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Using cumulative distribution functions to characterize X-ray line complexes.

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Abstract

The X-ray Athena (Advanced Telescope for High-Energy Astrophysics) mission, selected in 2014 by ESA within its Cosmic Vision Program to address the Hot and Energetic Universe scientific theme, will offer spectroscopic and imaging capabilities exceeding those of currently operating X-ray astronomy satellites. In particular, X-IFU (the X-ray Integral Field Unit), one of the two instruments to be on board the Athena Observatory, will provide unprecedented spectral resolution (2.5 eV at 7 keV) with 5 arcsec pixels.
As part of the Spanish contribution to this mission, an important effort has been invested in the detailed study of the impact of different algorithms devoted to the proper characterization of the energy of each photon that will be detected by X-IFU (see e.g., Ceballos et al. 2019ab, Cobo et al. 2020, Vega-Ferrero et al. 2022). The spectral resolutions achieved with the different strategies are evaluated by fitting X-ray line complexes corresponding to laboratory data generated with calibrated X-ray sources. Traditionally these data are binned in order to generate histograms which are subsequently fitted using the familiar chi-squared statistic or a maximum-likelihood approach (Fowler 2014).
In this work, we show how the use of cumulative distribution functions can be employed to determine the fit of X-ray line complexes constituted by several lines without the need to perform an a priori data rebinning. The method has been checked using simulated data, and the results indicate that it can recover photons beyond the fitting range. The procedure has been programmed in Python and the source code is publicly available.

My poster is available at https://zenodo.org/record/6922198#.Y1beYuxBxB0