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Photoionized Plasma and Opacity Experiments on the Z Machine

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Laboratory experiments at Z use high energy density to create plasma conditions similar to extreme astrophysical environments, including stellar interiors and accretion powered objects. The importance of radiation unifies these topics, even though the plasmas involved are very different. Understanding stellar interiors requires knowledge of radiation transport in dense, hot, collision-dominated plasma. A Z x-ray source was used to measure iron plasma transmission at 156 eV electron temperature, 2x higher than in prior work. The data provide the first experimental tests of absorption features critical for stellar interior opacity models and may provide insight into whether the present discrepancy between solar models and helioseismology originates in opacity model deficiencies or in some other aspect of the solar model. In contrast, accretion physics requires interpretation of x-ray spectra from lower density photoionization-dominated plasma. Exploiting astrophysical spectra requires a spectral model that connects the observations with a model that describes the overall picture of the astrophysical object. However, photoionized plasma spectral models are largely untested. Z-pinch radiation was used to create photoionized iron and neon plasmas with photoionization parameter 5-25 erg cm /s. Comparisons with the data improve x-ray photoionization models and promote more accurate interpretation of spectra acquired with astrophysical observatories. The prospects for new experiments at the higher radiation powers provided by the recently upgraded Z facility will be described.* In collaboration with scientists from CEA, LANL, LLNL, Oxford, Prism, Queens University, Swarthmore College, U. Nevada Reno, and Sandia ++Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.