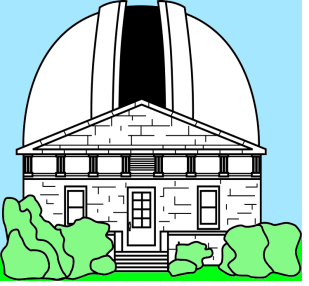


Bright star astrometry using the Gaia reference frame

Norbert Zacharias

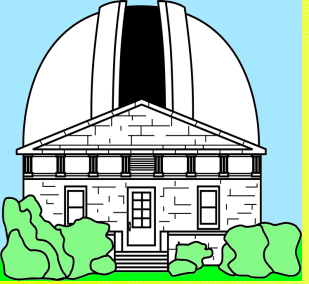
U.S. Naval Observatory

nzIAUc8@gmail.com



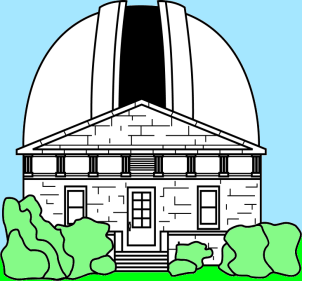
Layout of talk

- URAT project overview
- Bright star observing
- Details, details ...
- Status, plan



URAT project overview

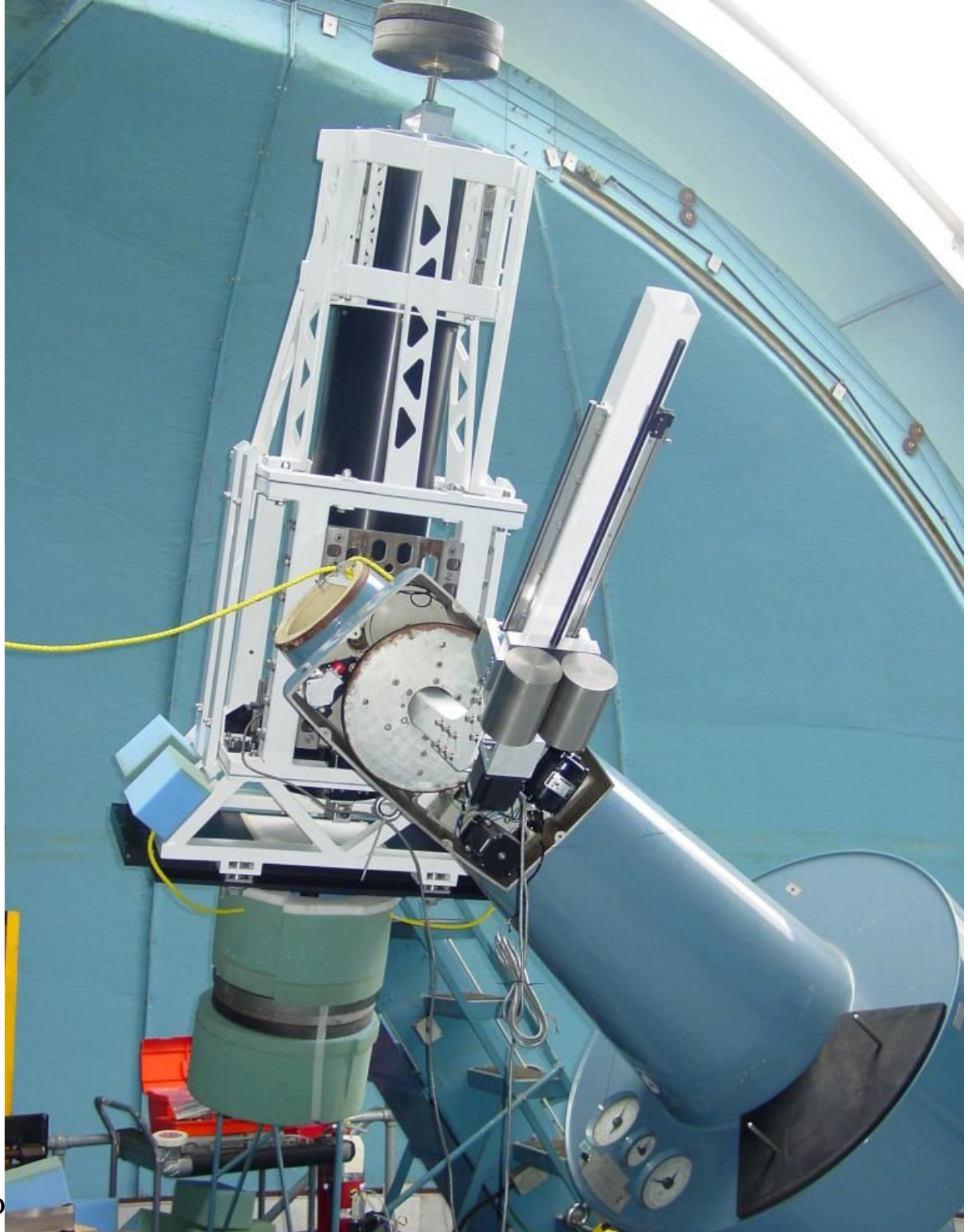
USNO Robotic Astrometric Telescope

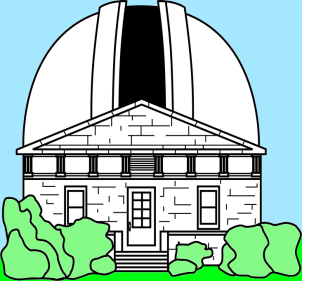


astrograph
May 2009
at USNO

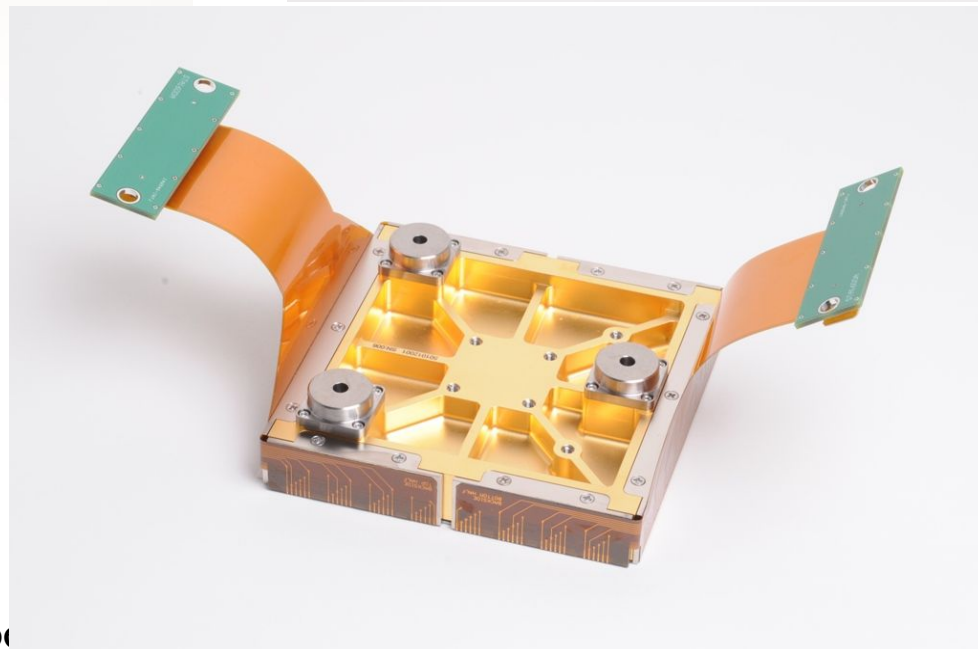
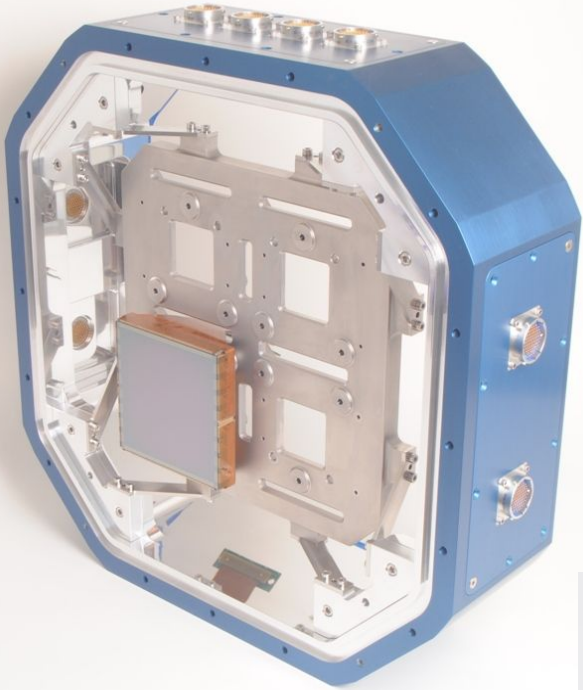
2017 Aug 30

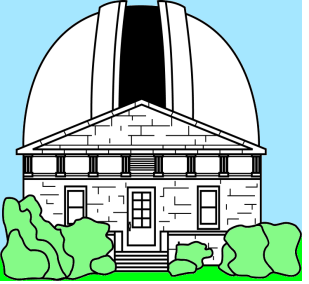
No





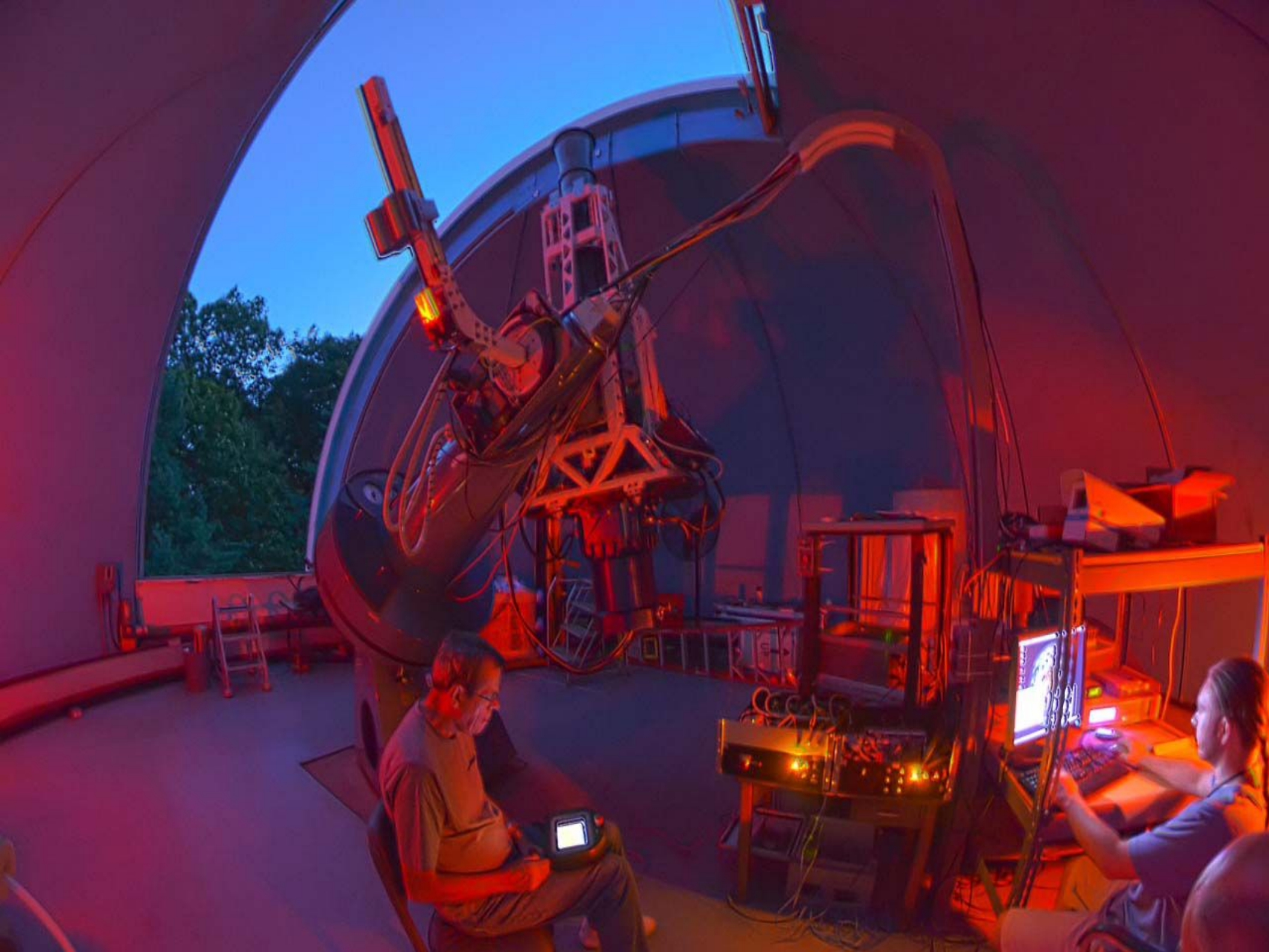
spring 2010, STA CCD packaging

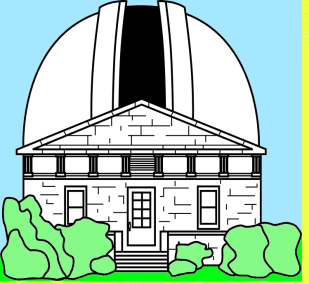




URAT project

- use “red lens” with modified astrograph
- STA detector: (10,560 by 10,560 pixels, 9 um)
 - 10k test camera: 1st light October 2007
 - “4-shooter” camera funded FY08
- URAT observing program
 - 1st light of URAT in Washington, DC: September 2011
 - URAT survey at NOFS: April 2012 – June 2015
 - over 95,000 exposures taken each 28 sq.deg
 - since Oct 2015: bright star survey south (CTIO)
- URAT1 star catalog (Zacharias 2015+, Vizier I/329)
- URAT Parallax Catalog (UPC, Finch 2016+, I/333)



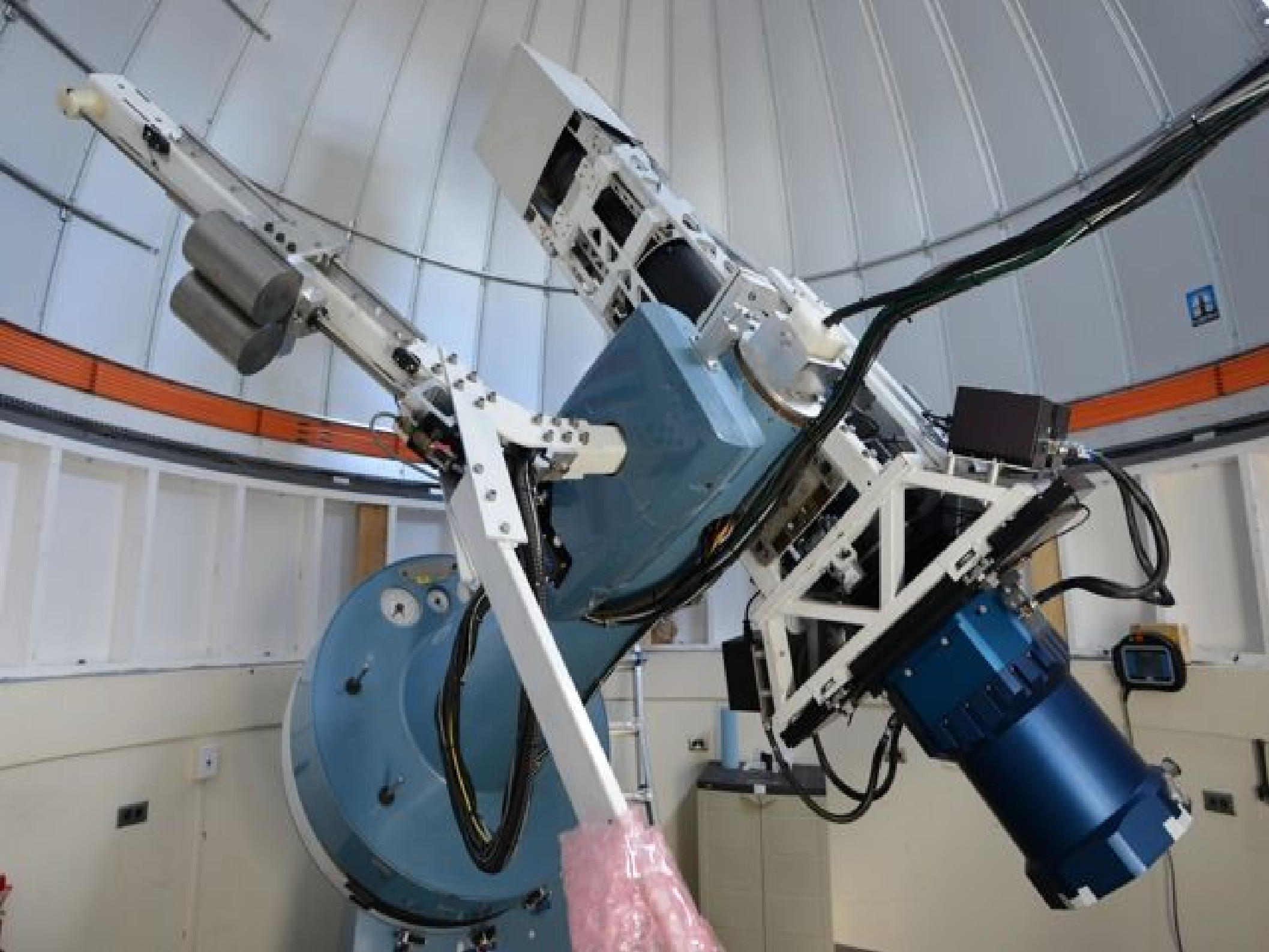


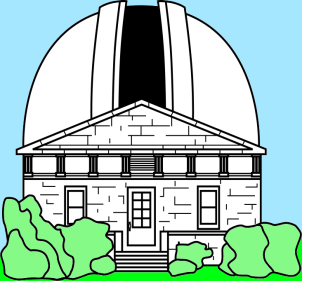
Bright star observing

grating + ND spot

observing at CTIO

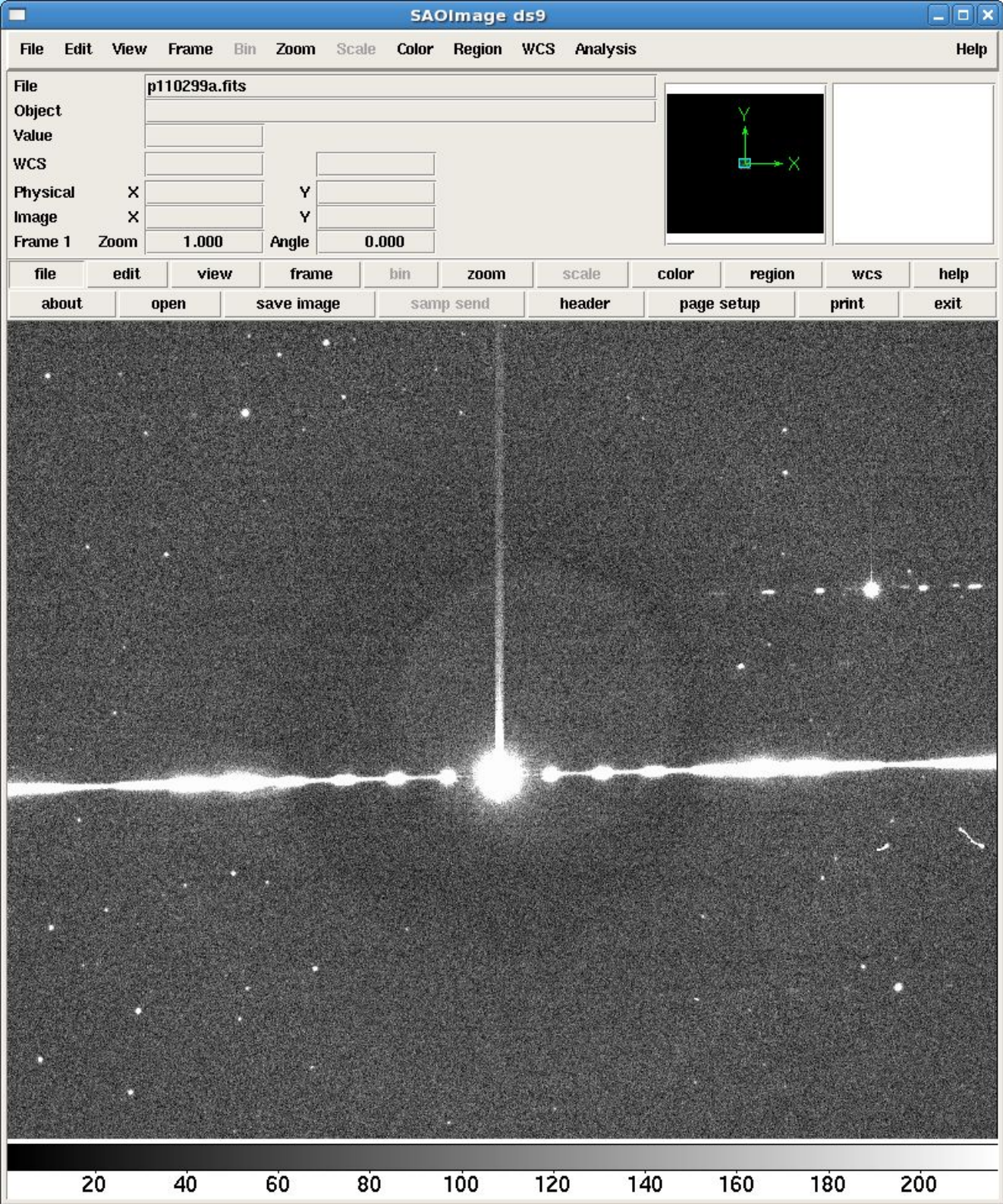




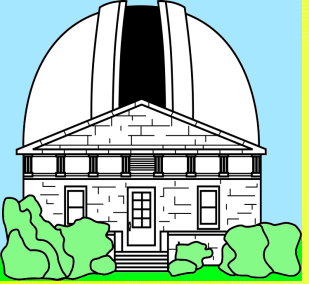


2 surveys at CTIO

- **General** sky survey (-90 to +30 deg Dec):
 - 4.5 mag attenuation **grating**, 60, 30, 2x 10 sec expos. / field
 - covers URAT (about R) mag **3.7 to 16.5**
 - about 50 expos. / year per target
- **Brightest stars** (-90 to +30 deg Dec):
 - 4.5 mag **grating + neutral density spot** (another 4.5 mag)
 - individual target all stars from **Sirius to** about R = **4.5 mag**
 - multiple exposures per pointing, 60, 30, 10, or 5 sec
 - about 20 epochs per year, times numb. expos. each pointing

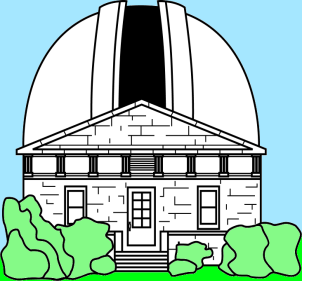


**5 sec
exposure of
Sirius with
ND spot filter
and grating**



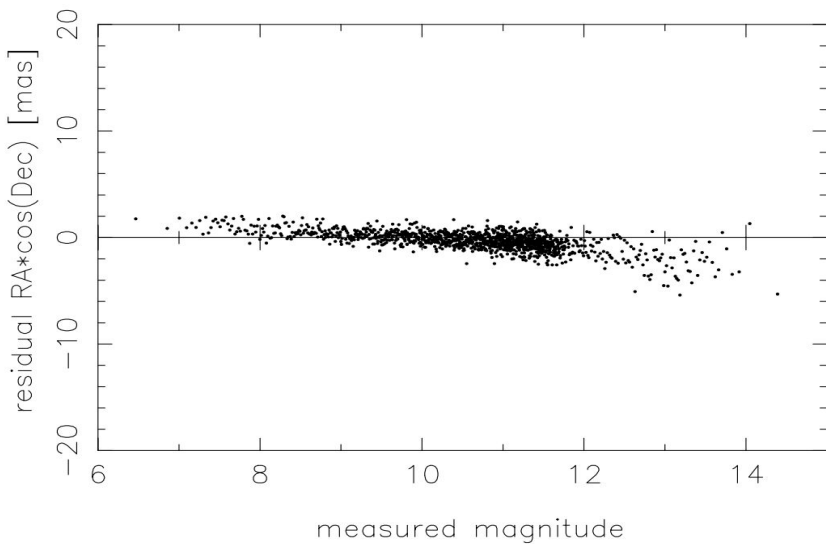
Details, details ...

“odd” CCD, system.error corrections

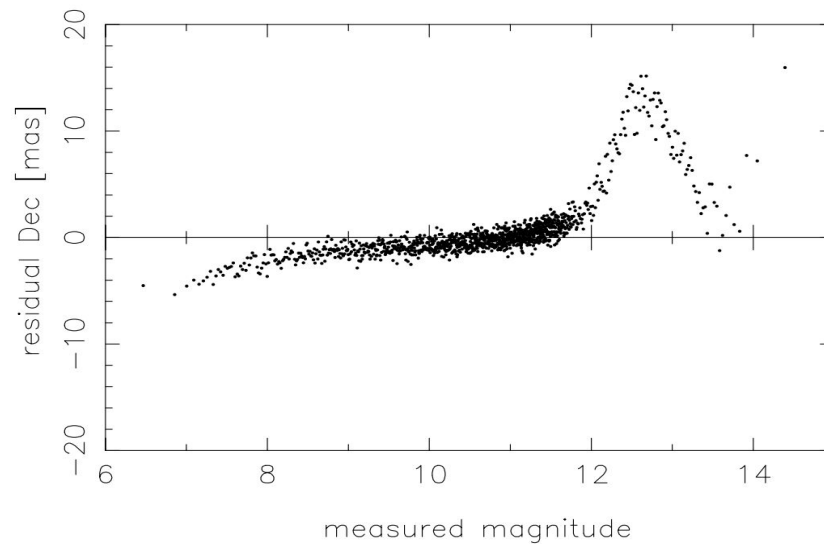


odd residuals CCD #4

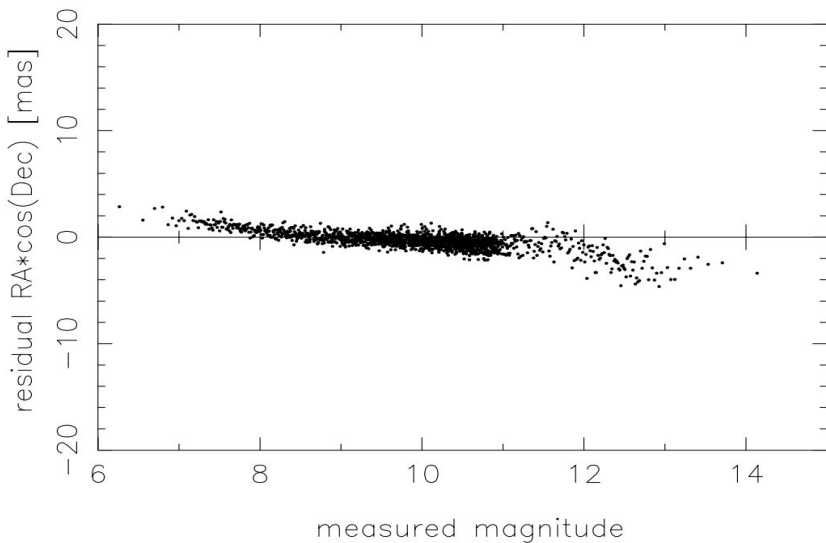
CCD D 30s gif=0,2 bin=2000



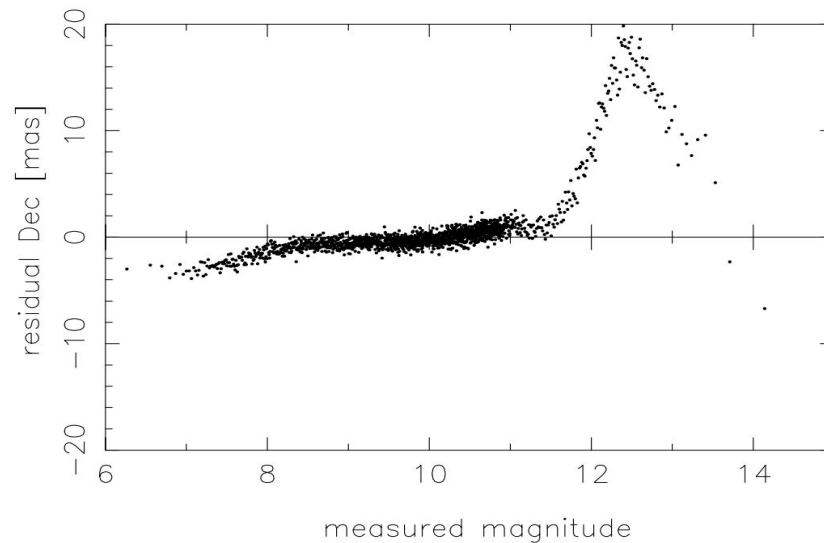
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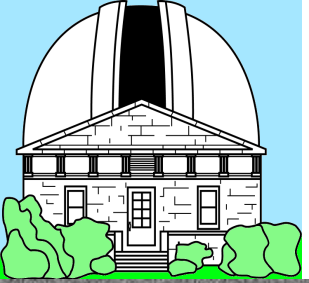


CCD D 60s gif=0,2 bin=2000

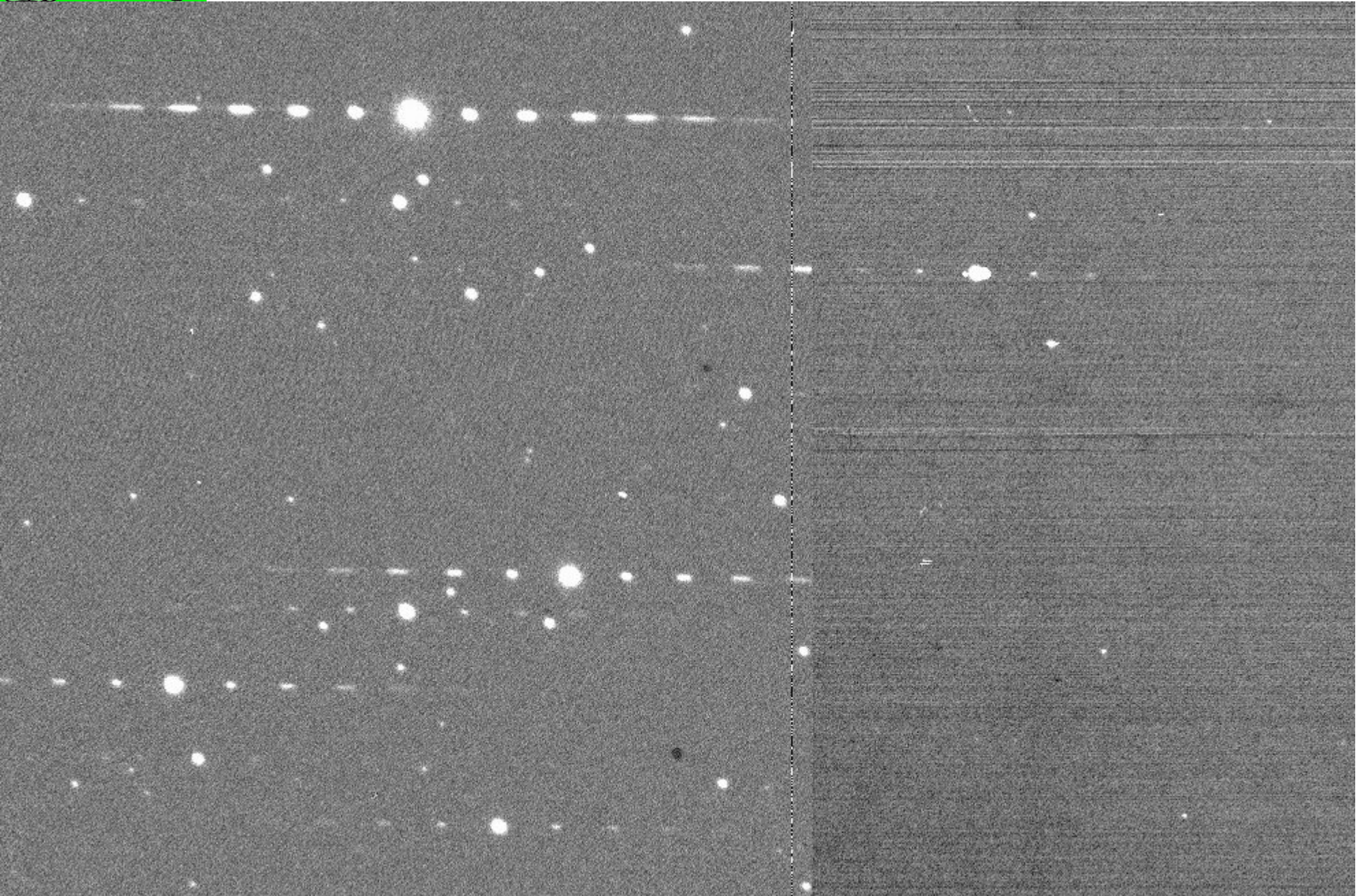


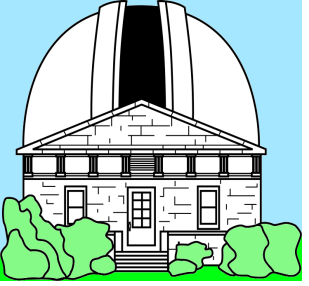
CCD D 60s gif=0,2 bin=2000



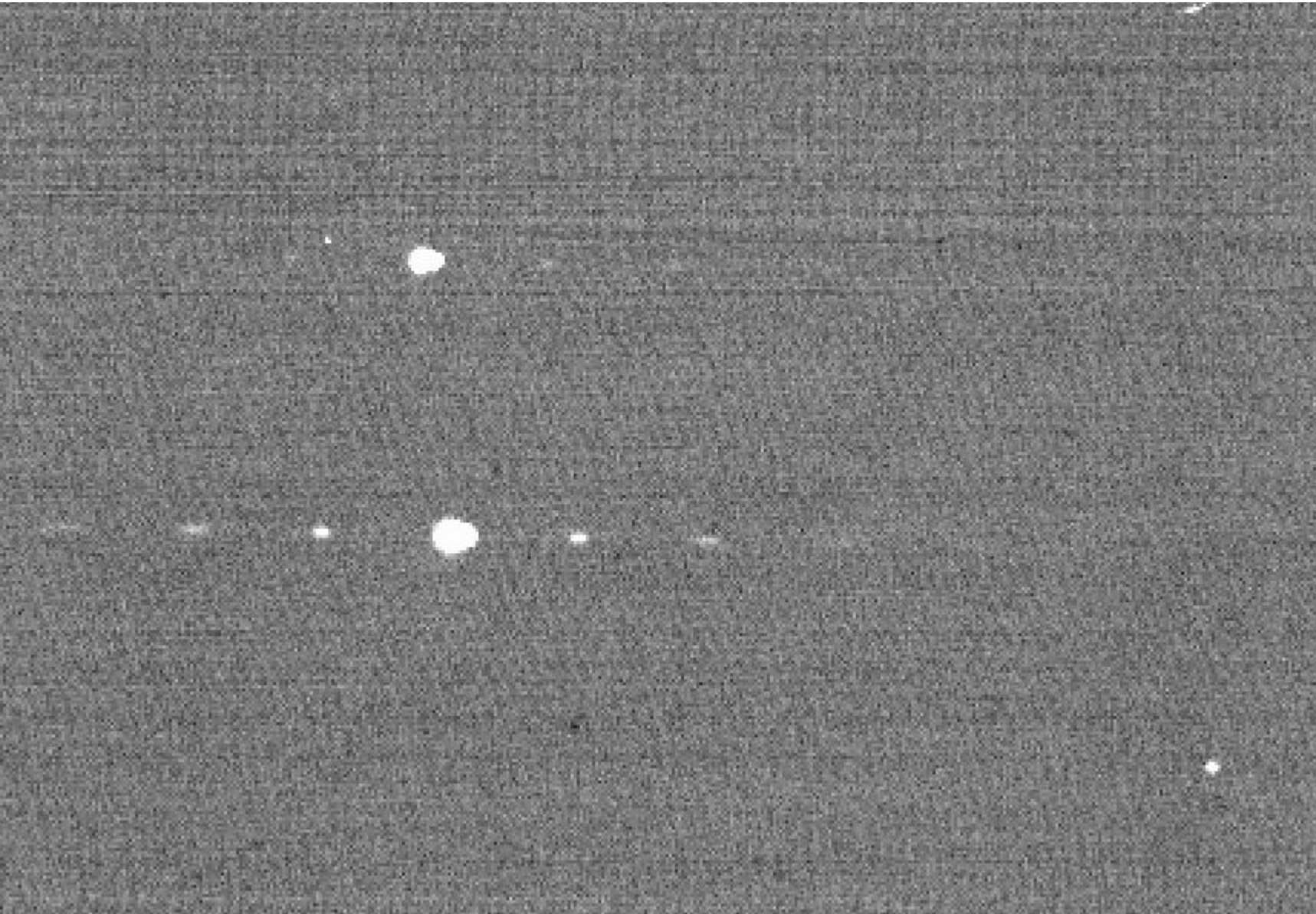


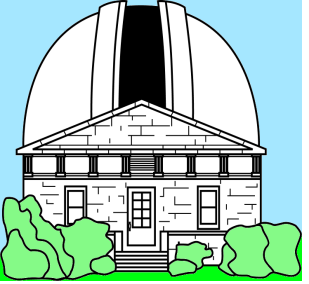
look at pixel data ...





**anomaly of 1 readout port of 8,
later that port went dark**

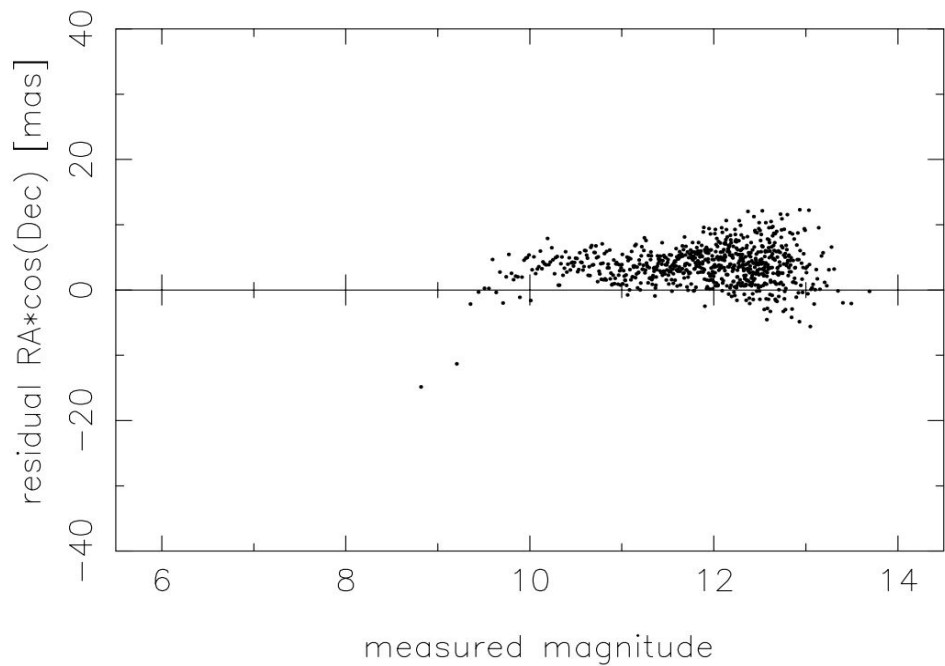




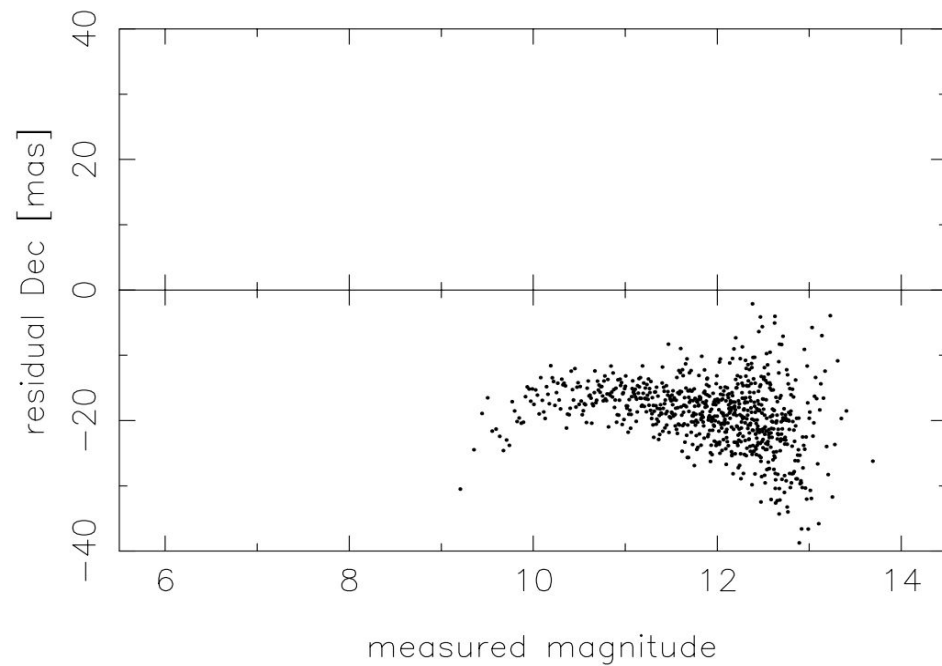
systematic position errors of grating images

- left, right **diffraction images** should be identical
- obtain positions of those slightly elongated images
- take mean position of left and right **1st order images**
- should be **same as central image position**
- in **real life**, of course, this is **not** the case

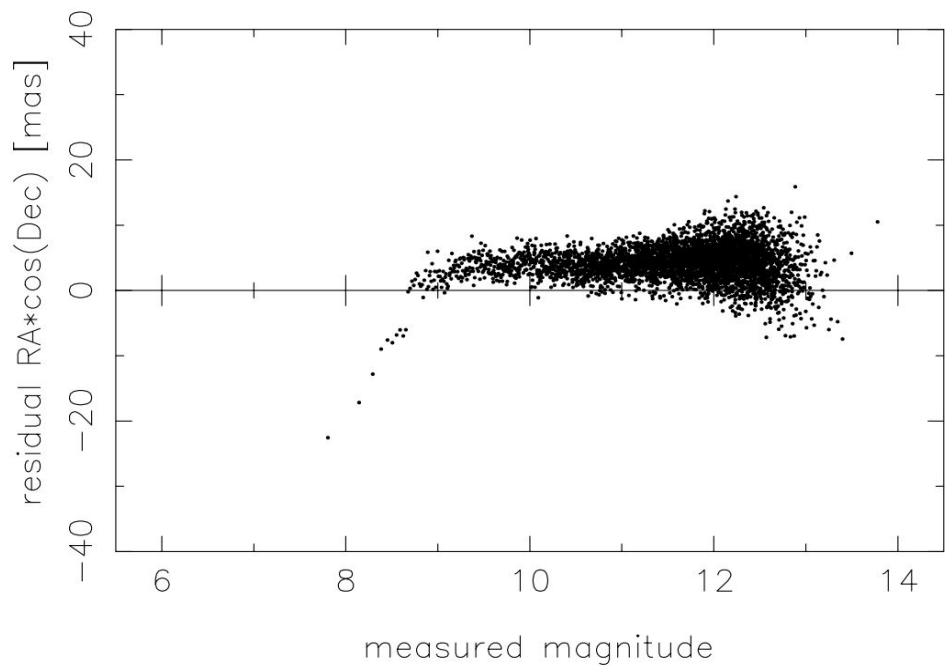
CCD A G15a 30sec gif=1,3 bin= 400



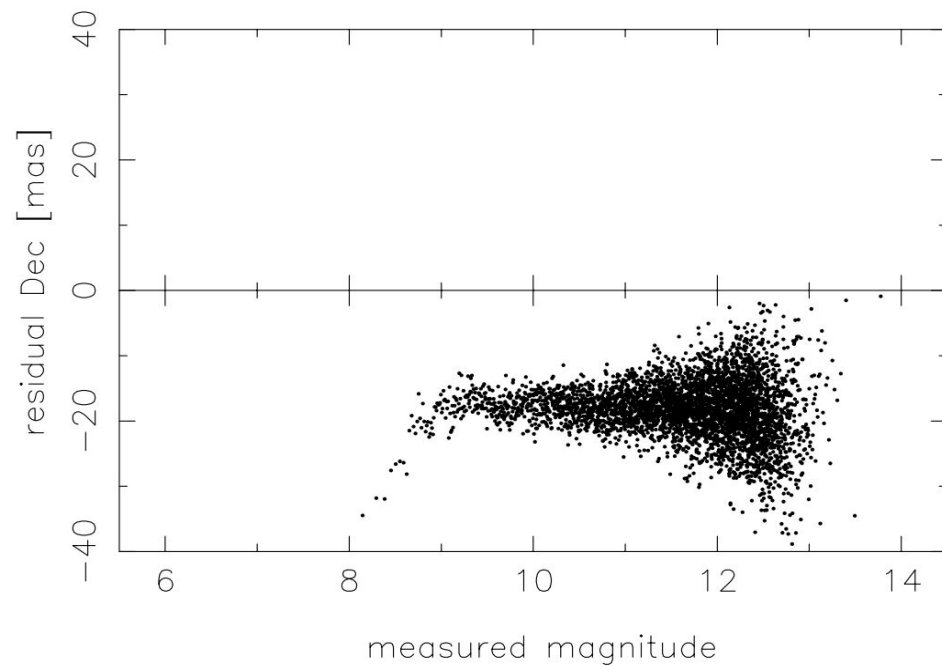
CCD A G15a 30sec gif=1,3 bin= 400

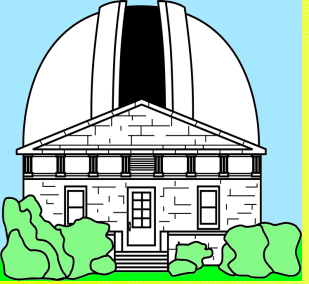


CCD A G15a 60sec gif=1,3 bin= 400



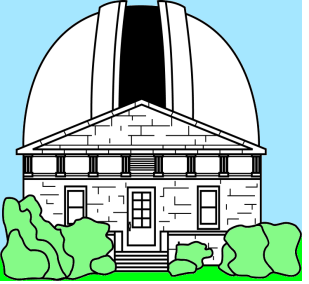
CCD A G15a 60sec gif=1,3 bin= 400





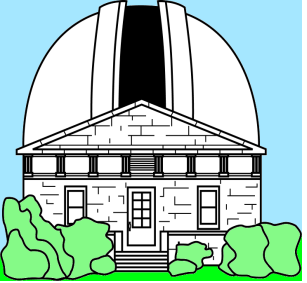
Status, plan

Where are we, what is next?



status of project / to do

- 2 years of observing at CTIO in Oct 2017
- system.error correction model has been derived
- astrometric reductions of 150,000 exposures in progress (using UCAC5 = UCAC + Gaia DR1) as reference frame (i.e. TGAS + proper motion updated fainter stars)
- derive position differences to Hipparcos data at individual epochs for stars not in TGAS
- derive trigonometric parallaxes similar to UPC1 (publish by end of 2017)



Summary

- URAT observations at CTIO, mainly bright stars
- Gaia DR1 + UCAC-DR1 proper motions = reference frame
- use of objective grating plus ND spot filter
- new trig. parallaxes (Dec = -90 to +30, to about 15 mag) coming up by end of 2017 (non-TGAS stars)
- get positions of all bright stars (Dec = -90 to +30)
 - multiple epochs per year
 - compare to Hipparcos and Gaia data
 - publish early 2018