SPEX: High-resolution spectral modeling and fitting for X-ray astronomy

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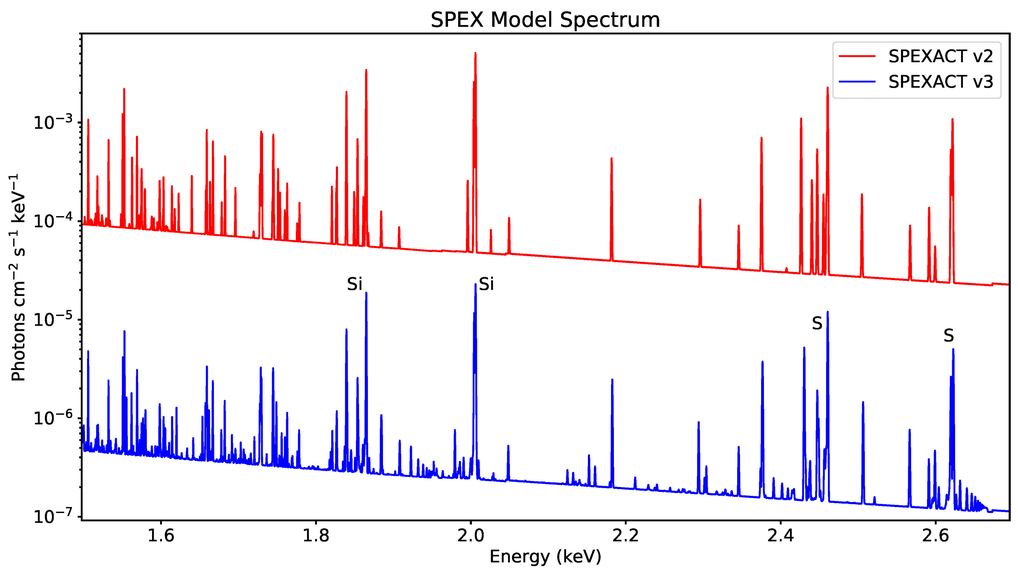
Abstract

We present the SPEX software package for modeling and fitting X-ray spectra. Our group has developed spectral models, atomic data and code for X-ray applications since the 1970's. Since the 1990's these are further developed in the public SPEX package. In the last decades, X-ray spectroscopy has been revolutionized by the high-resolution grating spectrometers aboard XMM-Newton and Chandra. Currently, new high-resolution detectors aboard the Hitomi mission, and future missions like XRISM, and Athena will provide another major step forward in spectral resolution. This poses challenges for us to increase the atomic database substantially, while keeping model calculation times short. On this poster, we summarize our efforts to prepare the SPEX package for the next generation of X-ray observatories.



Improvement of model spectra after atomic database upgrade.

What is SPEX?

SPEX is a software package optimized for the analysis and interpretation of high-resolution cosmic X-ray spectra. The software is especially suited for fitting spectral models to observed spectra from current X-ray observatories like XMM-Newton, Chandra, Suzaku, and Hitomi.

The package contains:

- Atomic database focused on ions with lines in the UV and X-ray regime.
- A set of commonly used physical spectral models based on the atomic database.
- Tools to load and optimize observed X-ray spectra.
- Fitting routines to fit the spectral models to observed spectra.
- Output of physical plasma parameters based on the spectral models.

Currently, the package works using a command prompt interface. A Python interface is being developed.

Challenges in X-ray spectroscopy analysis software

New X-ray observatories like XRISM and Athena will revolutionize high resolution X-ray spectroscopy because of a substantial increase of spectral resolution and sensitivity. This poses the following challenges for analysis software:

- Expand atomic (line) databases
- Increase accuracy of model calculations
- Dealing with larger spectra and response matrices
- More flexible user interfaces
- Software needs to run smooth on typical desktop/laptop, so try to keep the complex model evaluations fast.

Useful links

	SPEX website http://www.sron.nl/astrophysics-spex
	SPEX at Zenodo https://doi.org/10.5281/zenodo.1924563
	PYSPEX tools at Github https://github.com/spex-xray/pyspextools

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