ISGRI Spectrum of the Cosmic X-ray Background from INTEGRAL's Earth Observation

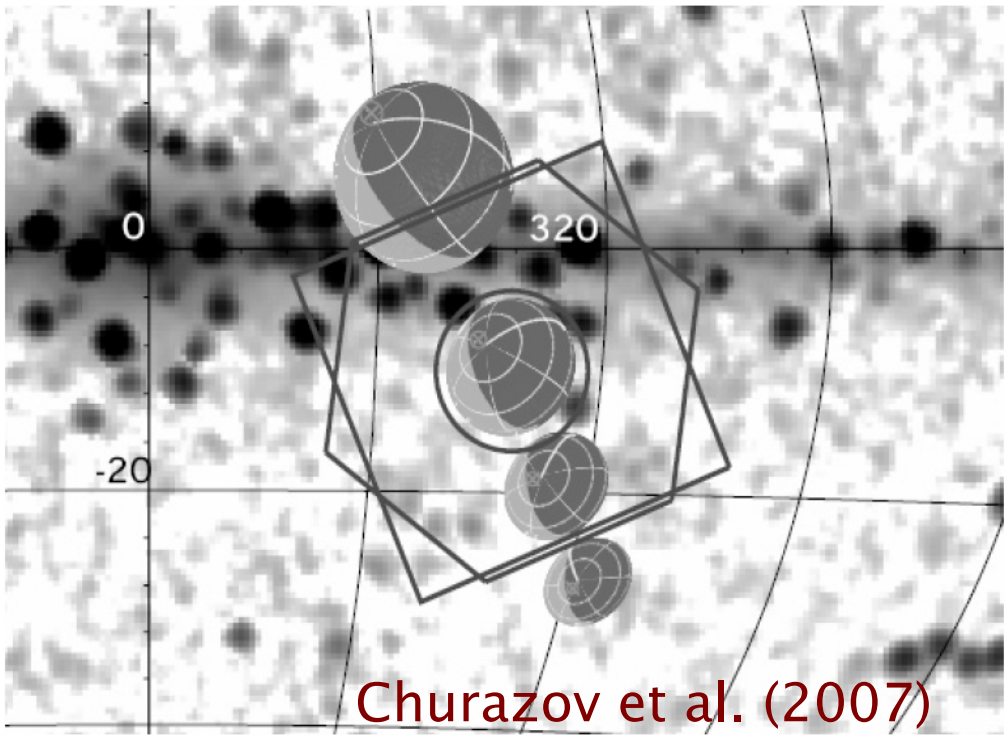
Marc Türler *(ISDC, Geneva)*

(Collaborators: **Masha Chernyakova, Andrii Neronov, Nicolas Produit, Roland Walter, …***)*

INTEGRAL's Earth Observation

- 4 similar public observations of ~8 hours at start of revol. 401 404, 405 & 406 in Jan-Feb 2006
- Earth moving through FoV at ~fixed attitude

- Pointing includes the galactic plane close to the bulge (Norma arm)
- Earth diameter ~10°, but decreasing with time (+ rotation, etc.)

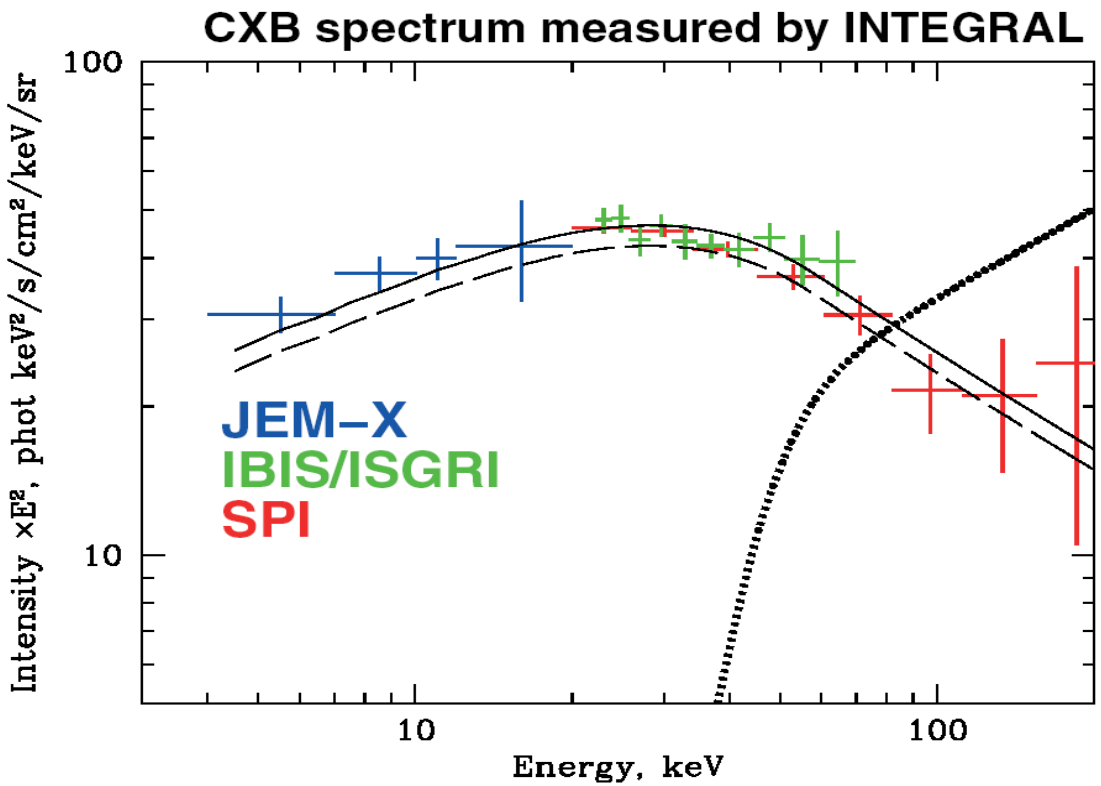


Churazov et al. (2007)

Previous Study

- Churazov et al. (2007) use **Monte-Carlo simulations** of the atmospheric emission due to cosmic rays and the reflection by the Earth of the **HEAO-1 spectrum**. They fit the **normalization** of these spectra to the observed "Earth-modulated" spectrum (~depth in the lightcurves).

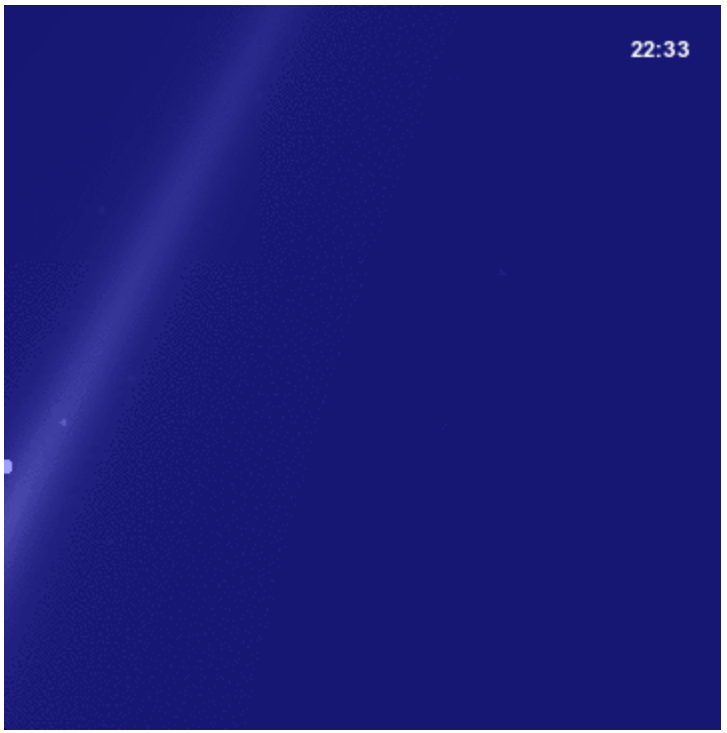
- We use a different approach for which the CXB spectral shape is **free**!



Sky component model

- We model the spatial distribution of 4 components modulated by the Earth occultation (s/c attitude & Earth position):

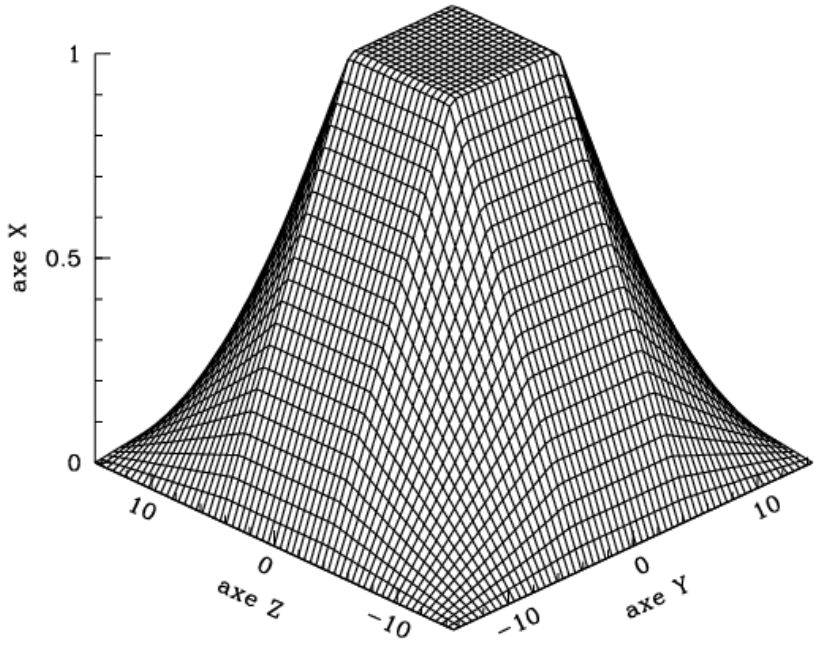
- Galactic ridge emission
- All (>2σ) point sources
- Cosmic X-ray background
- Earth emission:
  - CXB reflection
  - Atmospheric emission (due to cosmic rays)



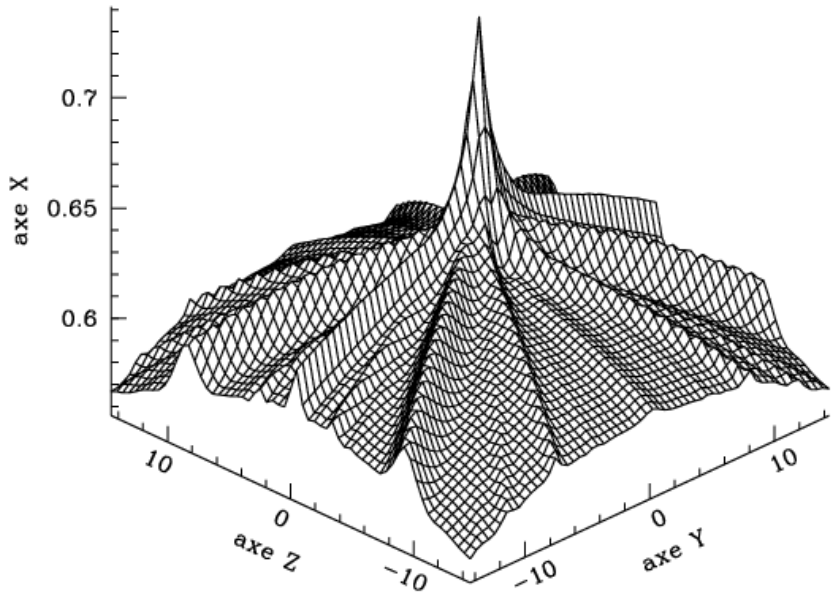
Instrumental components

Additional components are due to the instrument: an uniform (SPI-ACS modulated) instrumental background, as well as the modulation by the instrumental responses:

IBIS exposure map

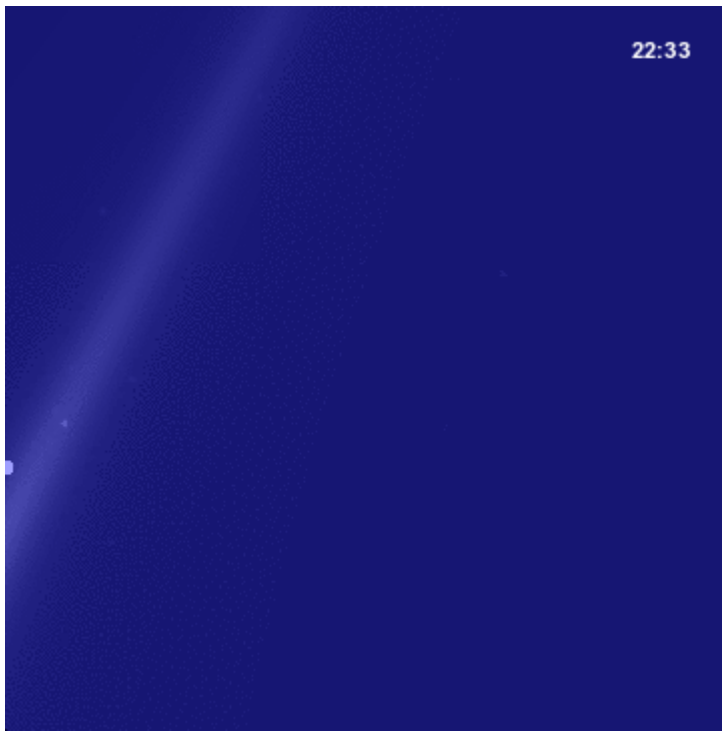


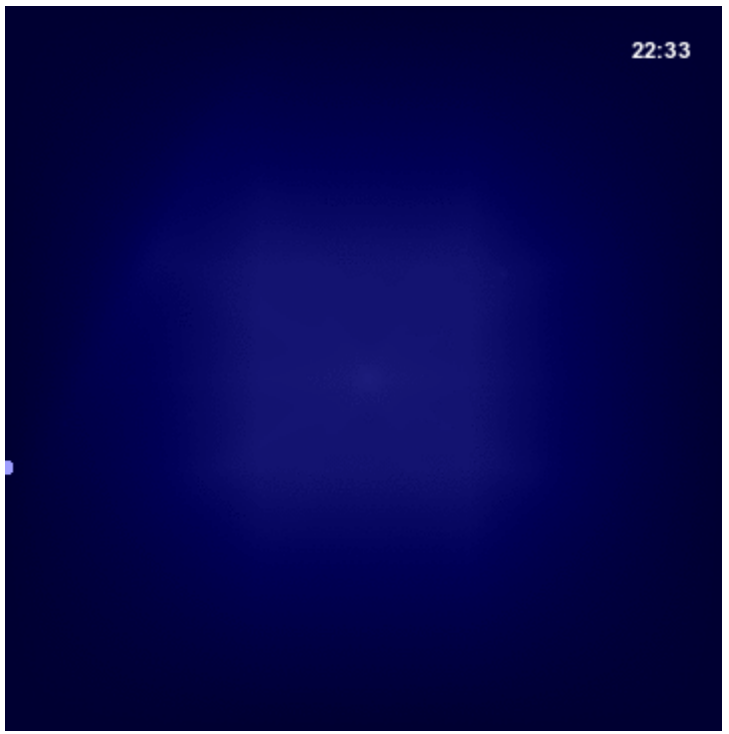
IBIS efficiency map (Nomex) at 30 keV



Complete model

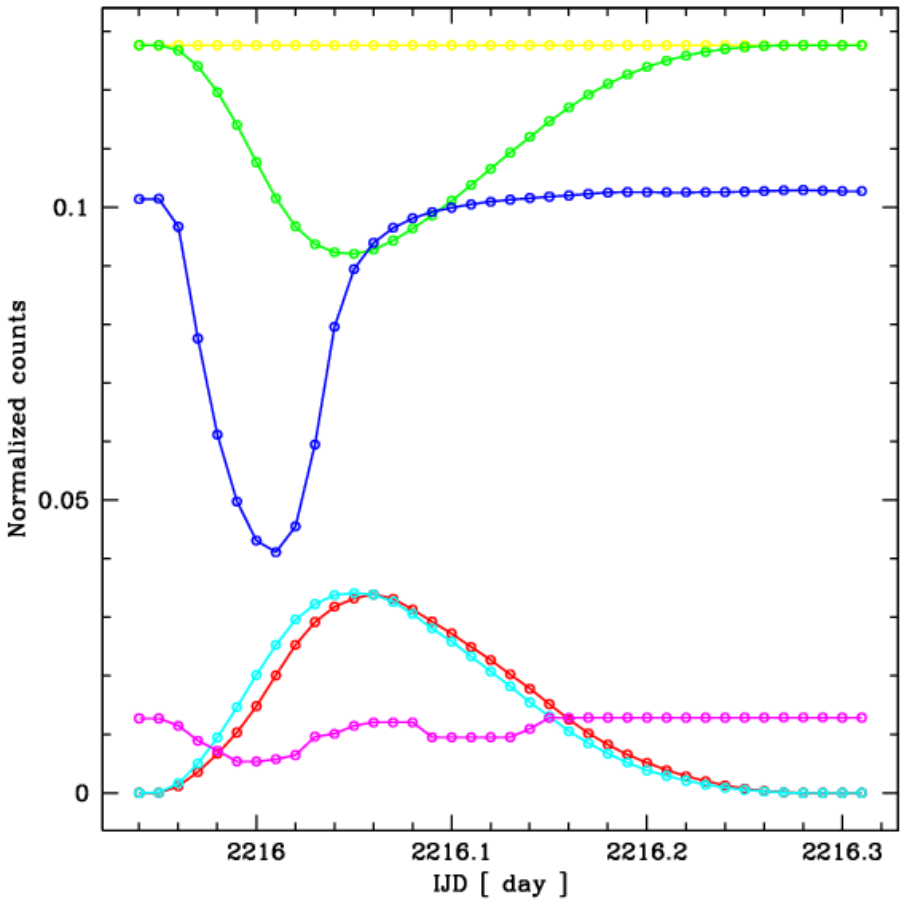
The convolution with the exposure and efficiency maps modifies the detector lightcurve profile:

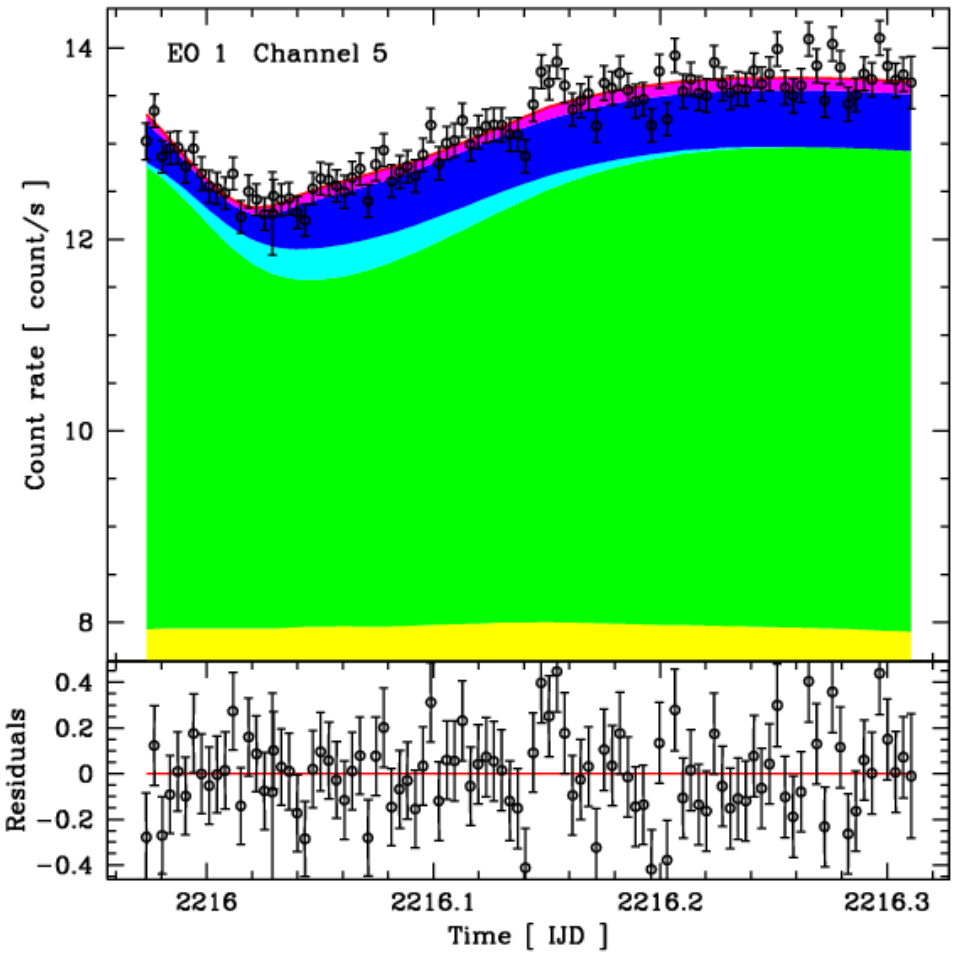




Fitting the model lightcurves

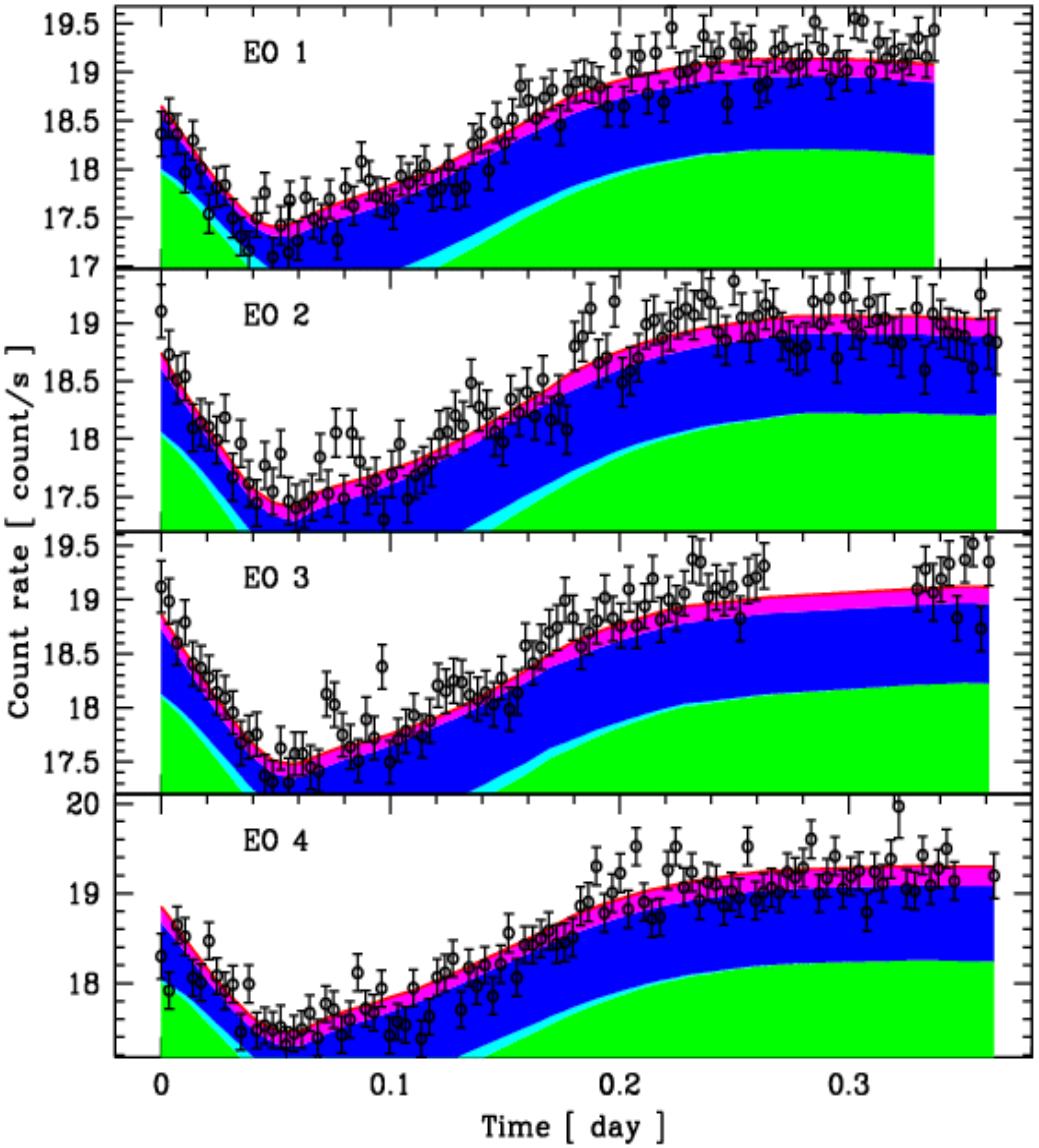
- Model lightcurves are generated for each EO and all spectra channels to be fitted to the data.





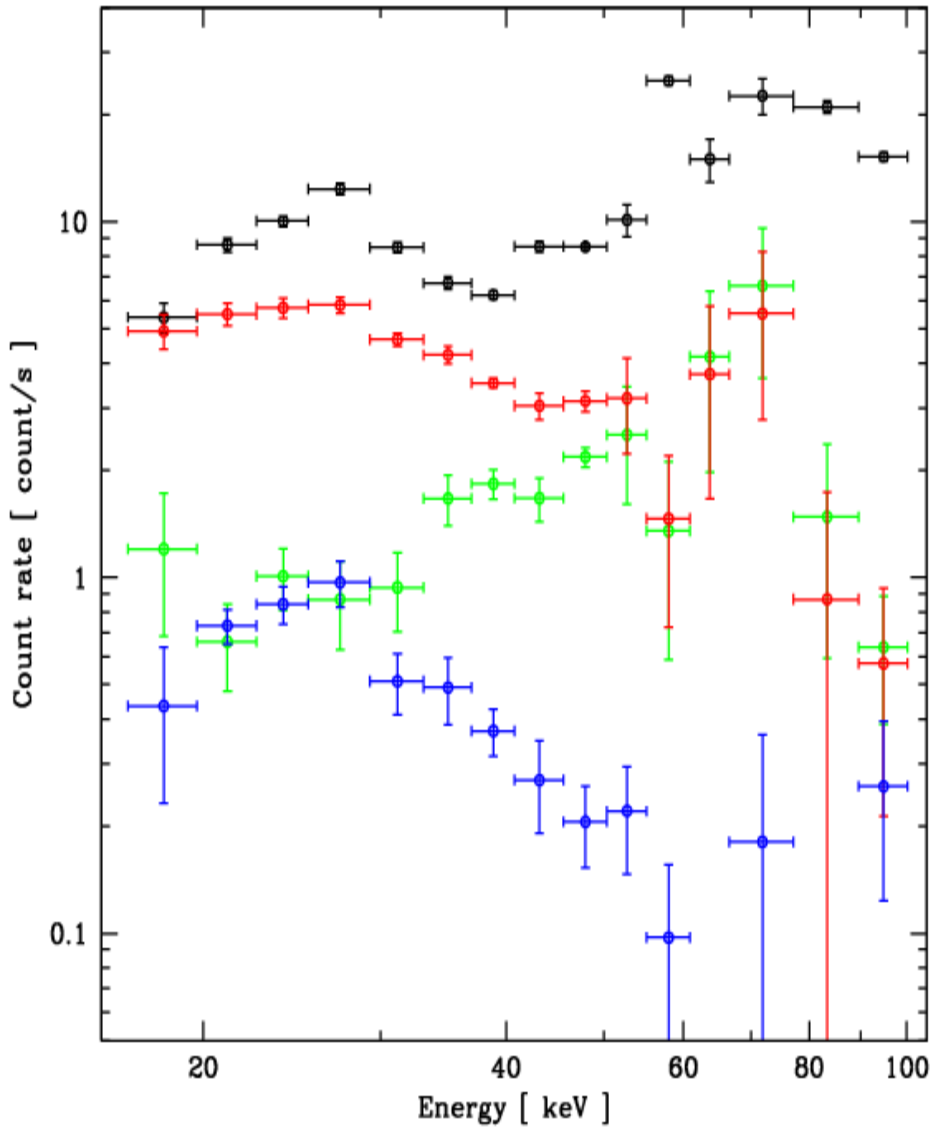
Using all four Earth Obs.

- We do **separate fits to all four EOs** which cannot be averaged because of different:
  - s/c attitude
  - point sources (fixed count rate extracted for each EO)
  - instr. background (based on SPI-ACS lightcurve)



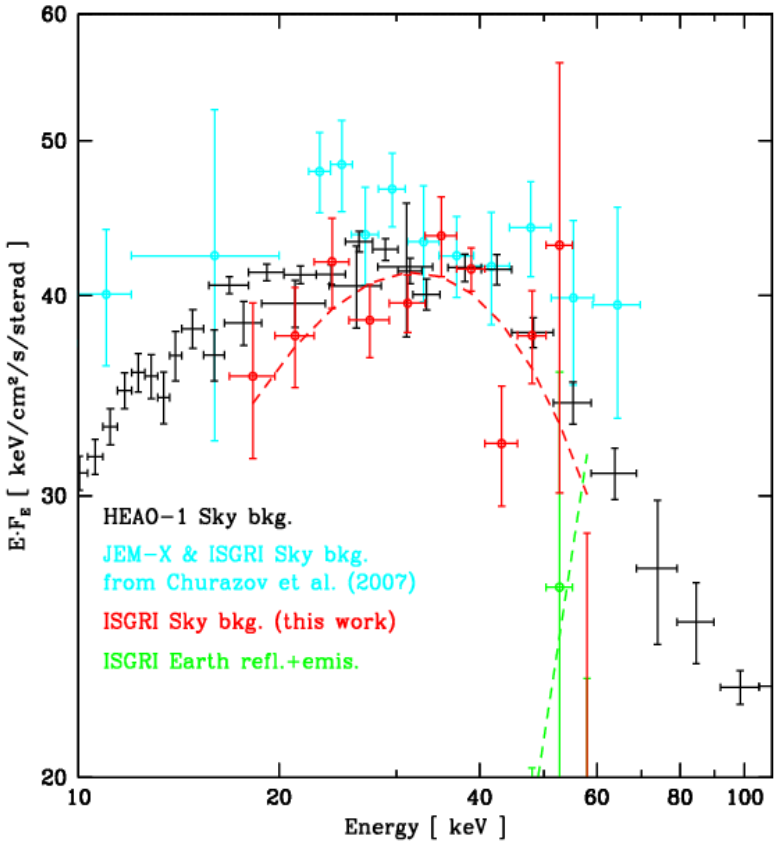
Resulting count spectra

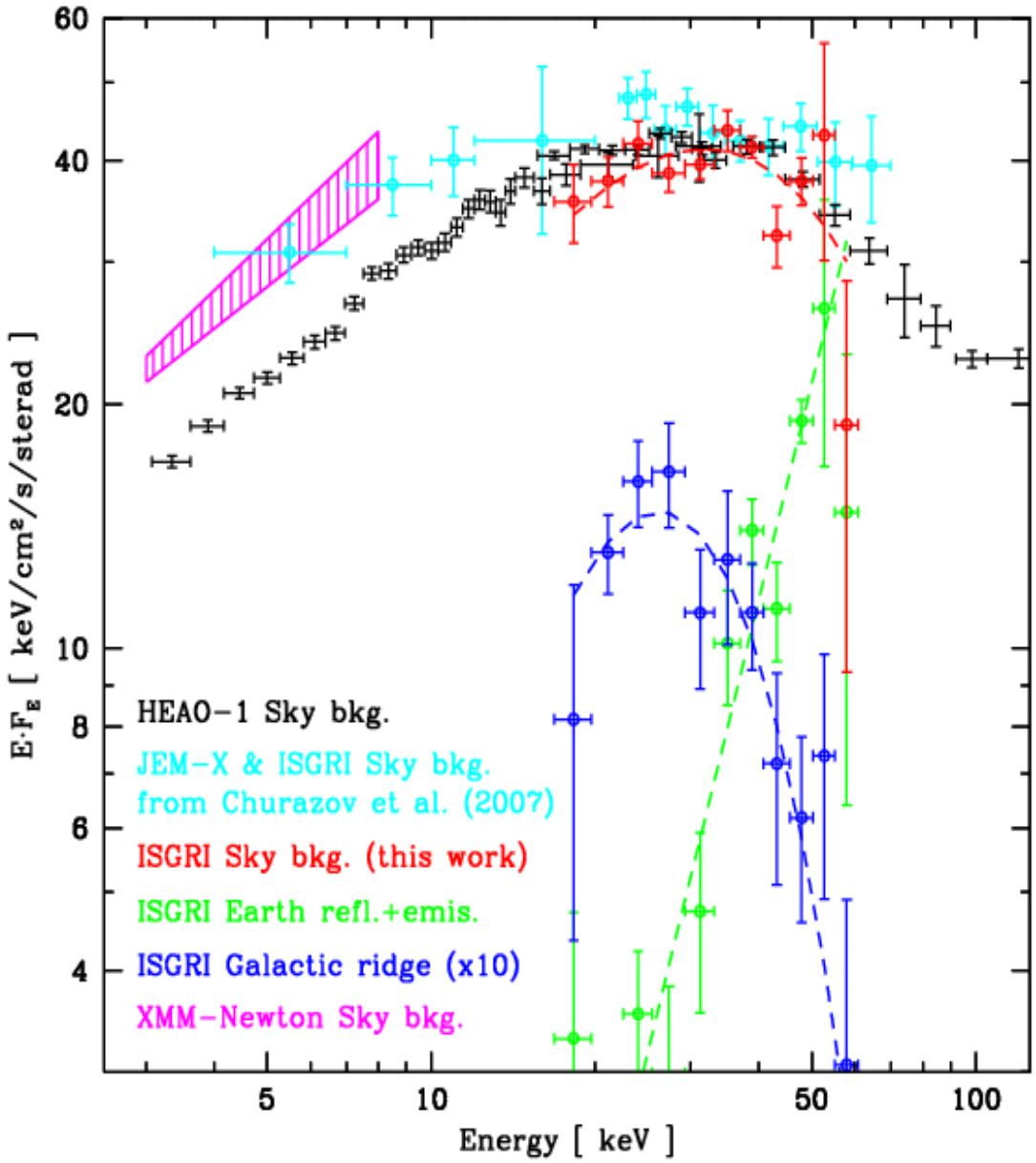
- Average count spectra are obtained with some additional constraints to fight against degeneracy:
  - Earth emission is a smooth transition from only CXB reflection to only Earth atmospheric emission
  - We favor models with dominant instrumental background
  - and with Earth emission being well above the Galactic Ridge at higher energy.



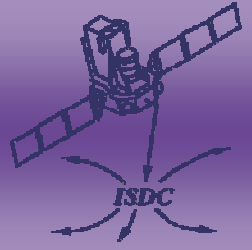
Final component spectra

- Unfolded spectra are obtained with XSpec using OSA 7.0 ISGRI ARF & RMF responses





Summary & Conclusion



- We decomposed the ISGRI detector lightcurves into various model components including the Cosmic X-ray Background and the Galactic Ridge emission.
- The obtained CXB spectrum in the 20-60 keV range is consistent with the HEAO-1 spectrum.
- Because of degeneracy between some components, an unique solution is however difficult to obtain without introducing additional constraints.
- Future work will try to solve this problem by reducing the number of free parameters (e.g. by fitting component spectra to all data simultaneously or by fixing the spectrum of the Earth emission).