The spectral lines of the accretion tori

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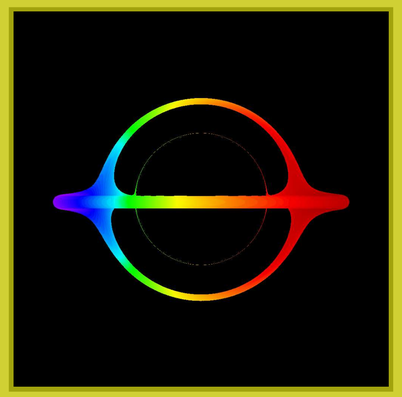


Abstract

Spectroscopic analysis of the radiation of binary stellar systems, which contain a neutron star or a black hole, is still among the most topical areas of relativistic high energy astrophysics. The strong dependence of the spectral profiles on the configuration of the source-observer system suggests that the spectral profiles can carry substantial information about the compact object and its surrounding area. We study the spectral lines of the accretion tori oscillating in the vicinity of the compact object as measured by an observer located at infinity. From comparison of spectral lines for different observer, compact object and tori configurations one can see, that influence of observer inclination is dominant over influence of torus oscilation mode or spin of the compact object. However there are diferencies in spectral line profiles for different spins especially if observer inclination is close to $90°$ which can be principially used for getting information about real compact object parameters in the future.

Spectral line profiles obtaining with LSD$^+$ code

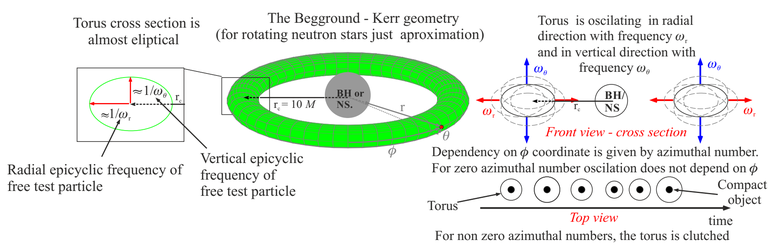


Figure 1. Torus configuration (based on Abramowicz et. al 2006, Blaes et. al 2006 and many others) implemented in code LSD$^+$ (see Bakal et. al 2010,2015).

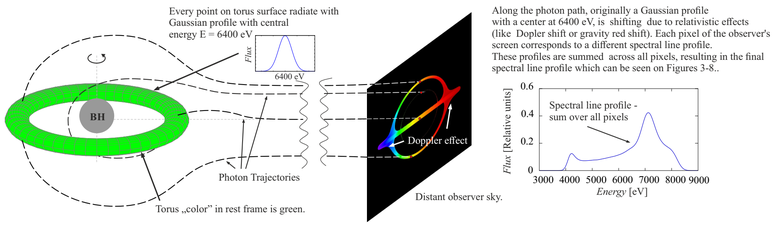


Figure 2. Procedure of the spectral lines obtaining demonstrated for observer inclination $i = 90°$.

Figure 3 - *Spectral lines for Schwarzschild geometry ($a = 0$) and zero azimuthal numbers ($m_r, m_\theta = 0$).*

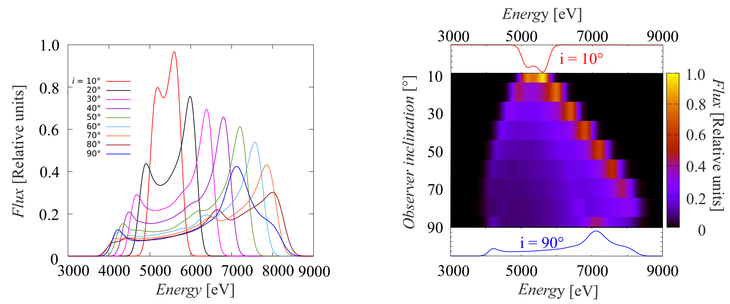


Figure 4 - *Spectral lines for zero spin ($a = 0$) and non-zero azimuthal numbers ($m_r, m_\theta = -1$).*

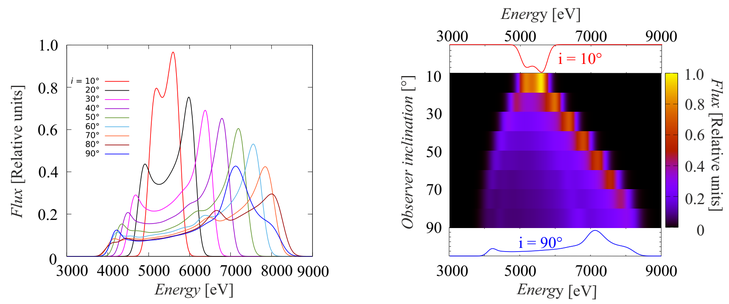


Figure 5 - *Spectral lines for middle value spin ($a = 0.5$) and zero azimuthal numbers ($m_r, m_\theta = 0$).*

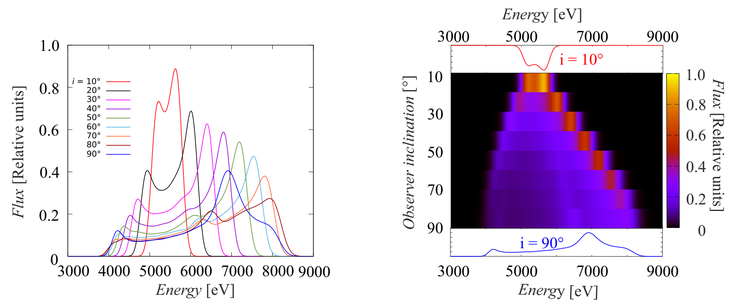


Figure 6 - *Spectral lines for non zero spin ($a = 0.5$) and non zero azimuthal numbers ($m_r, m_\theta = -1$).*

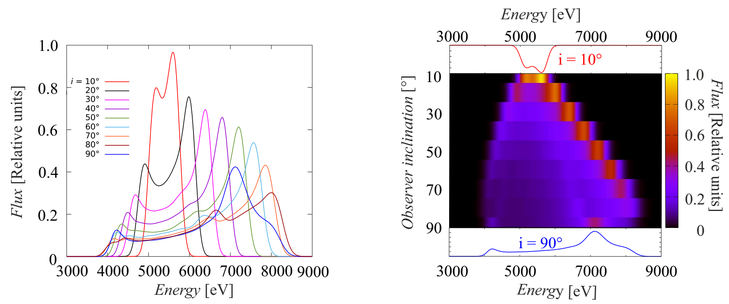


Figure 7 - *Spectral lines for high value of spin ($a = 0.9$) and zero azimuthal numbers ($m_r, m_\theta = 0$).*

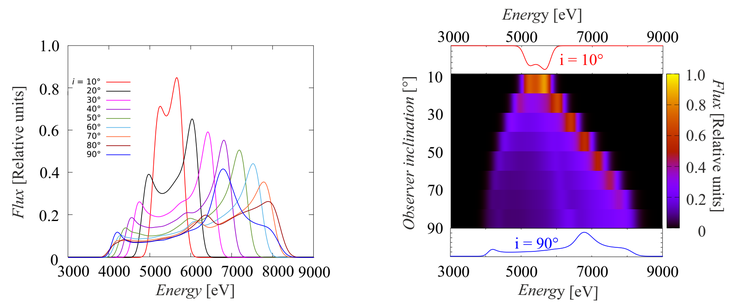
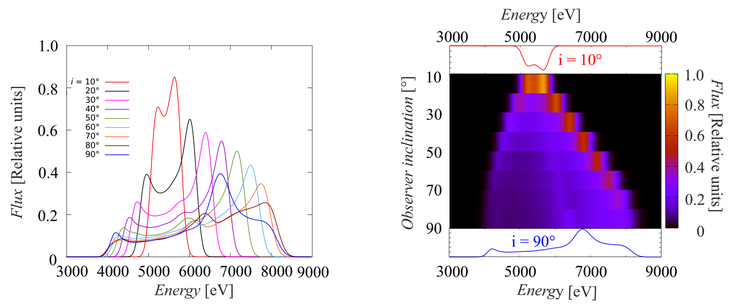


Figure 8 - *Spectral lines for high value spin ($a = 0.5$) and non zero azimuthal numbers ($m_r, m_\theta = -1$).*



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