Automatizing the CAHA 2.2m telescope for a polarimetric survey ?

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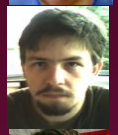
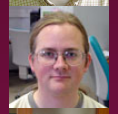
CDTI, Madrid, 23rd March, 2012.

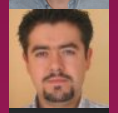
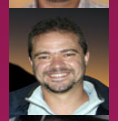
• The IAA-CSIC group: Who are we?









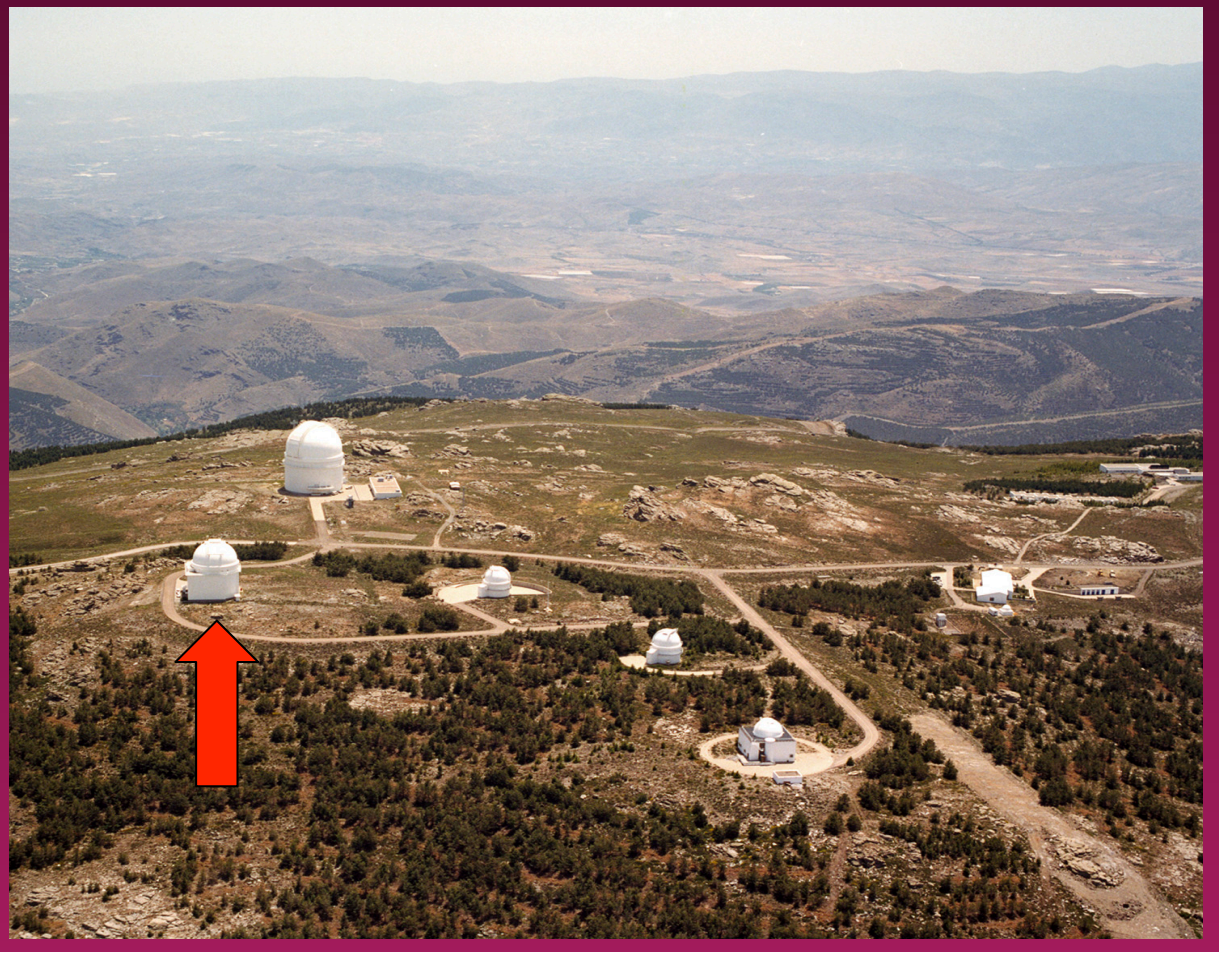





- Alberto Castro-Tirado. IAA. Permanent staff.
- Petr Kubanek. IAA. PhD Student.
- Martin Jelínek. IAA. PhD Student.
- Javier Gorosabel. IAA. Permanent Staff.
- Ronan Cunniffe, IAA. Engineer.
- Sergey Guziy, Nikolaev Observatory, Ukraine.
- Yuri Ivanov. Optician. Univ. of Crimea, Ukraine.
- Antonio de Ugarte Postigo. IAA. Postdoc.
- Ovidio Rabaza. University of Granada. Engineer.
- Óscar Lara Gil. University of Malaga. Engineer.
- Rubén Sánchez Ramírez. IAA. PhD Student University
- Juan Carlos Tello. IAA. PhD Student University

- Introduction.
  - ✓ The CAHA observatory and the 2.2m telescope.
- Automatizing the 2.2m CAHA telescope.
  - ✓ The RTS2 software.
- A polarimetric pathfinder survey for the 2.2m CAHA telescope?
  - ✓ The EDIPO polarimeter.
- Summary

• Calar Alto Observatory (CAHA):

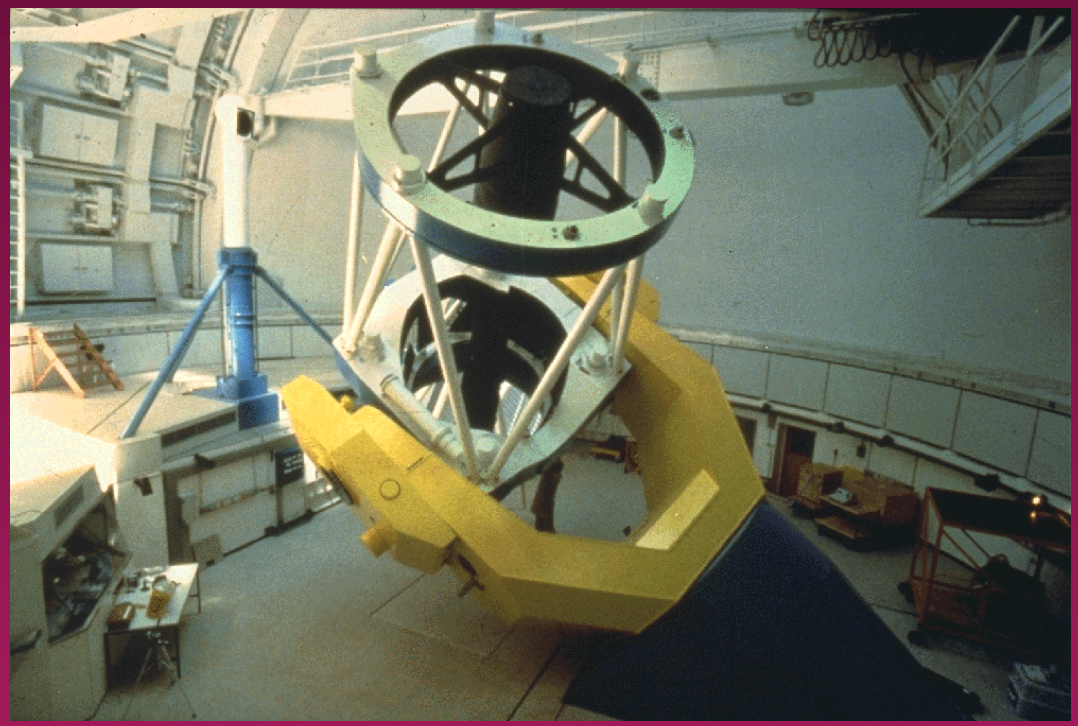
- ✓ Operated by IAA-CSIC (Granada) and MPIA (Heidelberg).
- ✓ Altitude of 2168 m. Province of Almería.
- ✓ Astronomically useful nights ~70% (Sánchez et al. 2007).
- ✓ Median seeing ~0.9” (Sánchez et al. 2007).
- ✓ Main telescopes:
  - 1.23 m
  - 2.2 m
  - 3.5 m
  - 1.5 m OAN
  - 0.8 m Schmidt



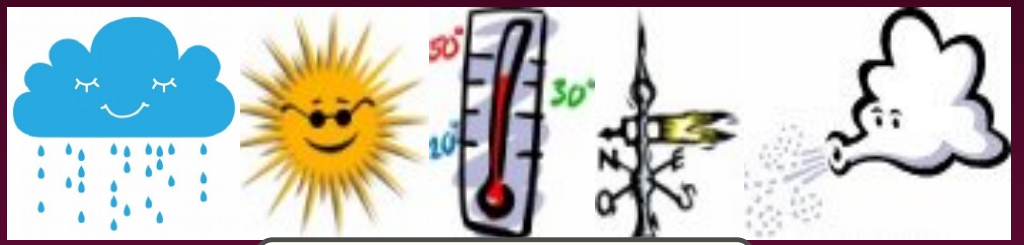
- The 2.2 m telescope at a glance:

- ✓ Opening in 1979.
- ✓ Built by C. ZEISS (Oberkochen).
- ✓ Mainly the cassegrain focus is used.

Aperture	2.2m
Optic system	Ritchey-Crétien
Focal ratio	f/8
FoV total	67’
Aberration free FoV	~33’



- Interaction of rts2 with the EPICS data-base

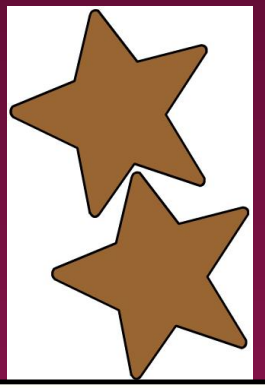


Meteo station

3.5m

2.2m

EPICS



DIMM extinction, monitor

1.23m

rts2

FITS header

- Robotizing the 2.2m with RTS2

✓ RTS2 is a public code running autonomously the telescope, dome, instruments, meteo-stattion, astrometry and archiving.

✓ The RTS2 code is the base of the PhD Thesis of Petr Kubanek.

✓ Its installation at the 1.23m CAHA telescope is almost completed.

✓ RTS2 is designed to avoid interferences with the previously installed control systems.

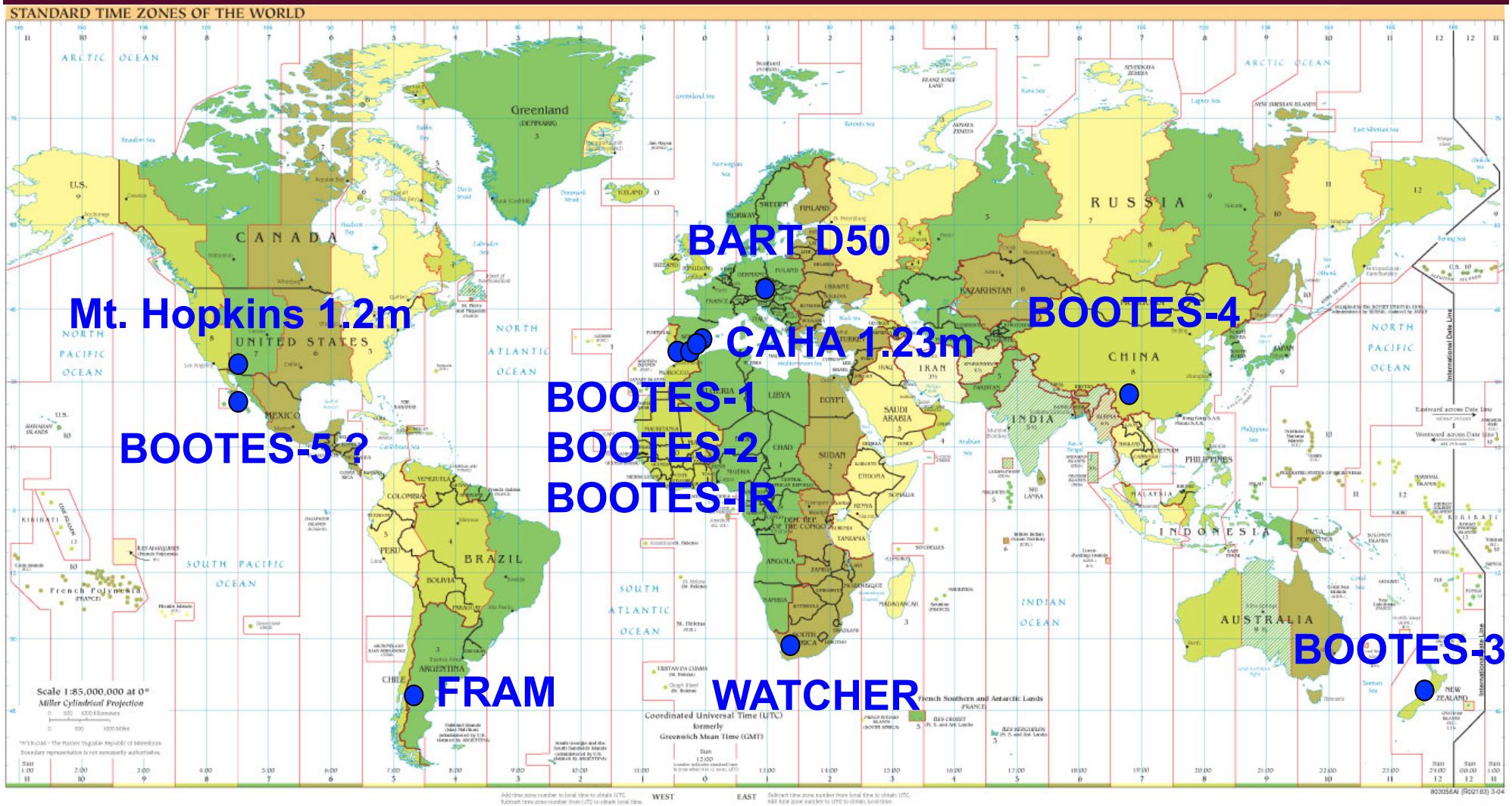
✓ RTS2 supports sockets with high-energy satellites to respond automatically to triggers (GRBs, magnetars, etc…).

✓ RTS2 can follow up solar system objects throught its connection to the Minor Planet & Comet Ephemeris Service.

✓ RTS2 in the process of handling ephemeris to observe space debris.

• Distribution of RTS2 network

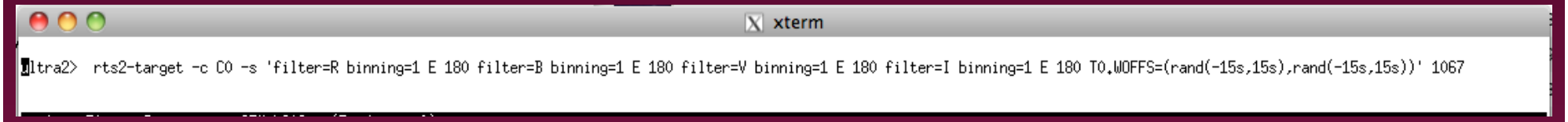
- ✓ Where is rts2 used?

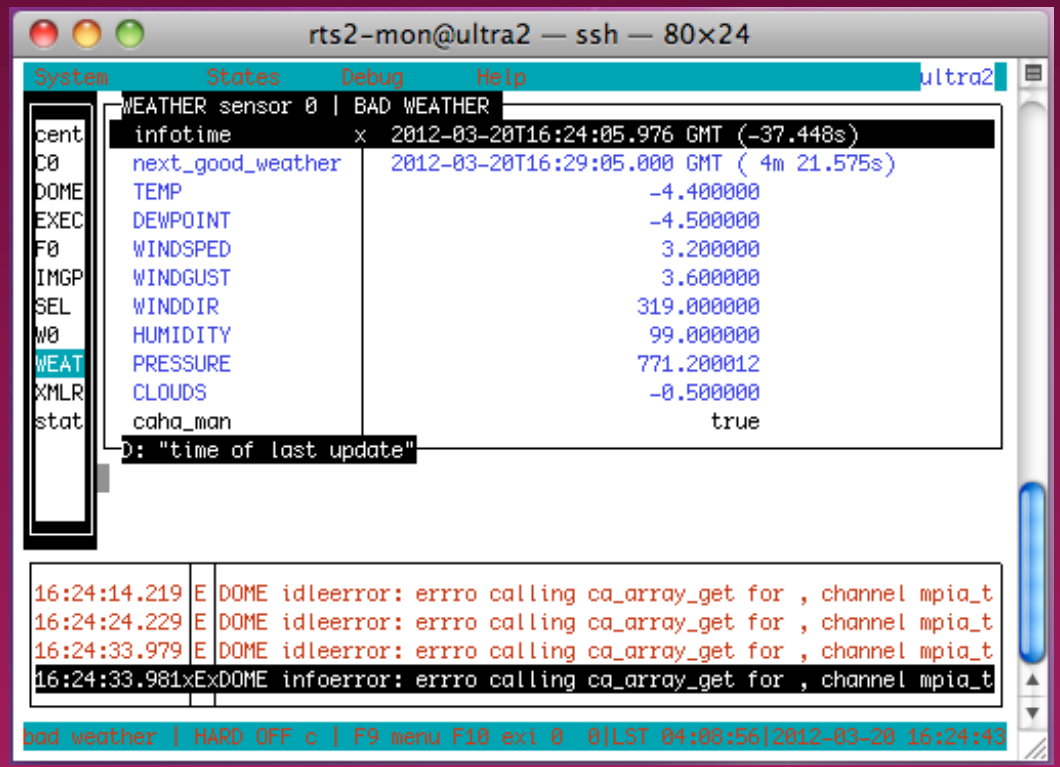


- RTS2 *(http://www.rts2.org)*:

✓ Engineering mode (detailed information).

- The Dome, telescope, camera controlled with a single xterm !
- Full weather information.
- Queues and scripts built with line commands.

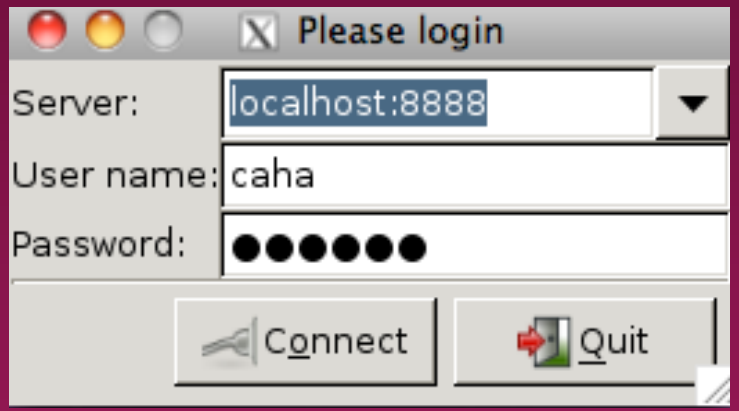


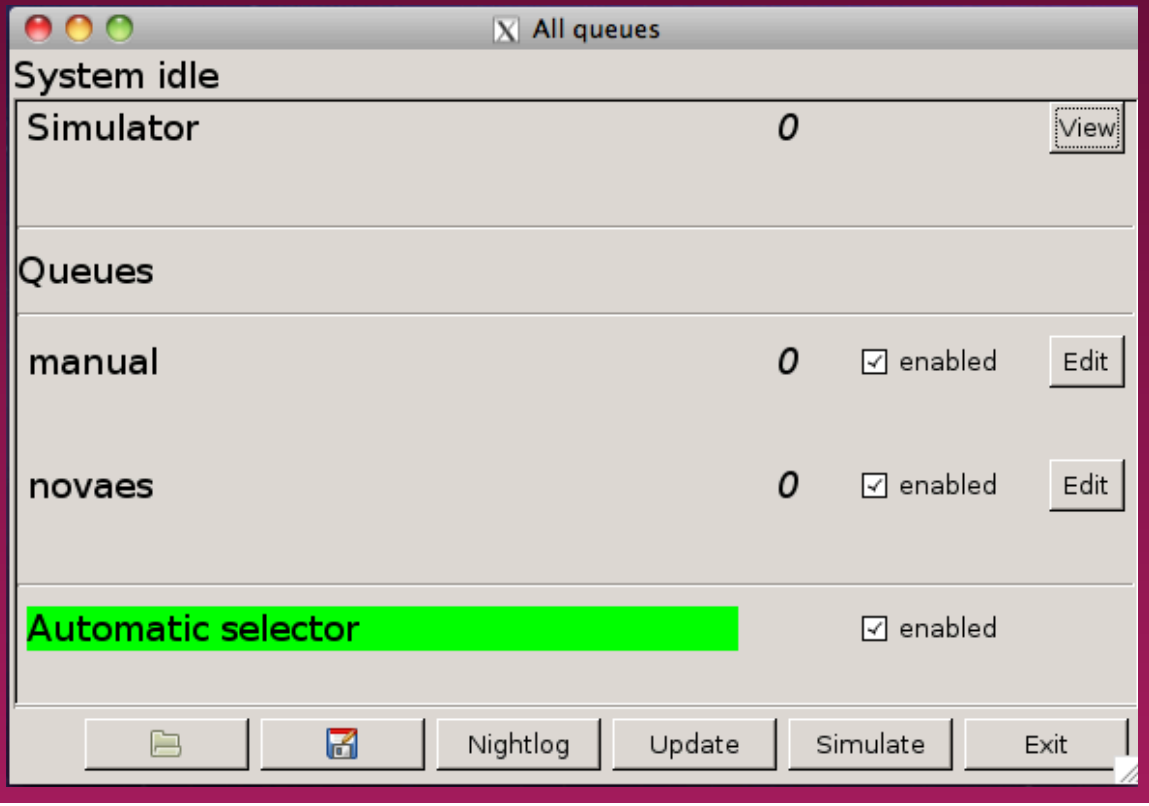


- RTS2 *(http://www.rts2.org)*:

✓ Observer mode (Friendly).

- Queues are constructed either by an Automatic Selector or manually.
- The result of the queue can be simulated.
- A manual queue of 1 element = remote observation by an on-line observer.

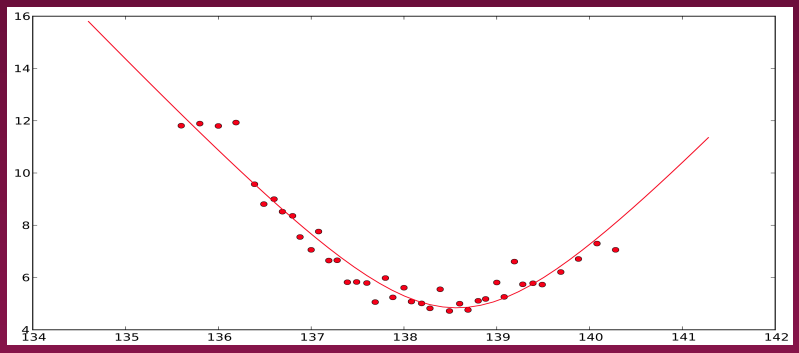


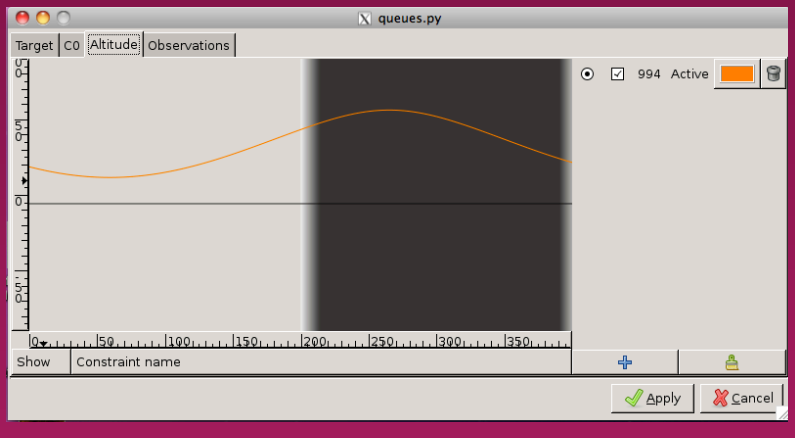


- RTS2 *(http://www.rts2.org)*:

✓ Observer mode (Complete).

- Based on a bank of targets.
- Each target has a label.
- The bias, flat field and focus sequence are considered as targets with dedicated labels.





queues.py

Group: *** ALL ***

Target name: 4

Minimal altitude: -90

Target ID	Target Name	RA	DEC
520	PG1514+034	15:17:14.000	+03:10:27.00
537	107 456	15:38:43.000	-00:19:47.00
538	107 457	15:38:46.000	-00:20:15.00
541	107 458	15:38:50.000	-00:24:27.00
542	107 459	15:38:51.000	-00:22:31.00
554	107 614	15:39:42.000	-00:13:10.00
557	107 484	15:40:17.000	-00:21:13.00
560	107 640	15:40:50.000	-00:16:48.00
561	G153 41	16:17:55.000	-15:35:52.00
563	-12 4523	16:30:18.000	-12:39:08.00
570	108 1848	16:36:58.000	+00:05:57.00
571	108 475	16:37:00.000	-00:34:40.00
576	PG1647+056	16:50:18.000	+05:32:53.00
582	-4 4226	17:05:15.000	-05:05:05.00
585	109 949	17:44:13.000	-00:02:28.00
586	109 954	17:44:15.000	-00:02:17.00
598	110 340	18:41:29.000	+00:15:22.00
599	110 477	18:41:43.000	+00:26:41.00
601	110 246	18:41:51.000	+00:05:20.00
602	110 346	18:41:55.000	+00:10:00.00
603	110 349	18:42:13.000	+00:10:14.00
611	110 364	18:42:52.000	+00:07:54.00
614	110 496	18:42:59.000	+00:31:08.00
616	110 497	18:43:02.000	+00:30:56.00
618	110 499	18:43:07.000	+00:28:00.00
620	110 504	18:43:11.000	+00:30:05.00
625	110 441	18:43:34.000	+00:19:40.00
628	110 450	18:43:52.000	+00:22:58.00
641	112 704	20:42:02.000	+00:19:10.00
653	113 440	21:40:35.000	+00:41:45.00
659	113 342	21:41:00.000	+00:27:34.00
661	113 241	21:41:09.000	+00:25:50.00
662	113 245	21:41:13.000	+00:21:51.00
663	113 459	21:41:15.000	+00:43:04.00
665	113 466	21:41:28.000	+00:40:14.00
668	113 475	21:41:51.000	+00:39:19.00
673	113 34	21:41:59.000	+00:01:07.00
675	113 149	21:42:06.000	+00:09:27.00
680	113 491	21:42:25.000	+00:43:53.00
681	113 492	21:42:28.000	+00:38:21.00
682	113 493	21:42:29.000	+00:38:10.00
683	113 495	21:42:30.000	+00:38:07.00

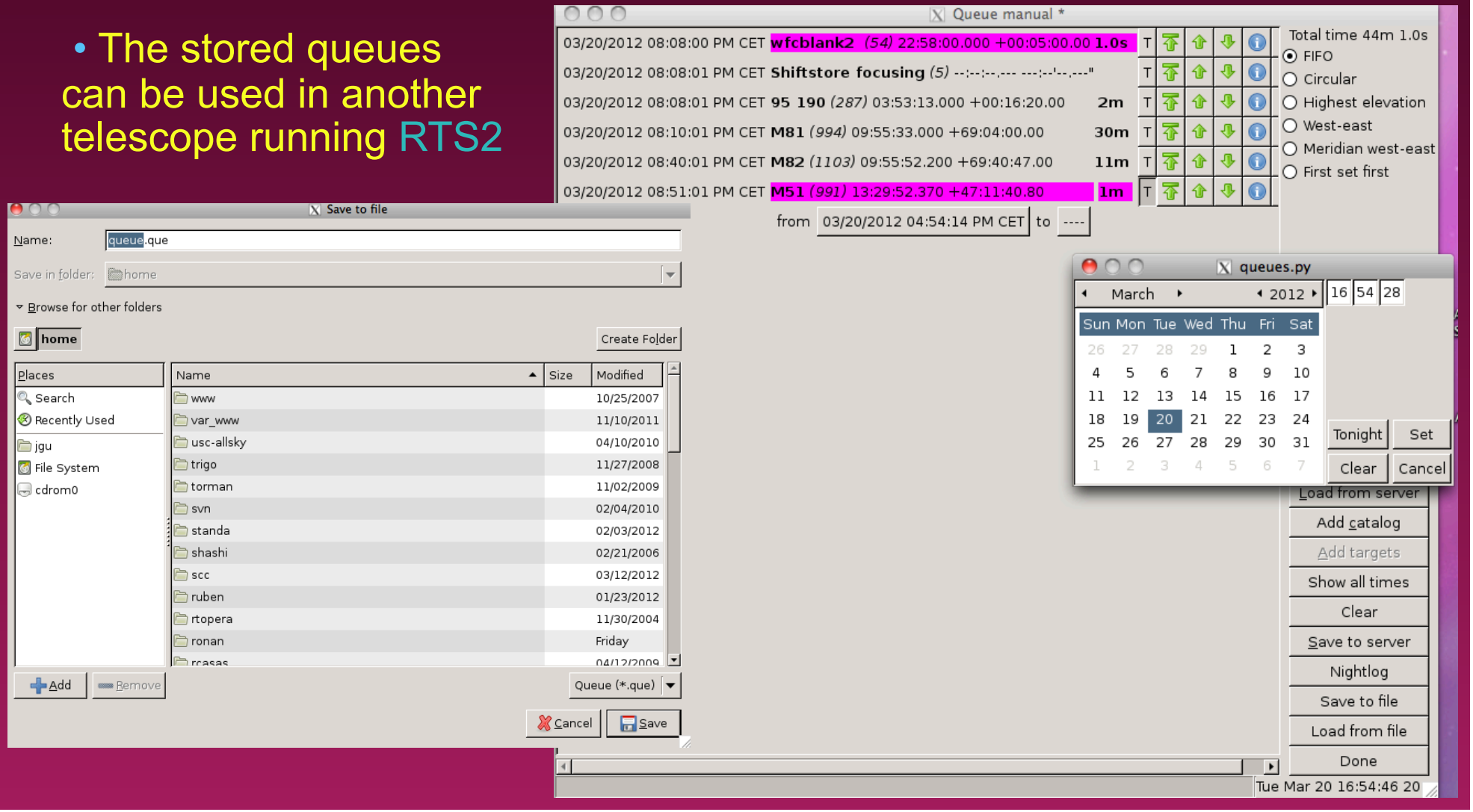
Add Exit

- RTS2 *(http://www.rts2.org)*:

✓ Observer mode (reproducible).

- The queues can be stored for a further night.

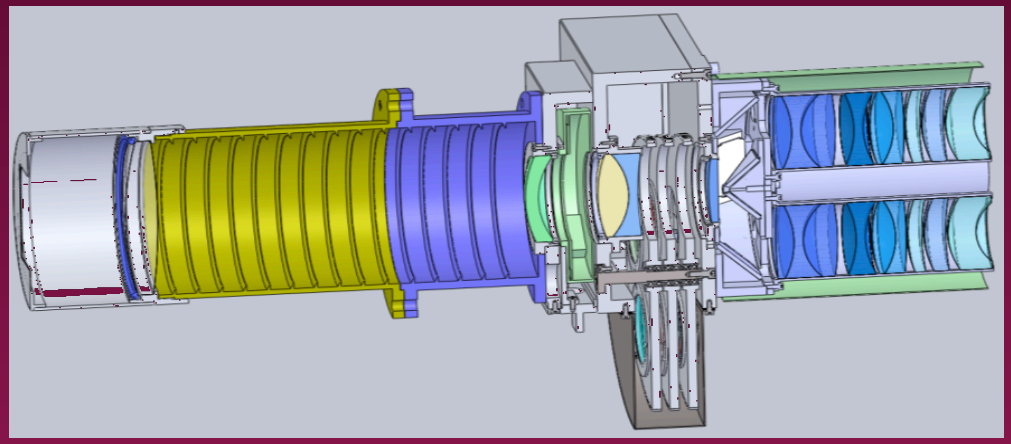
- The stored queues can be used in another telescope running RTS2

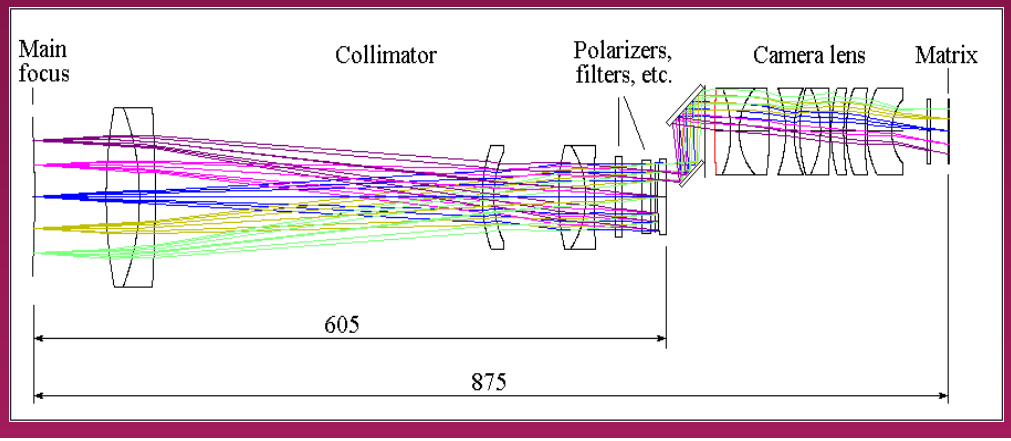


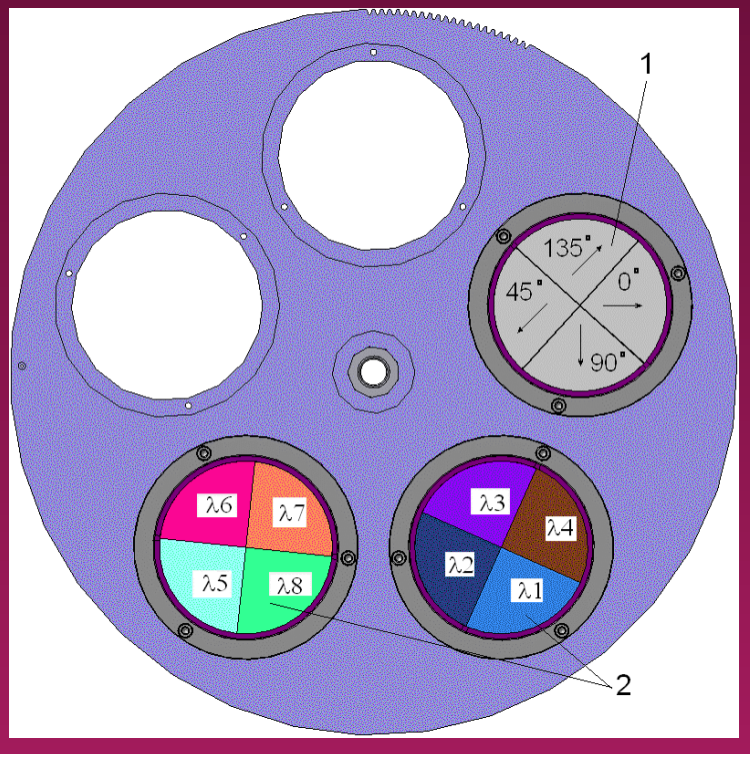
• The EDIPO optical polarimeter.

- ✓ Designed to measure simultaneously the Stokes parameters *Q* and *U*.
- ✓ Based on polarid films, dividing the parallel beam if 4 identical parts.
- ✓ The filter wheel allows a multiband simultaneous ugrz -band mode.
- ✓ 4 identical CCDs and 3 filter wheels.

$$Q = (I_o - I_{90}) / (I_o + I_{90})$$
$$U = (I_{45} - I_{-45}) / (I_{45} + I_{-45})$$

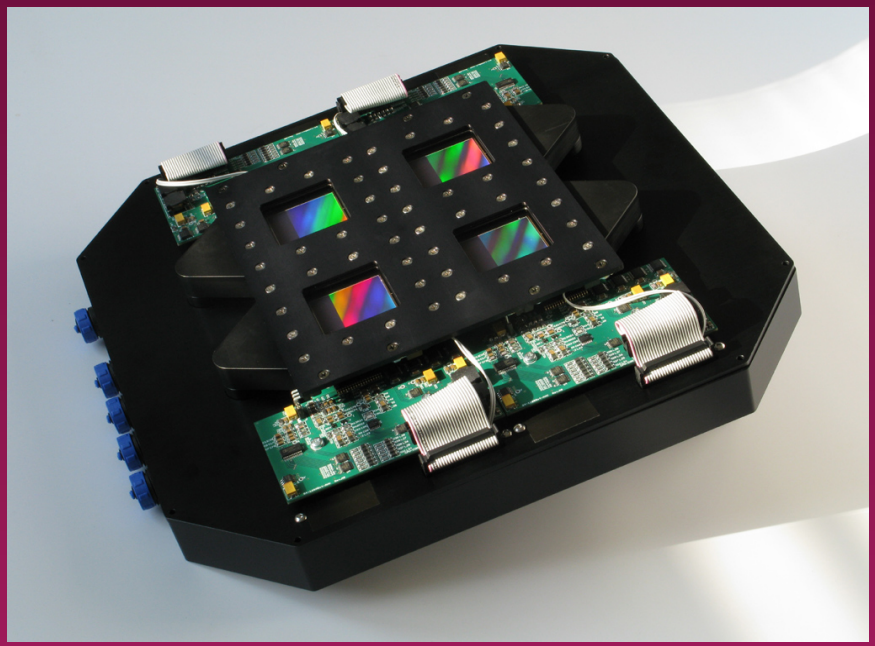


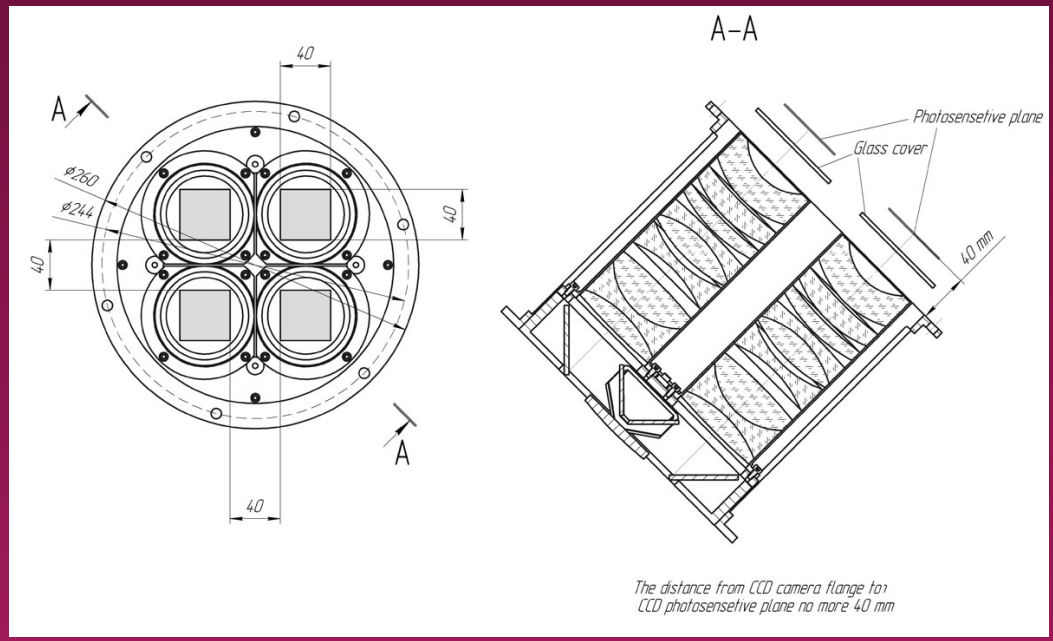




• The EDIPO optical polarimeter.

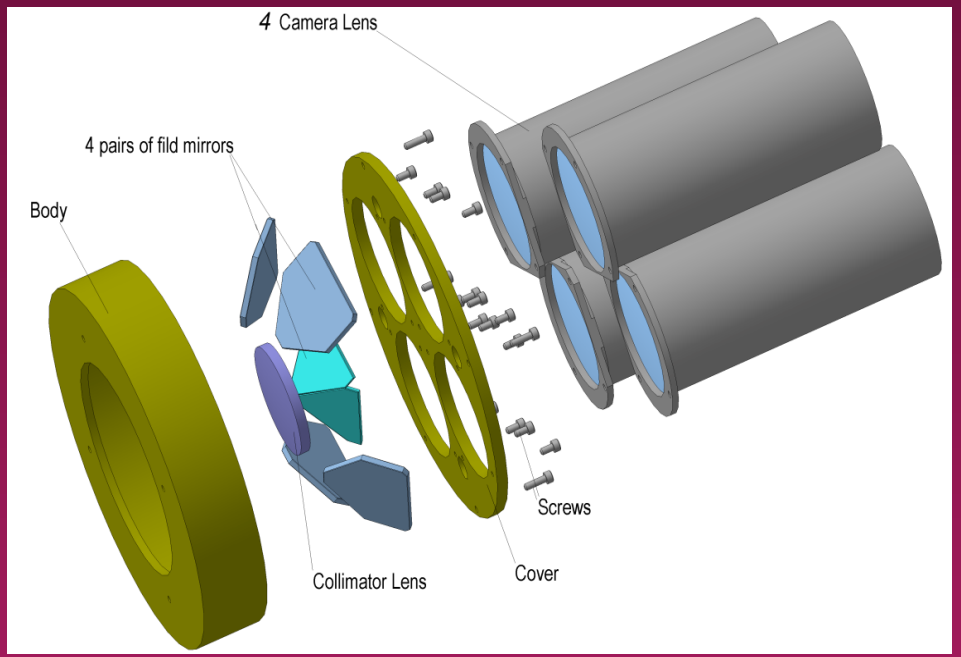
- ✓ Four KODAK KAF-16803 4k x 4k.
- ✓ Peltier cooling in 2 phases. T ~ 230 K.
- ✓ Pixel size = 9μm ➔ 0.28 “/pix.
- ✓ EDIPO has a FoV of 19’ x 19’ < 2.2m CAHA aberration free FoV.
- ✓ Cost 250 K€.

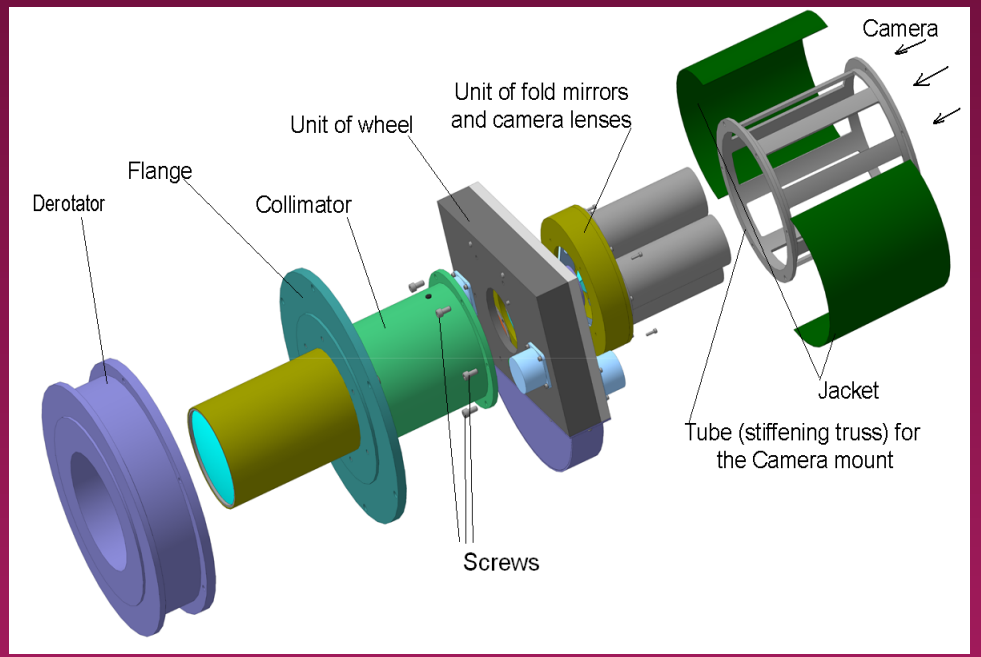




• The EDIPO optical polarimeter.

- ✓ Currently under construction. Finished for the end of 2012.
- ✓ Not sensitive to atmospheric variations.
- ✓ Polarimetric accuracy of 0.1% for sources *R*<16 in Texp = 1 hour.
- ✓ Equipped with a λ/4 plate it can also measure *V (circular polarimetry)*.
- ✓ EDIPO has been designed for an f/8 telescope like the 2.2m CAHA.





• An EDIPO pathfinder survey at the 2.2m?

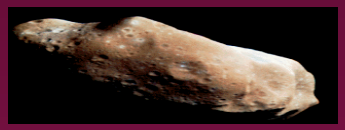
✓ Polarimeters tend to have smaller FoVs than the one of EDIPO.

✓ Most polarimetric surveys so far only map small regions.

✓ RTS2 queues are optimized to do routinary observations like surveys:

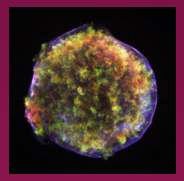
- Map the large-scale Galactic magnetic field.

- Polarimetric surveys of asteroids.



- Polarization monitoring of AGNs.

- Explosion geometries in supernovae.



- Small-scale magnetic field of star forming regions.

- Magnetic field configuration in the ejecta of GRBs.

- Polarimetric monitoring of comets.

- Summary

1. The RTS2 control system fully integrated in the EPICS of CAHA

2. The RTS2 control system already running at the 1.23m CAHA telescope

Easily transportable to the 2.2m CAHA telescope

3. The EDIPO polarimeter is fully compatible with the 2.2m CAHA optical system

4. The EDIPO polarimeter would provide novel science, with a broad range of science cases

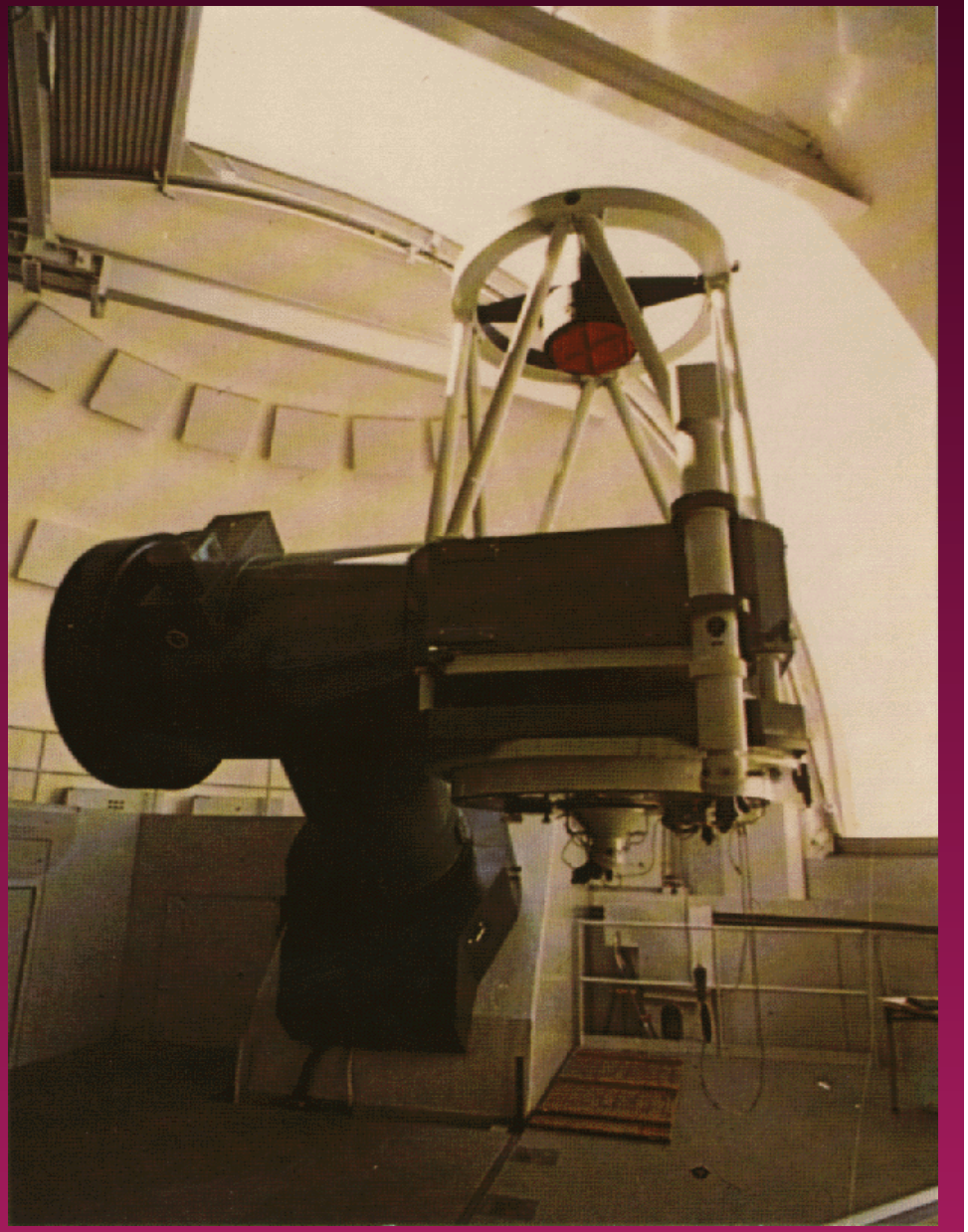
The combination of EDIPO + RTS2 + 2.2m is a **cheap**, **realistic** and **efficient** project that would provide unique science.


The End
28.01.2006 22:36

• The 1.23 m telescope at a glance:

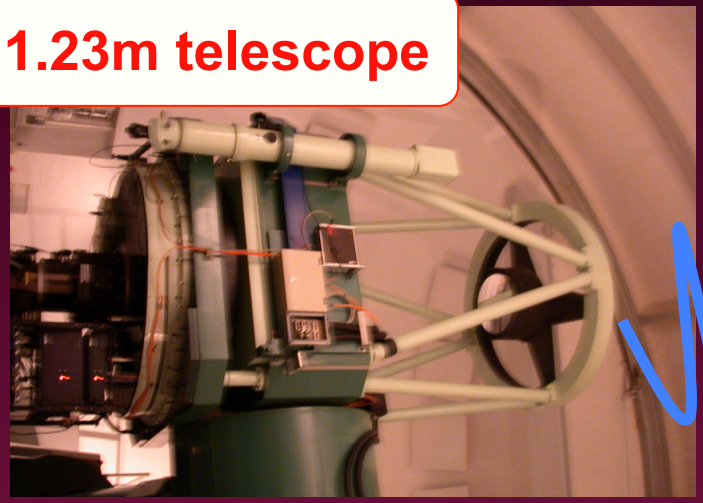
- ✓ Built in 1975 by C. Zeiss.
- ✓ RTS2 installation almost completed
- ✓ Only the inclusion of the autoguider is missing.

Aperture	1.23m
Optic system	Ritchey-Crétien
Focal ratio	f/8
FoV total	90’
Aberration free FoV	~15’
Mount	German

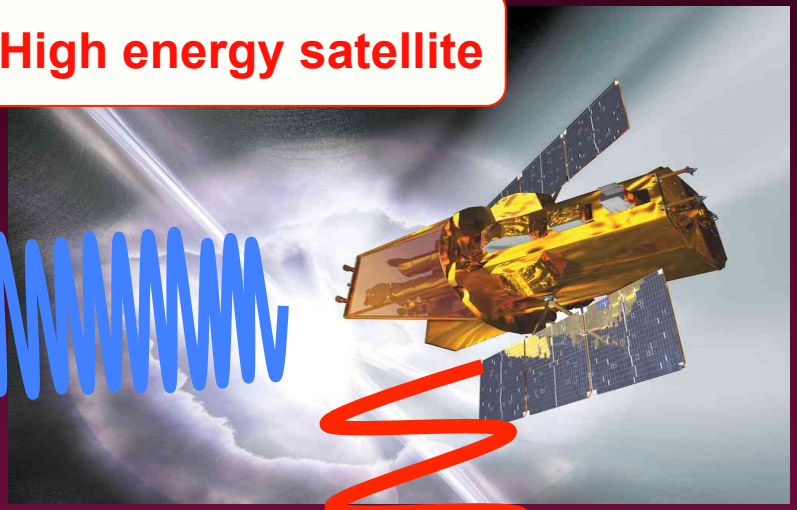


✓ rts2 at 1.23m responds to alerts of the GCN network

1.23m telescope

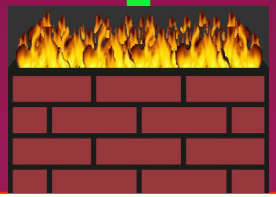


High energy satellite

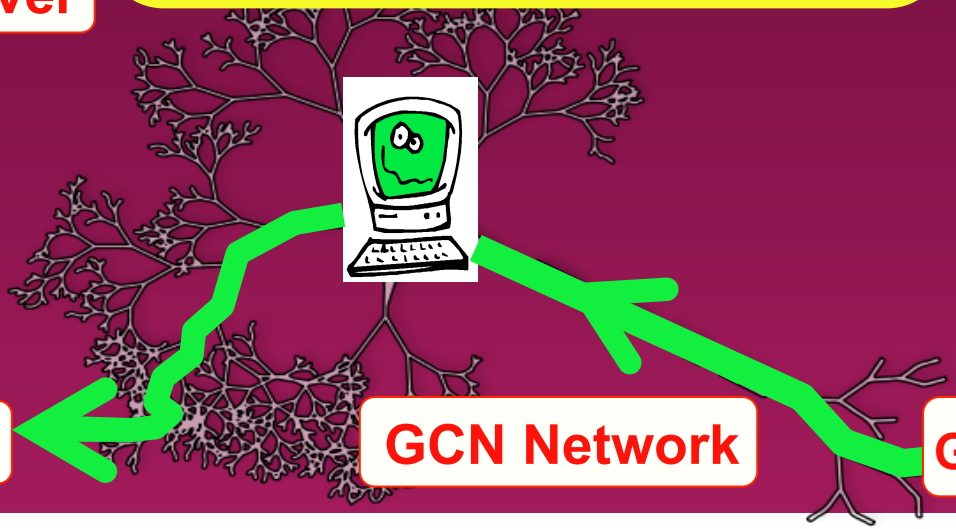


CAHA rts2 server

This process takes 1-4 min



CAHA firewall



GCN Network

Ground tracking station

- ✓ Mimir: near-IR polarimeter, FoV 10’x10’. 1.8m Perkins telescope.
- ✓ CASPROF, photomultiplier, single object. 2.15m CASLEO telescope.
- ✓ Torino, photomultiplier, single object. 2.15m CASLEO telescope.
- ✓ FORS2, VLT. FoV = ½ x (6.8’x6.8’). No simultaneous.
- ✓ ALFOSC (standard), NOT. FoV = ½ x (6.4’x6.4’). No simultaneous.
- ✓ ALFOSC (WeDoWo), NOT. FoV = ½ x (6.4’x6.4’) at most.
- ✓ FAPOL, NOT, photomultiplier, single object.
- ✓ CAFOS, 2.2m CAHA. FoV = ½ x (8’x8’). No simultaneous.
- ✓ WHT, LIRIS, near-IR. FoV = 4.6’x4.6’.