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Invited Lecture

LINE SHAPE MODELING FOR MAGNETIC WHITE DWARF AND TOKAMAK EDGE PLASMAS: COMMON CHALLENGES

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About 10% of white dwarfs are known to have a magnetic field strength of 10^5 to 5×10^8 G, as indicated from spectroscopic observations and models (Kepler et al. 2013, Landstreet et al. 2012, Külebi et al. 2009). An interpretation of the shape of absorption lines requires the Zeeman effect be accounted for in line broadening models, in addition to the Stark effect associated to the plasma microfield. Under specific conditions, the plasma located at the edge of tokamaks has conditions close to white dwarf stellar atmospheres (T_e and T_i are of the order of 10^4 K and N_e can be higher than 10^{14} cm^{-3} in divertor configurations (Potzel et al. 2014, Lipschultz et al. 1998)) and the magnetic field can be strong enough so that line shapes are affected both by the Zeeman effect and Stark broadening. In this work, we report on line broadening models accounting for the simultaneous action of electric and magnetic fields. A focus on collision operator models is done. In particular, it is shown that the early work by Griem, Baranger, Kolb, and Oertel ("GBKO" model (R. Griem et al. 1962)) for nondegenerate energy levels can be adapted to hydrogen emitters affected by the Zeeman effect. Following previous works for ion broadening in a near-impact regime (Rosato et al. 2009), we perform new calculations of hydrogen Balmer lines in magnetized plasmas. An extension of collision operator models to regimes where non-binary interactions between an emitter and perturbers are present can be devised through an adaptation of the so-called unified theory (Rosato et al. 2012). We discuss this model and present an adaptation to magnetized plasmas.

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