High Energy Sources Observed with OMC/INTEGRAL

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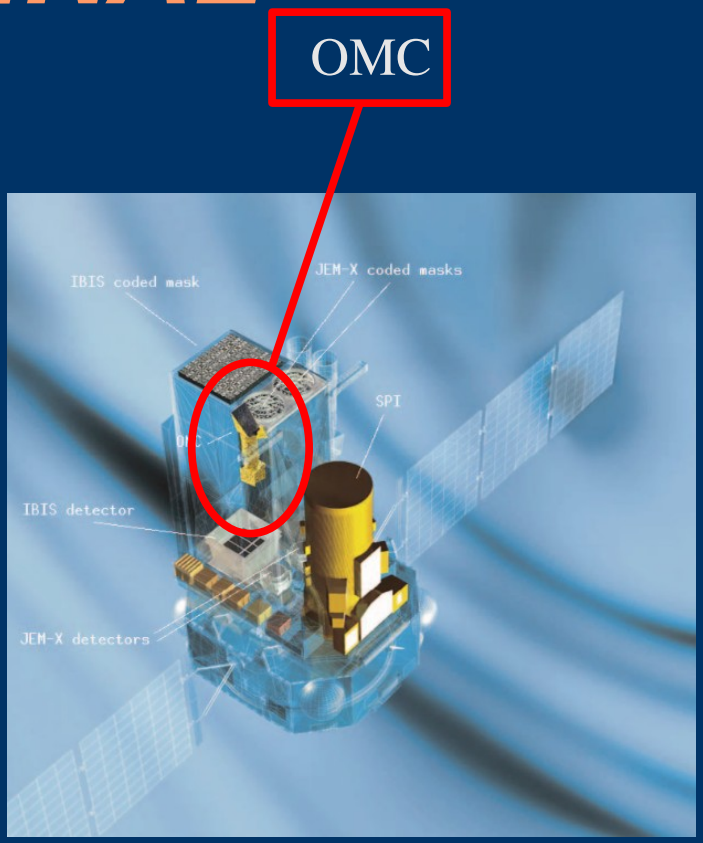
Albert Domingo
LAEFF-INTA



Headlines

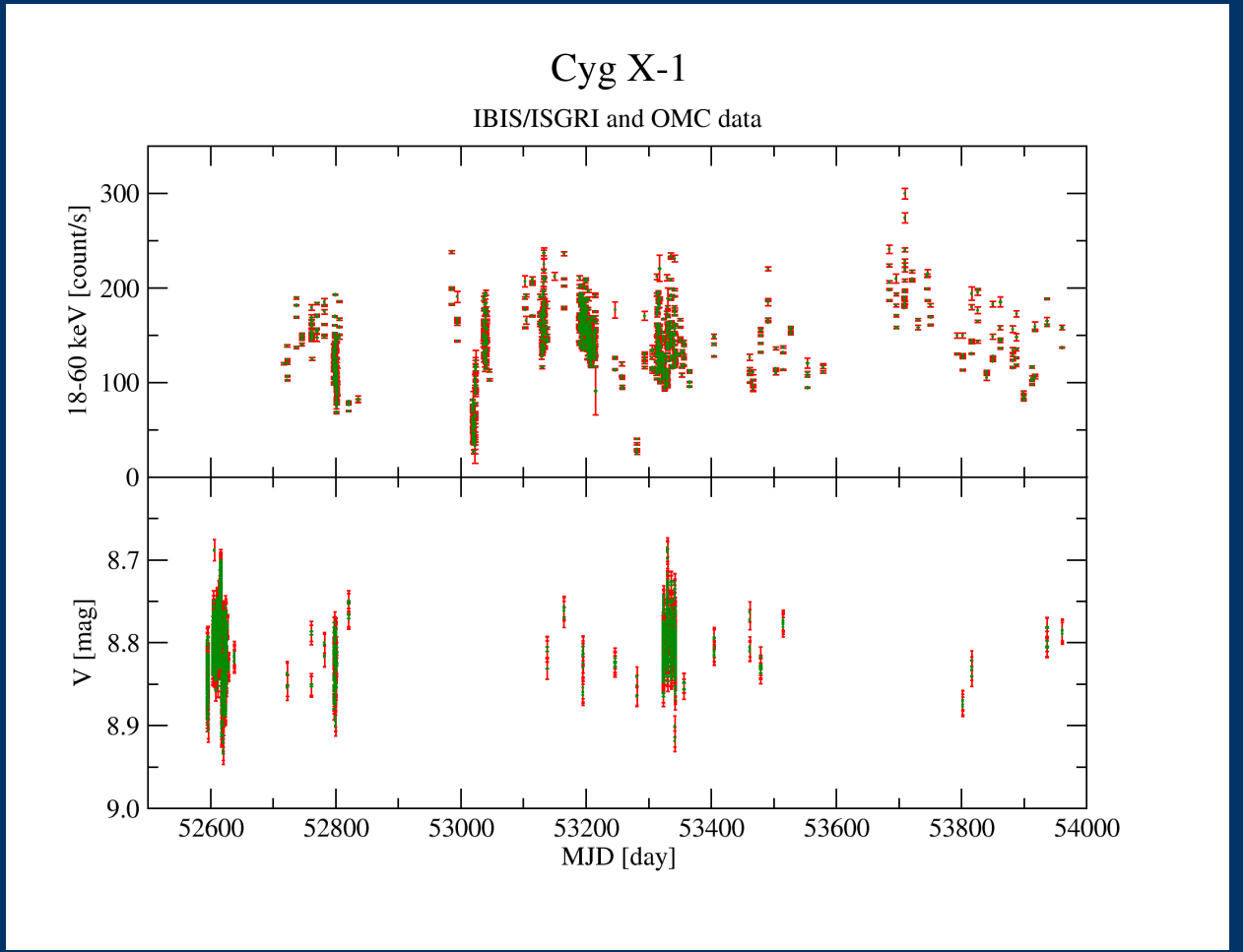
- 3rd IBIS/ISGRI Catalog optical counterparts. High energy sources detected with IBIS/ISGRI.
- Galactic Bulge Monitoring. INTEGRAL monitoring of the Galactic Bulge region.
- Conclusions.

3rd IBIS/ISGRI Catalog, Optical Counterparts

- All have been observed with INTEGRAL and have simultaneous gamma ray, X-ray and optical data.
- The gamma-ray data shown here have been provided by the *Southampton Gamma-ray Astrophysics Group*.
- Statistics:
  - ~30 Good counterparts.
  - ~90 Contaminated, weak or not detectable.
  - ~140 Without known counterpart.
  - ~140 Not observed.

3rd IBIS/ISGRI Catalog: Cyg X-1

- HMXB
- Masses (Herrero et al 1995):
  - Mstar=17.5Msun
  - Mbh=10.1Msun
- Orbital period ≃ 5.6d



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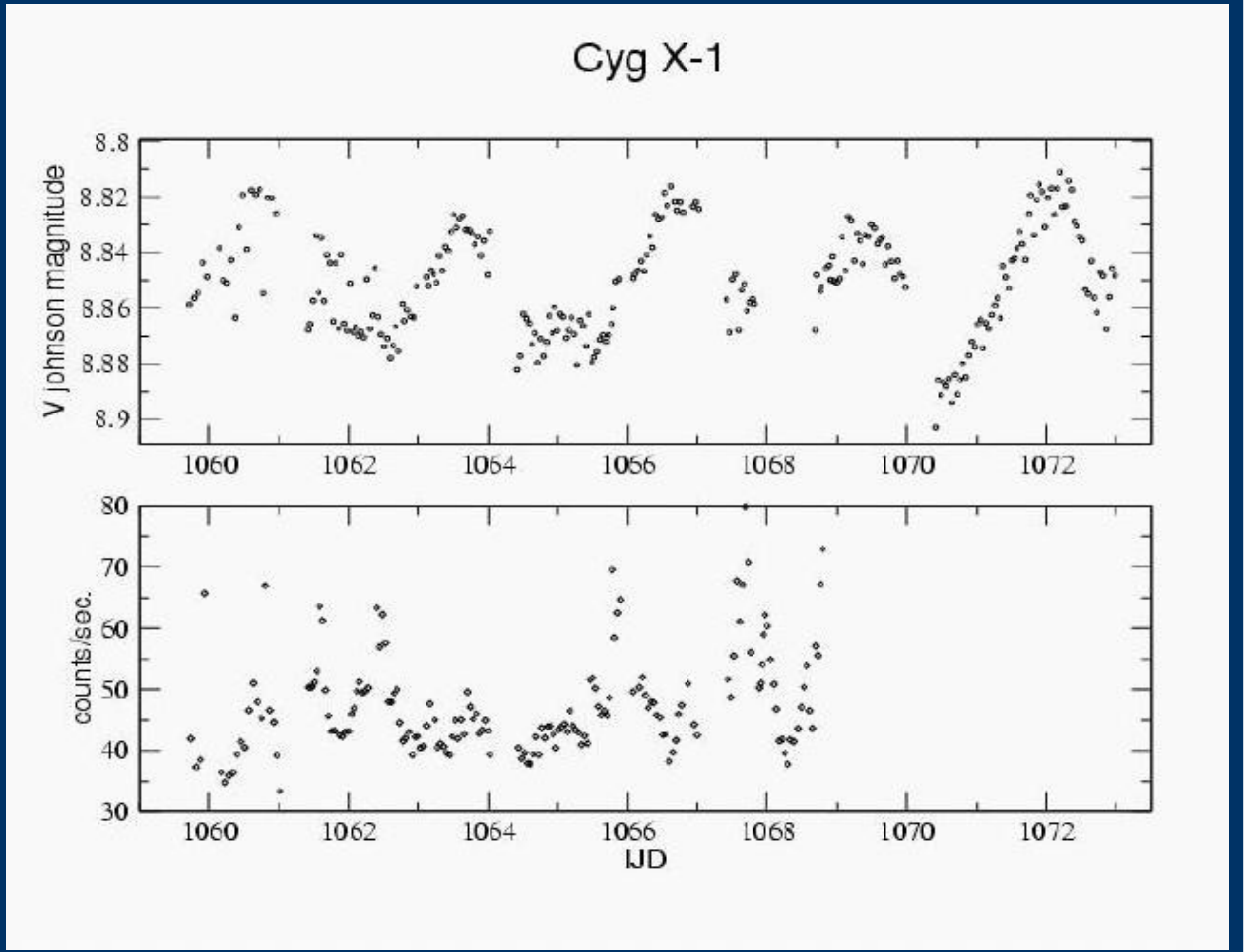
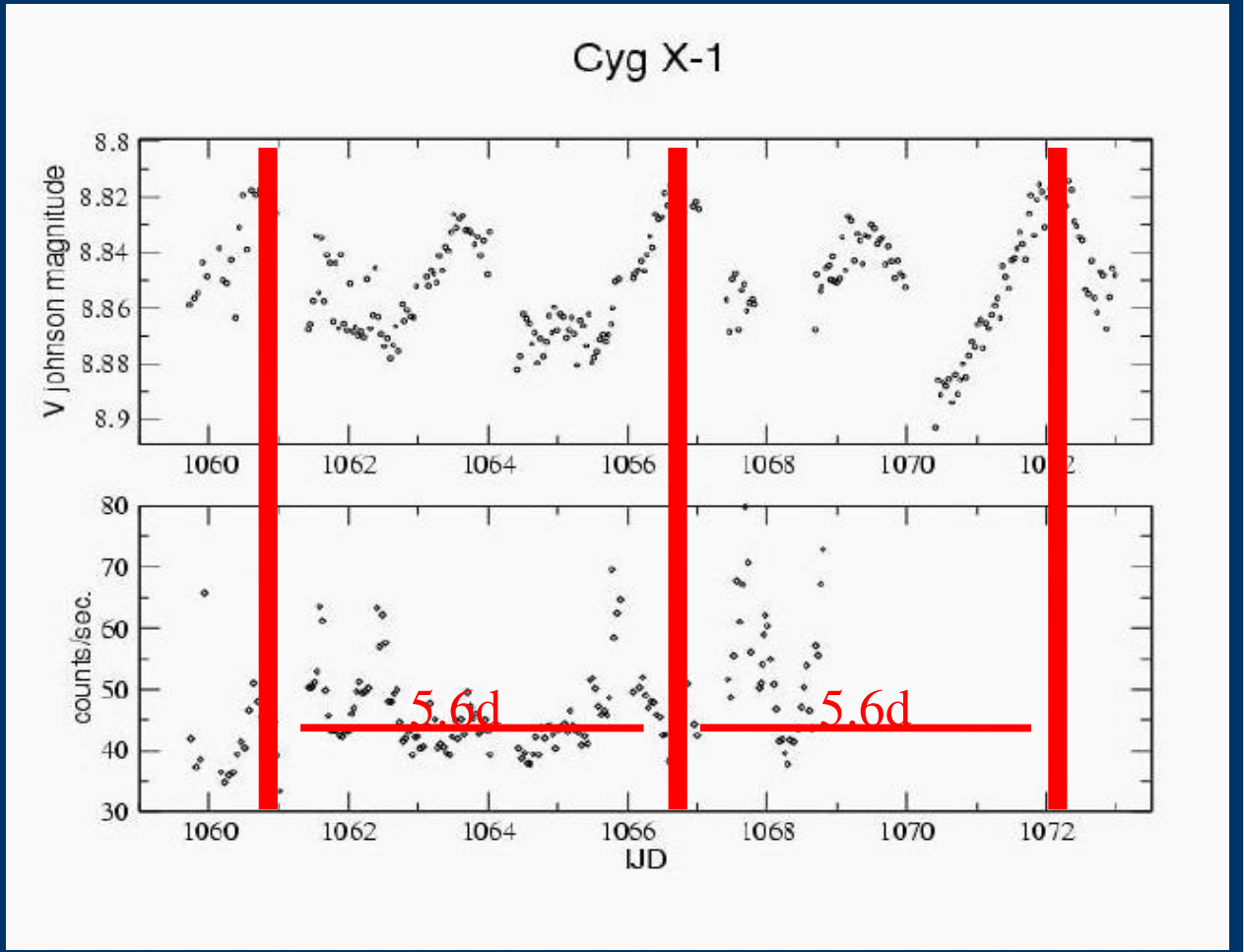


3rd IBIS/ISGRI Catalog: Cyg X-1

- Light curve due to tidal distortion.
- Difference between maxima could be attributed to a non uniform distribution of the surface brightness.



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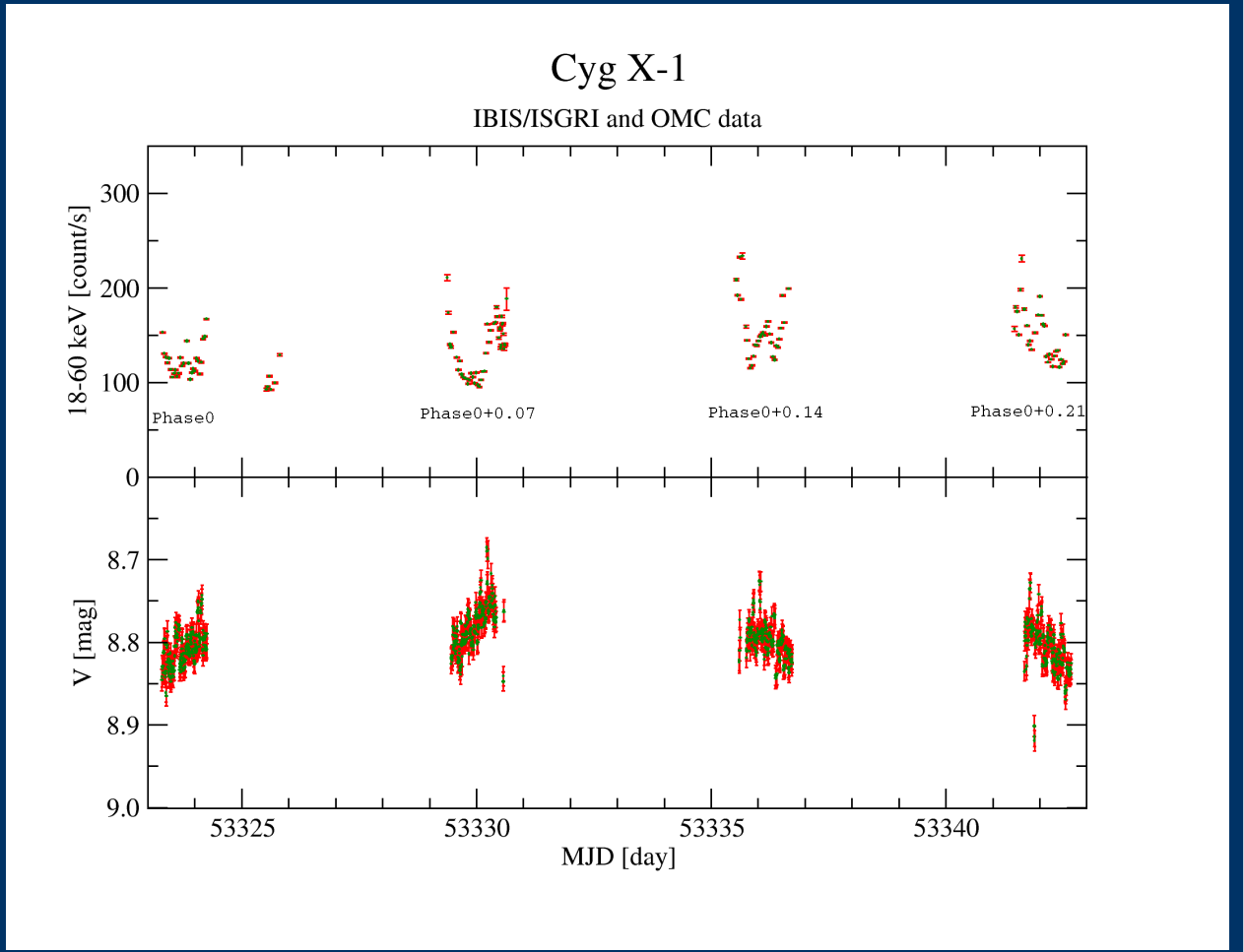

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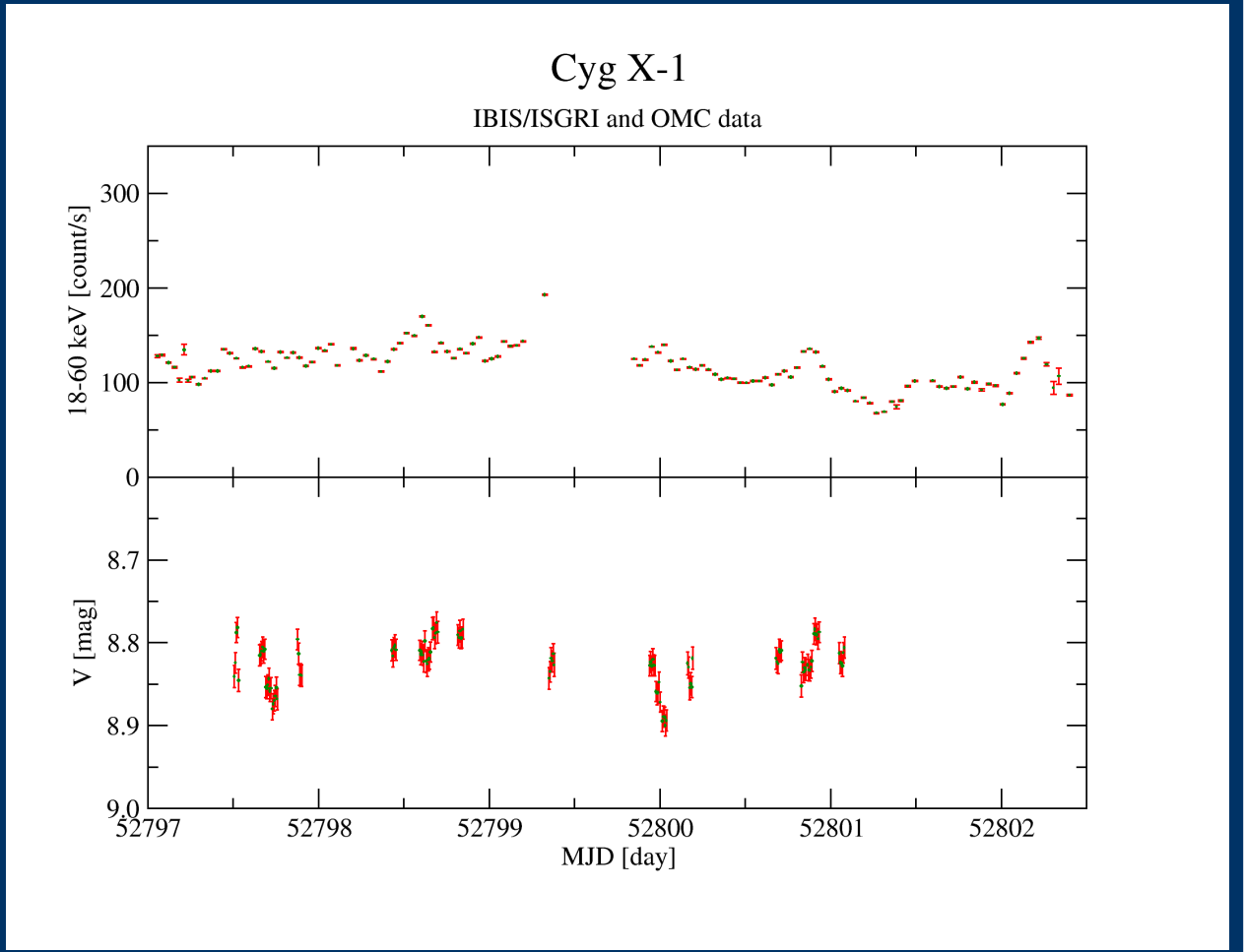
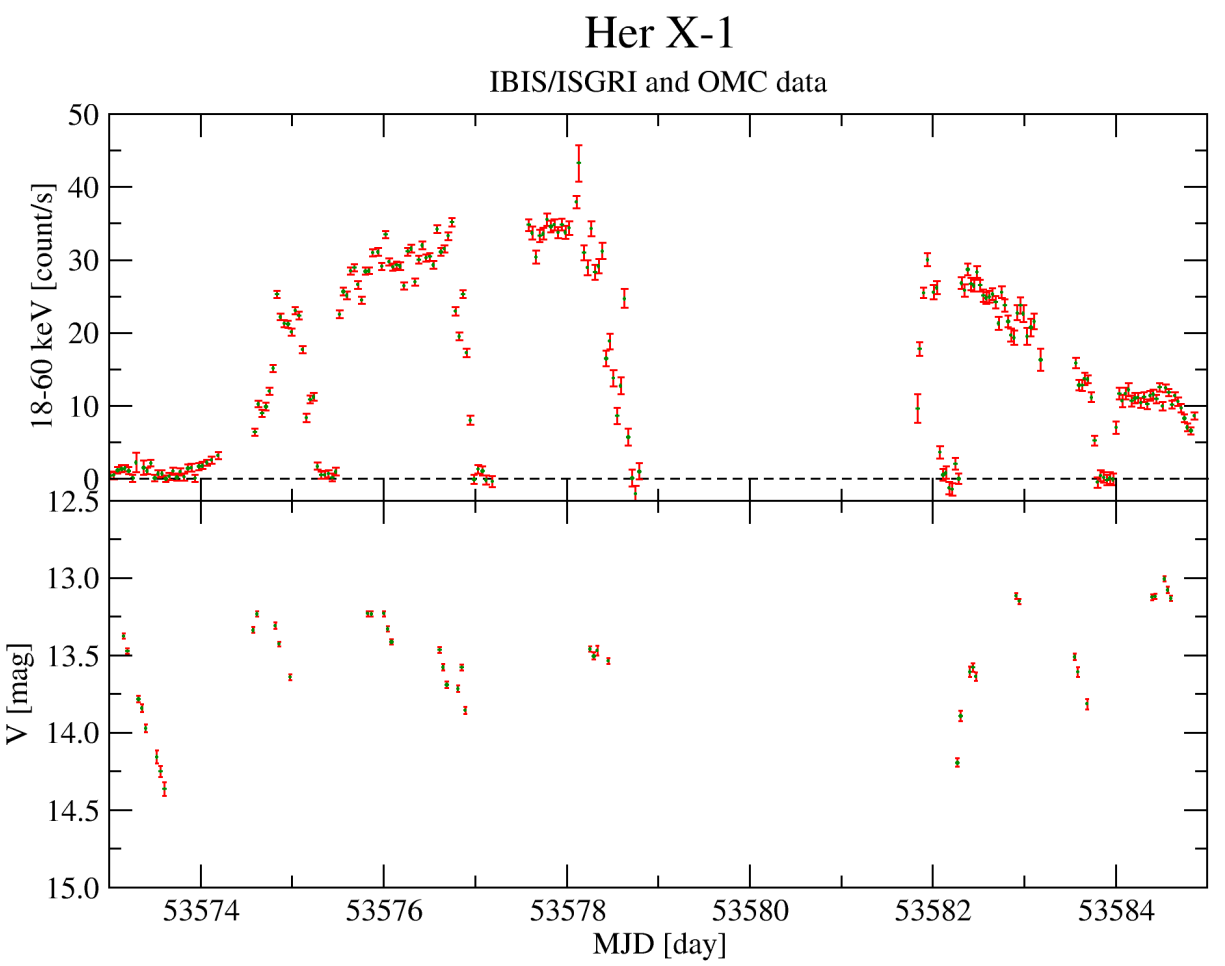


3rd IBIS/ISGRI Catalog: Her X-1

- Accreting X-ray binary.
- Pulsar.
- X-ray source eclipses due to orbital period (≃1.7 days).
- Super orbital period: disk precession?



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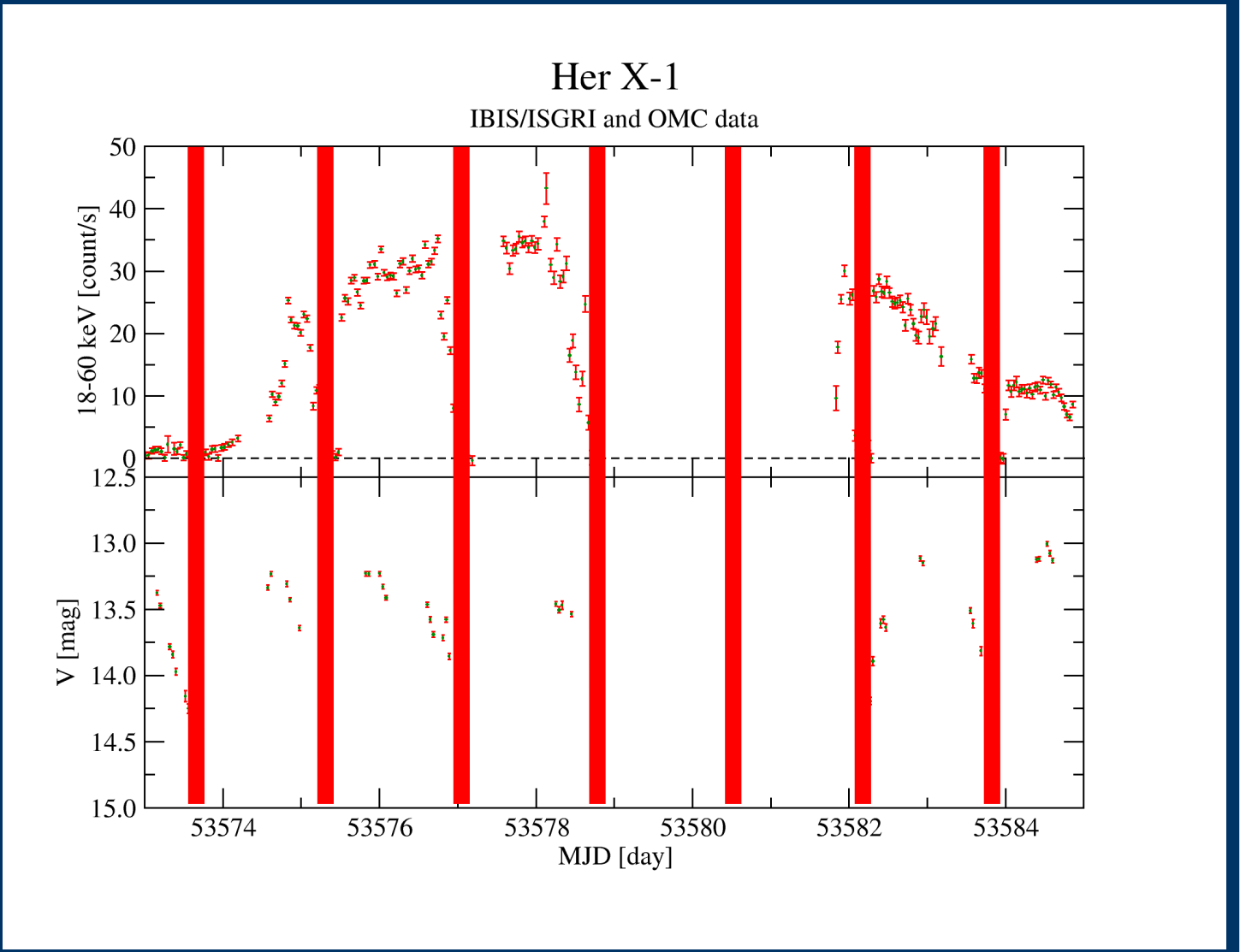
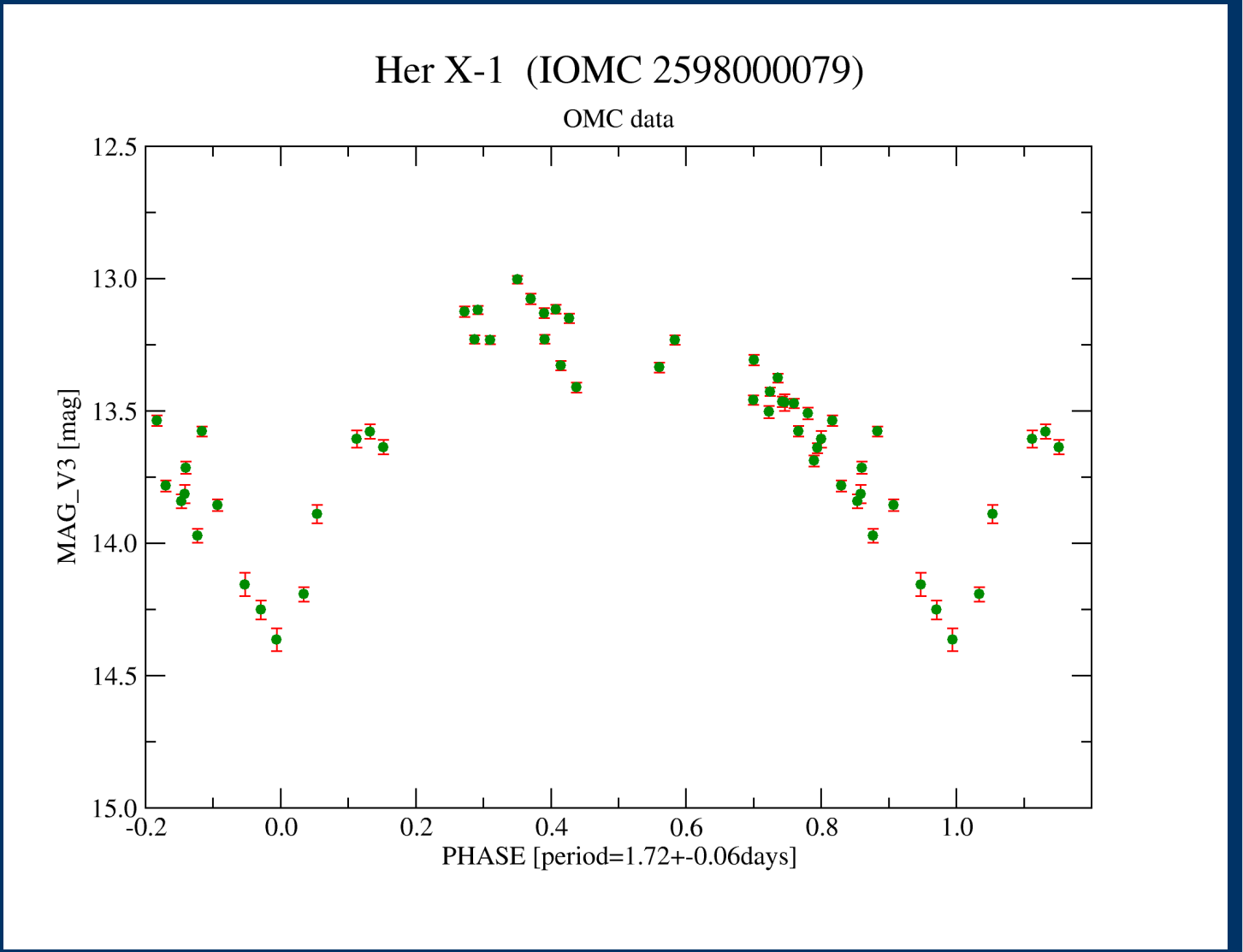


3rd IBIS/ISGRI Catalog: Her X-1

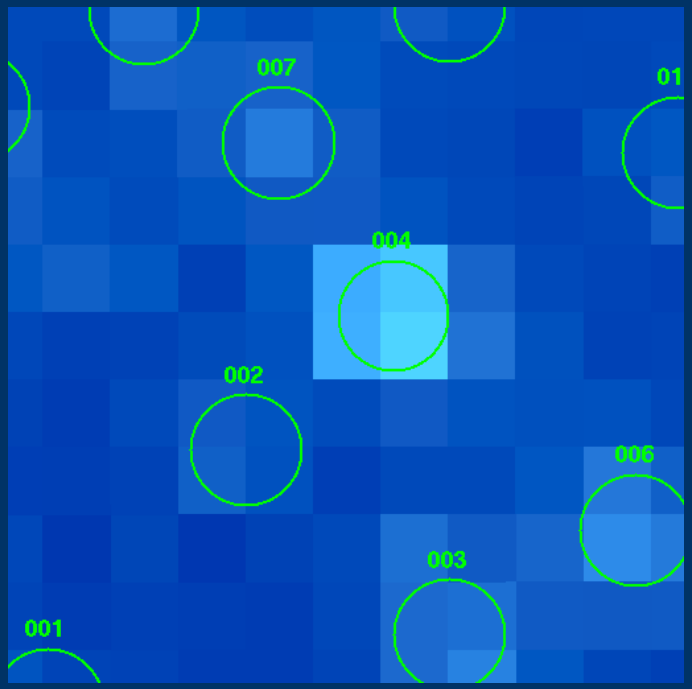
- Optical variation due to X-ray heating on the side facing the neutron star.

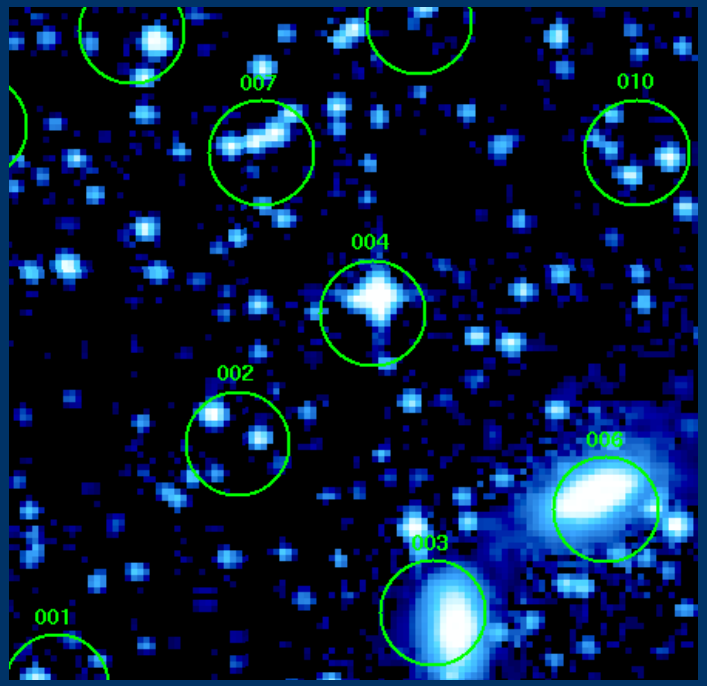


3rd IBIS/ISGRI Catalog: ESO 328-36

- For sources with uncertainty in his coordinates, big images are created.
- All sources are constant except 004 (Veron2004 counterpart).

OMC
V filter

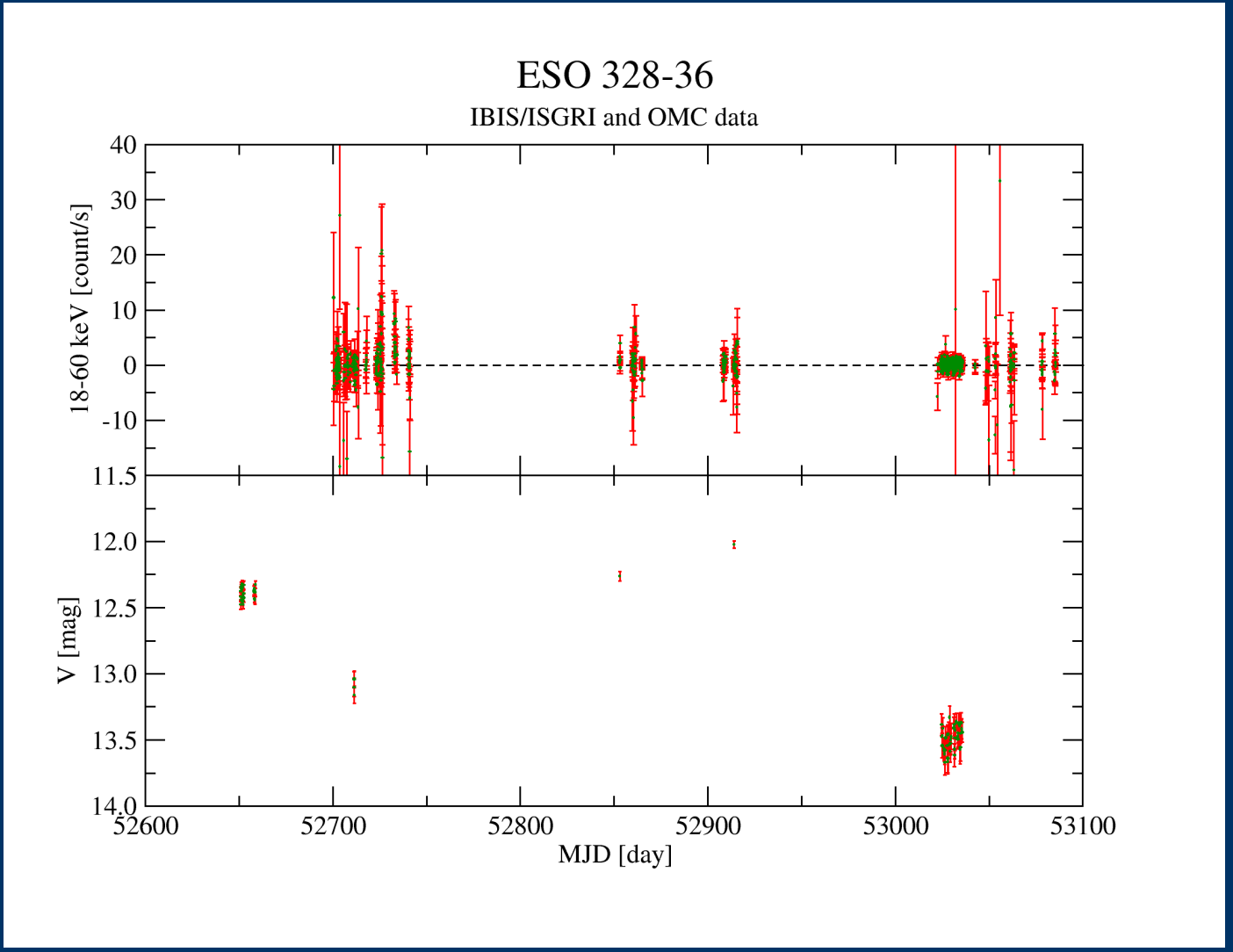




DSS
B filter

3rd IBIS/ISGRI Catalog: ESO 328-36

- Seyfert 1 galaxy (Simbad)
- Monthly variations
- Factor 4 in optical flux, not correlated with gamma rays.



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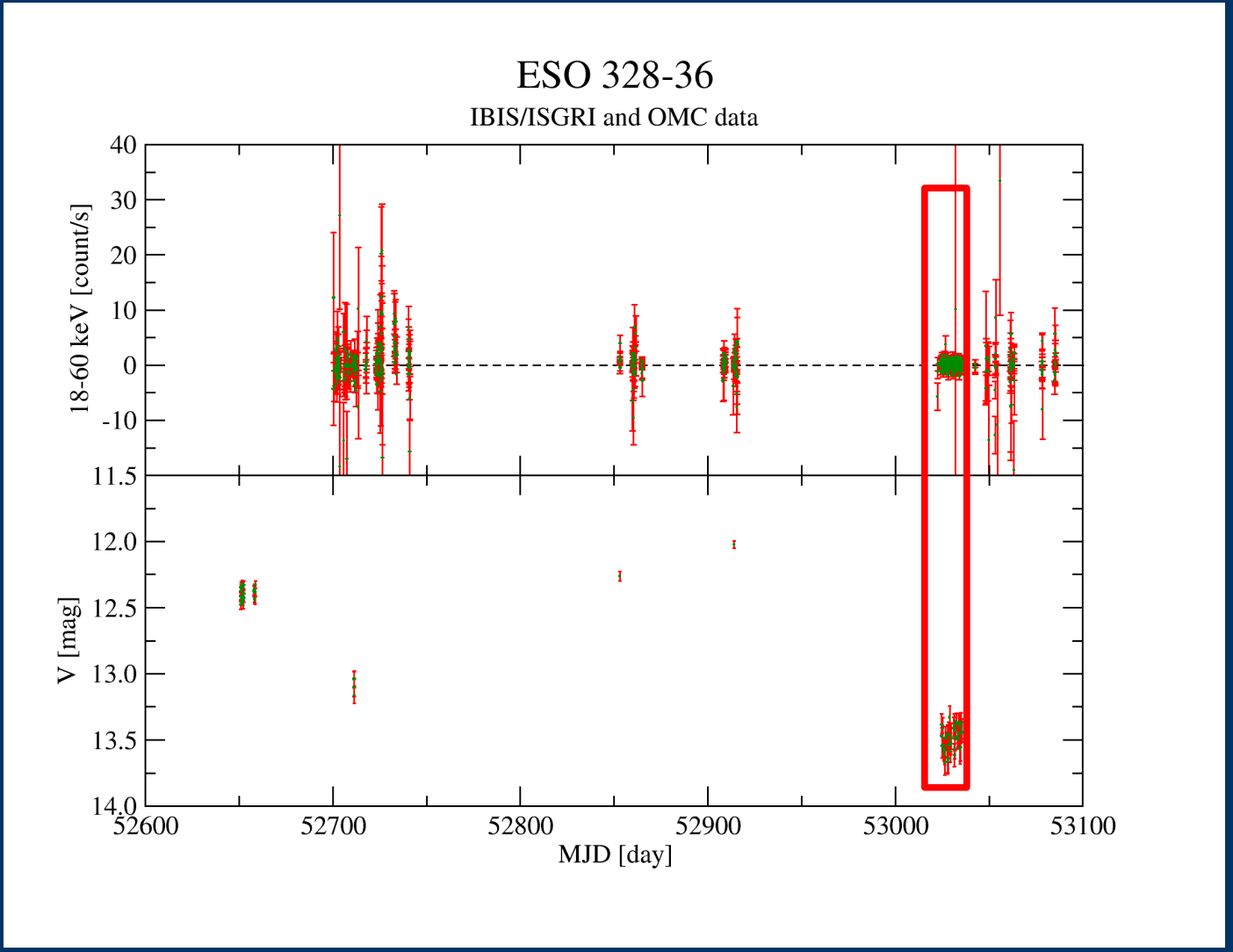

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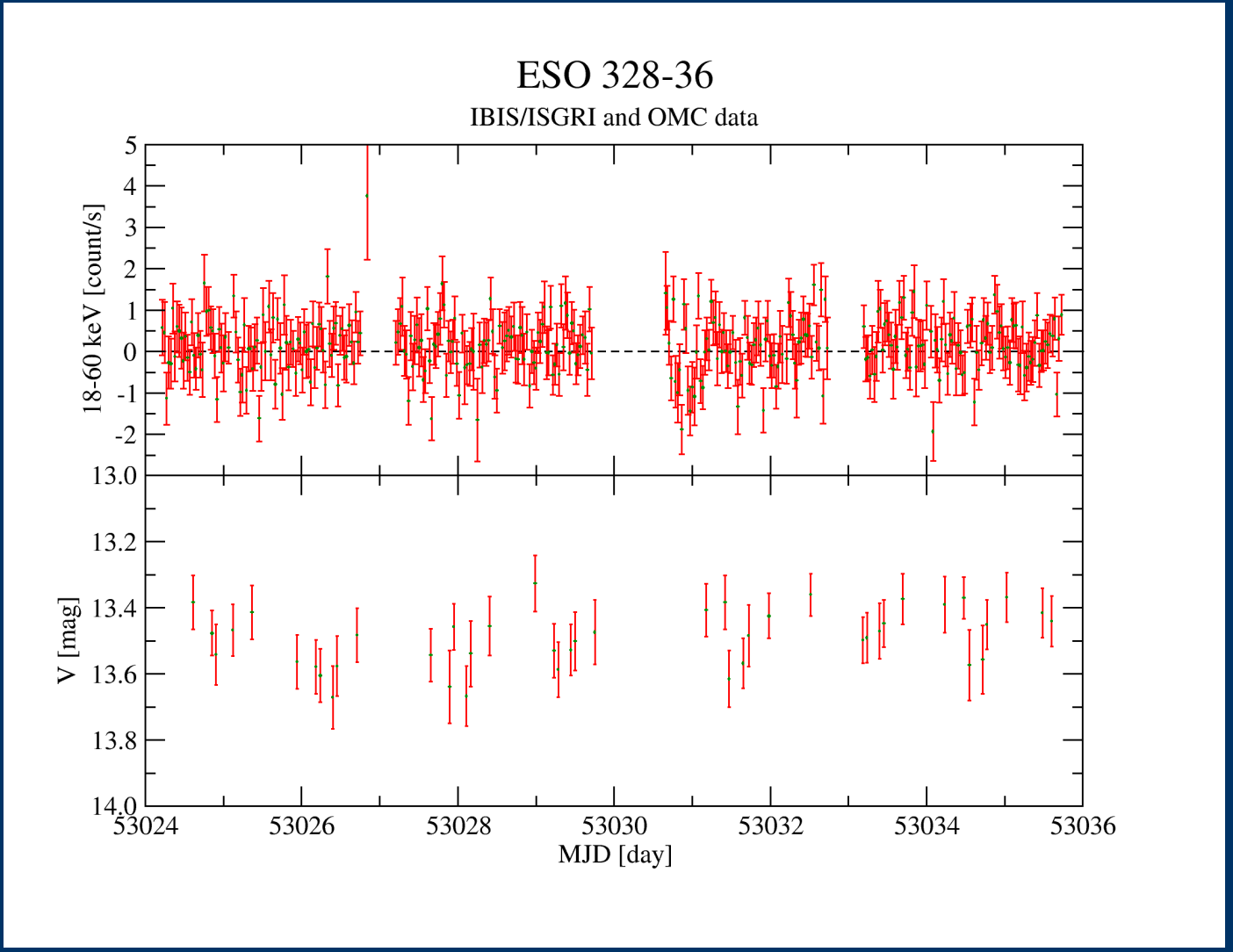
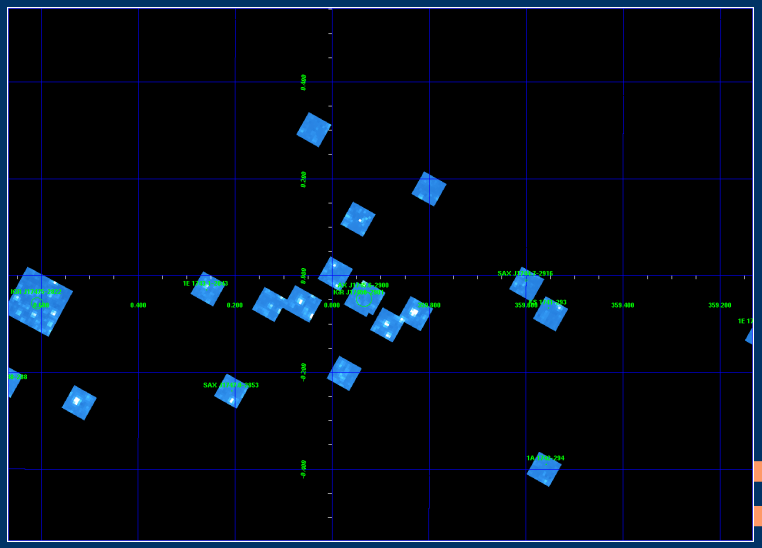


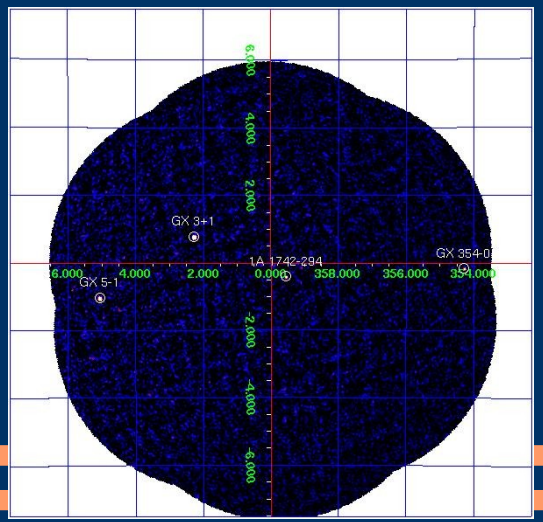
Galactic Bulge Monitoring

- Regular and frequent INTEGRAL monitoring of the Galactic Bulge region.
- Public data (IBIS/ISGRI and JEM-X) available at: http://isdc.unige.ch/Science/BULGE
- Kuulkers et al, 2007.

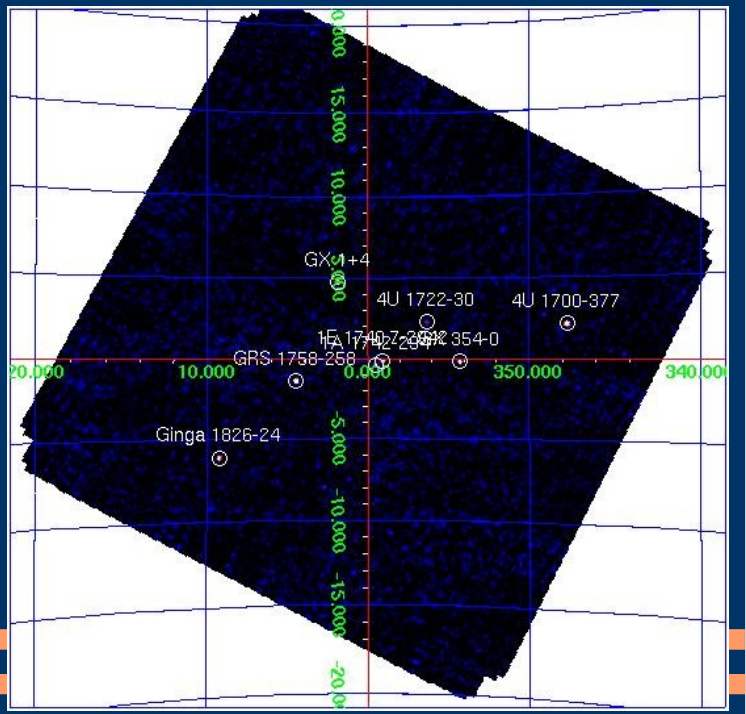
OMC



JEM-X



IBIS/ISGRI

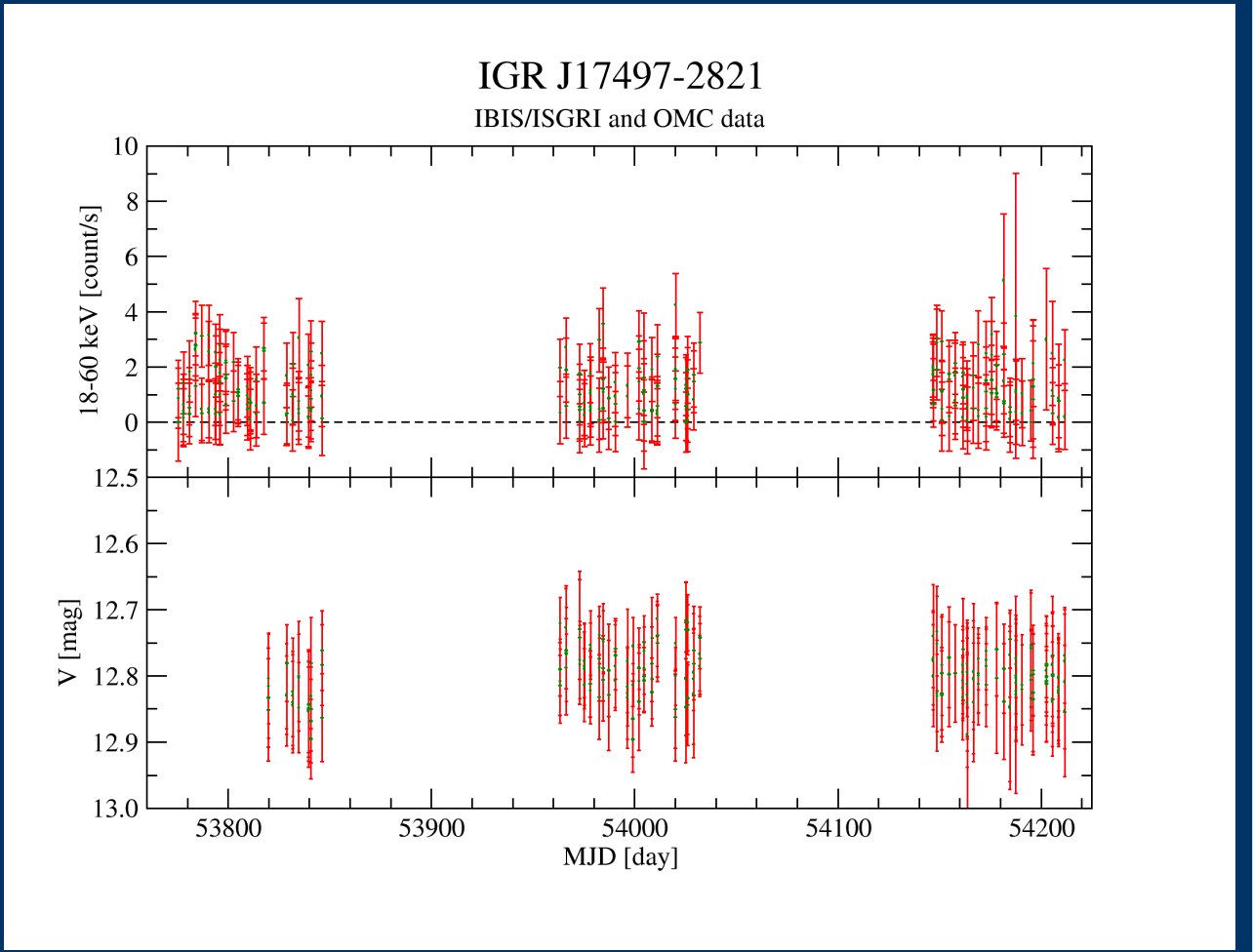


Galactic Bulge Monitoring

- 90 sources are being monitored with OMC (all of them are high energy sources):
  - 5 Optical counterparts.
  - 3 Probable counterparts.
    - There is a source inside the error circle.
  - 22 Not detected.
    - Absorbed sources.
  - 18 Small coordinate error, but crowded field.
    - Bad light-curve because of contamination.
  - 41 Medium coordinate error (<2.5pix~44'').
    - The source is not detected, but OMC could detect bursts.
  - 11 Large coordinate error (>2.5pix~44'').

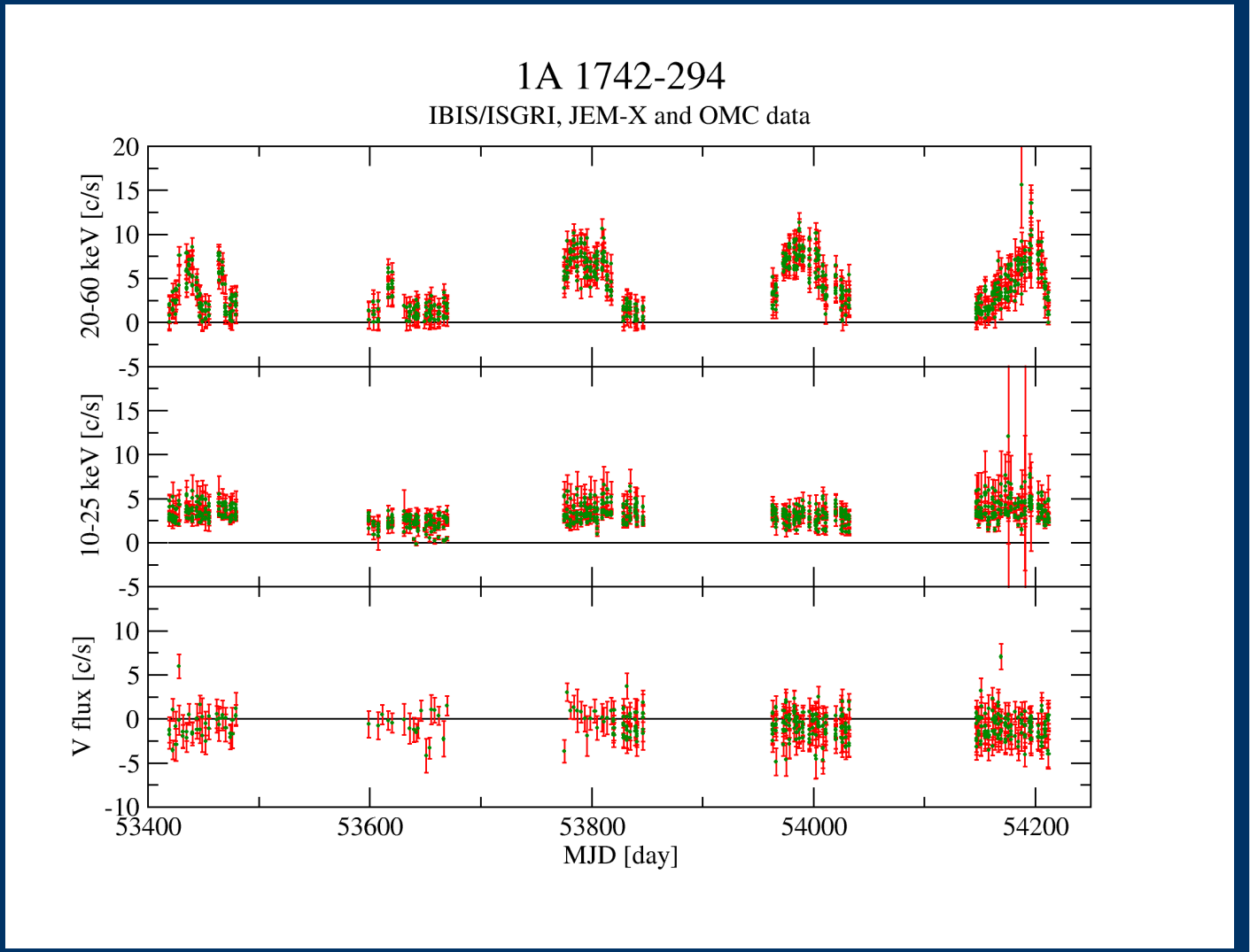
Galactic Bulge Monitoring: IGR J17497-2821

- Fast transient source.
- HMXB.
- Optical counterpart.
- Companion star O9Ib.
- Constant flux up to now.



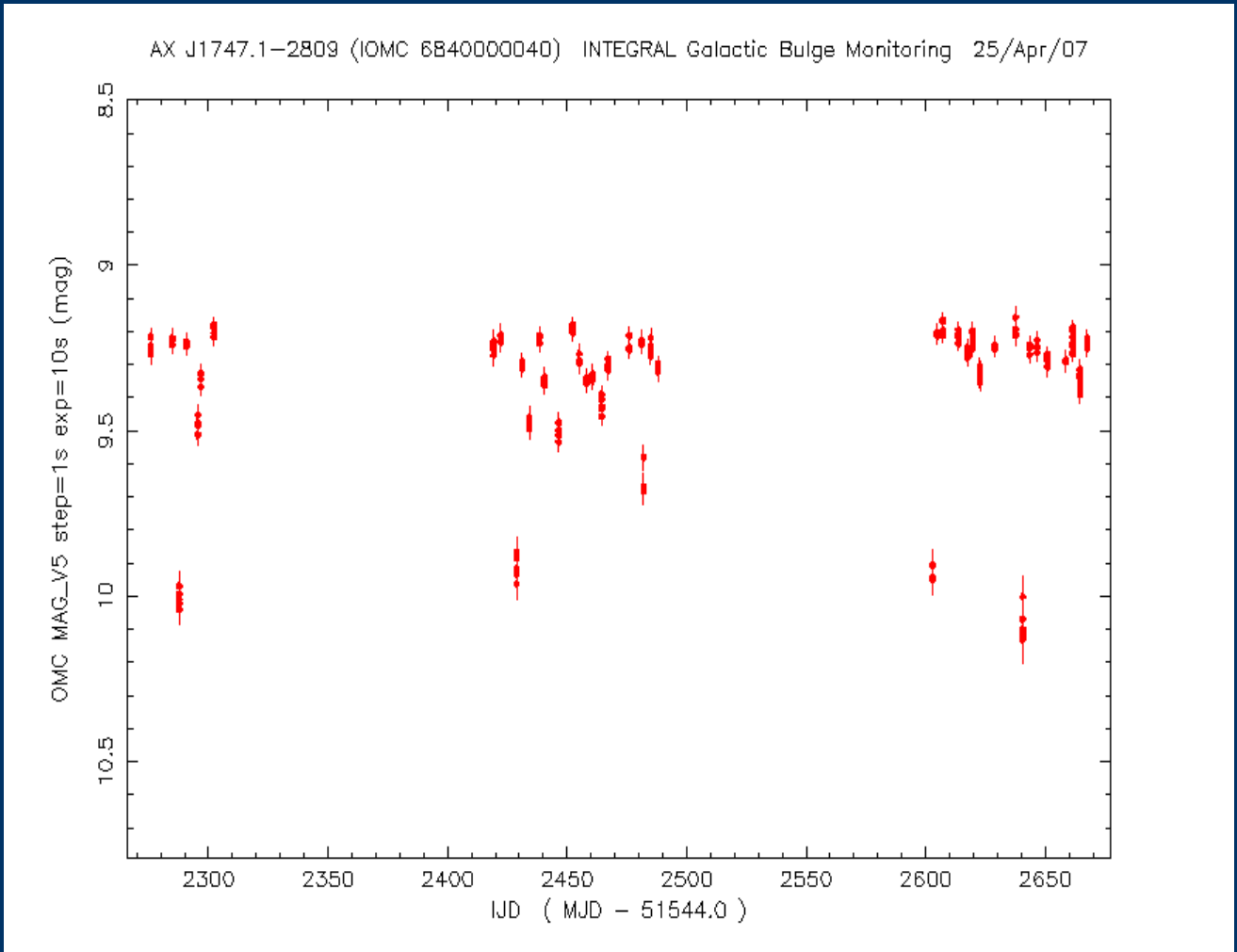
Galactic Bulge Monitoring: 1A 1742-294

- LMXB.
- X-ray buster.
- Varying monthly.
- Not burst detected in optical.



Galactic Bulge Monitoring: 1E 1743.9-2809

- 1E 1743.9-2809 (Einstein, Rosat) = BN Sgr (Sidoli et al, 2001).
- Optical counterpart.
- Eclipsing binary.
- Period error calculated with OMC: ±1.1s (5ppm).



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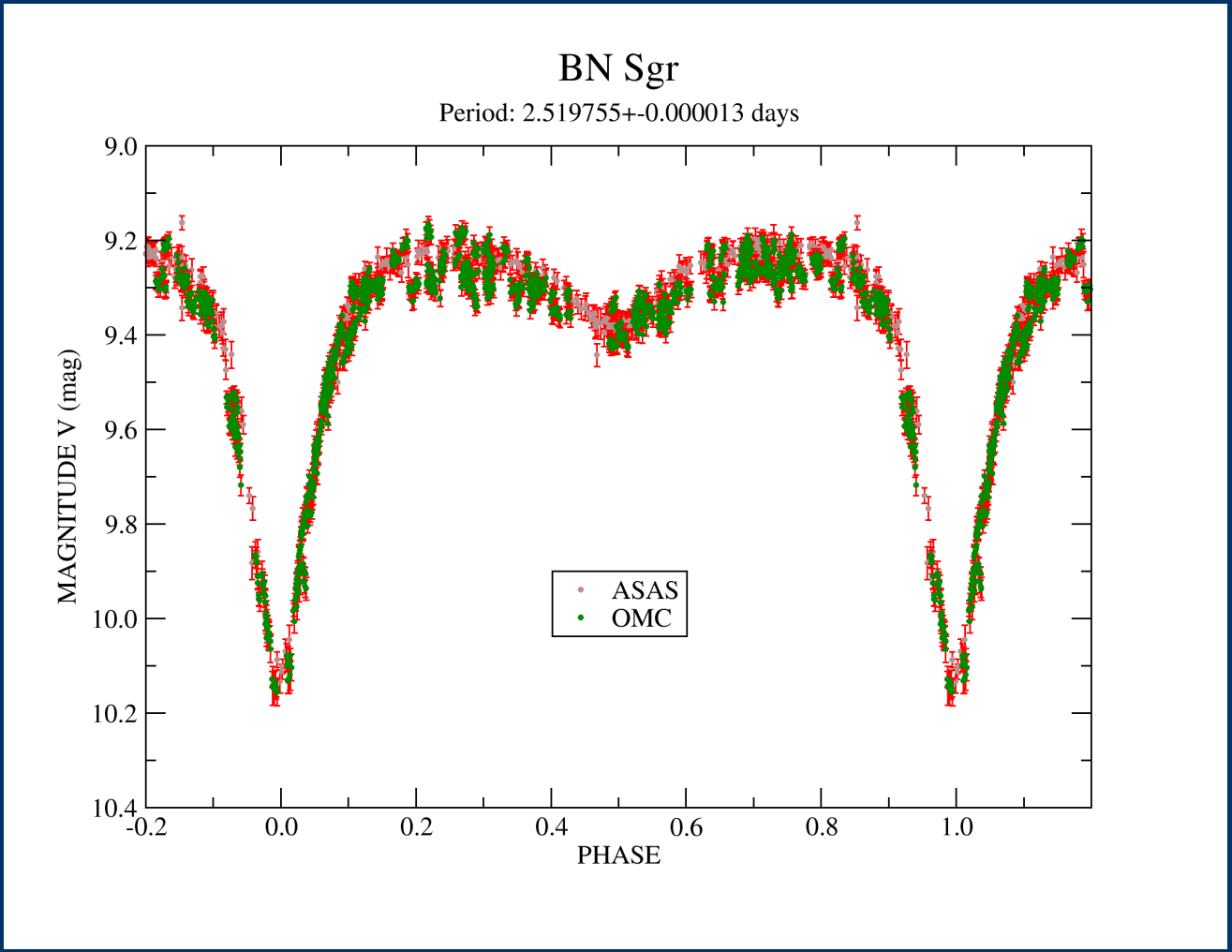

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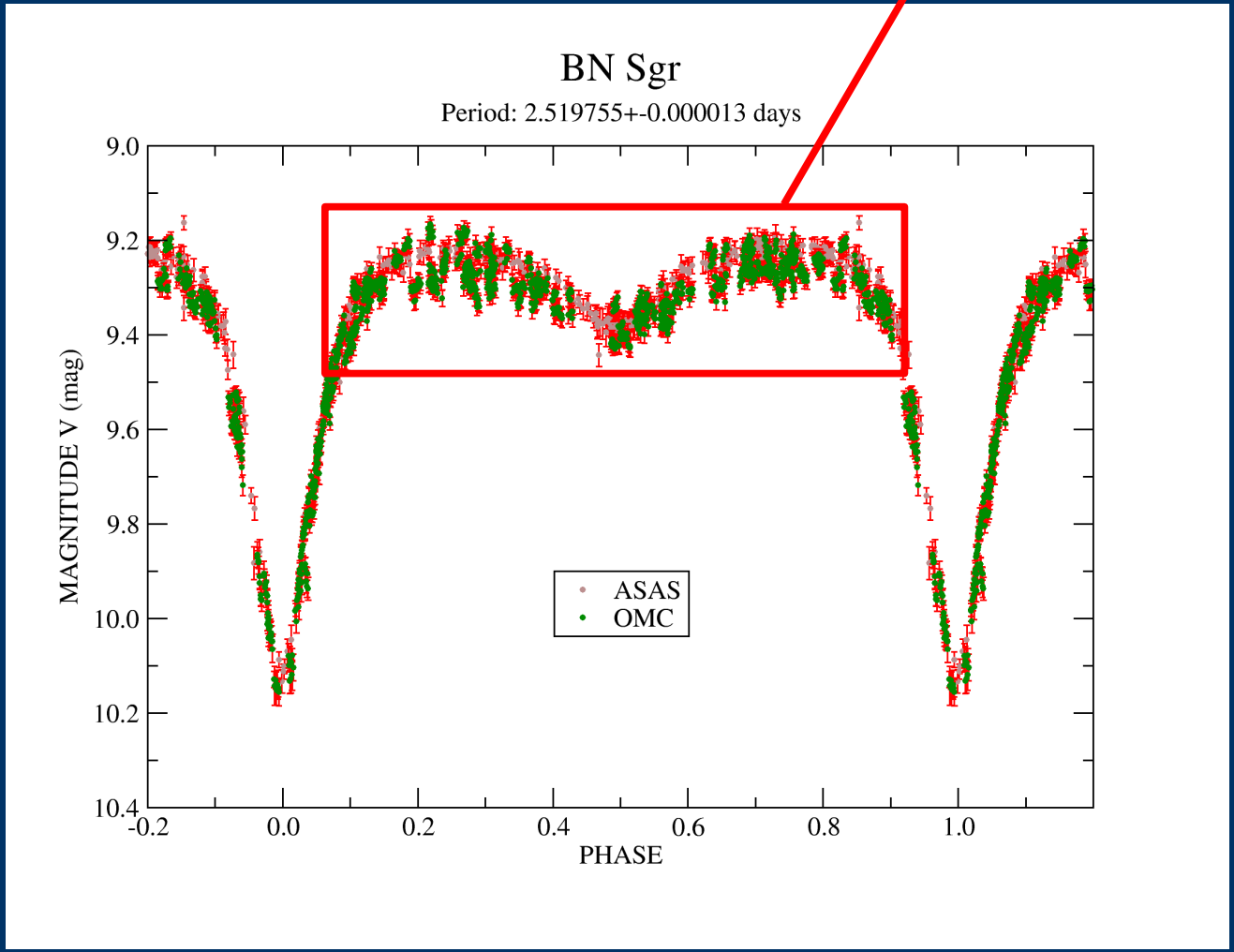
Small variations, probably due to differences in surface brightness



Conclusions

- OMC has obtained a lot of optical light-curves of high energy sources (and also thousands of typical optical variables).
- We are studying what the correlation between light-curves at different energies can tell us about the properties of the objects.
- There is a huge amount of public data. It is available at some web pages.
  - http://isdc.unige.ch/Science/BULGE
  - http://sdc.laeff.inta.es