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STARK BROADENING IN SOLID-DENSITY PLASMAS: A COMPUTATIONAL APPROACH

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The generation of solid-density plasmas using free-electron lasers opened up the possibility of experimentally studying the atomic structure of these extreme systems. While much successful work has been done on this topic the shape of the spectral lines emitted under these conditions has not been thoroughly studied. This is owed, in part to the fact that most transitions are very short-lived (fs scale), and their lifetime is dictated by intra-atomic processes such as Auger decay, which makes the use of typical line-shape approaches inadequate. In this work, we focus on the Heα emission of a solid-density Mg plasma generated at the LCLS. Recent work (Pérez-Callejo et al., 2024) showed that this line is emitted from a plasma in local thermodynamic equilybrium (LTE), which makes traditional lineshape models applicable. We present results using the standard theory of the Stark effect as well as Molecular Dynamics simulations, both methods adapted to study a crystalline plasma, where the ionic structure needs to be carefully considered. The results are compared with the experimentally-measured lineshape and the influence of different broadening mechanisms is discussed.