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X-ray winds with the WINE model: a detailed photoionization treatment of relativistic outflows in quasars

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Ultra-fast outflows (UFO) in the X-ray band are now observed in about half of of active galactic nuclei (AGN). They are likely launched at accretion disk scales with relativistic speeds (around 0.1-0.3 c), and can reach a very high mechanical power. However, up to now very little is known about the physics behind these extreme phenomena, including the launching mechanisms and their geometry. So far, mostly absorption profiles have been modeled and compared with observations.

To gain new insights from the data, we developed a new spectral model describing both absorption and emission from a photoionized wind. A first version of the model has been applied to the UFO in the nearby ($z = 0.184$) and luminous ($L_{bol} = 10^{47} erg/s$) quasar PDS456 (Luminari et al. 2018), with promising results. Particular attention is devoted to the wind kinematic and geometry, including the covering fraction and the inclination of the wind with respect to the line of sight. Moreover, the radiative transfer code XSTAR, which is now included in the model, allows us to take accurately into account the photoionization equilibrium of the wind with respect to its density and velocity profiles.
Relativistic effects have also been modeled carefully, using a first-principle approach. This leads to a sensitive improvement of the simulated spectra already for moderate outflowing velocities ($\approx 0.01c$), and generates important effects for high UFO velocities of $\approx 0.1 - 0.2c$.
The spectral diagnostics of the model will allow to fully exploit the unprecedented energy resolution of the upcoming X-ray observatories XRISM and ATHENA.
This work is done in collaboration with Prof. F. Tombesi and F. Vagnetti (Univ. of Rome "Tor Vergata), Dr. E. Piconcelli (INAF - Rome), Prof. K. Fukumura (J. Madison University, USA) and Dr. D. Kazanas (GSFC/NASA, USA).

Topic

Active Galactic Nuclei: accretion physics and evolution across cosmic time

Affiliation

University of Rome "Tor Vergata" and INAF - Rome Observatory

Primary author: LUMINARI, Alfredo (University of Rome "Tor Vergata")

Co-authors: Dr KAZANAS, Demosthenes (NASA/GSFC); PICONCELLI, Enrico (Istituto Nazionale di Astrofisica (INAF)); VAGNETTI, Fausto (Istituto Nazionale di Astrofisica (INAF)); TOMBESI, Francesco (University of Rome "Tor Vergata"); Prof. FUKUMURA, Keigo (J. Madison University, USA)

Presenter: LUMINARI, Alfredo (University of Rome "Tor Vergata")

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