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Neutron star radius-to-mass ratio from accretion disc occultation

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The equation of state (EoS) of matter at supranuclear densities in the core of neutron stars (NSs) contains key information on the properties of the strong force and the possible existence of exotic states of matter; however it is only poorly constrained from earth-based experiments and theory. NS properties, the precise values of M and R in particular, encode unique information on the EoS, and different approaches have been proposed to measure, or at least constrain, NS radii. I present a new method to measure the R/M ratio of disk accreting NSs which display a relativistically broadened Fe-Kα profile: this method exploits the occultation of the inner disk region right behind the NS by the body of the NS itself as seen by an observer at infinity. The occultation imprints conspicuous features in the line profiles especially for disk inclinations > 65° and NSs of radius larger than R > 6 GM/c^2, and can provide a proxy of the NS R/M ratio. We developed a dedicated model within XSPEC and by fitting it to current data from a few high-inclination NS low mass X-ray binaries, we found that the signal to noise ratio of the X-ray spectra from present-generation instruments is probably insufficient to measure the R/M ratio. However, through XSPEC simulations adopting response matrices of the near-future eXTP mission we showed that R/M can be measured to ~3% precision over a range of inclinations. Such precision in radius determination is required to draw quantitative conclusions on the EoS of ultra-dense matter and represents the goal that other methods too aim to achieve in the future.
If time allows, I will also talk about some factors that can influence the current and future analysis of disk-emitted radiation in the X-ray spectra, focusing in particular on the Fe-Kα line.

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