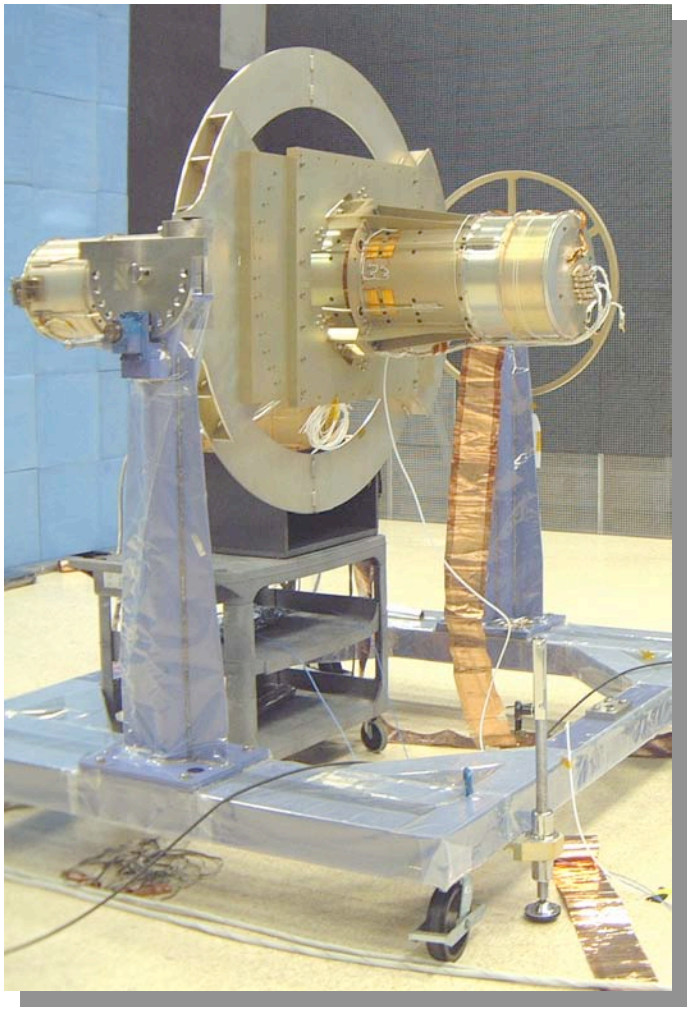
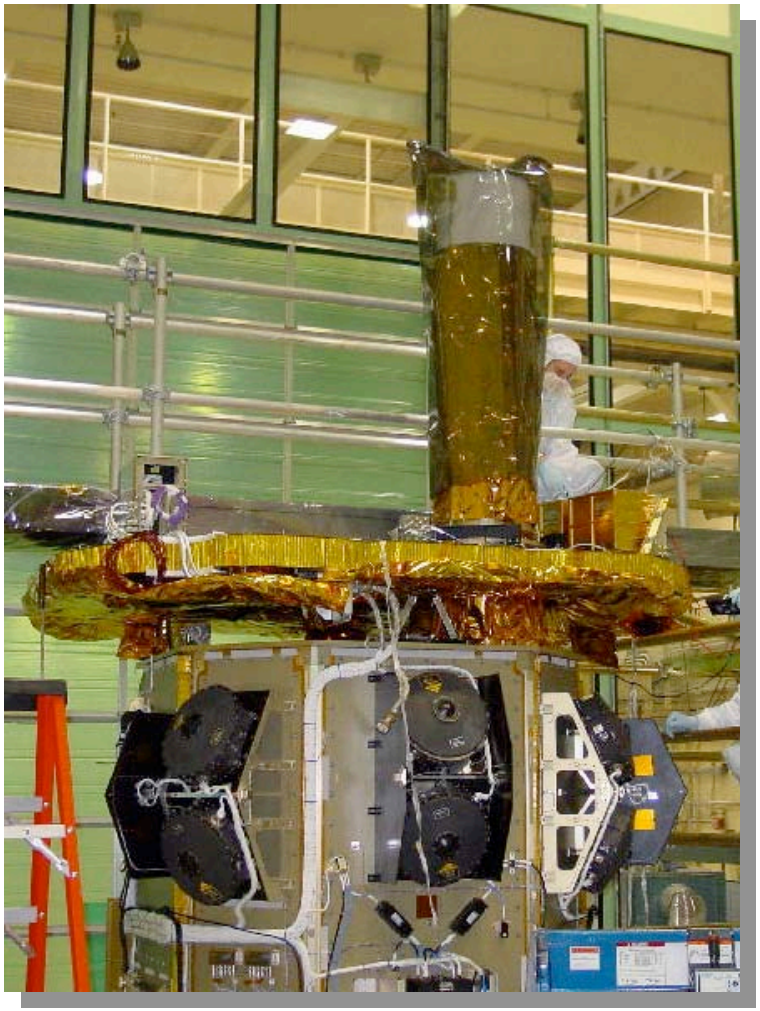
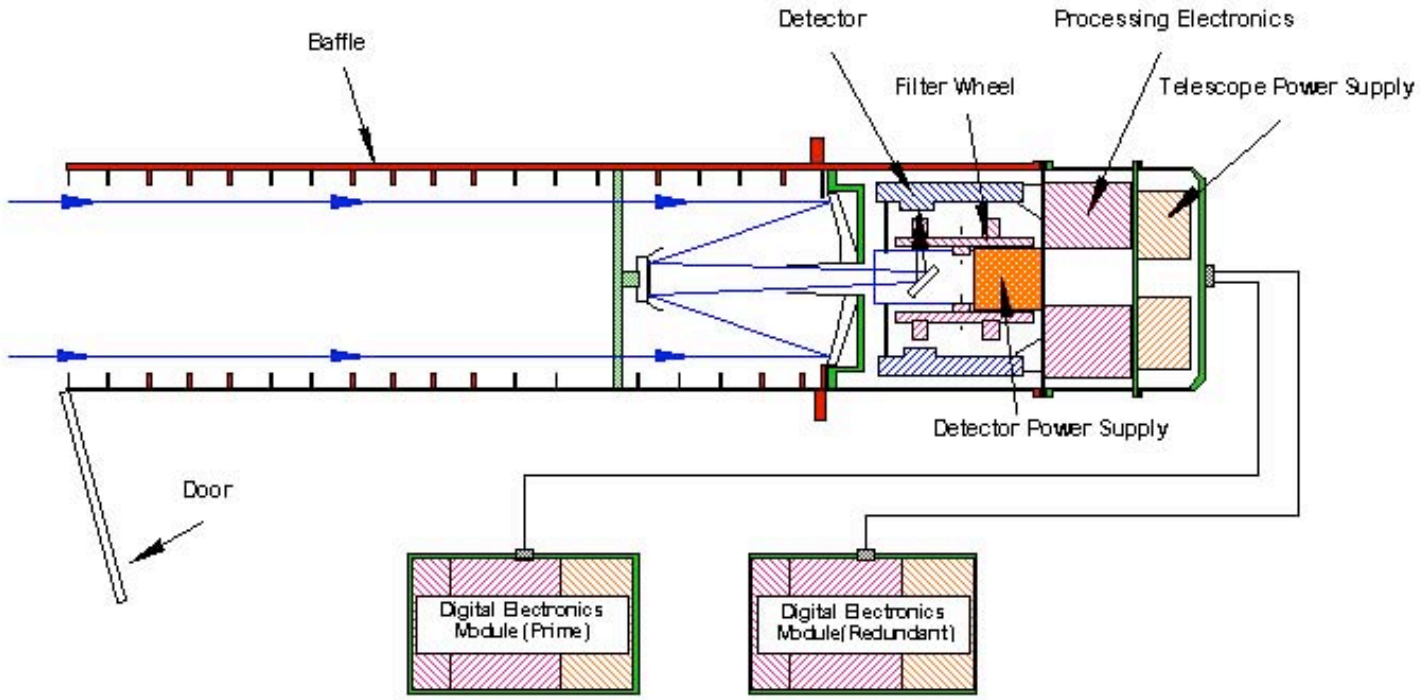
The Ultraviolet/Optical Telescope (UVOT)



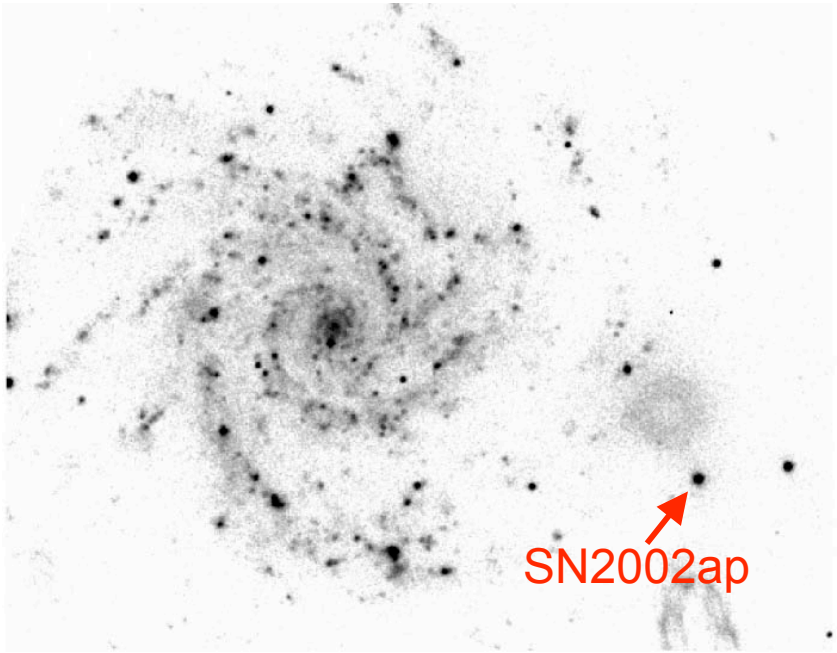


UVOT Schematic

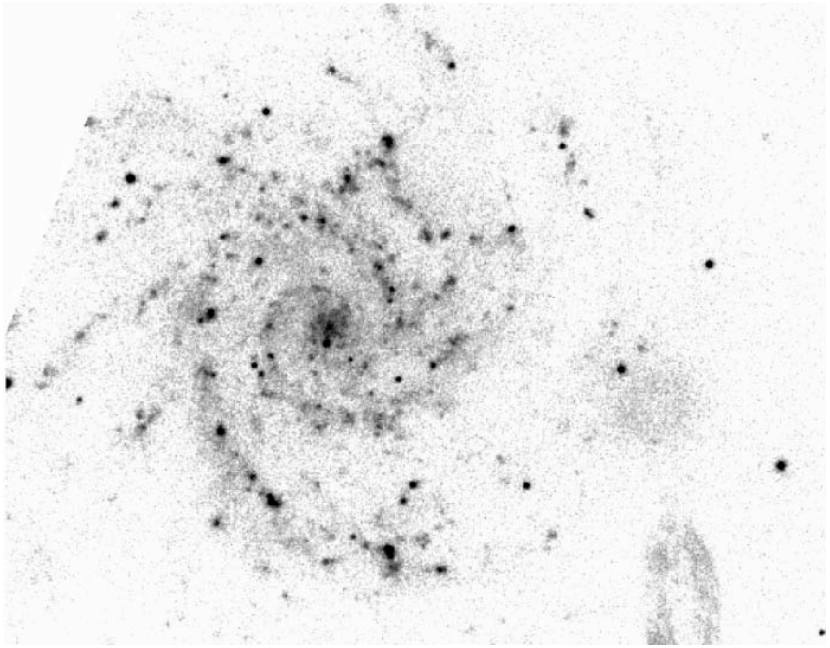


M74: XMM-OM

2002

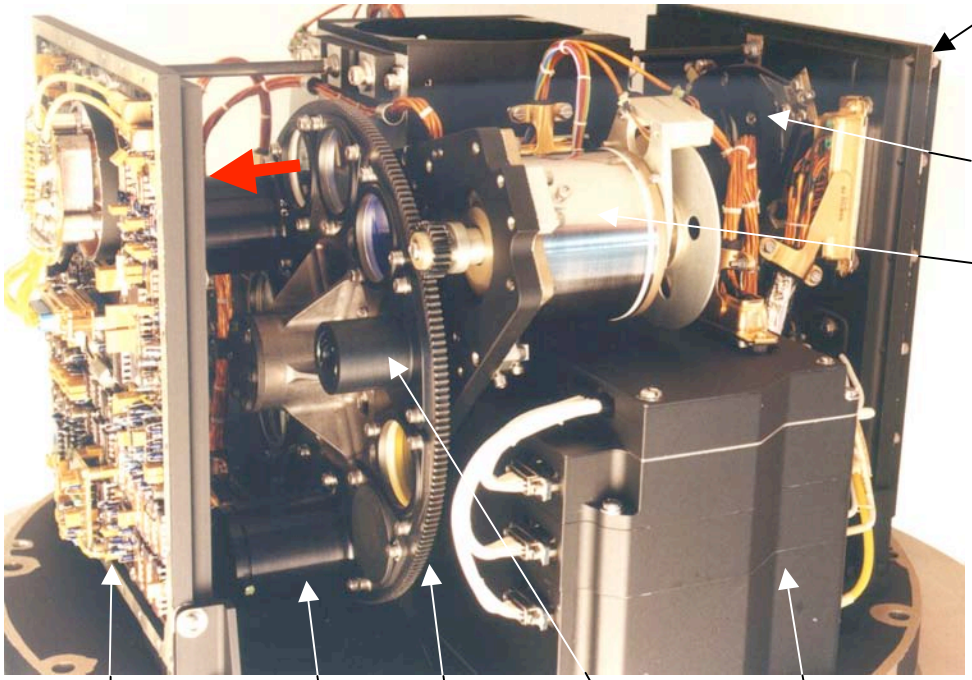


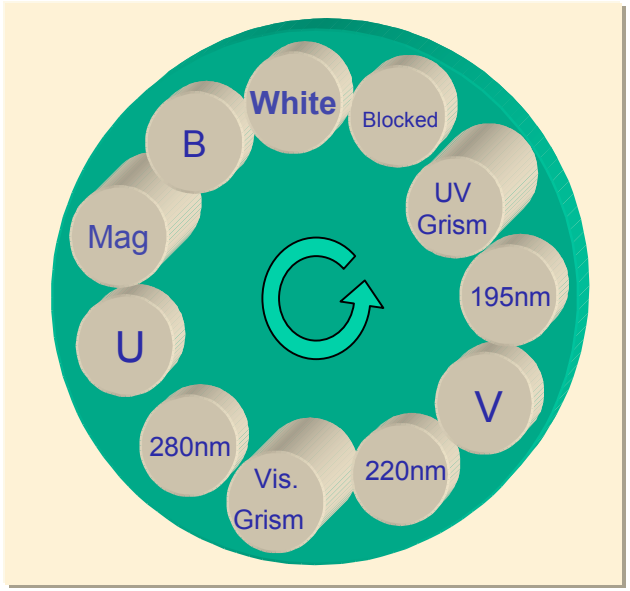
2003



Images taken in 280nm filter

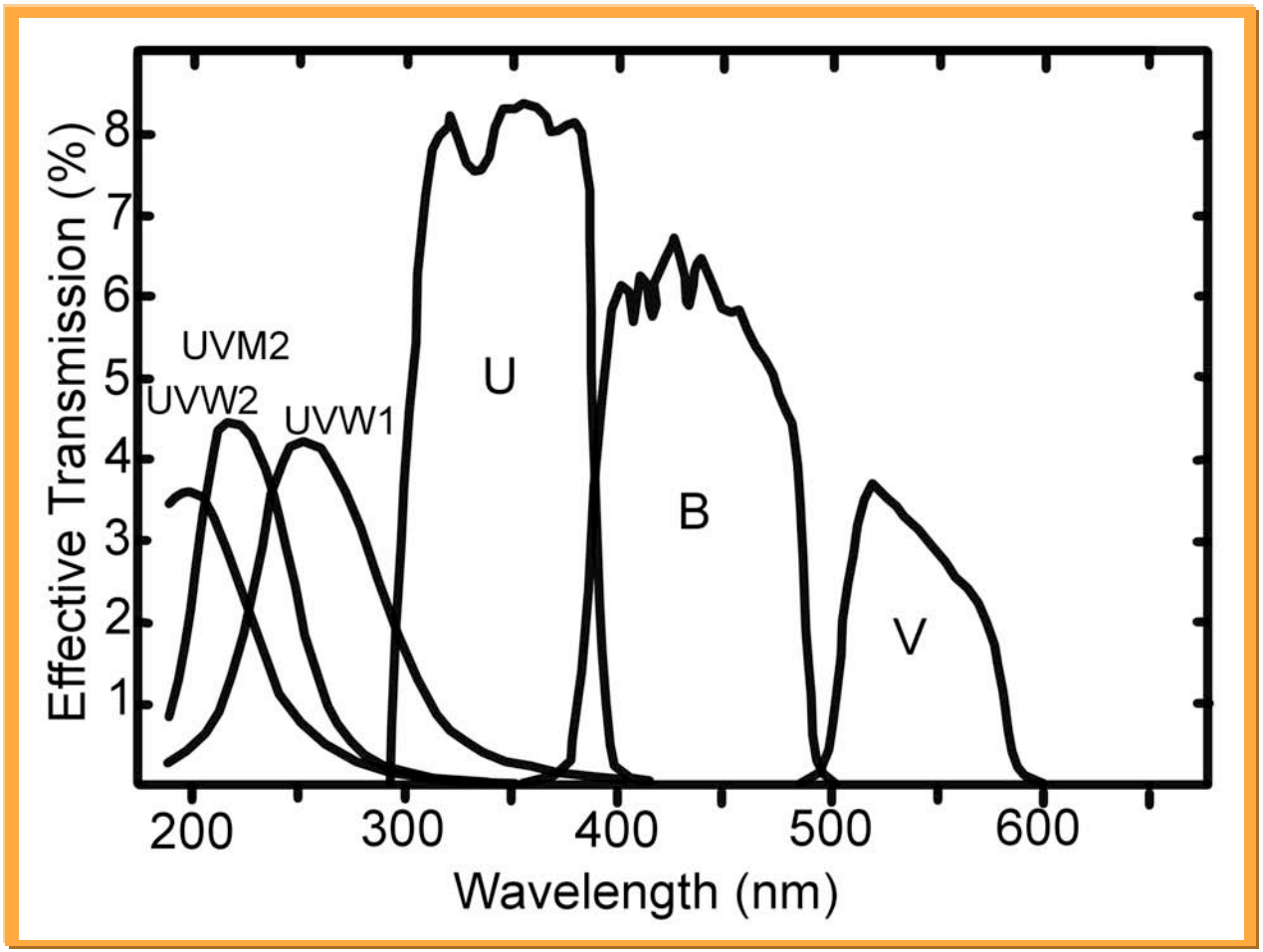
UVOT detector module





Filter wheel schematic showing position of optical elements

Colour Filters



Limiting Magnitude

Expected performance				
	Spectral Type			
Filter	B0	A0	G0	K0
U	23.5	22.1	21.3	20.4
B	23.3	22.8	22.2	21.9
V	22.7	22.1	21.9	21.9
White	24.7	23.6	23.0	22.7

Limiting B magnitudes for a 5 sigma detection in 1000s

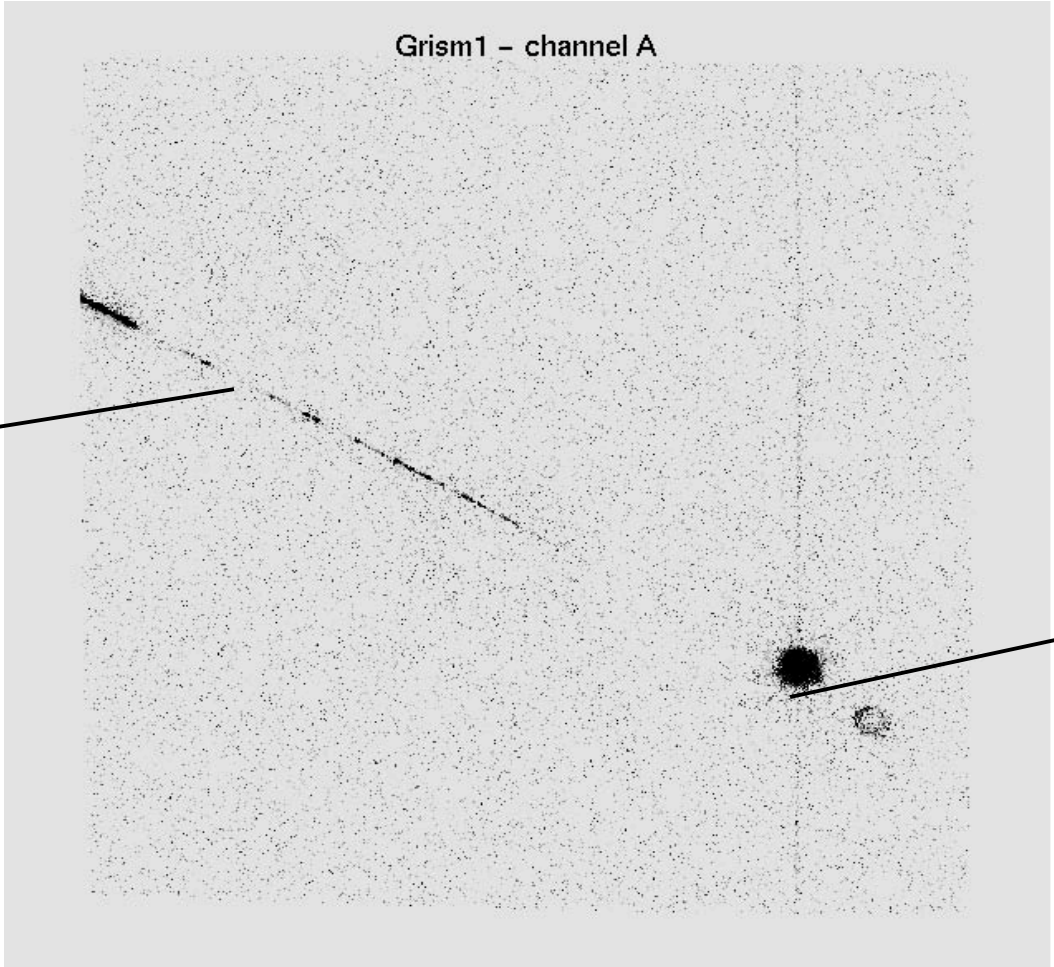
UVOT zero points

Filter	$\lambda_{cen(nm)}$	Chan A	Chan B
White		20.47	20.64
V	550	18.18	18.36
B	440	19.03	19.27
U	350	18.44	18.60
UVW1	260	17.82	17.99
UVM2	220	17.70	17.88
UVW2	200	17.77	17.89

Estimated photometric zero points for an A0 star observed with the UVOT. The zero point corresponds to the stellar magnitude that yields 1 c/s in the detector.

Grism Data

Calibration data

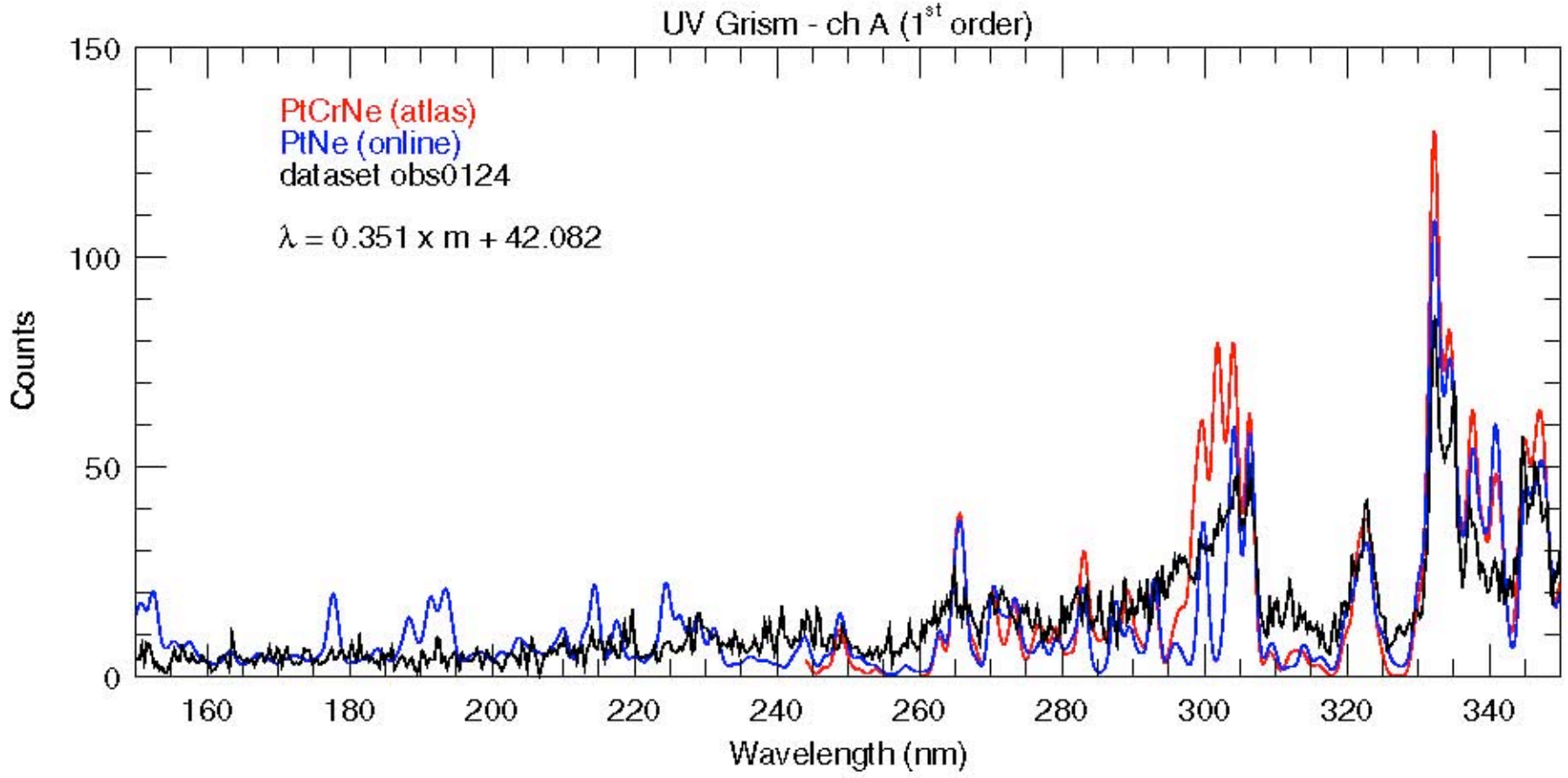


First order dispersed spectrum

Zero'th order

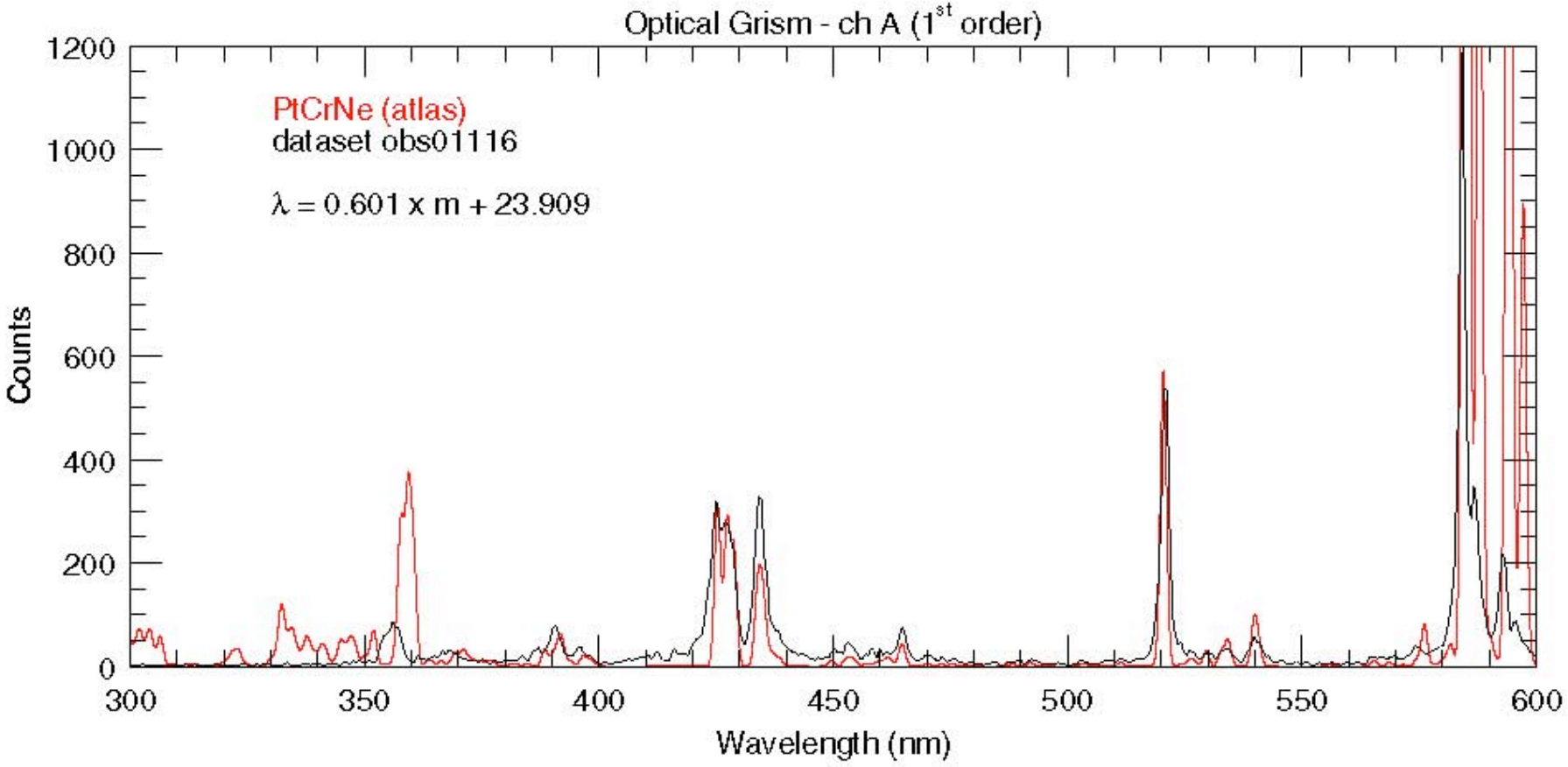
UV Grism

Calibration data



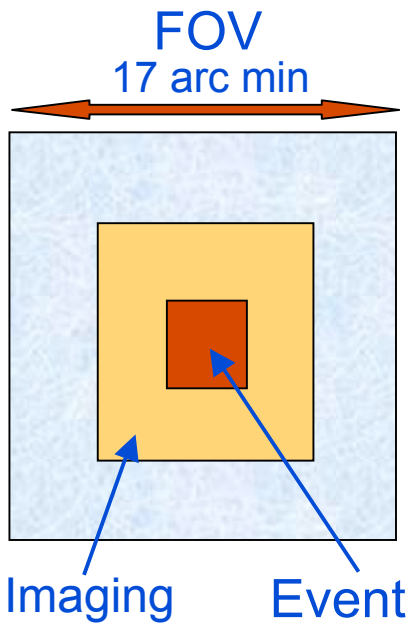
Optical Grism

Calibration data



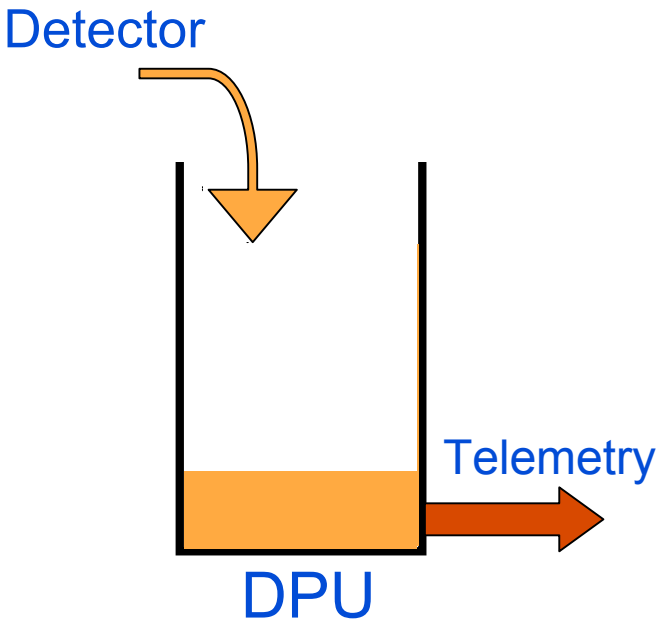
UVOT Observing modes

Mode	Description
Event	Record position and time of each photon event to ~11 ms accuracy
Imaging	Integrate image in onboard memory for preset exposure time, compensating for spacecraft motion



- Detector can be windowed in both modes
- Two modes can run simultaneously in different windows
- Choice of modes is a trade-off between science and available onboard memory
- Event mode used at beginning of automated burst response
  - Window size reduced as positional uncertainty improves
- Imaging mode used later in burst evolution when rate of change less.

Data flow

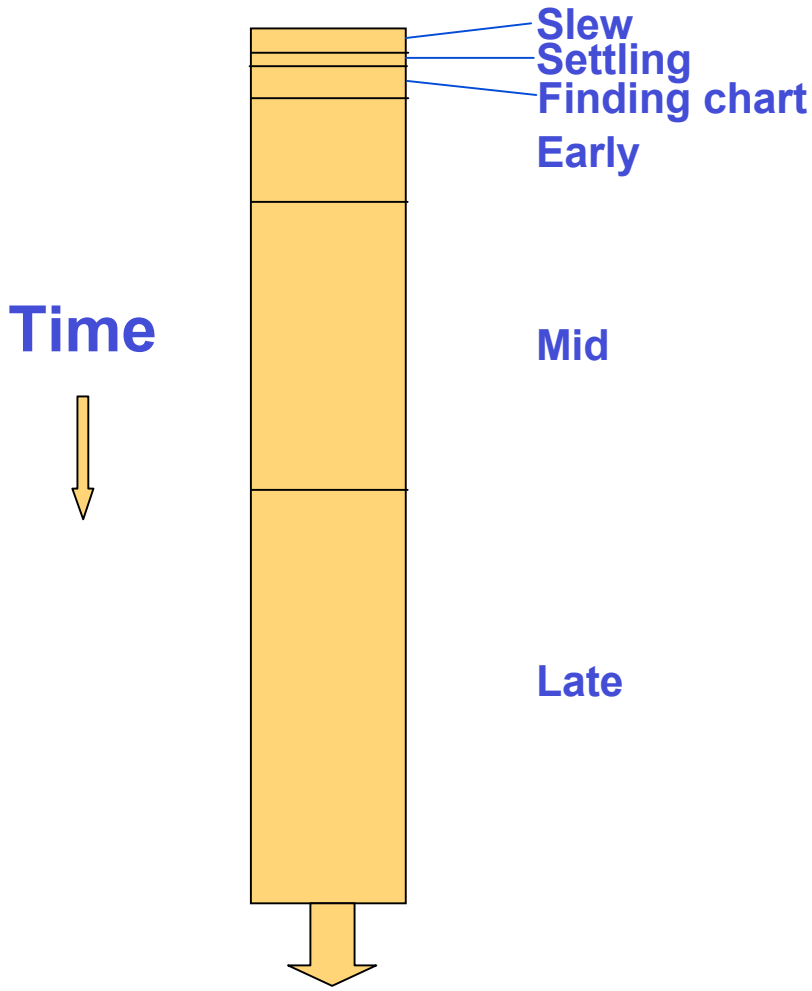


UVOT Automated Target (AT)

UVOT observing sequence for automated GRB response

- Multi-colour light curves by cycling filters
- Rapid cadence (exposures ~20 sec) at burst peak
  - Detector in event + image mode
- Exposures increased to 1000s as burst fades
  - Detector in image mode
- Choice of which filter elements are in sequence
  - A number of alternative sequences can be stored onboard

AT observation phases



Onboard software uses elapsed time from burst to define early/mid/late phases

Slewing

Slew

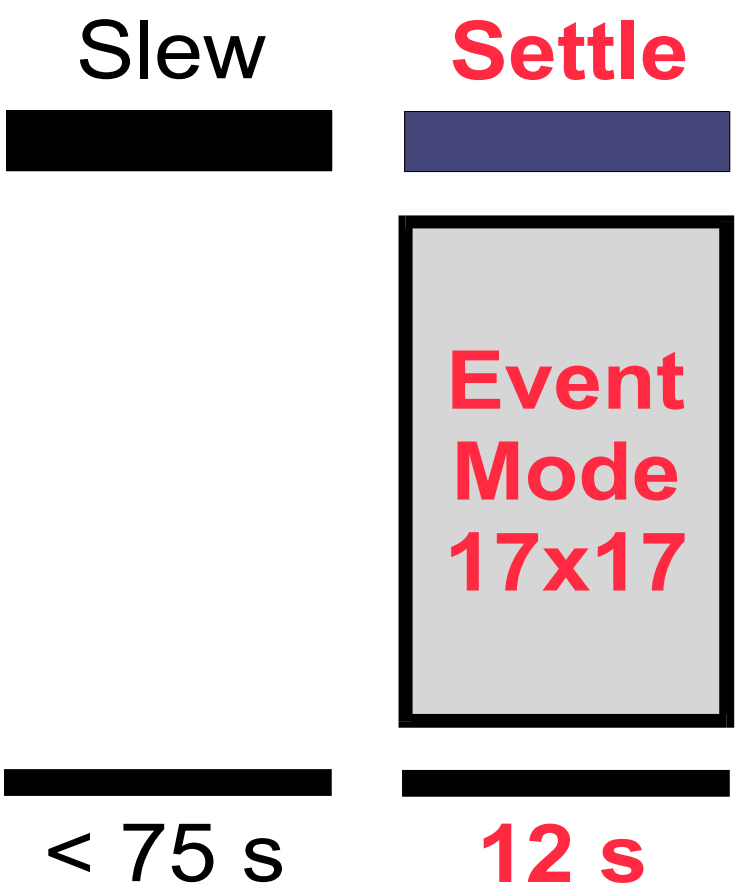
[redacted]

[redacted]

< 75 s

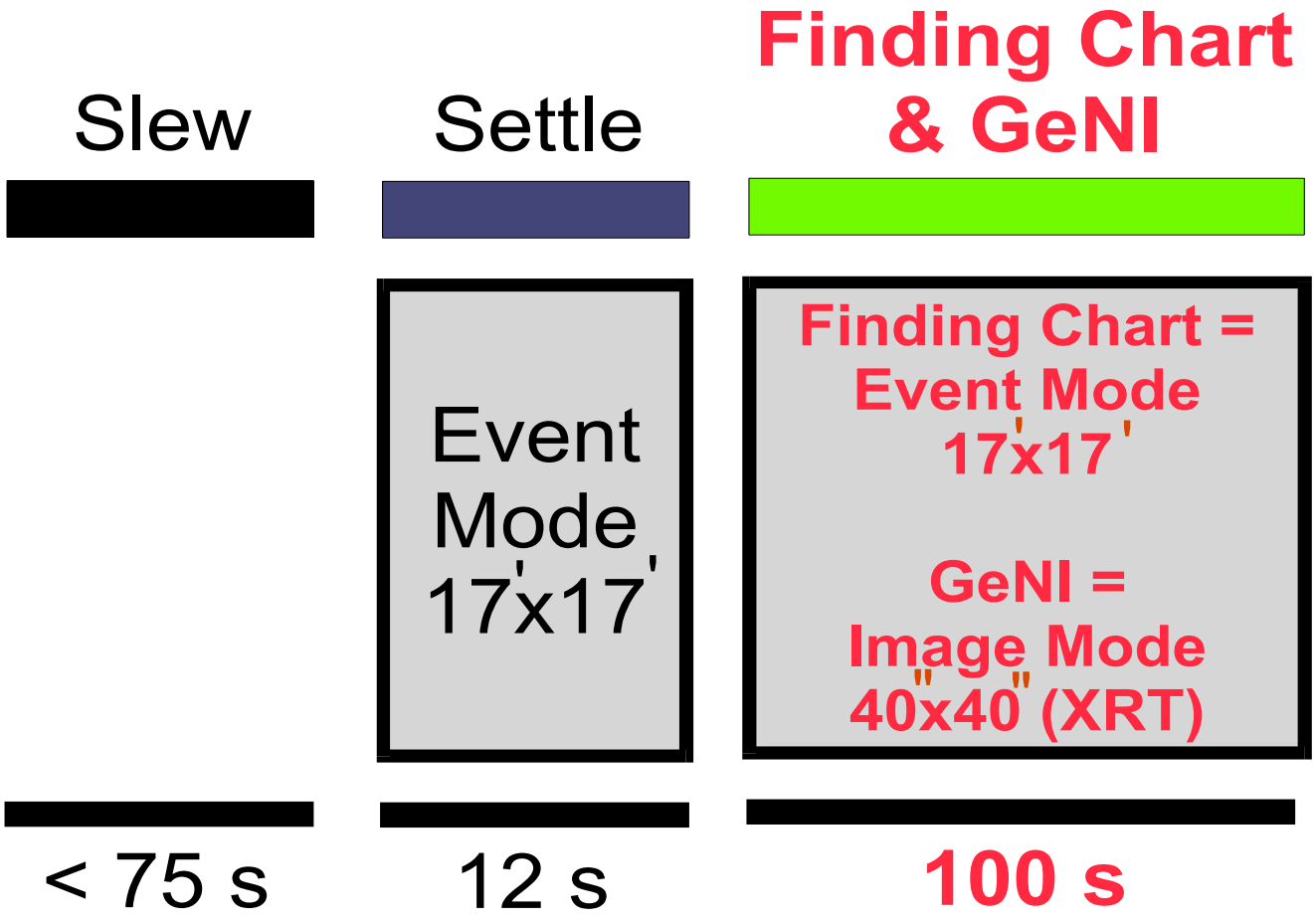
- S/C moving to target
  - Arrives in < 75 s
- UVOT HV not turned up
- No data are collected

Settling



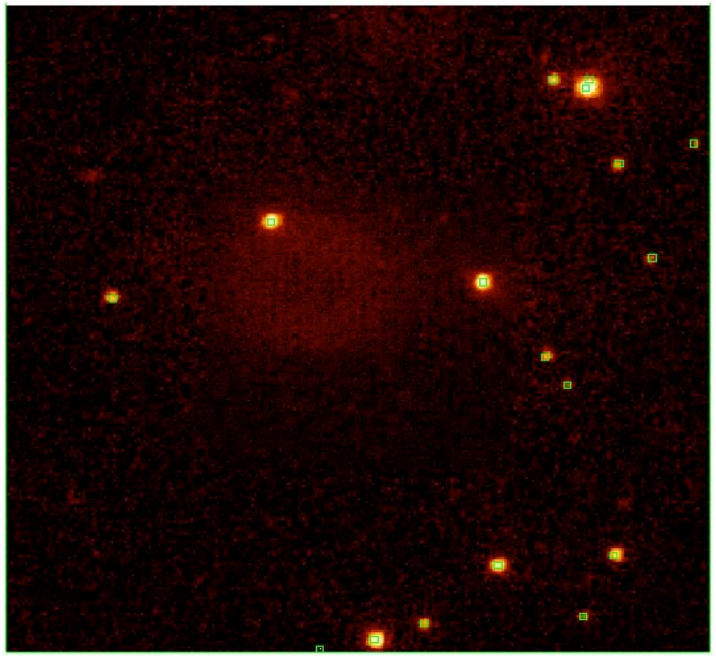
- S/C settling on target
  - Approximately 12 s
- Target moving in UVOT FoV
- Mode = Event
- FoV = Full
- Filter = UVW2 (200nm)
- Exposure = ~12 s
- Data sent thru Malindi

Finding Chart & GeNI

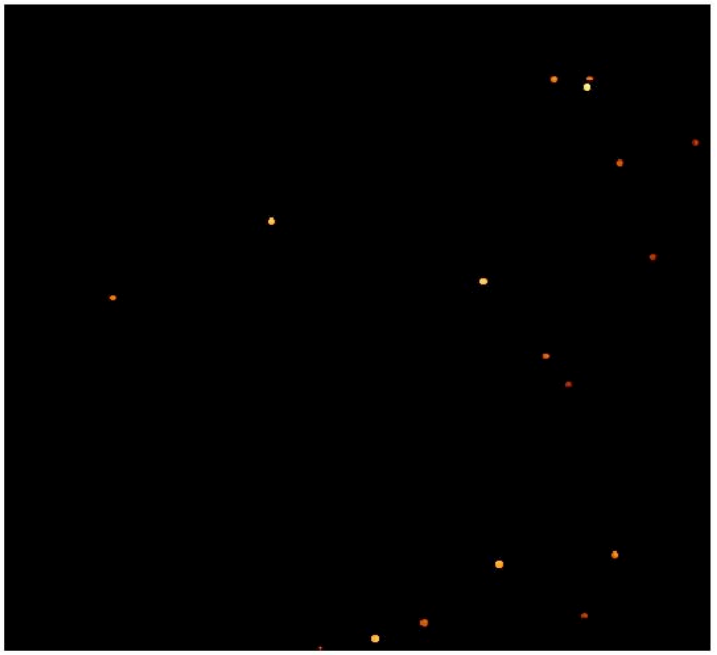


Finding Chart (Cont)

UVOT Image



Finding Chart (Bright Pixel List)



This OM image was sent through the FC during SVP. Green boxes mark the 5x5 postage stamps that are telemetered.

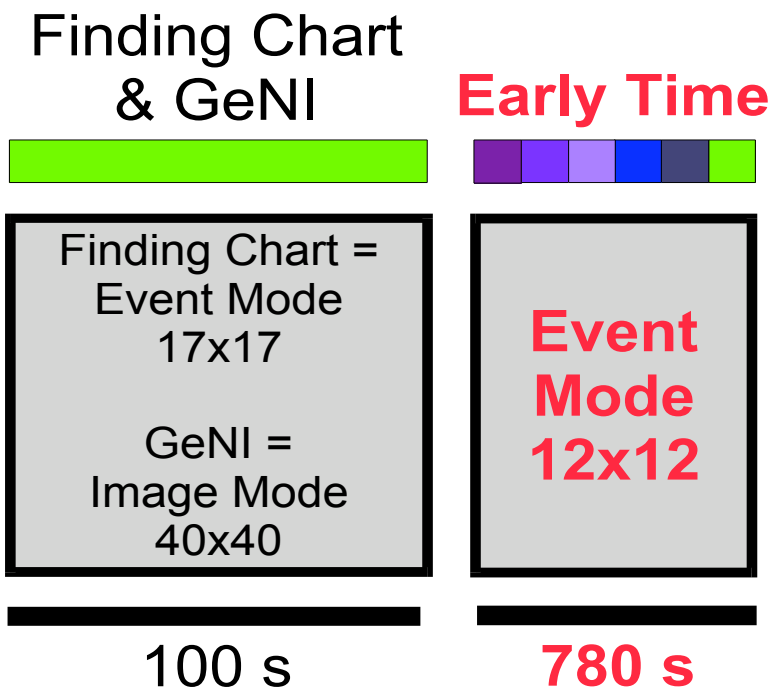
Finding Chart

- S/C tracking target
- Finding Chart
  - Mode = Event
  - FoV = Full
  - Filter = V
  - Exposure = 100 s
  - Parameterized data sent thru TDRSS to GCN
    - ➢Entire Finding Chart data sent thru Malindi

GRB Neighborhood Image (GeNI)

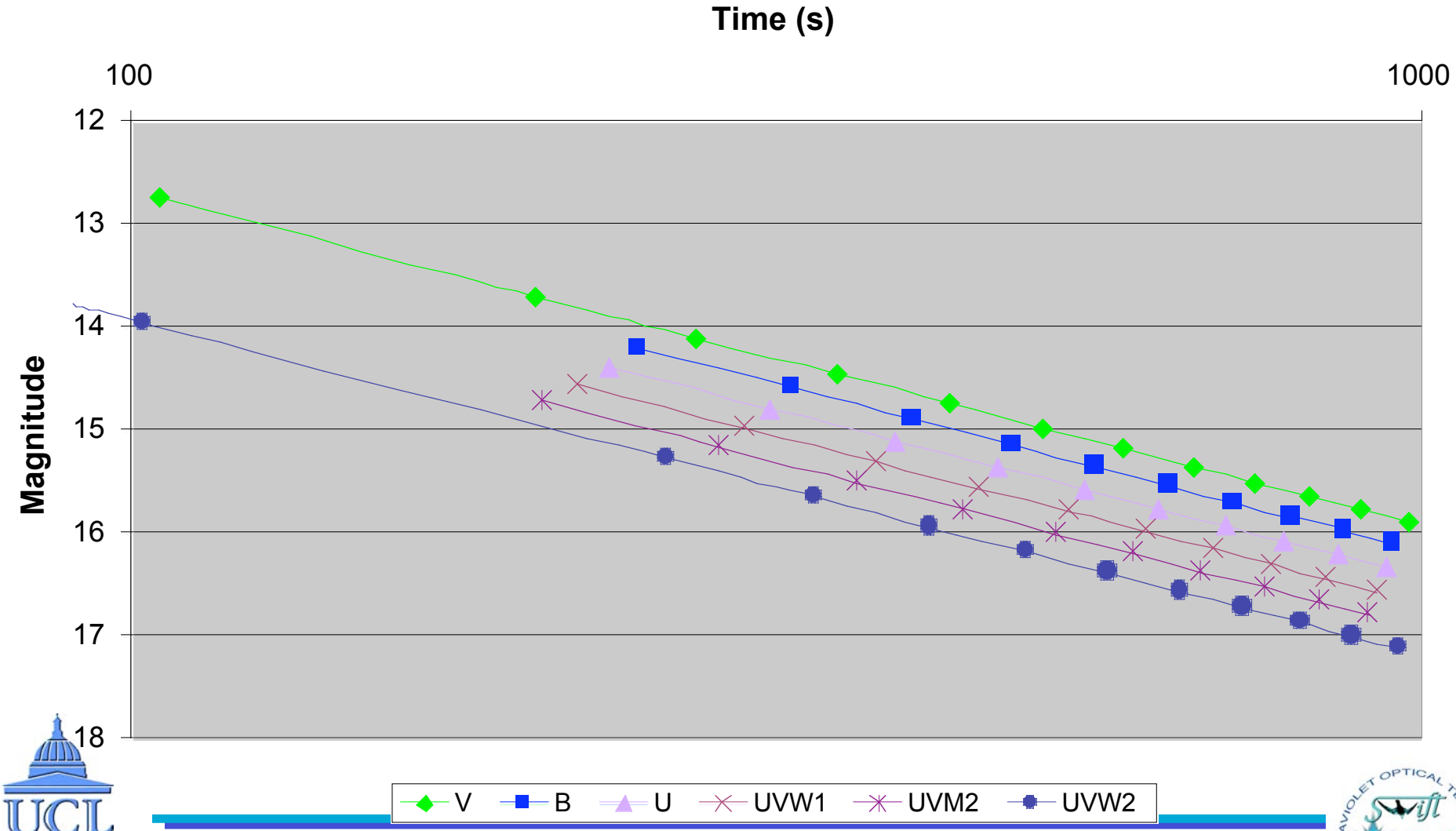
- GeNI
  - Mode = Image
  - FoV = 40x40 arcsec (Centered on XRT position)
    - FoV = 320x320 arcsec (Centered on BAT position)
  - Filter = V
  - Exposure = 100 s
  - Binning = 1x1 (w/ XRT position)
    - Binning = 8x8 (w/ Bat position)
  - Data sent thru TDRSS to GCN

AT - Early Time



- Mode = Event
- FOV = 12x12 arcmin
- Filters = Broadband
- Exposure = 20 s
- Data sent thru Malindi

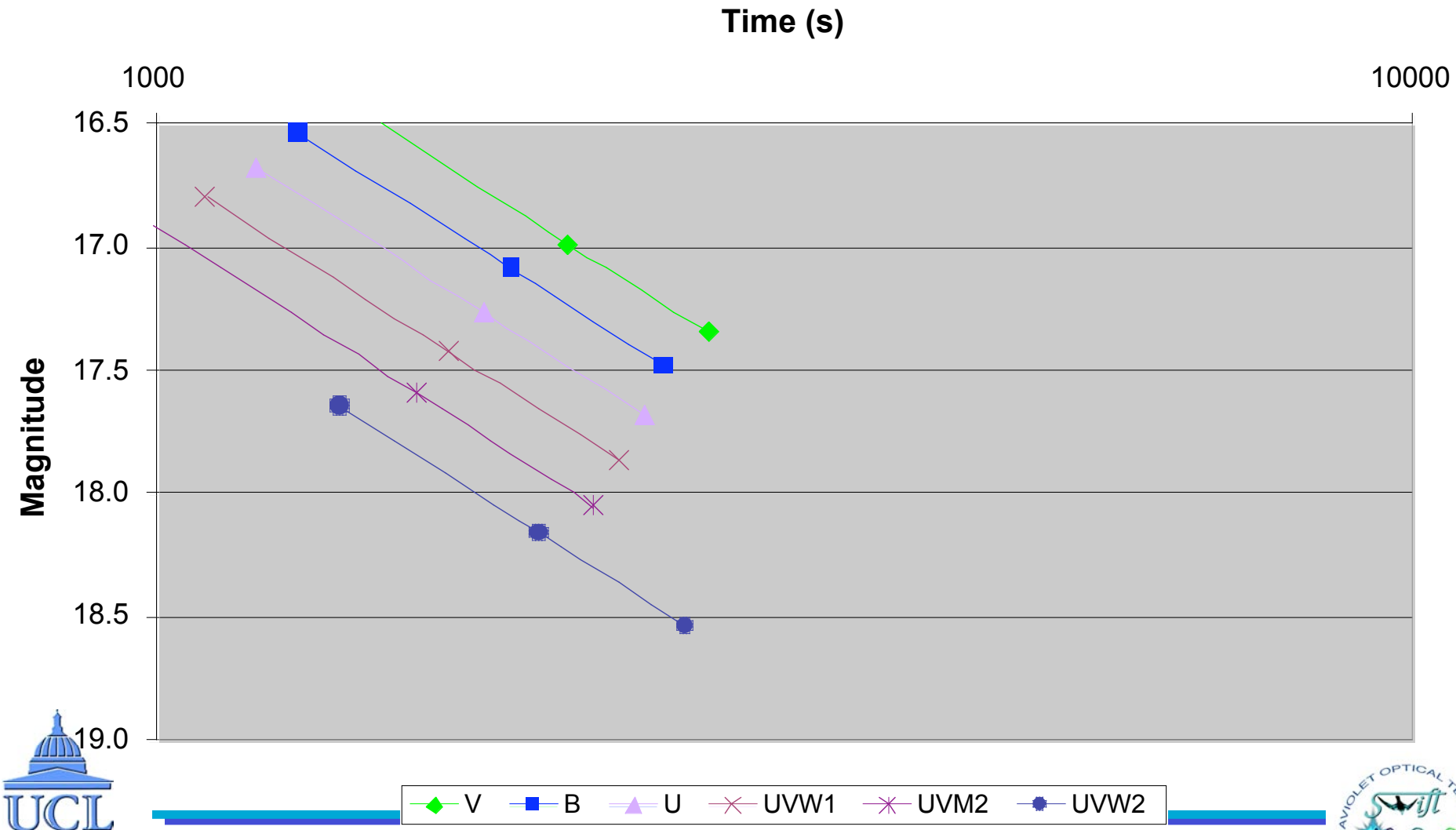
AT - Light Curve (Early)



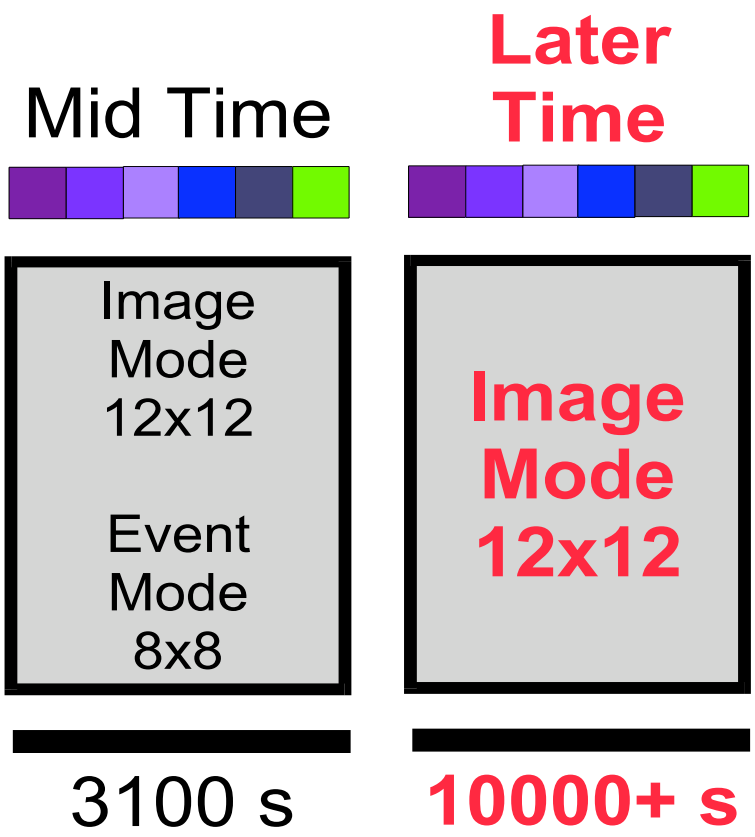
AT (Middle Time)

- Mode = Event & Image
- FOV = 8'x8' (Event) & 12'x12' (Image)
- Filters = Broadband
- Exposure = 100 s
- Binning = 2x2
- Data sent thru Malindi

AT – Light Curve (Middle)

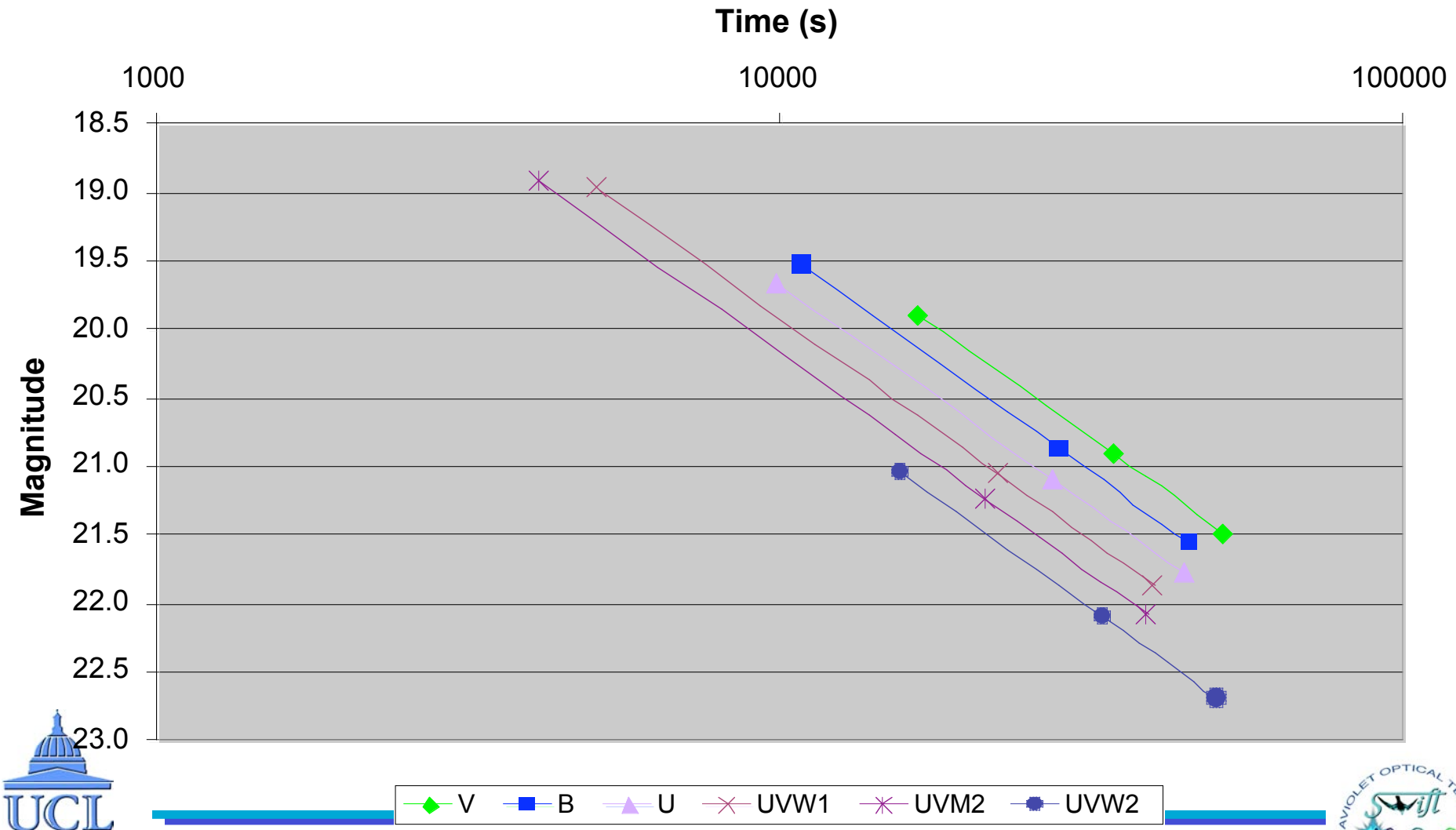


AT (Later Time)

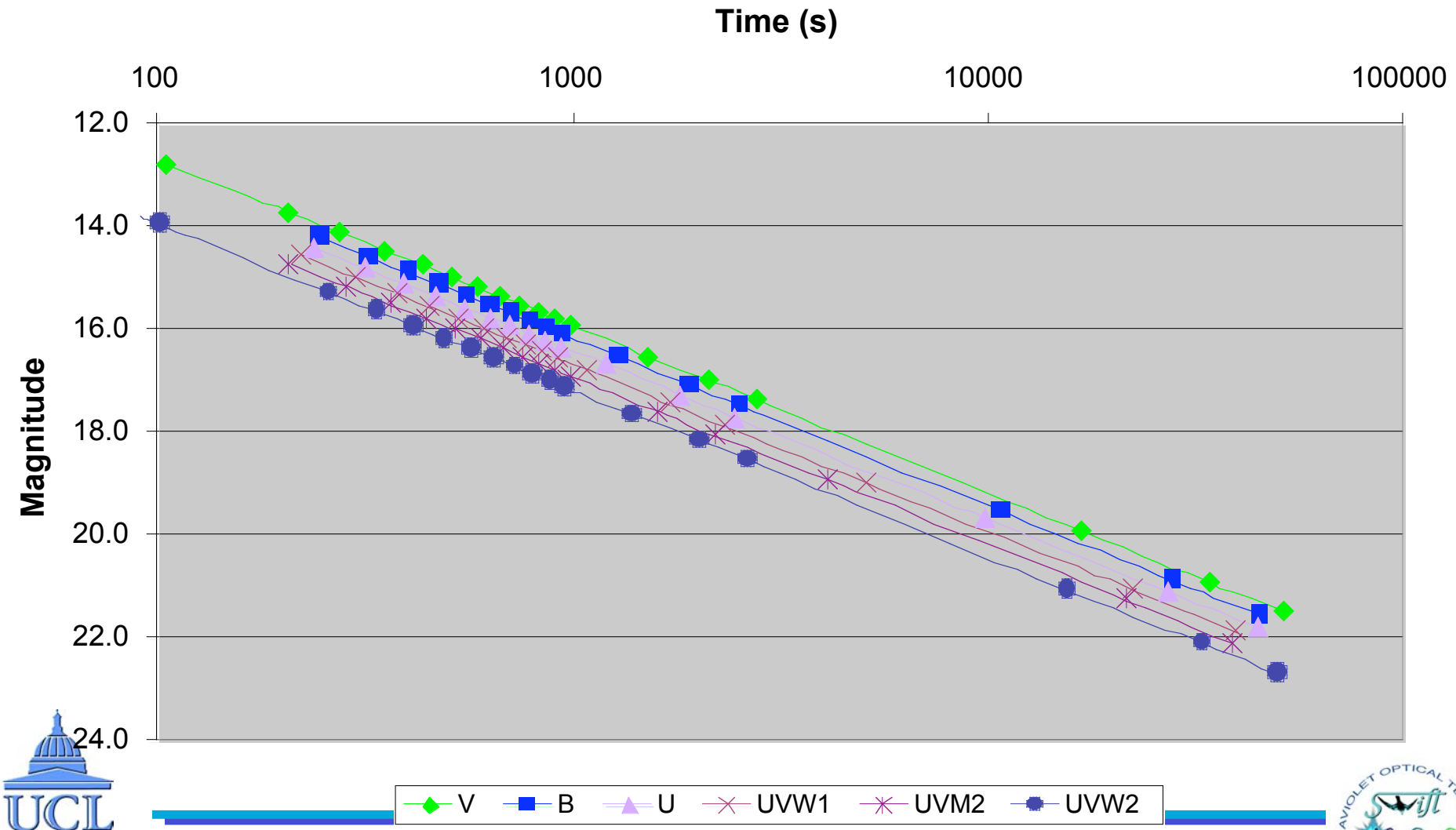


- Mode = Image
- FOV = 12'x12'
- Filters = Broadband
- Exposure = 900 s
- Binning = 2x2
- Data sent thru Malindi

AT – Light Curve (Later)

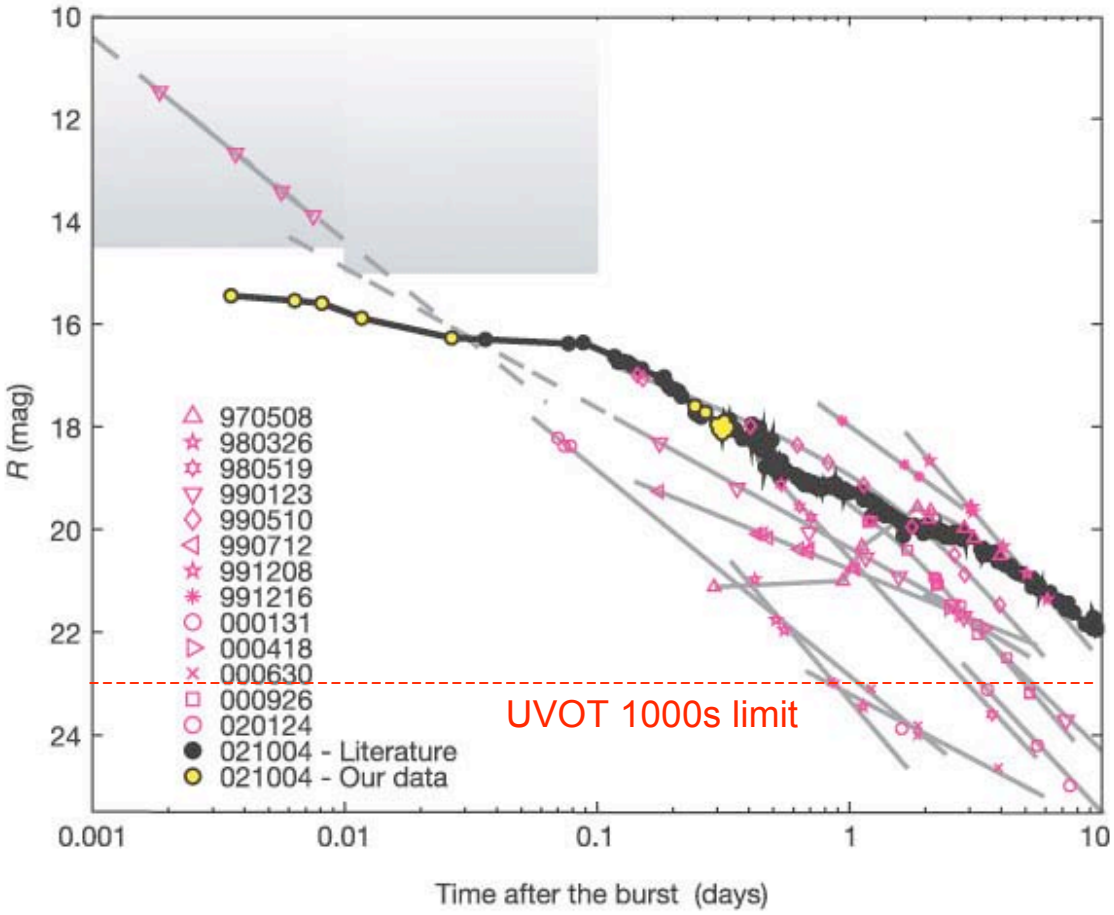


AT –Light Curve (Total)



In context…

Fox et al. 2003
Nature 422, 284

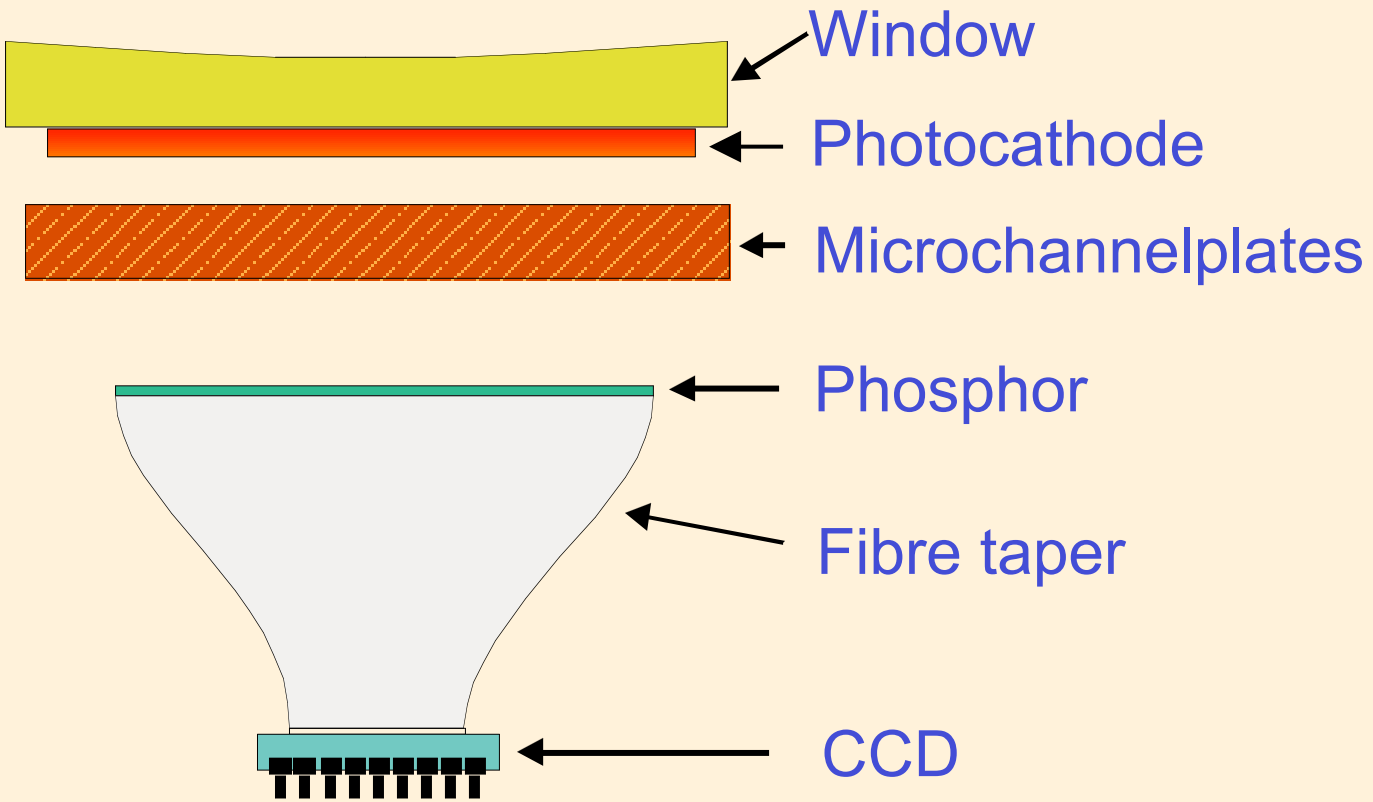


End

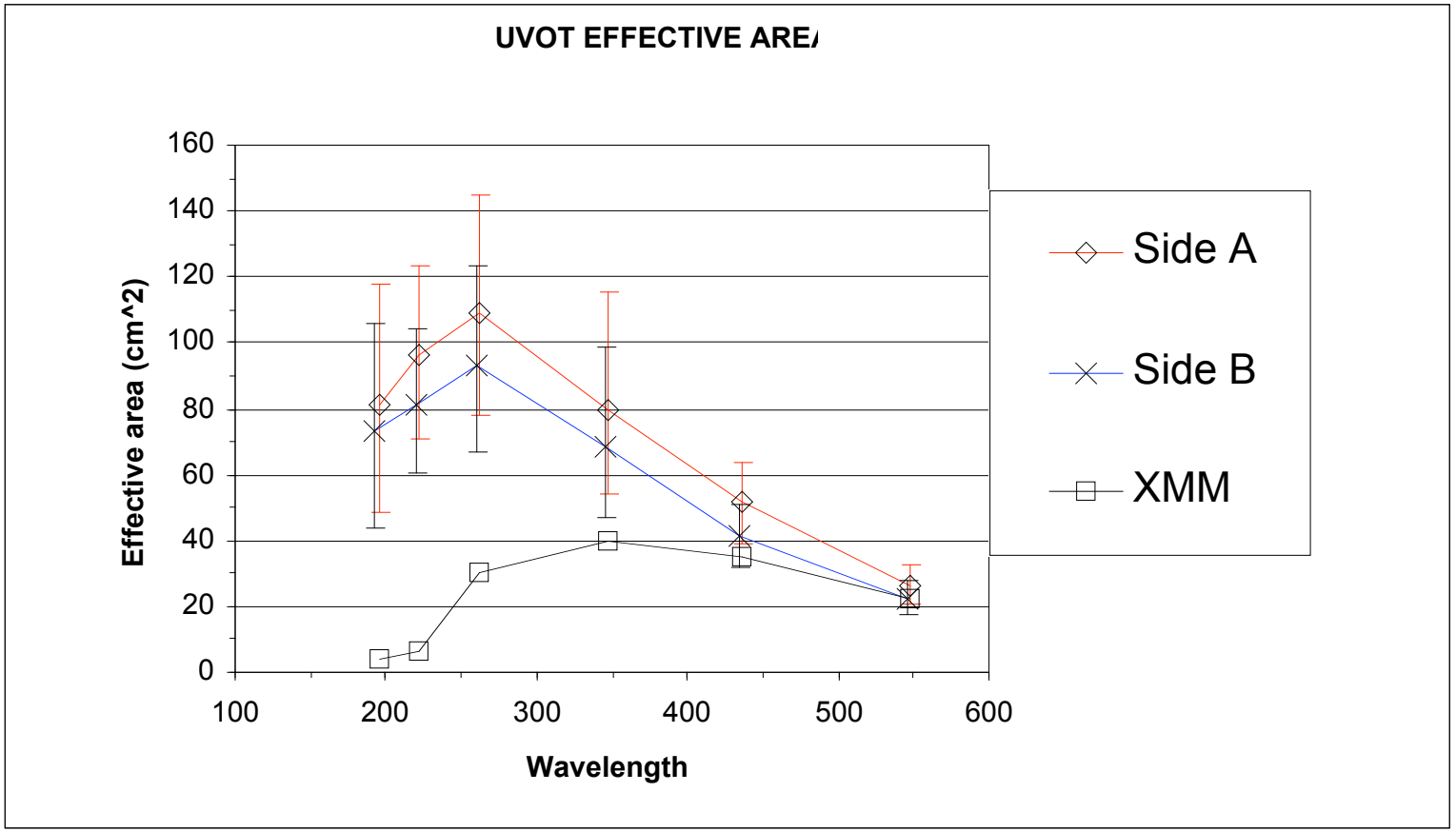
Instrument Characteristics

BAT	XRT	UVOT
•Wide FoV coded-aperture imager •Detectors: CdZnTe •Detection elements: 256 x 128 •FOV: 1.4 steradians •Spatial resolution: 20 arcmin •Energy range: 15-150 keV •Eff. Area: 5200 cm^2 •Energy Res: 3.3 keV at 60 keV •Astrometry: 4 arcmin •Sensitivity: 5x better than BATSE	•Wolter 1 X-ray telescope •CCD camera: 600x600 pixels •FOV: 24x24 arcmin •Pixel: 2.4 arcsec •Energy range: 0.2-10 keV •Eff. Area: 110 cm^2 (1.5 keV) •Energy Res: 130 eV •Astrometry: <2.5 arcsec •Sensitivity: $2x10^{-14}$ $erg/cm^2/s$	•Modified Ritchey-Chretien telescope •Intensified CCD: 2048x2048 pixels •FOV: 17x17 arcmin •Pixel: 0.5 arcsec •Wavelength range: 170-650 nm •Eff. Area: 90 cm^2 (250 nm) •Wavelength discrimination: colour filters, Grisms ($\lambda/\Delta\lambda$~300) •Astrometry: <0.3 arcsec •Sensitivity: B=24 (unfiltered)

MIC Detector Schematic



Range & Responsivity



'White light' filter response