Oxygen opacity experiments relevant to white dwarf interiors

D.C. Mayes[1], D.E. Winget[1], M.H. Montgomery[1], B.H. Dunlap[1], J.E. Bailey[2], G.P. Loisel[2], T. Nagayama[2], T.S. Perry[3], R.F. Heeter[4], S.B. Hansen[2], T.A. Gomez[2], C.J. Fontes[3], D.P. Kilcrease[3], J. Colgan[3]

[1] *Astronomy Department, University of Texas at Austin, TX, USA*
[2] *Sandia National Laboratories, Albuquerque, NM, USA*
[3] *Los Alamos National Laboratory, Los Alamos, NM, USA*
[4] *Lawrence Livermore National Laboratory, Livermore, CA, USA*

The accuracy of opacities at stellar interior conditions has recently been called into question. These opacities are one mechanism for controlling the transfer of energy within a star toward the surface and are thus important for accurate modeling of white dwarf (WD) cooling ages. We have established experiments to investigate opacities of materials at stellar interior conditions at the Z Pulsed Power and National Ignition Facilities. Oxygen is one of the elements we are studying, which is relevant for white dwarf interiors. Previous experiments with iron revealed notable differences between theory and experiment as temperature and density were increased, resulting in an underestimate of the mean opacity. Oxygen, despite its simpler atomic structure, may also show discrepancies but due to different physics. Of particular interest is how higher densities affect the opacity spectrum and how models are handling these effects. Conditions attainable in these experiments are still much lower than some of the most important conditions for oxygen opacities in WDs but are higher than any achieved previously in the lab for opacity studies. We are experimentally accessing conditions well inside the envelopes and similar to those at the base of convection zones within these stars. Ultimately, improvements to our understanding of density effects, even at our presently attainable conditions, can affect how we model opacities at much higher temperatures and densities deeper inside WDs. This poster will discuss the experimental platforms, the methods used for diagnosing plasma conditions, and preliminary results from each platform.

This work was supported in part by the Wootton Center for Astrophysical Plasma Properties under U.S. DOE cooperative agreement number DE-NA0003843, the Fundamental Science Program of SNL, and NIFs Discovery Science Program. SNL is managed and operated by NTESS under DOE NNSA contract DE-NA0003525.