ZAPP: THE Z ASTROPHYSICAL PLASMA PROPERTIES COLLABORATION

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The new generation of z-pinch, laser, and XFEL facilities can produce astrophysically-relevant laboratory plasmas with energy densities beyond what was previously possible. Furthermore, macroscopic plasmas with uniform conditions can now be created, enabling more accurate determination of the material properties. This presentation will provide an overview of our research at the Z facility investigating stellar interior opacities, AGN warm-absorber photoionized plasmas, spectral line emission from photoionized plasmas near accretion powered objects, and white dwarf photospheres. The Z Astrophysical Plasma Properties collaboration is staging Z experiments that simultaneously investigate all four of these topics. The benefits and challenges associated with designing, executing, and interpreting four simultaneous experiments will be discussed. Recent progress in two of the four projects will also be described. Stellar opacities are an essential ingredient of stellar models and opacity models have become highly sophisticated, but laboratory tests have not been done at the conditions existing inside stars. Our research is presently focused on measuring Fe at conditions relevant to the base of the solar convection zone, where the electron temperature and density are believed to be 190 eV and 9×10^{22} e/cc, respectively. The second project is aimed at producing a white dwarf photosphere in the laboratory. Emergent spectra from the photosphere are used to infer the star's effective temperature and surface gravity. The results depend on knowledge of H, He, and C spectral line profiles under conditions where complex physics may be important, especially for the line wings. These profiles have been studied in past experiments, but puzzles emerging from recent white dwarf analysis have raised questions about the accuracy of the line profile models. Proof-of-principle data has been acquired that indicates radiation-heated quiescent hydrogen plasmas can be produced with ~ 1 eV temperature and $10^{17} - 10^{19}$ e/cc densities, in a ~ $20 cm^3$ volume. Such plasmas would provide a valuable platform for investigating numerous line profile questions.

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