Beitrag ID: **25** Typ: **Invited Talk**

Direct Measurement of Hydrogen Opacity at Conditions Prevailing in the Interior of Small Stars

Donnerstag, 29. Januar 2026 08:30 (30 Minuten)

Understanding radiative energy transport in stellar interiors requires accurate knowledge of the opacity of dense hydrogen plasmas, yet direct experimental constraints in the relevant regime have been absent. We report measurements of hydrogen opacity at extreme densities—up to ~800× solid density—and temperatures of a few million kelvin, achieved through a tailored low-velocity capsule implosion at the National Ignition Facility. This approach produces conditions comparable to those in red dwarf stellar cores while suppressing background emission sufficiently to enable time-resolved X-ray radiography. By tracking X-ray transmission during stagnation, we extract the density evolution and opacity of the transient plasma. The measured opacities show significant deviations from commonly used stellar opacity models (e.g., OPLIB) and instead align with modern atomistic simulations such as average atom models. These results provide the first experimental benchmark of hydrogen opacity in the dense-plasma regime that dominates low-mass stellar interiors. Beyond astrophysics, the implosion design and diagnostics developed here are applicable to advanced concepts for inertial fusion energy, where accurate radiation transport models are likewise essential.

Autor: SCHUMACHER, Samuel (University of Rostock)

Co-Autoren: Herr LÜTGERT, Julian (University of Rostock); Frau BETHKENHAGEN, Mandy (Université Lyon); Herr BACHMANN, Ben (Lawrence Livermore National Laboratory); Herr STARRETT, Charles (Los Alamos National Laboratory); Herr TROSSEILLE, Clement (Lawrence Livermore National Laborator); Herr HALL, Gareth N. (Lawrence Livermore National Laboratory); Herr DIVOL, Laurent (Lawrence Livermore National Laboratory); Herr MASSE, Laurent (Lawrence Livermore National Laboratory); Herr SCHÖLMERICH, Markus (Lawrence Livermore National Laboratory); Herr SHAFFER, Nathaniel (University of Rochester); Herr LANDEN, Otto N. (Lawrence Livermore National Laboratory); Herr STERNE, Phil A. (Lawrence Livermore National Laborator); Herr REDMER, Ronald (University of Rostock); Herr KHAN, Shahab (Lawrence Livermore National Laborator); Herr GLENZER, Siegfried H. (SLAC National Accelerator Laboratory); Herr MACLAREN, Steve A. (Lawrence Livermore National Laboratory); Frau EBERT, Tina (Lawrence Livermore National Laboratory); Herr IZUMI, Nobuhiko (Lawrence Livermore National Laboratory); Herr DÖPPNER, Tilo (Lawrence Livermore National Laborator); Herr GERICKE, Dirk O. (Centre for Fusion, Space and Astrophysics, University of Warwick); Herr KRAUS, Dominik (University of Rostock)

Vortragende(r): SCHUMACHER, Samuel (University of Rostock)

Sitzung Einordnung: Session 8 - Astrophysics