Science with the OMC

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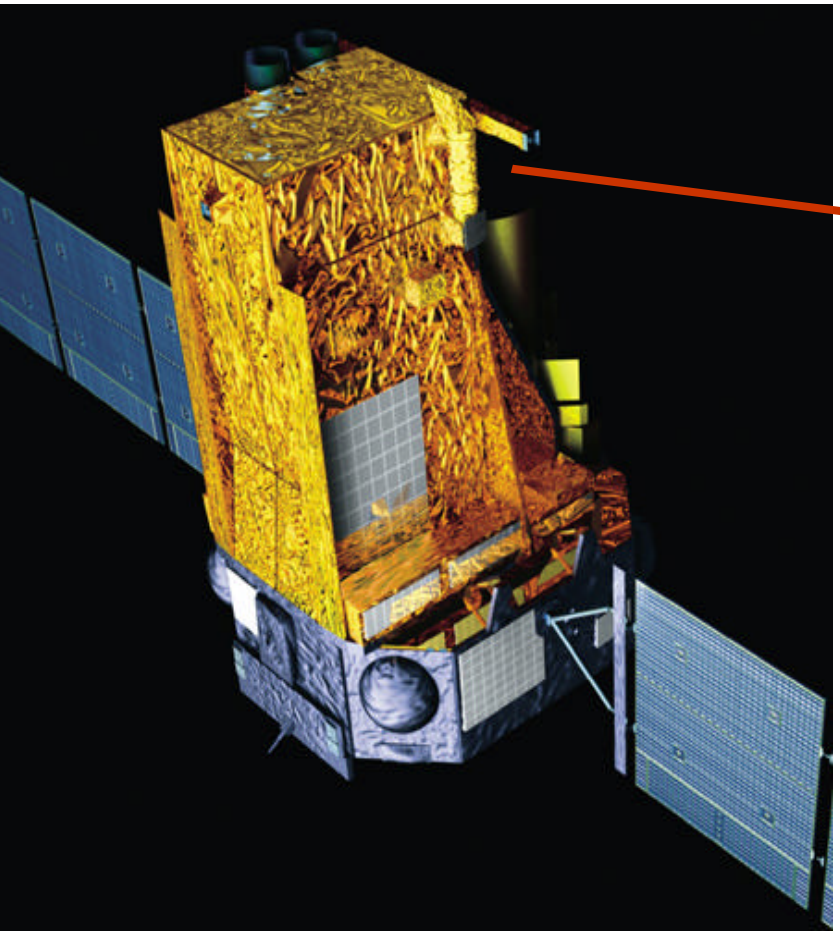
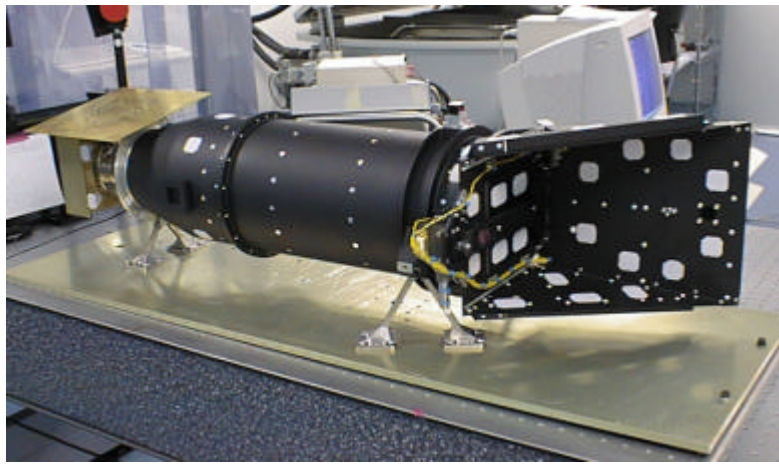
on behalf of the OMC consortium

INTEGRAL Workshop

ESTEC, January 18th, 2005

OMC: An Optical Monitoring Camera for INTEGRAL





OMC provides simultaneous optical photometry of the high energy sources being observed by IBIS, SPI and JEM-X

- It monitors also up to 100 potentially variable sources within its FoV in each pointing

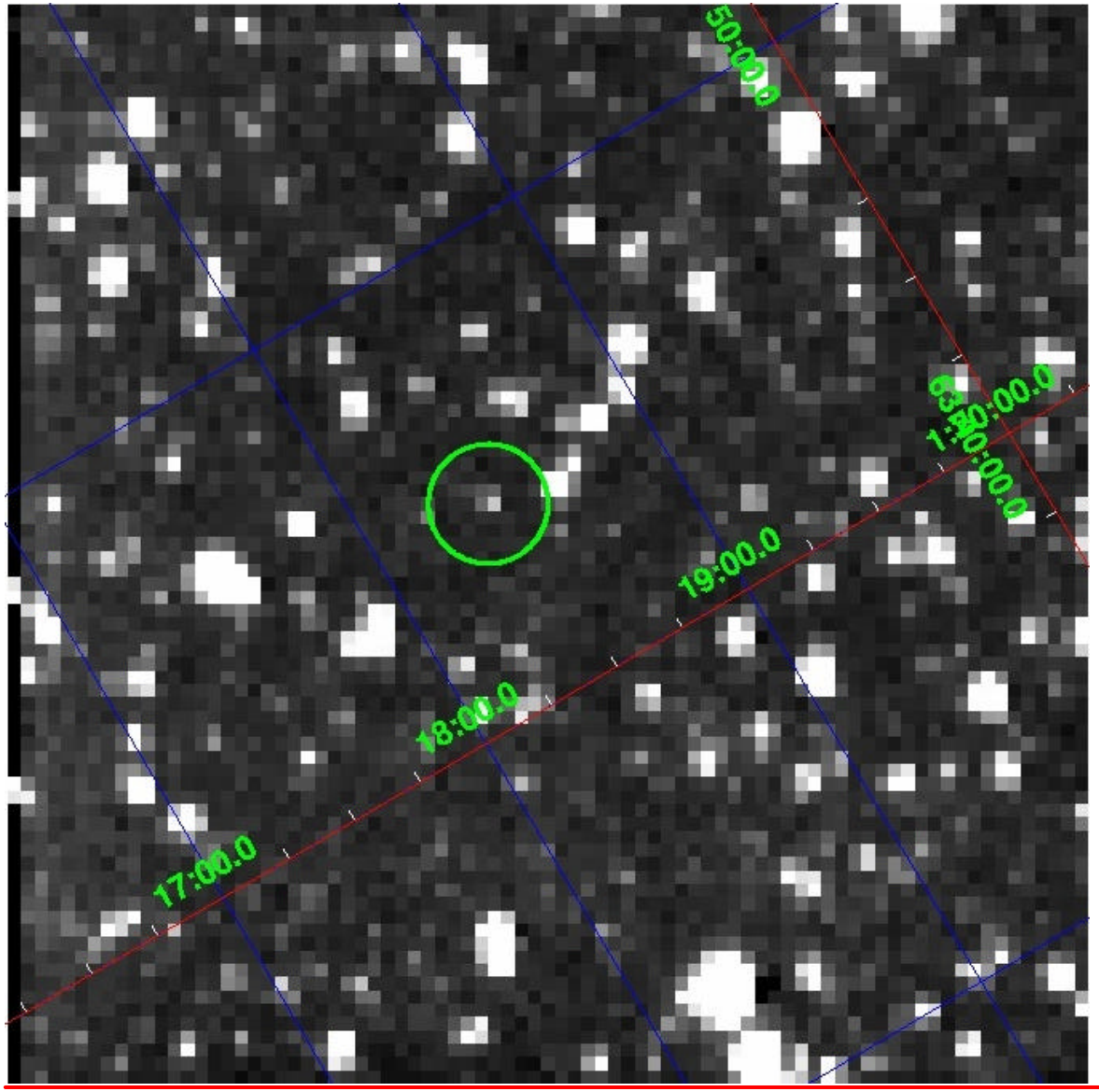
OMC main properties

Field of view	5°×5°
Aperture	50 mm
Focal length	153.7 mm (f/3.1)
Optical throughput	> 70 % at 550 nm
CCD pixels	1056 x 2061 (1024 x 1024 image area)
Angular pixel size	17”.5 x 17”.5
System point spread function	Gaussian with FWHM ≈ 1.4 pix
CCD quantum efficiency	88 % at 550 nm
Time resolution	> 3s
Typical integration times	10 – 200 s
Wavelength range	V filter (centered at 550 nm)
Limiting magnitude	< 17 (V) (10×100 s, 3σ)
Sensitivity to variations	ΔV = 0.005 (V=9) to ΔV = 0.15 (V=16) *(depending on crowding)*

Using OMC data

- OMC provides following data:
  - Photometrically calibrated CCD sections centered on the source of interest
    - Standard sections of 11x11 pixels (3'x3').
    - Mosaic of 5x5 sections of 11x11 pixels each (15'x15') for sources without accurate coordinates
    - Integration times sequence of 10 - 50 - 200 s (formerly 10 - 60 - 100 s)
    - Astrometric plate solution with an accuracy σ = 0.08 pix (=1.5") [from OSA 5.0 onwards]
  - Pipeline extracted lightcurve with 630 s sampling
    - Interactive analysis tools to modify the sampling of the data.

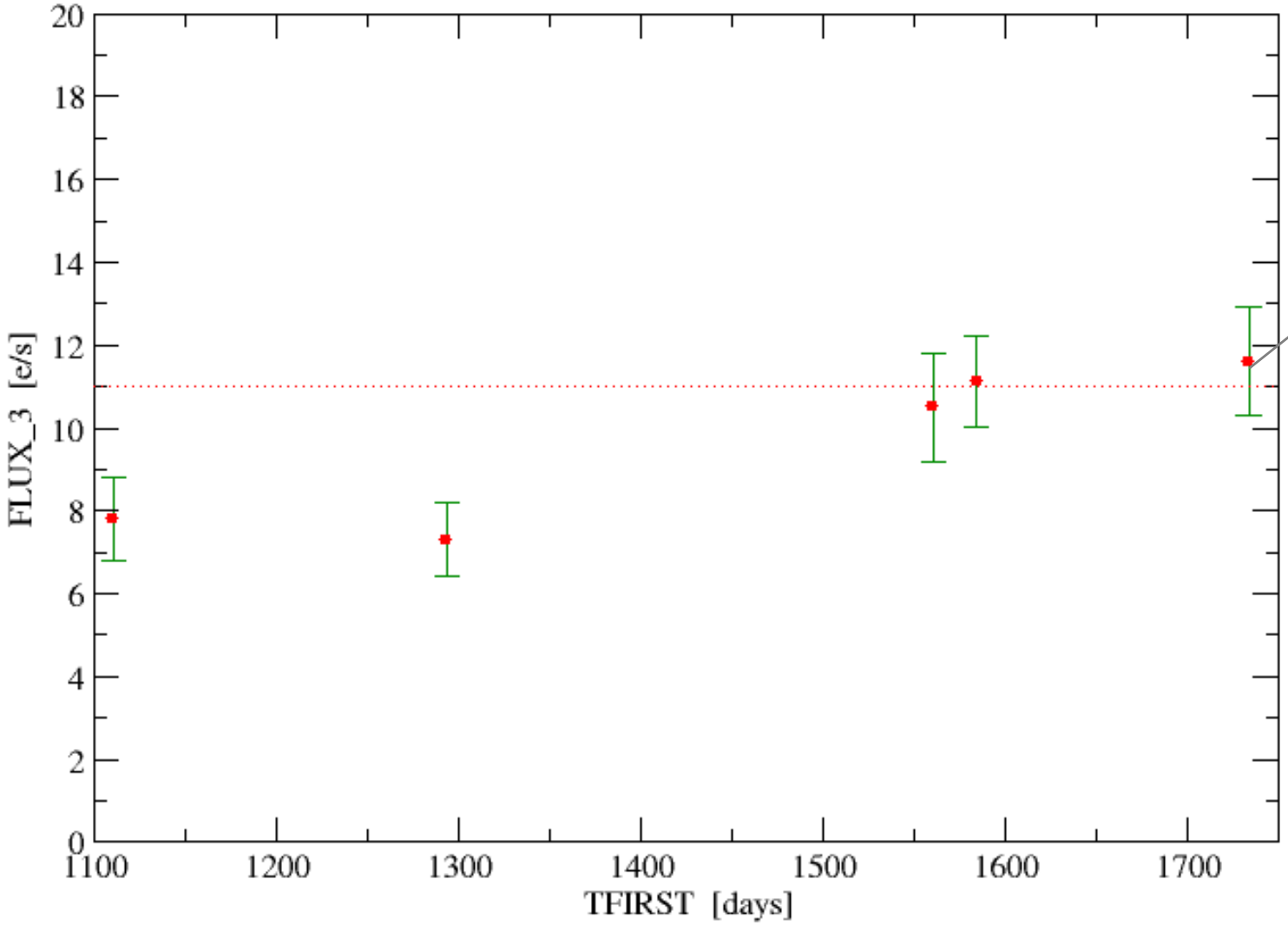
Example 1: X0115+634



Large window obtained in *trigger* mode

V ~ 15

X0115+634



September 0
outburst

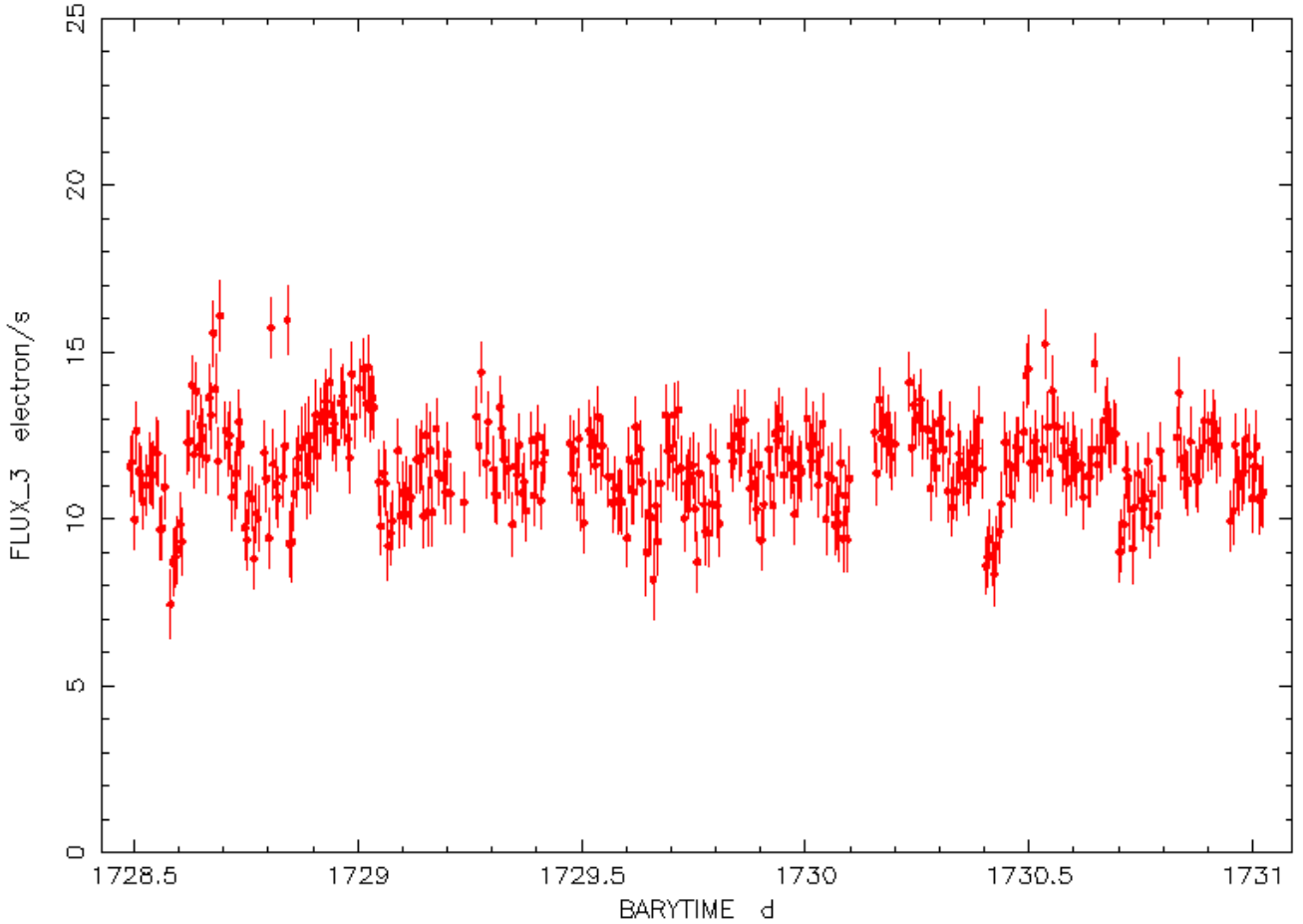
OMC provides the long term monitoring, allowing to compare the optical emission in normal and outburst modes.

X0115+634

REVOLUTION	FLUX [e/s]	COMMENTS
31	7.8 ± 1.0	Science 100s
92	**7.3 ± 0.9**	Science 100s
181	10.5 ± 1.3	Science 100s
189	11.1 ± 1.1	Science 100s
234	*9.4 ± 2.5*	Trigger (noisy)
238	*10.3 ± 2.8*	Trigger (noisy)
238	**11.6 ± 1.3**	Science 200s

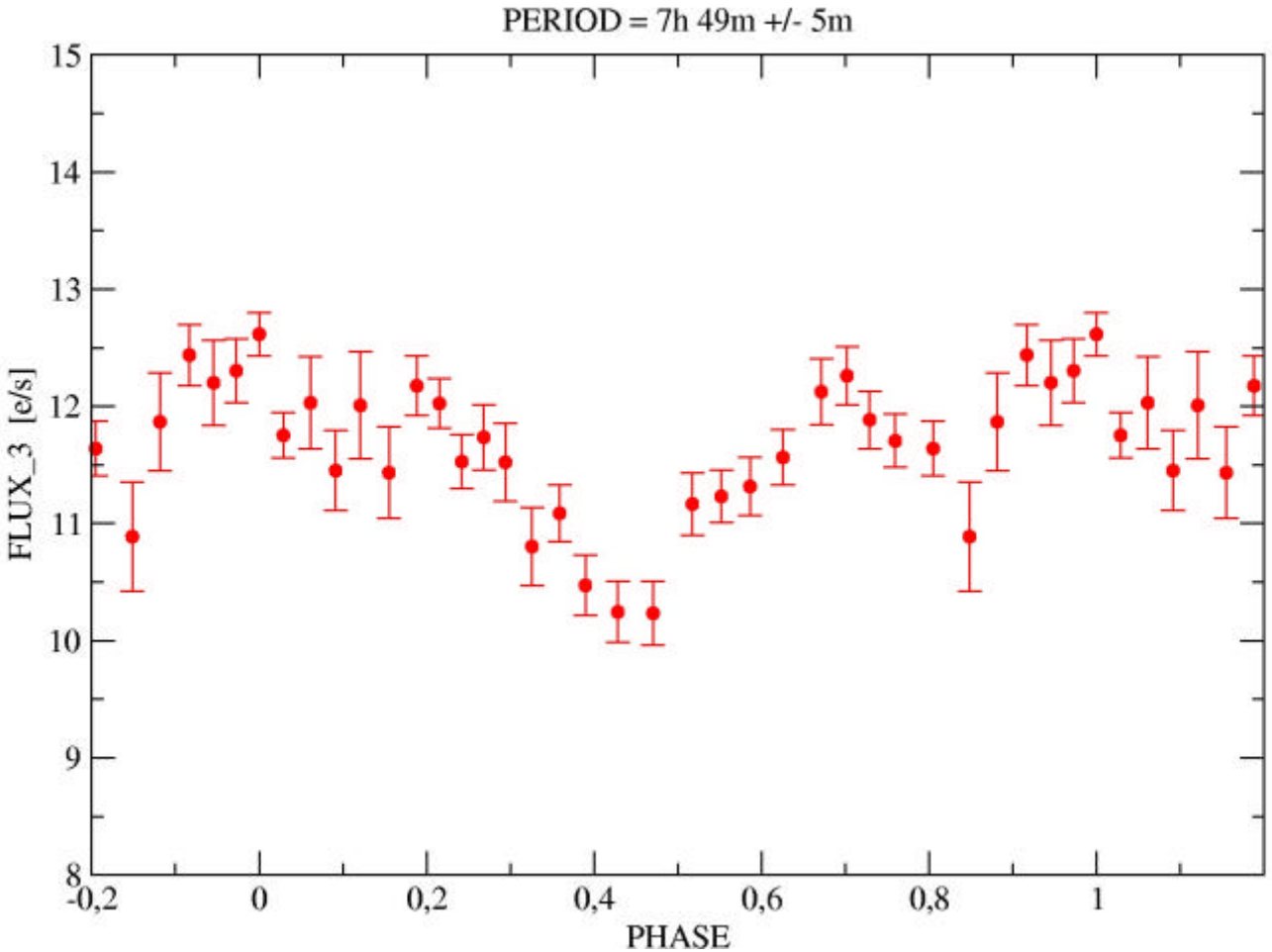
There has been an increase in optic
emission of around 40% compared
revolutions 31 - 92.

X0115+634



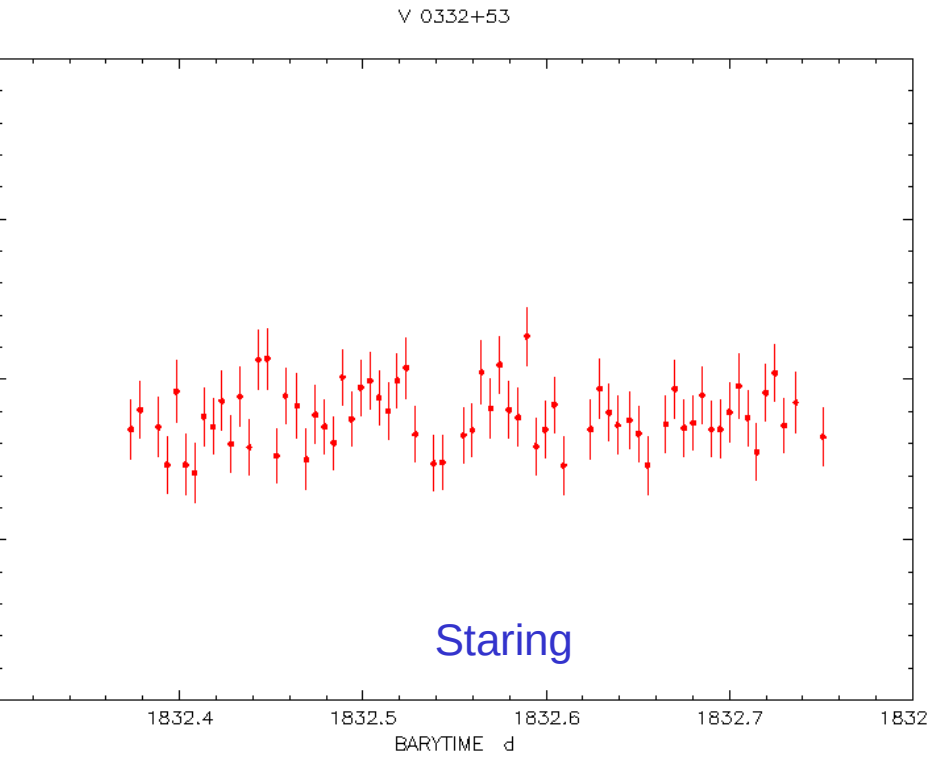
OMC provides also the short term variability of the source, and allows to compare the optical and high energy variability patterns.

X0115+634

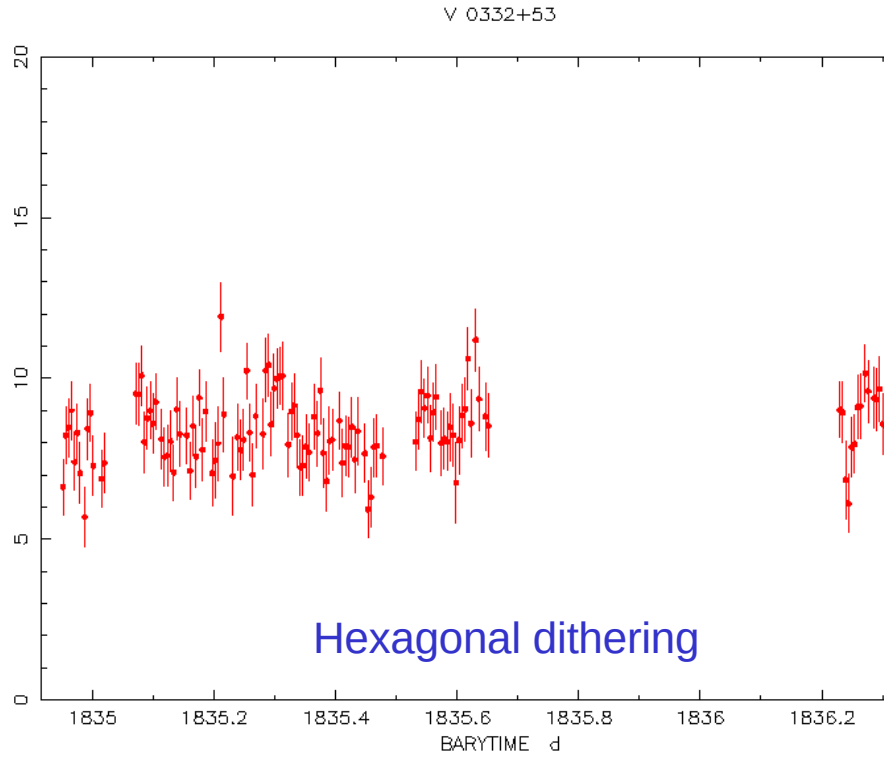


Fourier analysis yields a most likely variability period around 7h 49m, though the periodicity is not very clean.

Example 2: V0332+53



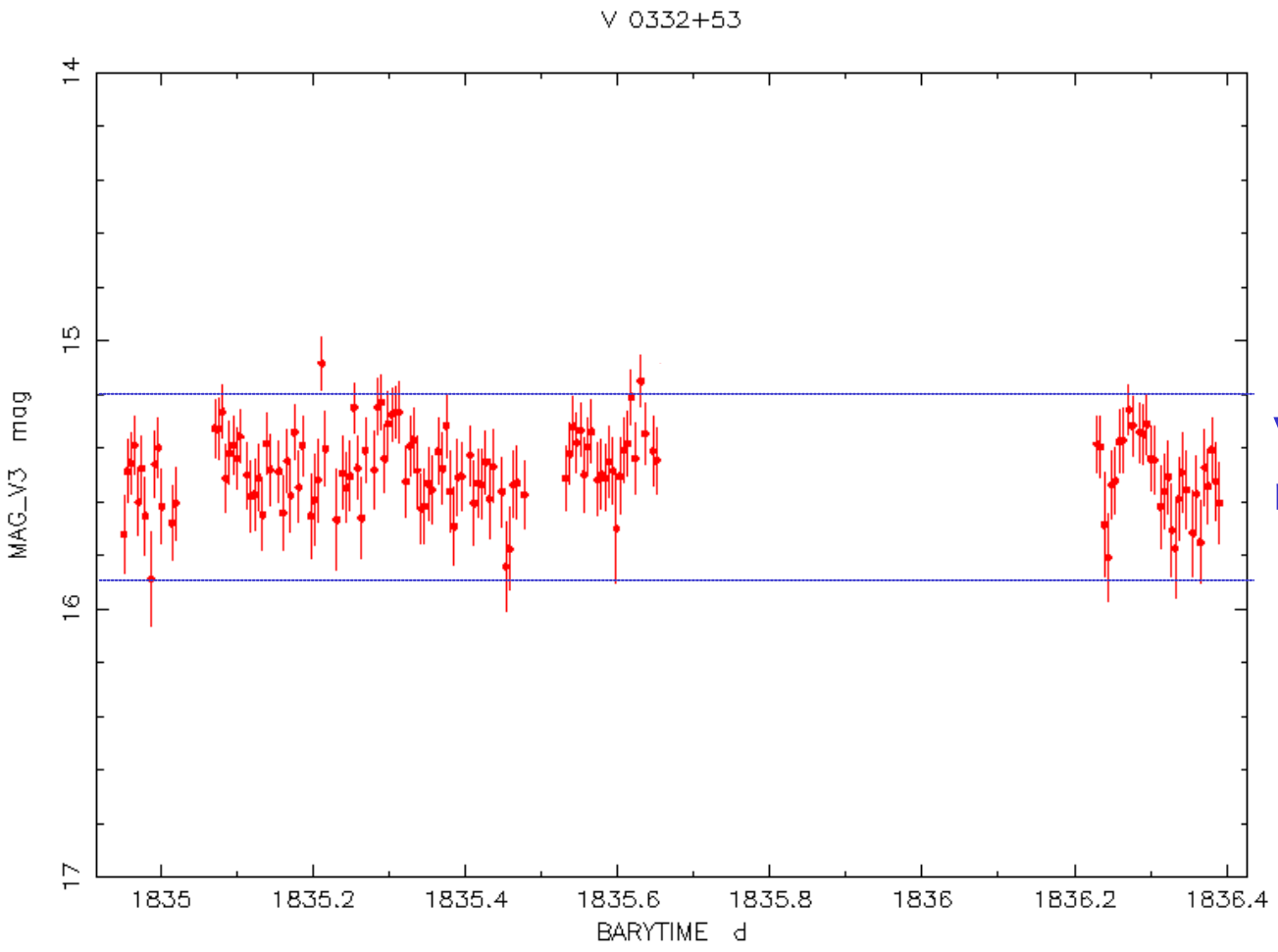
Staring



Hexagonal dithering

Just being studied. V ~ 15.5.

Example 2: V0332+53



Variability range as reported in the literatu

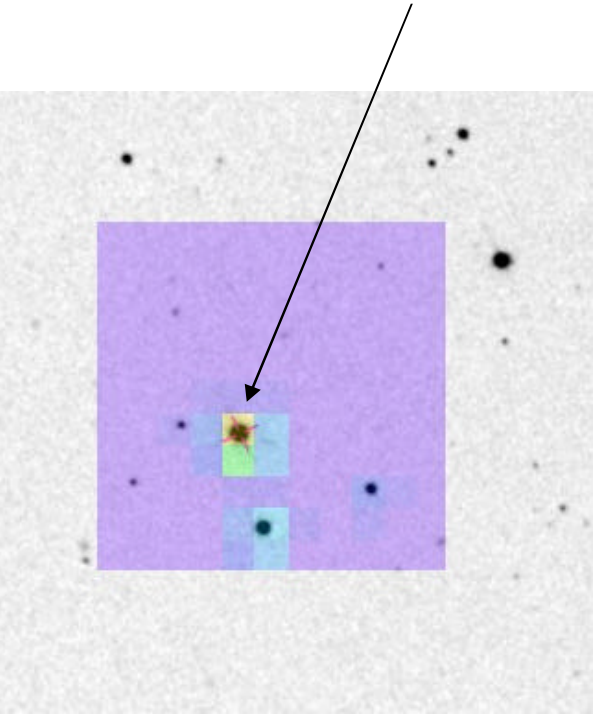
Difficulties (I)

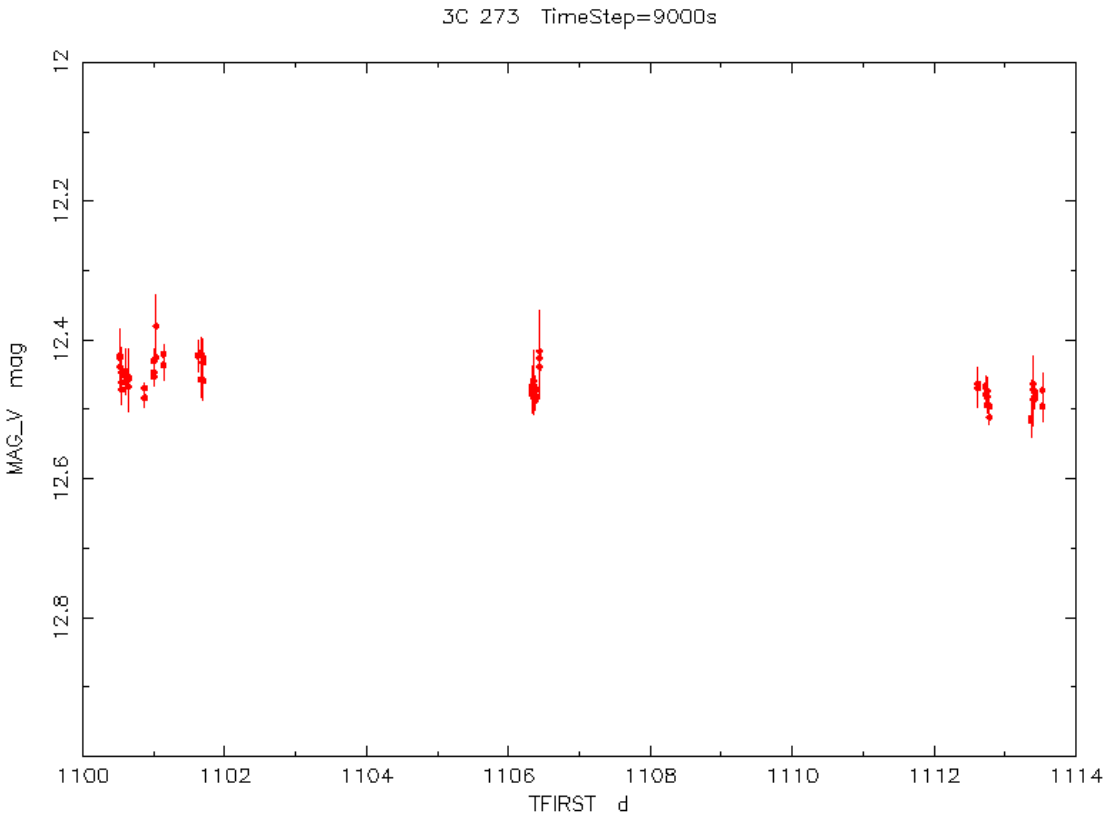
- OMC flat field evolves relatively fast. Calibrations every 6 weeks are not enough to provide ideal flat fielding.
  - There is a residual photometric uncertainty associated to the dithering patterns.
  - Variability below 15% associated to the dithering periodicity is suspicious.
- Photometric extraction in crowded fields is difficult.
  - The standard pipeline is not always able to recover the photometry in crowded fields.
  - Field rotation might induce significant errors in these cases.
  - Manual extraction has to be performed in these cases, assuring that the contributions by nearby stars are properly removed, if at all possible.

Difficulties (II)

- Standard pipeline extracts 1 photometric point every 10 minutes, combining long and short integrations.
  - For weak sources, more accurate results are obtained combining only the longest integrations available.
  - It is strongly recommended to use the interactive tools to improve the accuracy by optimizing the sampling.
- For high energy targets without accurate coordinates only CCD mosaics are provided, centered on the expected source coordinates.
  - The standard pipeline is not able to extract the photometry without accurate (~1') coordinates.
  - Calibrated mosaics have to be analyzed by hand. The accurate astrometric solution will be very helpful for that.

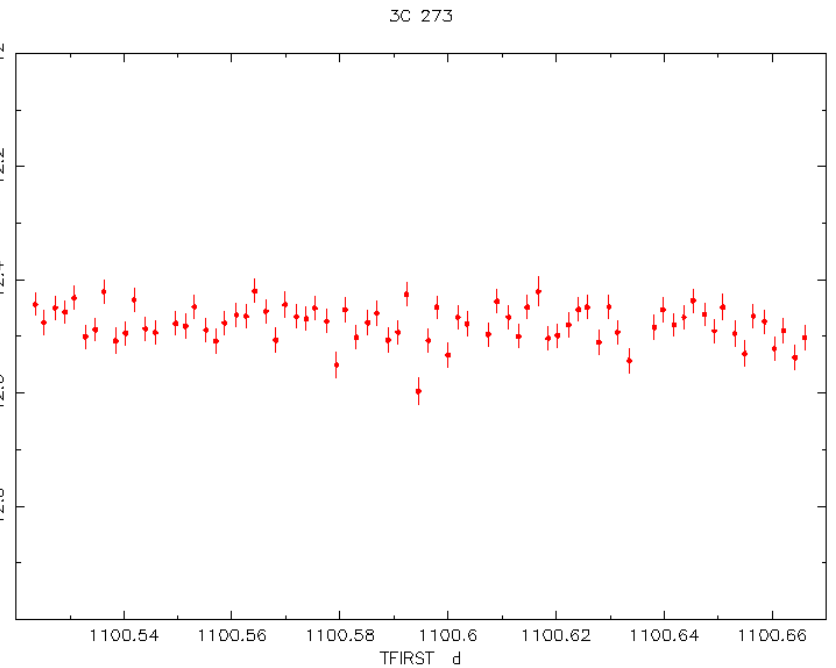
Example 3: 3C273

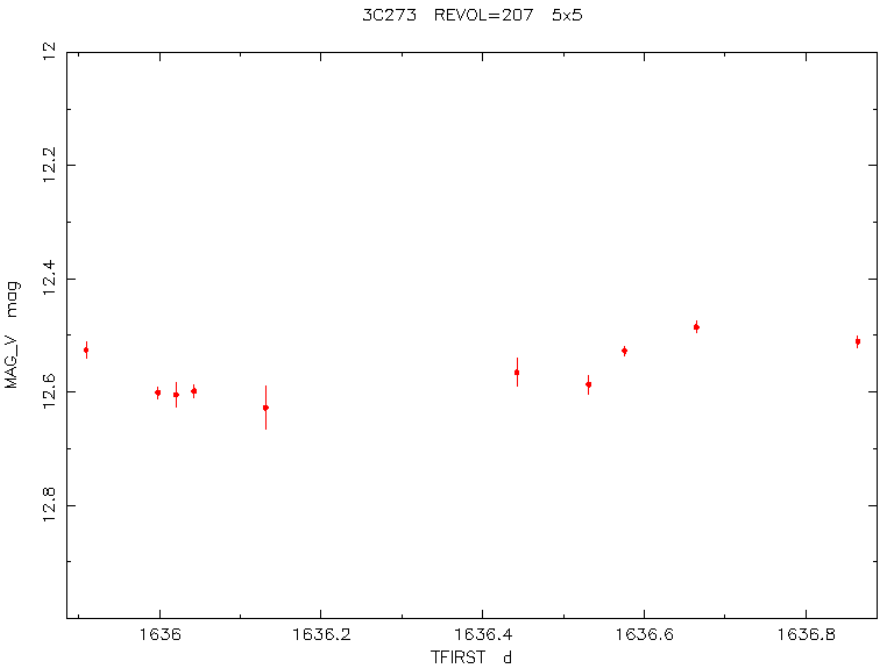




OMC photometry of 3C 273 is affected by a nearby star.
The optimized extraction algorithms provide nevertheless a reliable lightcurve.

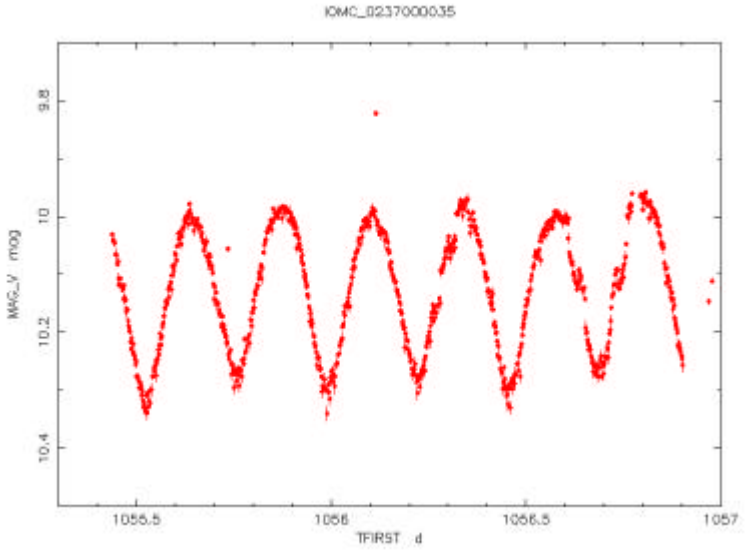
3C273

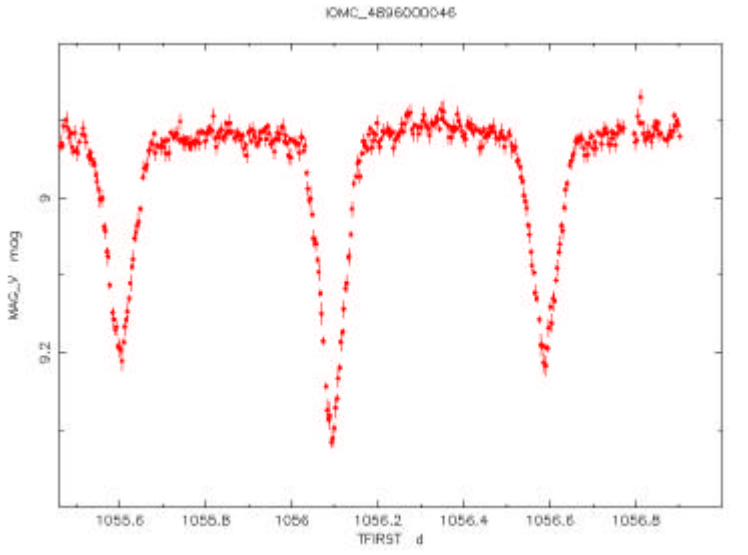


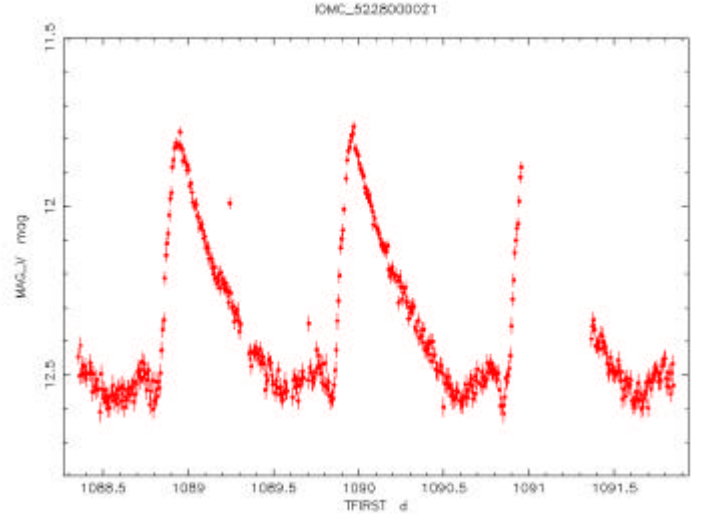


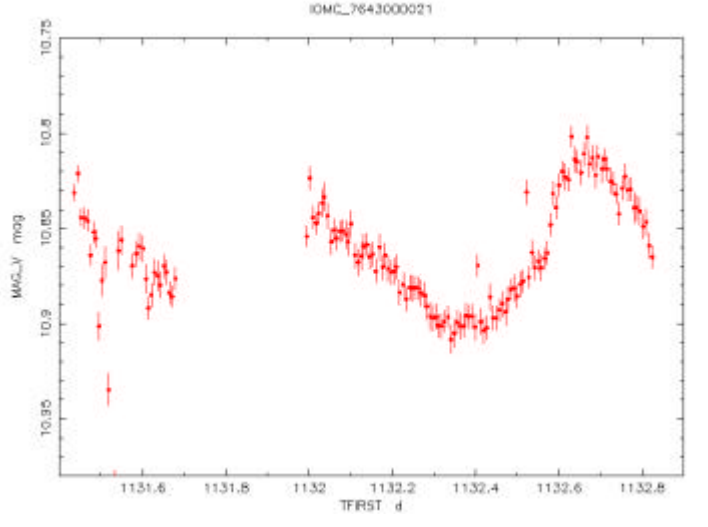
OMC provides the long term optical lightcurve, showing that 3C273 has stayed within $\pm$ 0.1 V mag. in the last 2 years.

Example 4: Optically variable sources









Summary statistics

- Almost 70.000 individual sources monitored up to now
- More than 400 targets with more than 500 photometric points
- Almost 9.000 targets with more than 50 photometric points (600 s each)

Only less than 200 sources have been analyzed in detail up to now by the OMC team.

Don't hesitate to ask for help if needed!