Using the line profiles for reflected Fe-K emission to determine the properties of black holes

Javier A. García [1]
[1)] California Institute of Technology
E-mail : javier@caltech.edu

Astrophysical black holes are readily observed through interactions with their environment. In cases where enough material is accreted, the gas forms an optically-thick and geometrically-thin disk which can produce copious amounts of radiation in the X-ray band. The strong X-rays are reprocessed in the surface of the disk, resulting in the emission of many atomic lines. This reflected radiation carries information about the physical composition and condition of the matter in the strong fields near the compact object. The most prominent feature is a blend of the fluorescent Fe K lines, which is blurred by Doppler and relativistic effects.

In this talk I will describe how by modeling the X-ray reflection spectrum with a focus on the inner-shell lines, one can estimate both the disk inclination and the angular momentum of the black hole (among several other physical quantities). The accurate modeling of spectral features requires new photoionization calculations for high-density plasmas (10^{18}–10^{22} cm^{-3}), which are typical conditions of these extreme environments. I will show the results of a systematic upgrade of the atomic parameters used in our models, accounting for plasma imbedding effects such as electron screening, stimulated processes, suppression of recombination, and enhancement of collisional excitation. I will show the implementation of these new models in fitting X-ray data from several astrophysical sources, which has revealed their significance in the derived abundances, the shape of the X-ray continuum, and provide a possible explanation for the origin of the unexplained soft-excess in the spectrum of many accreting black holes.