PhD student: Refiz Duro

- outreach page for the project , by Refiz Duro

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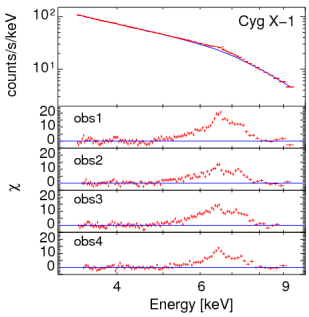
Responsible Advisor: Jörn Wilms (FAU Erlangen-Nuremberg)
Co-Advisors: Luciano Burderi (Cagliari), Jérôme Rodriguez (CEA Saclay)



Close to the black hole, the velocity in the material that is accreted onto the black hole is on the order of about 100000 km/s. Since in this accretion disk hot gas, which generates hard X-rays with energies above 10keV, and cold gas is next to each other, fluorescence line emission is produced. This line emission is mainly due to Iron. The high velocity of the gas as well as relativistic effects such as Doppler boosting and gravitational redshifting cause the observed Iron line to be strongly broadened. The broadening contains information about the parameters of the accretion disk (e.g., the way how energy is released in the disk) and on the properties of the black hole itself. For example, the iron line is broader if the black hole is rotating, since the innermost stable circular orbit around the black hole is closer to rotating black holes than to non-rotating ones.

First seen in Active Galactic Nuclei, such relativistically broadened lines have now been observed in both, Galactic black holes and in Active Galactic Nuclei. The line shapes observed are generally consistent with the picture above, however, the interpretation of the line shape still strongly depends on the assumed geometry of the accretion flow, i.e., on questions such as

- do the hard X-rays come from a hot plasma sandwiching the disk or from a radio jet?
- is the accretion disk close to the black hole really geometrically thin, or does it have a

different shape?

- what is the ionization structure of the disk, i.e., is the observed line only due to a single species of (ionized) iron, or is the ionization structure of the inner regions important?

In this project, the PhD student will work with existing models for the shape of the Fe Kα line as well as develop a more general framework for modeling the line based on the existing literature, but extending the existing calculations to the different accretion geometries currently being discussed. These calculations will be mainly numerically, making use of supercomputers available at the University of Erlangen-Nuremberg and also at the national supercomputing centers. These models will then be applied to recent data from satellite observatories such as *X MM-Newton*
, Chandra, and Suzaku. In contrast to existing work, a consistent approach to the data modeling will be used, such that parameters from the different observations can be compared. Furthermore, in collaboration with the co-advisors, the student will also be applying the models to relativistically broadened Fe Kα lines from accreting neutron stars.

An overview talk on the current state of the project as presented at the Collaboration Meeting in September 2010 in Istanbul can be found here .

Related publications

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