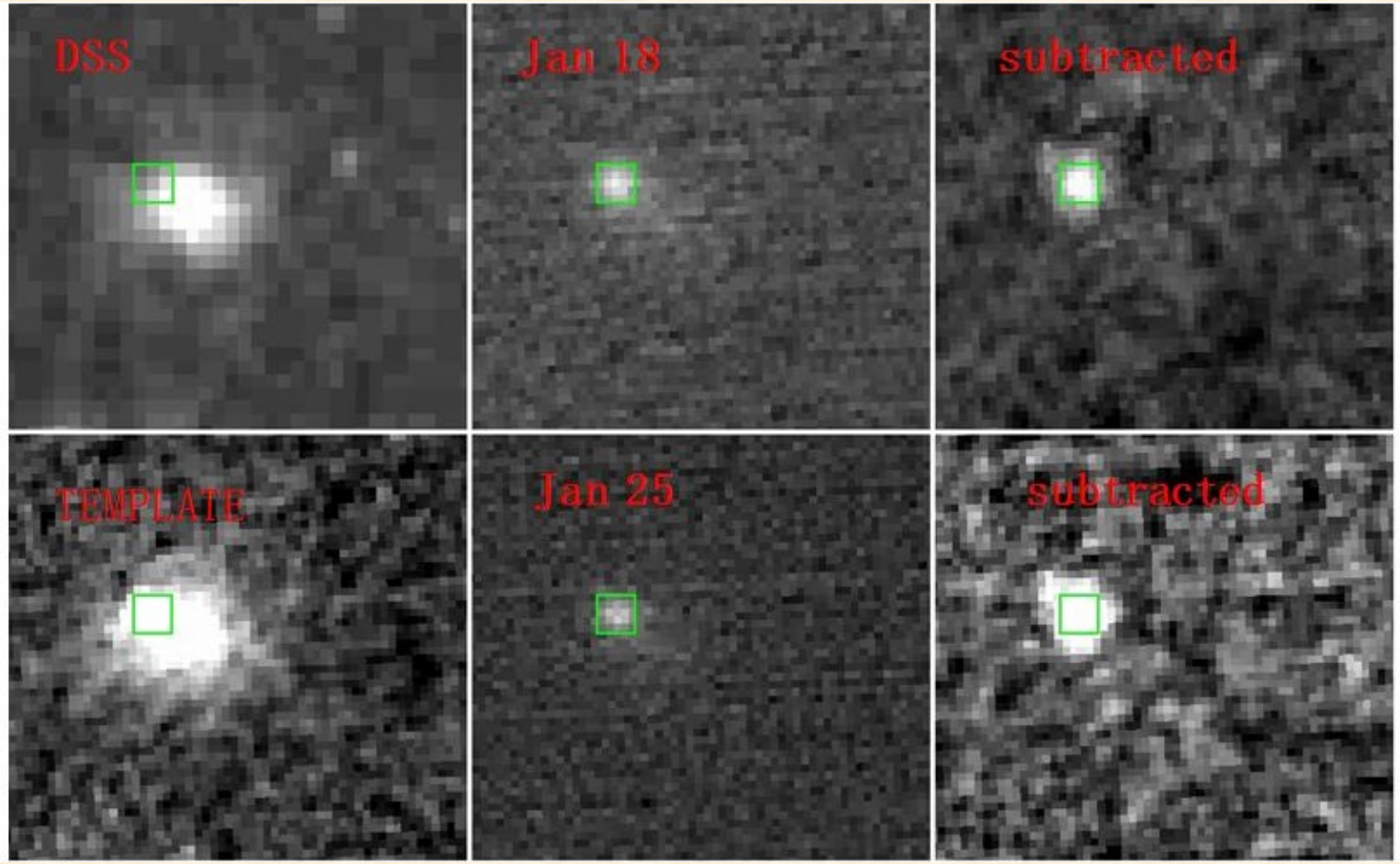
- Dec 27 started pipeline
- Jan 3 made templates
- Jan 8 started subtraction
- Jan 15 setup varible candidates website



AST3-2 images (SN2014J in M82)

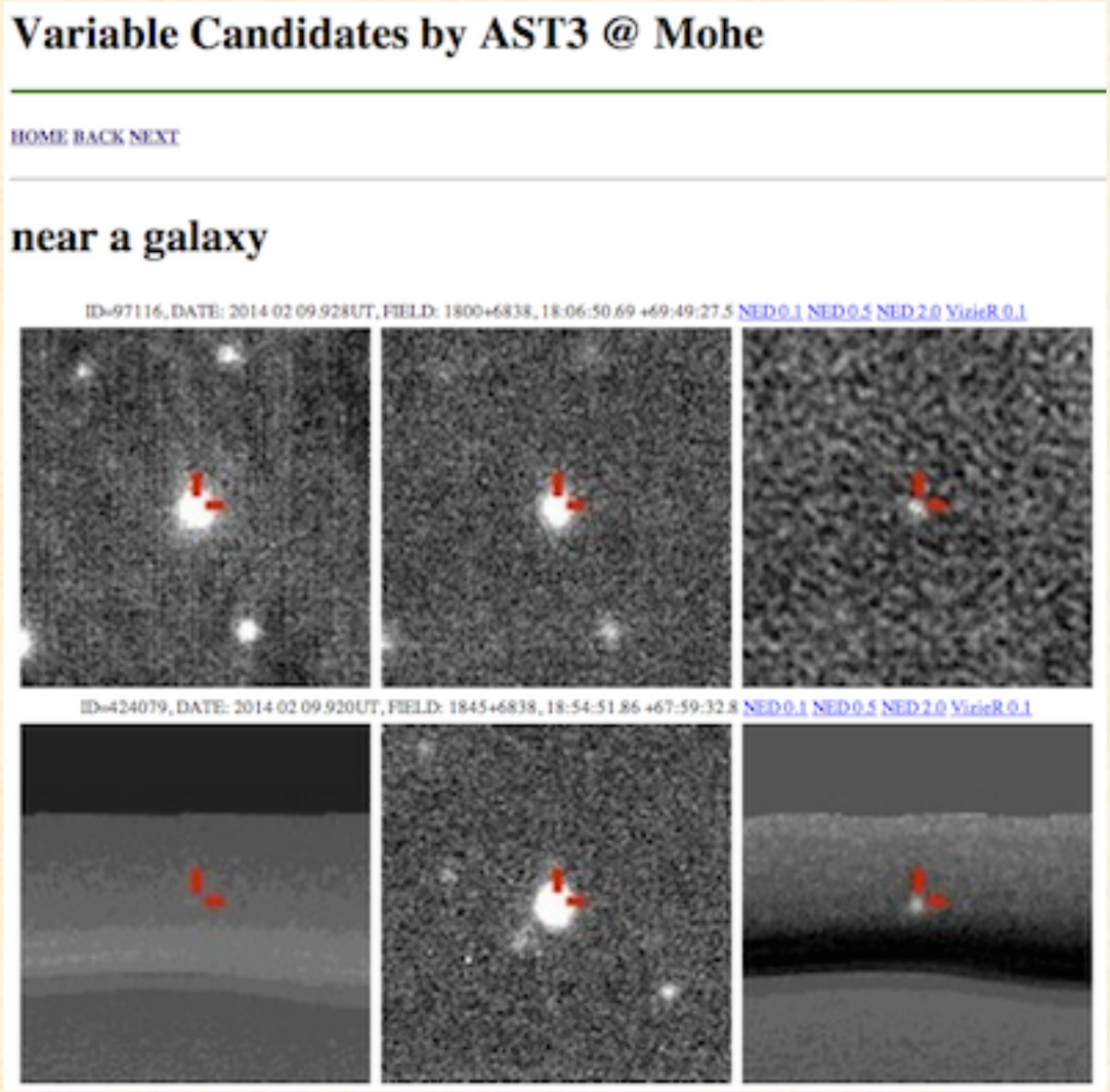
AST3-2 Mohe Test – SN Survey

AST3-2 Discovered SN2014M



Spectroscopically confirmed by Lijiang 2.4m (TNT group)

Real-time Transient Candidates Website



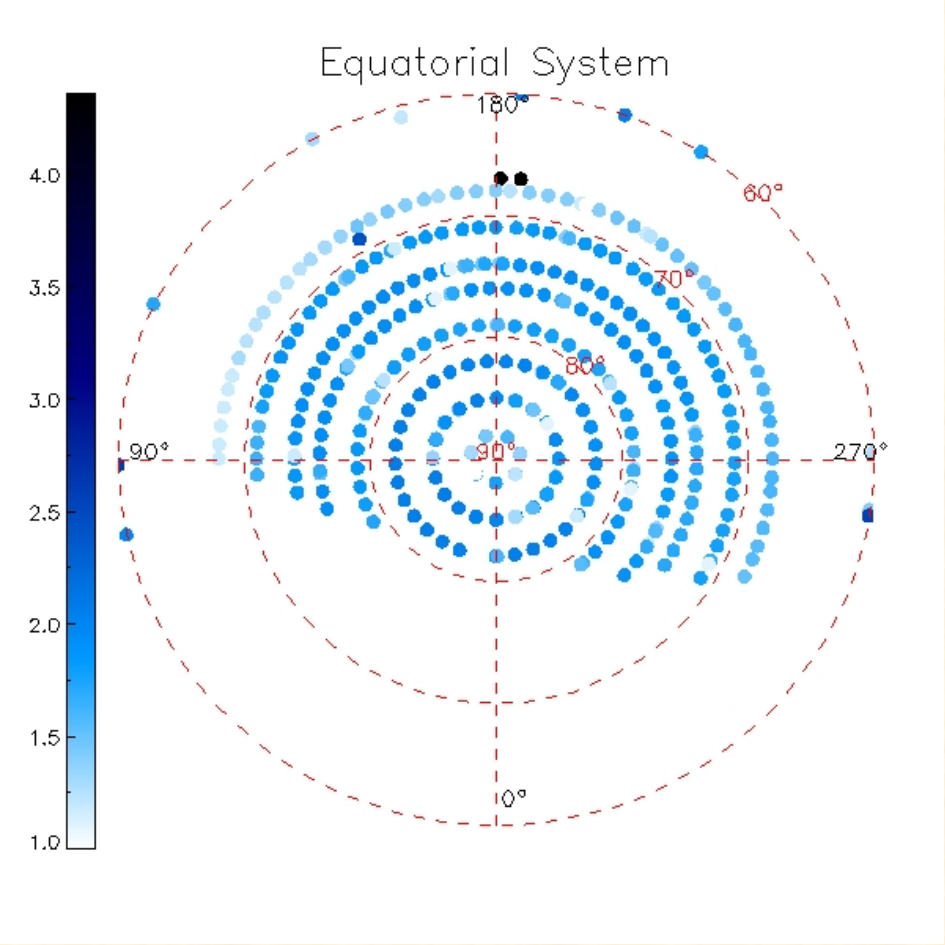
AST3-2 Mohe Test—simulating Dome A operation

COD: Control, Operation and Data system

- Computers never failed for 5 months
- Fully automatic operation (unattended)
- Data storage succeeded
- Pipeline succeeded

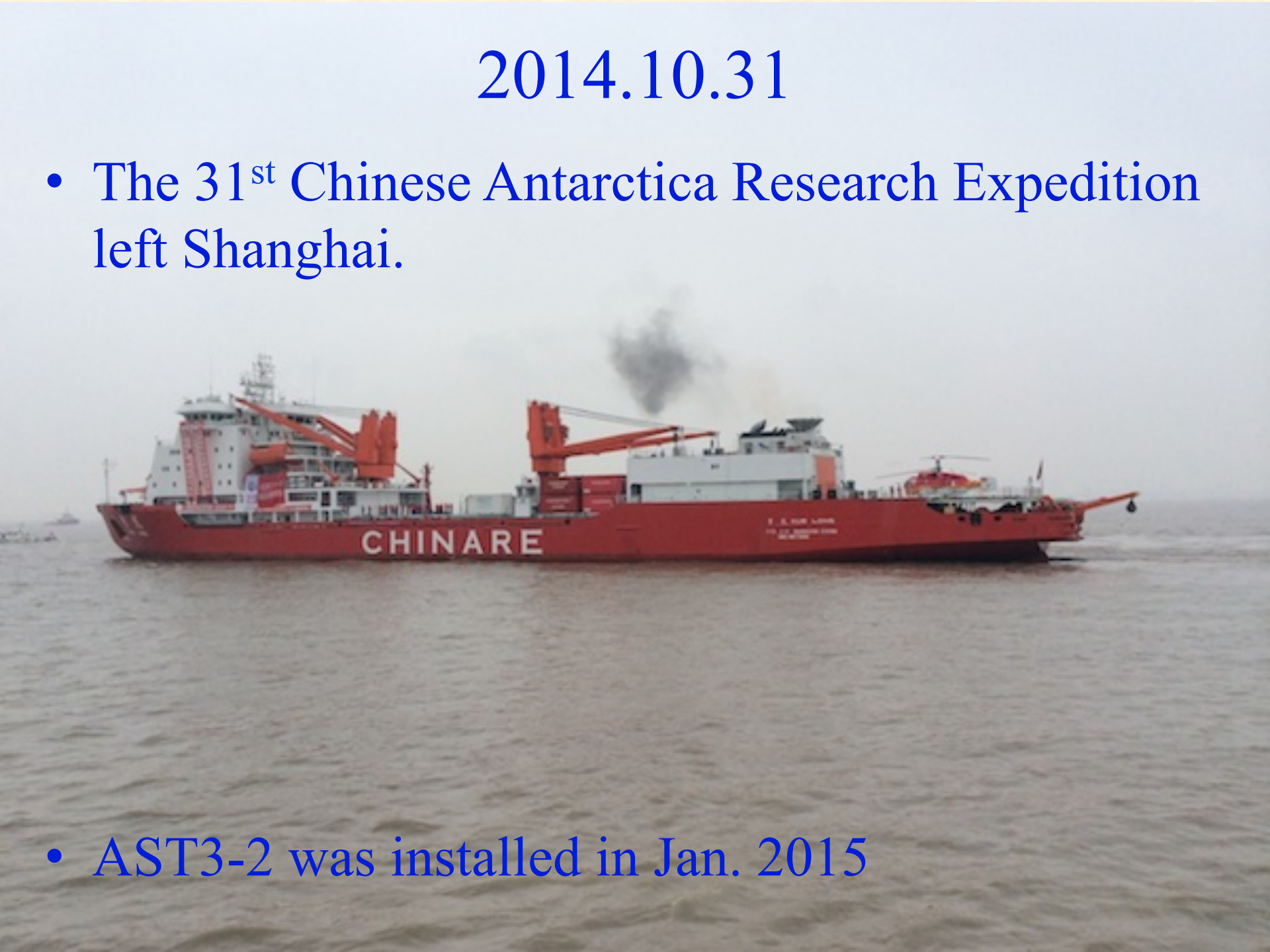
More work on:

- optimize survey strategy
- pipeline
  - generate light curves
  - auto-identify variables
  - …



2014.10.31

- The 31st Chinese Antarctica Research Expedition left Shanghai.



- AST3-2 was installed in Jan. 2015

AST3 in 2015

2014/2015 Traverse

- Fujia DU (杜福嘉)，Zhengyang LI (李正阳)

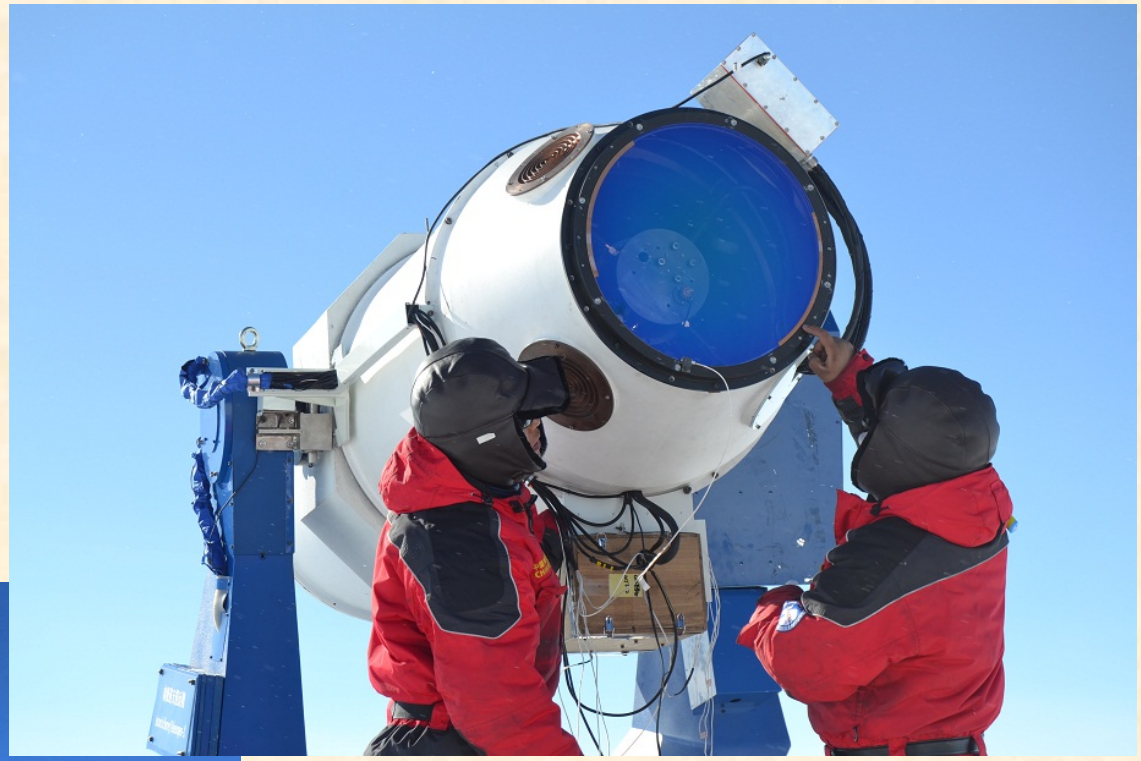
2014/2015 Traverse

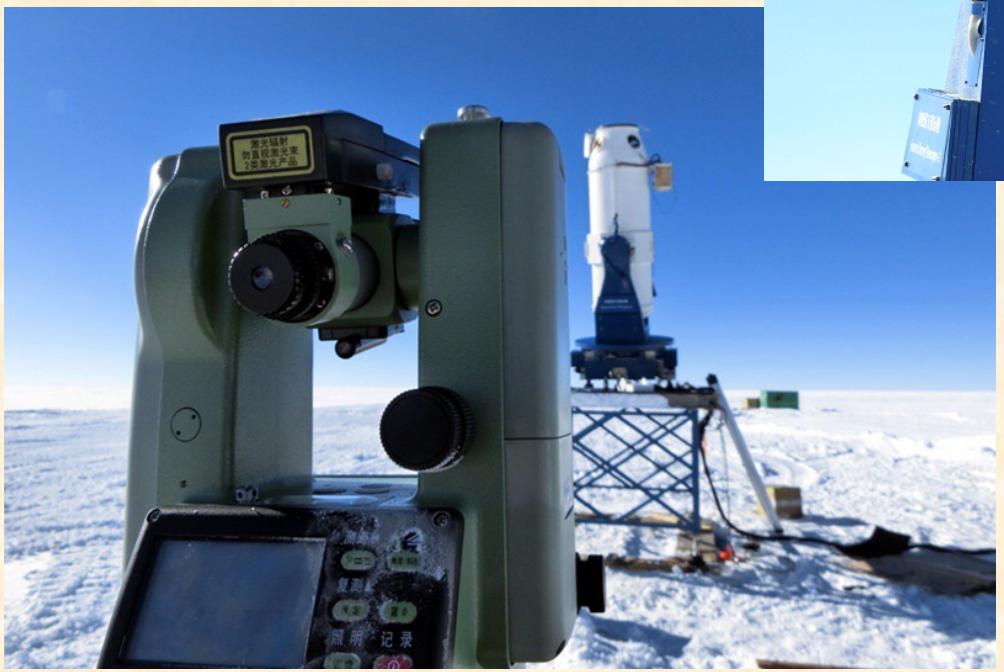
Dome A
- 4100m
- -30°C to -40°C

Dec. 30, 2014 --
Jan 23, 2015
(only 25 days)

2014/2015 Traverse

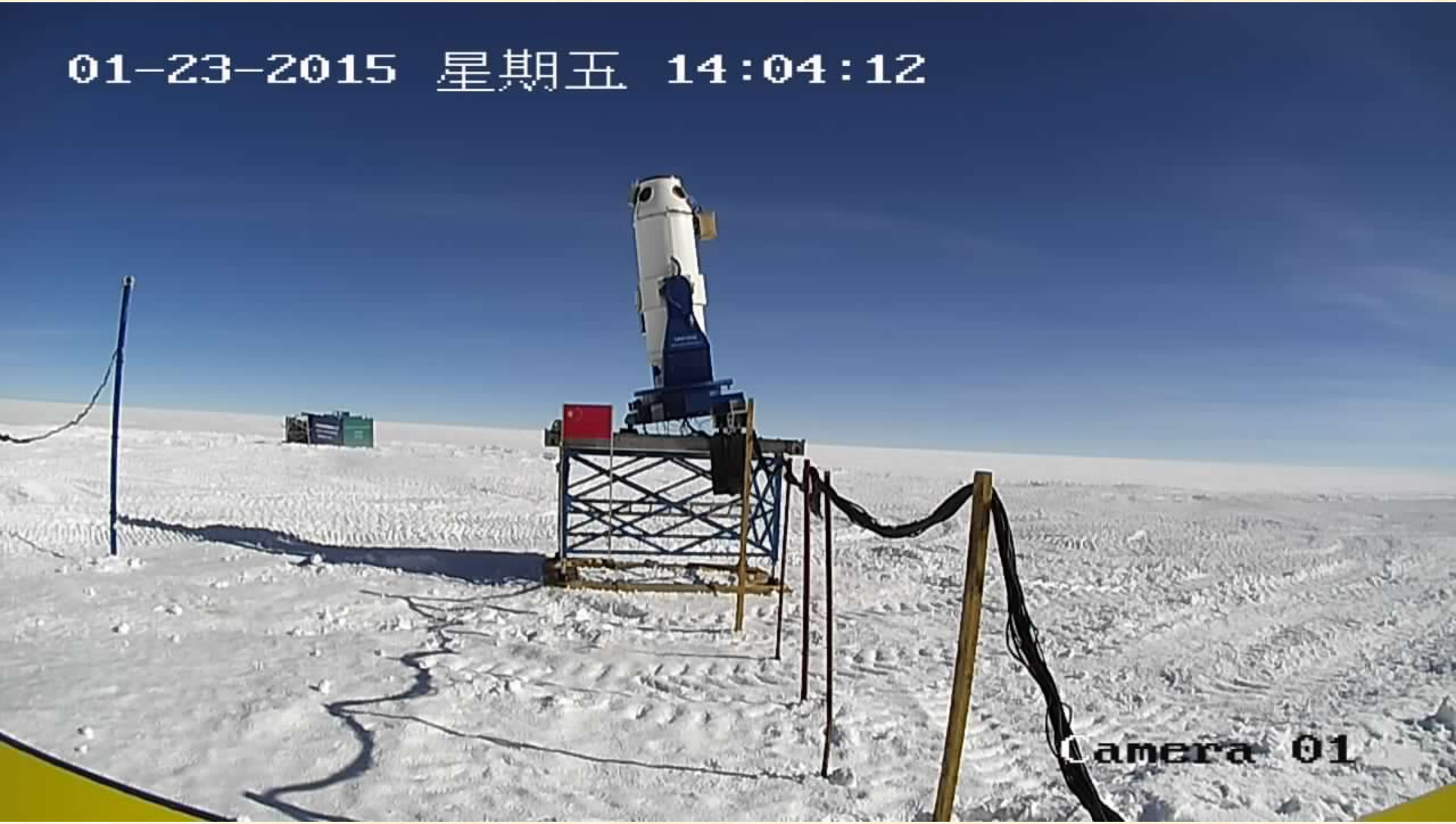
Dome A
- 4100m
- -30°C to -40°C



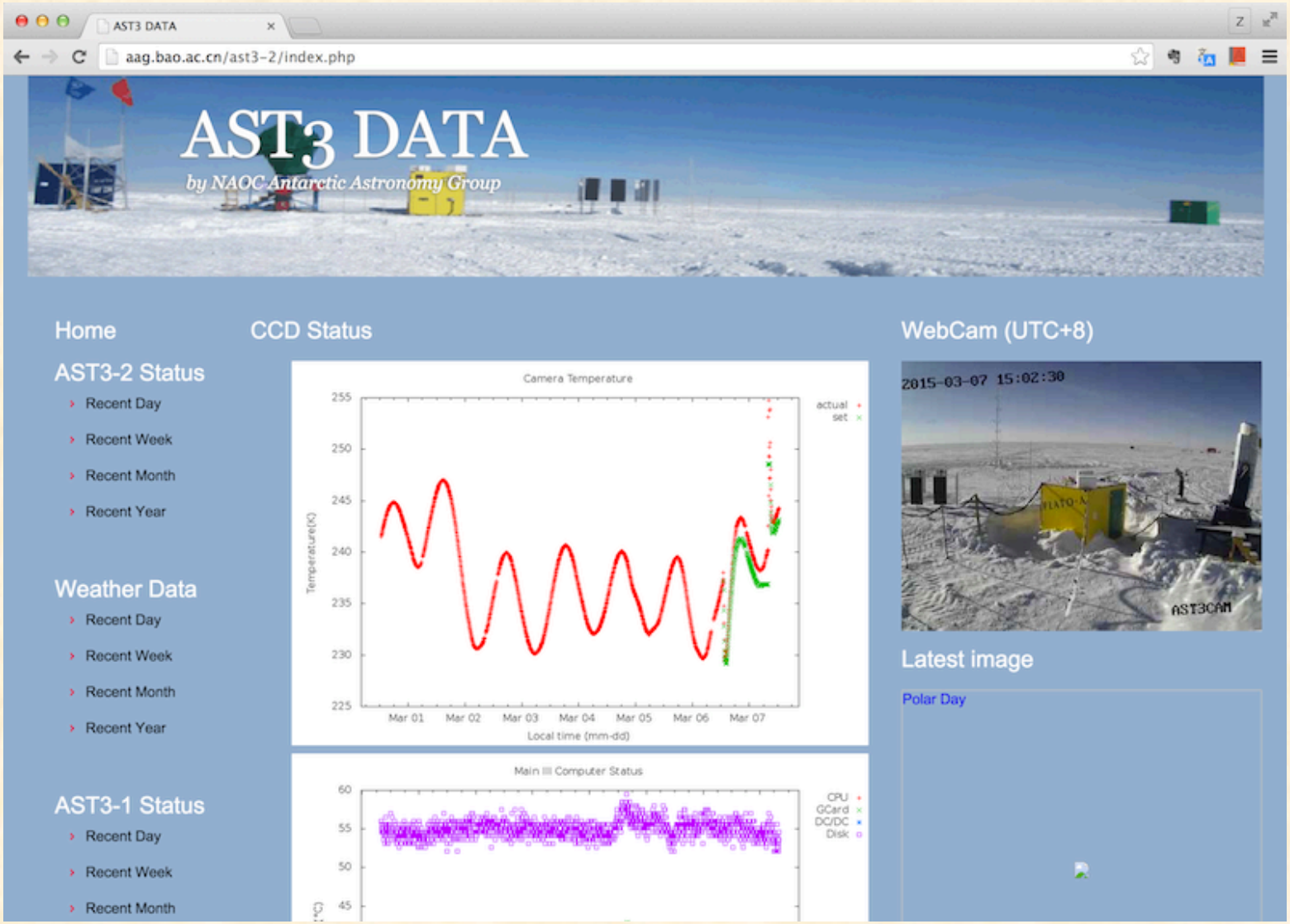


Dec. 30, 2014 --
Jan 23, 2015
(only 25 days)

2014/2015 Traverse

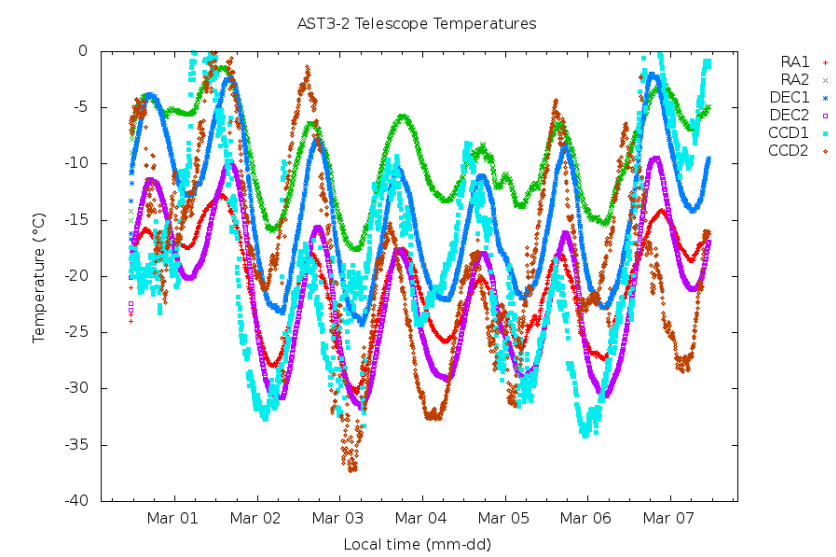


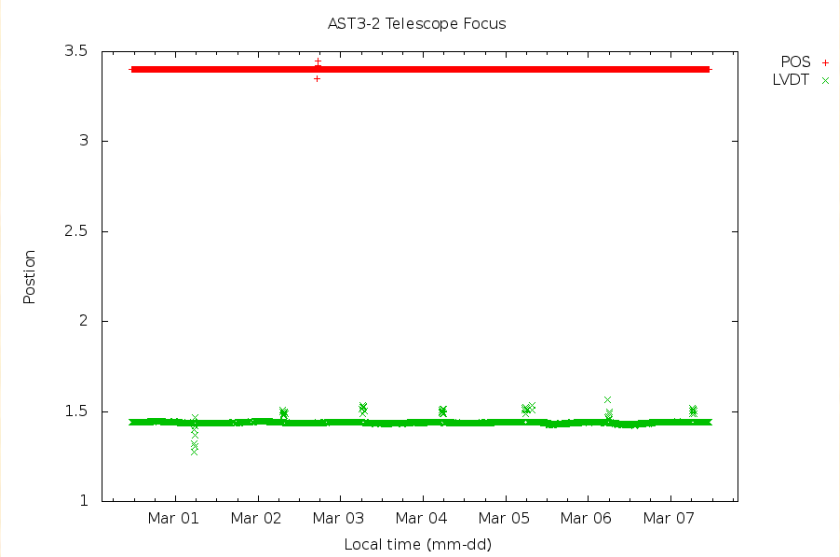
2015 Operation – Live status

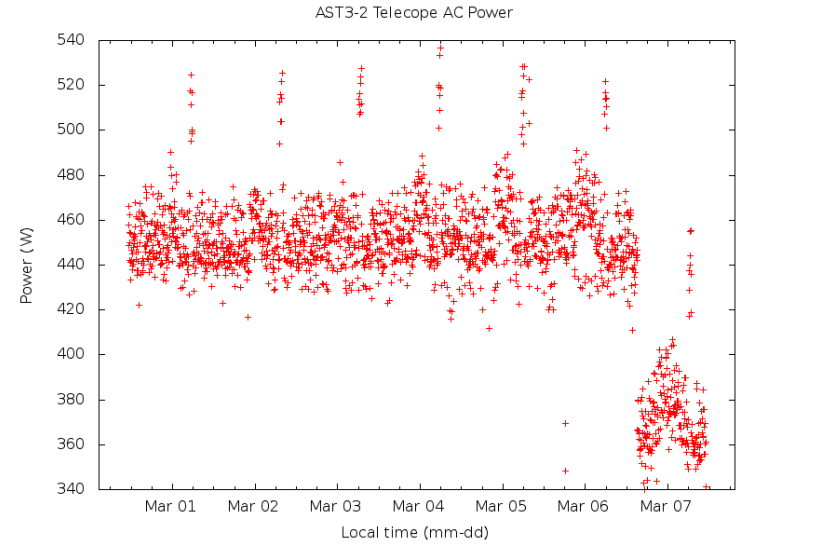


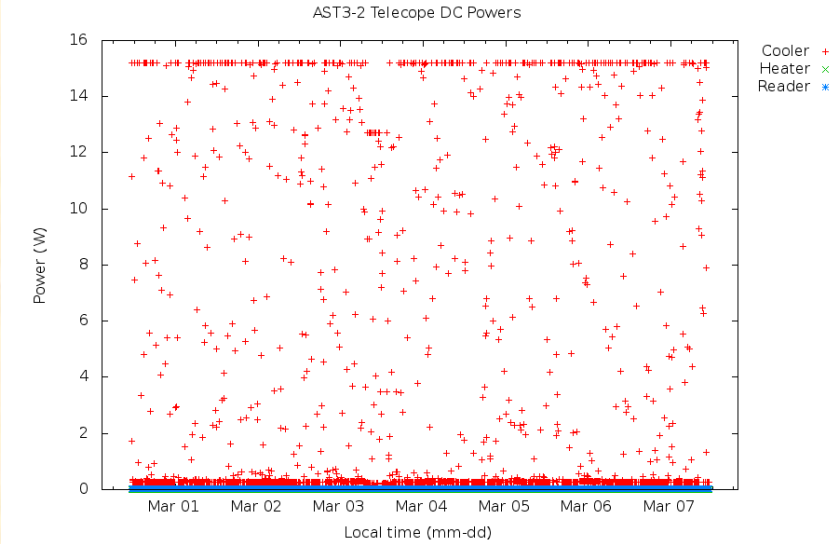
http://aag.bao.ac.cn/ast3-2/

2015 Operation – Live status



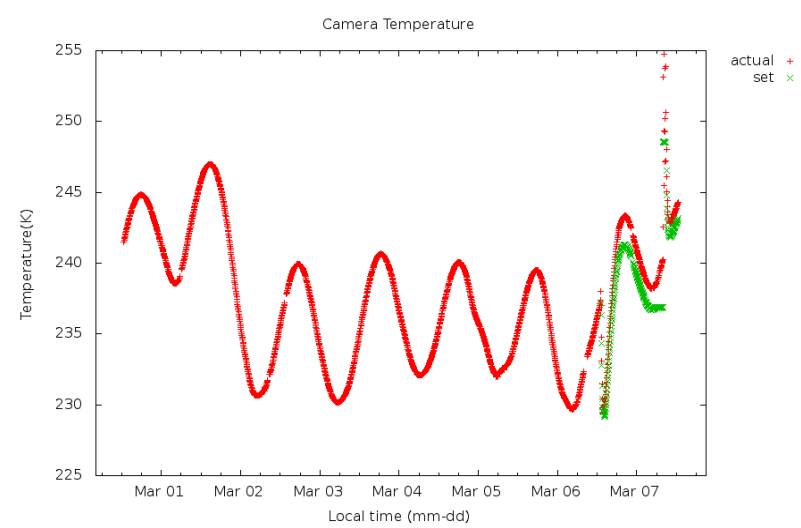


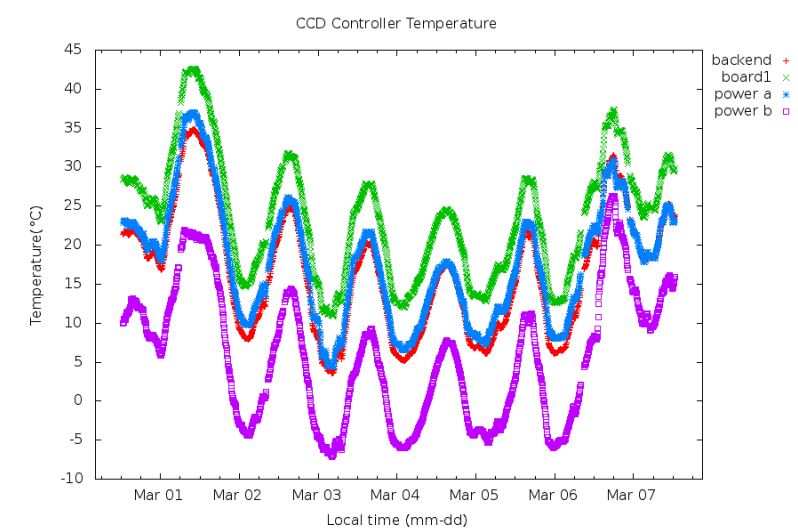


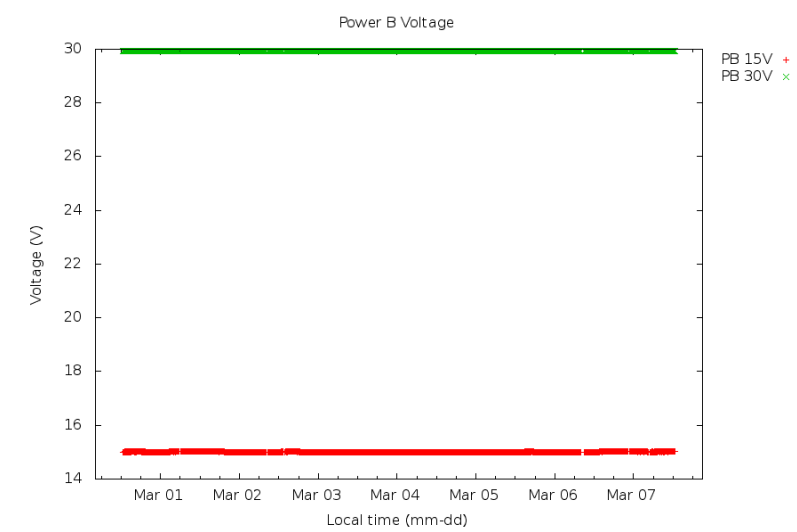


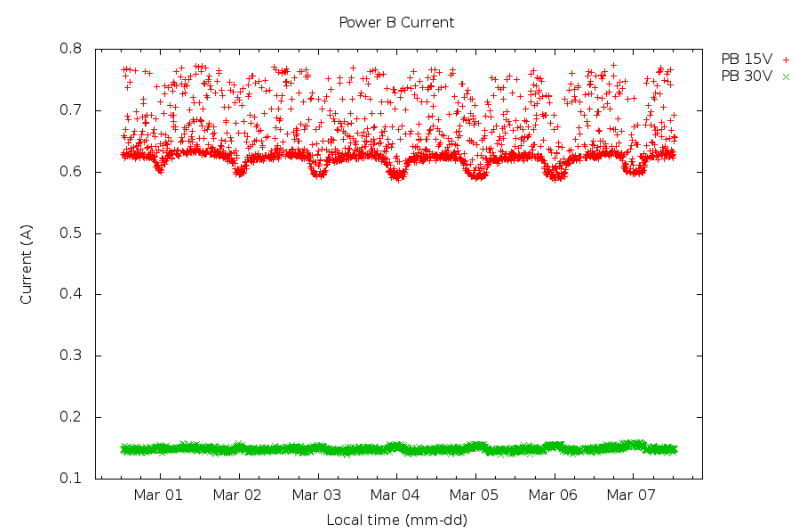
Telescope status

2015 Operation – Live status



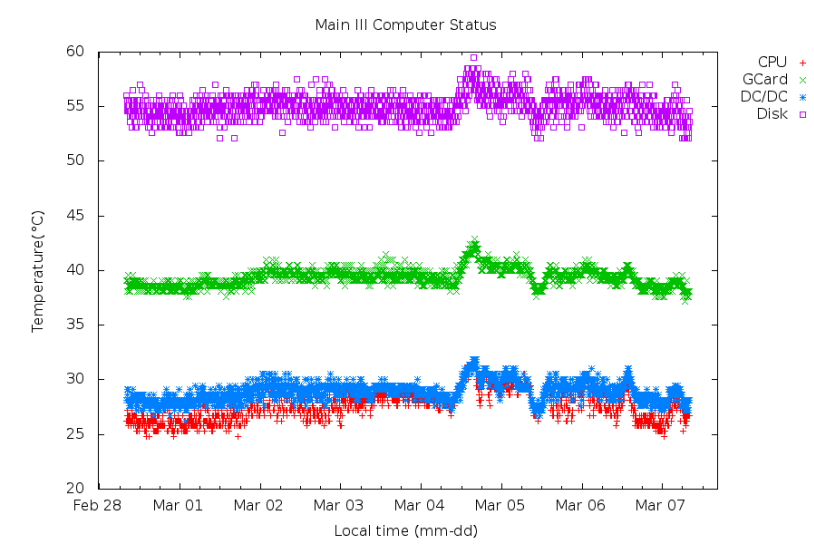


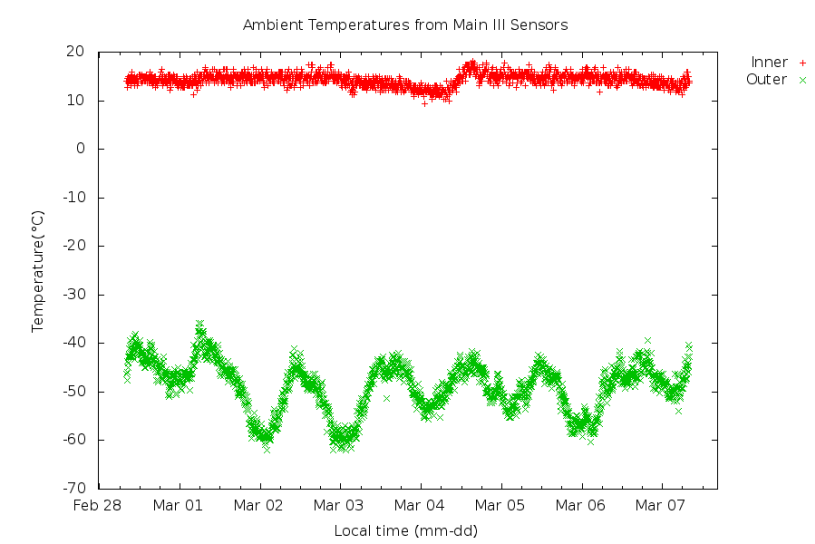


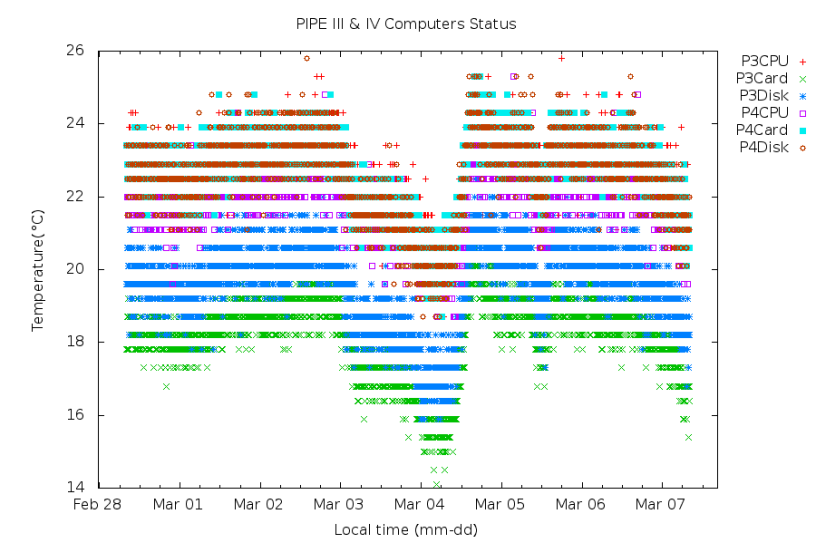


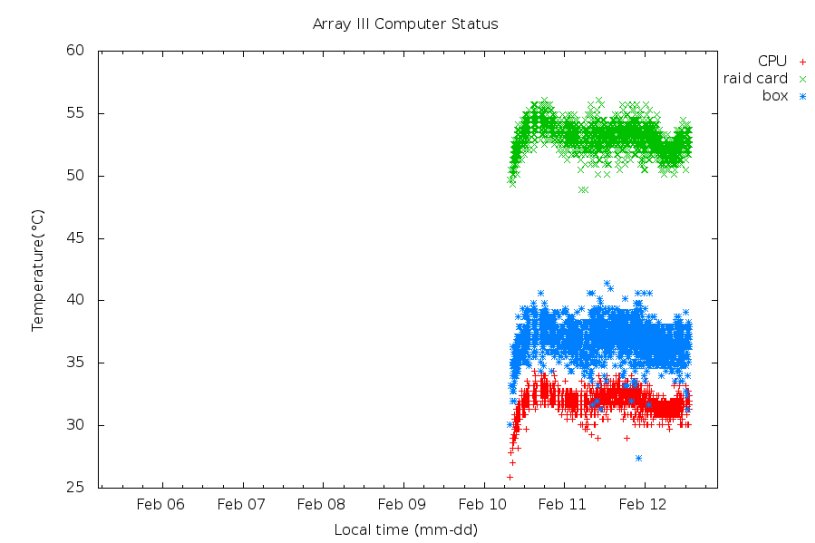
CCD camera status

2015 Operation – Live status









COD (operation) status

2015 Survey Scheduler

Telescope + CCD camera status

- Readout time
  - 2.5 sec for fast mode
  - 40 sec for slow mode
- Exposure time
  - 2.5 min/field (including overhead)

2015 Survey Scheduler (redesigned)

Survey Modes

- SN survey
  - 1000 sq. degrees (about 250 fields)
  - cadence ~ 1 day
  - redesigned to assign different priorities for different fields
- Exo-planet survey mode
  - 2 fields: continuous, repeated observations
- Special mode
  - Observe immediately when triggered

2015 Survey Scheduler

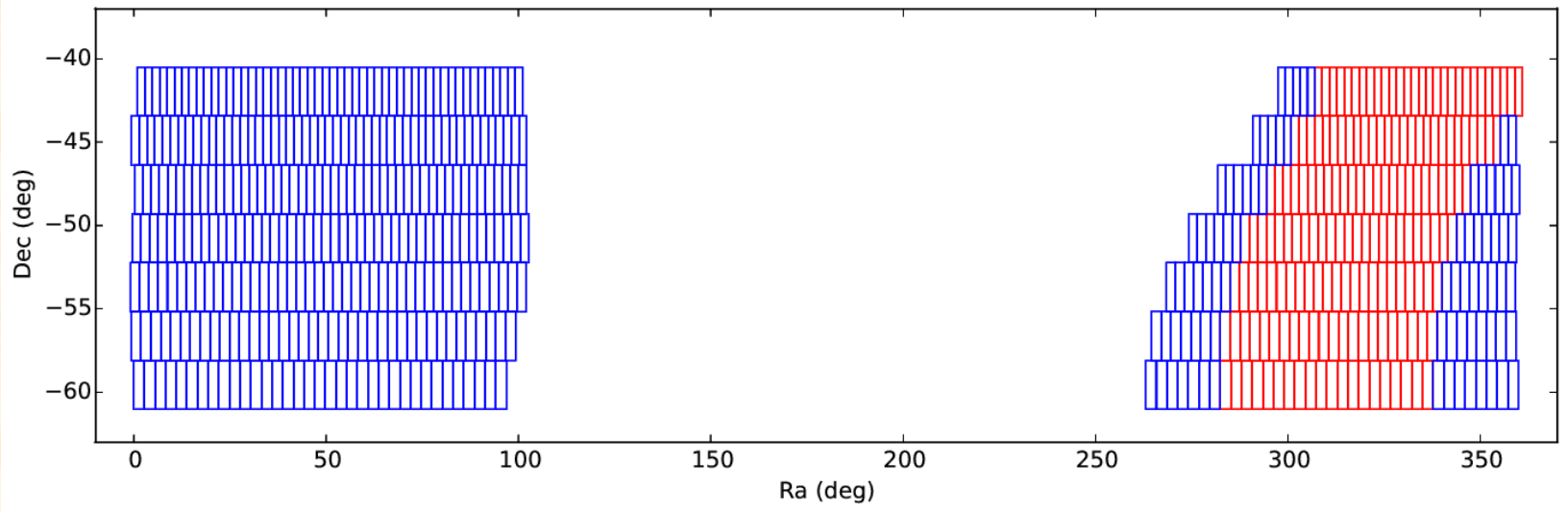
SN Survey

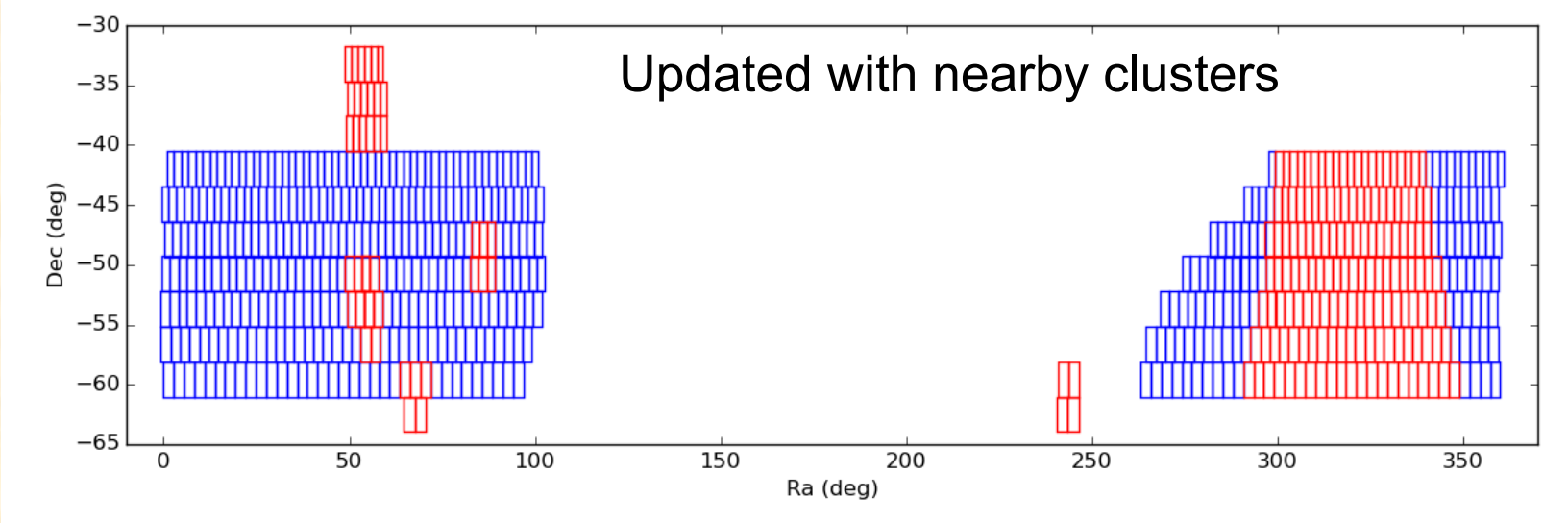
Automatically select the best field from the pre-defined survey areas, maximizing the efficiency.

- Assign priorities to fields
- Galactic latitude > 20°
- Low sky background
  - Sun altitude < -13°
  - Moon distance and phase
- Zenith distance <50°
- Minimize telescope motion

2015 Survey Scheduler

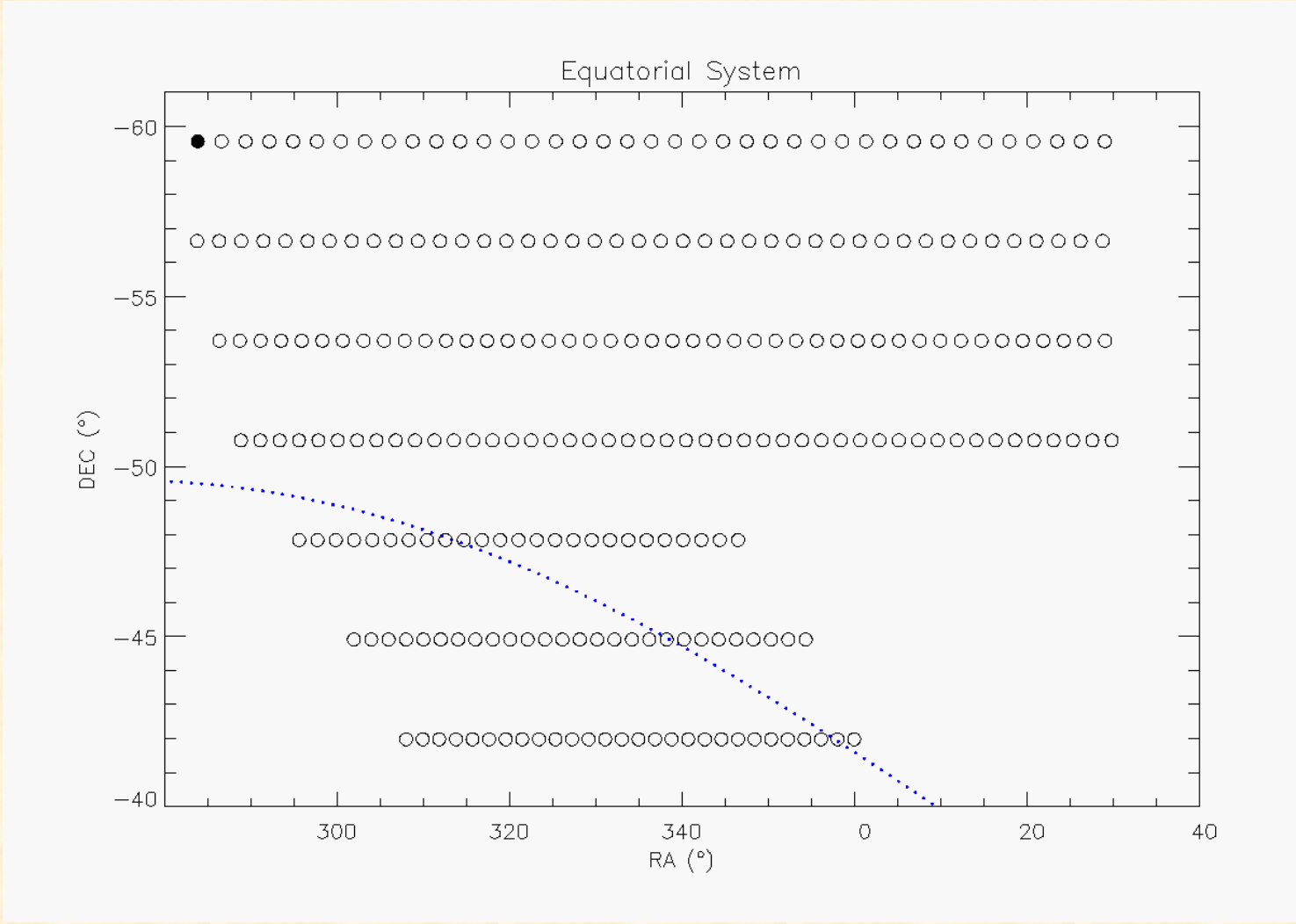
SN survey pre-defined fields (~ 2000 sq. deg, 500 fields)





2015 Survey Scheduling

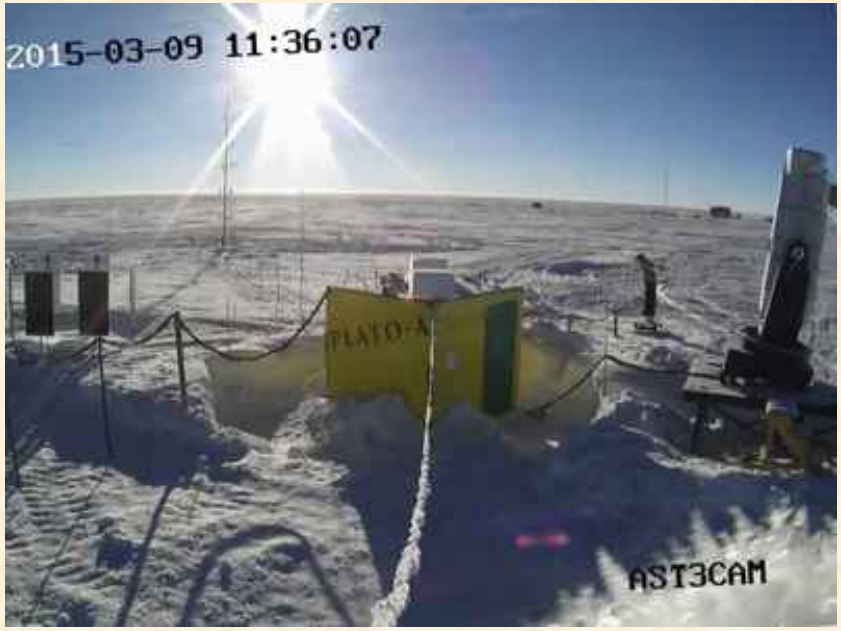
Simulation for June 25, 2015

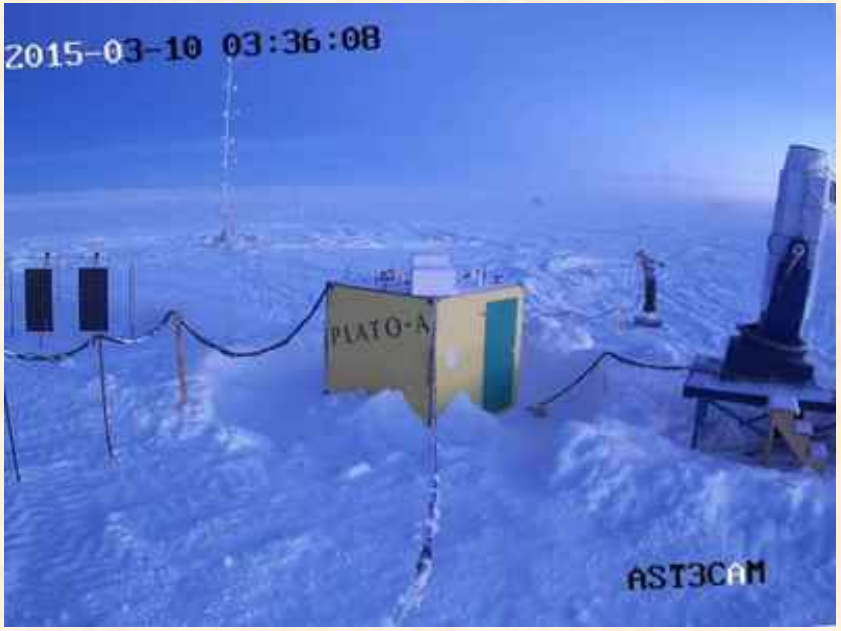


red line: telescope position limit

blue curve: zenith distance=50 deg

It is getting darker at Dome A!





We look forward to a successful observing season.

Thanks!