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Poster

STARK BROADENING OF Fe XXV LINES FOR NEUTRON STAR SPECTRA RESEARCH

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Broadening of spectral lines by collisions with charged particles or Stark broadening is the most important pressure broadening mechanism of spectral lines in the X wavelengths range in conditions of neutron star atmospheres and their envirionment. Stark broadened line profiles enter in the calculations of absorption coefficient, opacity, radiative transfer, acceleration of gravity and consequently, they are of interest for equation of state.

However, in the investigations of neutron stars, Stark broadening is considered very approximately. For example, Paerels (1997) proposed a method to measure masses and radii of neutron stars by simultaneous measurement of gravitational red shift and the acceleration of gravity at the surface. In the proposition of his method, Stark broadening of hydrogen lines is approximately estimated without taking into account the effects of magnetic field. Madej (1989) and Majczyna et al. (2005), in their models of neutron star atmospheres and iron rich spectra use for Stark broadening calculations approximate formula from Griem (1974) book (cf. Chap. IV 6), without magnetic field effects. Suleimanov et al. (2014) in their modelling of carbon neutron star atmospheres, considered the Stark broadening using very approximate Cowley (1971) formula and magnetic field effects are neglected.

Highly ionized iron lines are important for neutron star atmospheres modelling and investigation. For example Cootam et al. (2002) detected X-ray burst spectra of EXO 0748–676, with a Fe XXV feature (n = 2-3 transition).

In order to enable more accurate analysis and synthesis of Fe XXV features in the spectra of neutron stars and their environment, which contributes to the better testing of the physics of neutron stars, we calculated widths of Fe XXV spectral lines broadened by collisions with important charged constituents of neutron star atmospheres, electrons, protons, Fe XXVI and Fe XXVII ions. Calculations have been performed for a grid of temperatures and electron densities for plasma conditions of interest for neutron star atmospheres and their environments. The obtained results have been used also to test approximate methods (Cowley, 1971; Griem, 1974, Chap. IV.6) used for modelling of neutron star atmospheres. Since such results are also of interest for Virtual Observatories we will prepare them additionaly for implementation in STARK-B database (Sahal-Brechot, et al. 2015). STARK-B is also a part of Virtual Atomic and Molecular Data Center - VAMDC (Dubernet et al. 2010), which started as an FP7 project in 2009.

References

Cottam, J. et al.: 2002, *Nature*, **420**, 51.

Cowley, C. R.: 1971, *Observatory*, **91**, 139.

Dubernet, M., Boudon, L. V., Culhane, J. L., Dimitrijević, M. S. et al.: 2010, *J. Quant. Spectrosc. Radiat. Transfer*, **111**, 2151.

Griem, H. R.: 1974, Spectral line broadening by plasmas, Academic press.

Madej, J.: 1989, *A&A*, **209**, 226.

Majczyna, A., Madej, J., Joss, P. C., Rózanska, A.: 2005, *A&A*, **430**, 643.

Paerels, F.: 1997, *ApJ*, **476**, L47.

Sahal-Bréchot, S., Dimitrijević, M. S., Moreau, N., Ben Nessib, N.: 2015, *Phys. Scr.*, **50**, 054008.

Suleimanov, V. F., Klochkov, D., Pavlov, G. G., Werner, K.: 2014, *ApJS*, **210**, 13.