Cygnus X-3 INTEGRAL observations: understanding the high-energy nature of the system.

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Cygnus X-3 seen by INTEGRAL

- 4.8 hr asymmetric quasisinusoidal modulation.
- High spectral variability in the X-ray band.
- Two main spectral states: high/soft and low/hard.
- Spectral models: an interstellar absorption, a thermal component (bremss or bbody), a non-thermal component (power law (with and without cut-off) or Comptonization) and an iron complex (gaussian plus two absorption edges).
- PV data are distributed over 20 days, covering $\sim$ 100 orbital cycles of the system.

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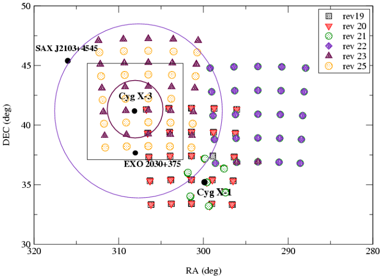
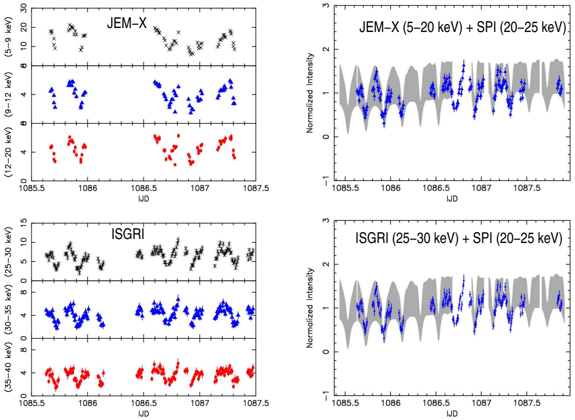


Light Curve Analysis

- Orbital flux modulation (from $P_{orb} = 4.75 \pm 0.02$ hr) from the soft (5 keV) to the hard (40 keV) X-rays.
- The soft X-rays (5-9 keV) are slightly more modulated than the hard X-rays (9-40 keV).



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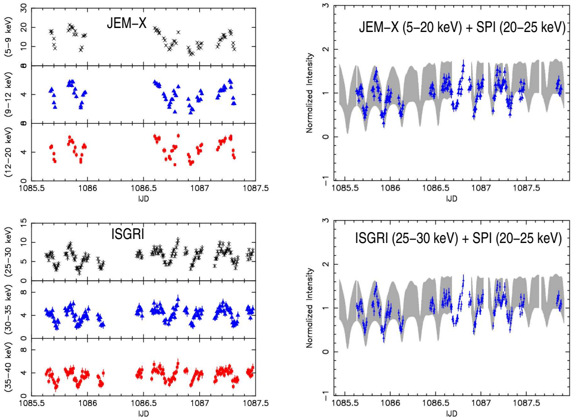

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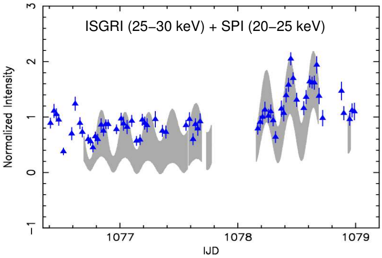
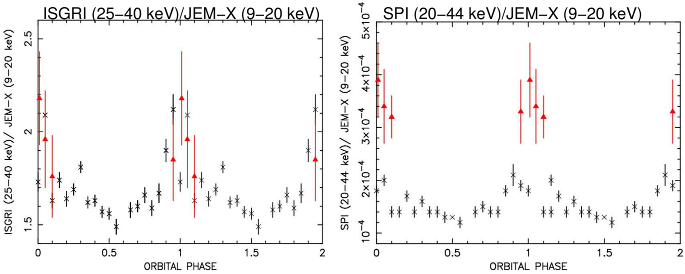


- Rev. 20 shows a lower intensity state and a different amplitude of the modulation at the beginning recovering its normal value toward the end of the revolution.

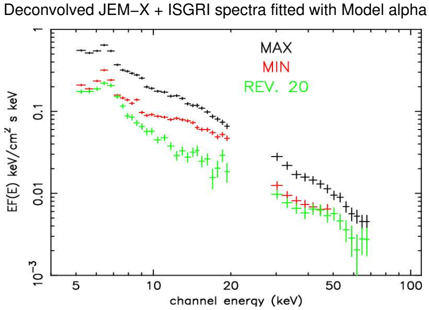
Color-Phase diagrams

- Color-Phase diagrams reveal phase and time (rev. 20) spectral variability.



ISGRI/JEM-X (right) and SPI/JEM-X (left) color-phase diagrams. Red triangles: revolution 20 data. ISGRI revolution 20 has a poor statistic since the source is nearly in the limit of detectability.

Model α: constant * absorption edge (9.2 keV) * (gaussian (6.5 keV) + blackbody + comptonization) (Rajeev at al. 1994)



- The soft excess (a blackbody component) does not vary with the orbital phase within less than a 10% of uncertainty. But it does on time (rev. 20).
- The opacity increases from the maximum orbital phase to the minimum orbital phase, reaching its highest value in rev.20.
- The iron line equivalent width increases from the maximum to the minimum luminosity, achieving its highest value in rev.20

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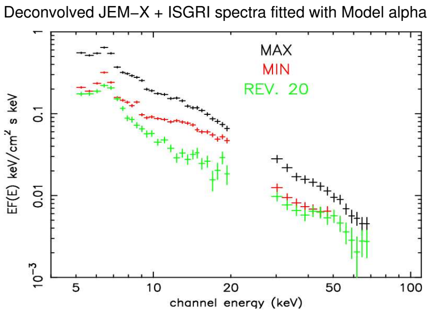

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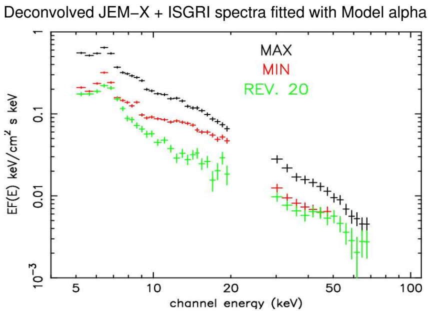

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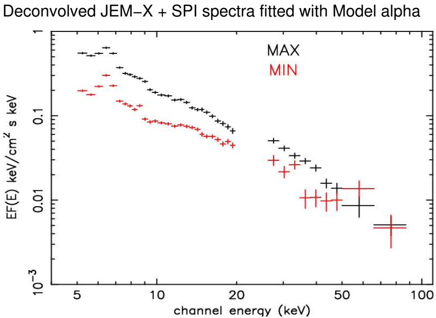

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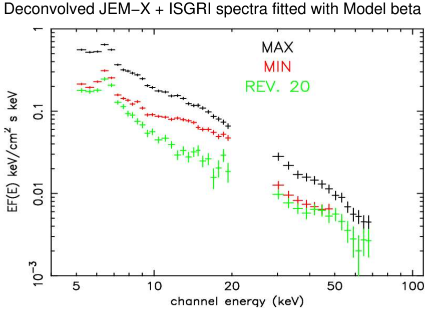

- Cygnus X-3 becomes soft when the flux is high and hard when the flux is low.
- This relationship between spectral hardness and flux is also seen in rev. 20 (the lowest flux and the hardest spectrum).
- The iron equivalent width increases from the maximum to the minimum intensity state, reaching its highest value in rev. 20

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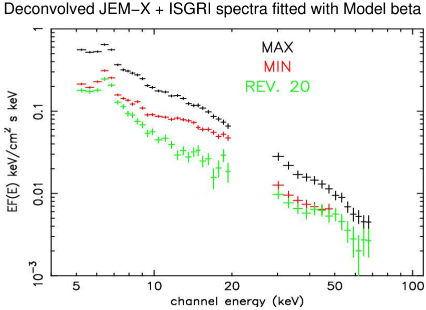

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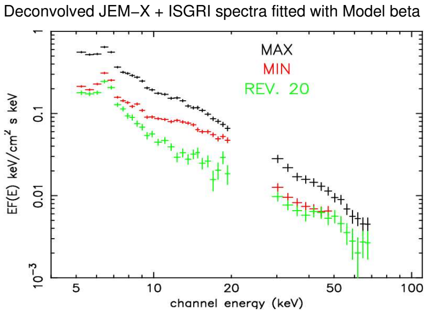

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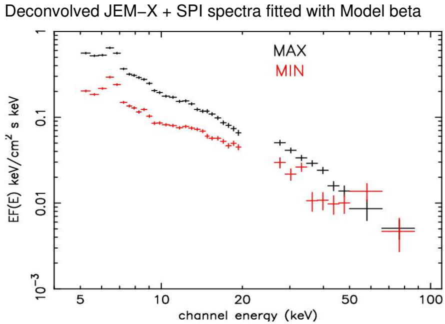

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Conclusions and Future Work

- We have detected spectral variability on orbital phase and on time (rev. 20).
- The transition to rev. 20 state can be explained as an increase of the optical depth of an envelope that surrounds the compact object (White & Holt (1982) and Manchanda (2002)).
- The X-ray modulation and the orbital phase spectral variability can not be explained due to an absorption mechanism (Manchanda (2002)). This behaviour should be due to a non-thermal mechanism.
- To explain the measured opacity variations between the maximum and minimum orbital phase intervals we need to assume the presence of non-uniform distributions of thermal and non-thermal electrons in the corona (Szostek & Zdziarski 2004).
- **Future work**:
  to characterise the source spectrum using a physical model and to carry out a phase spectral analysis using narrow intervals. To do so, we need to extend our database.