IAP Seminar

Verena und Hermann Geppert-Kleinrath

Los Alamos National Laboratory

Tuesday, 20th June 2023, 16:00 s.t.
TU Wien, Institut für Angewandte Physik, E134
1040 Wien, Wiedner Hauptstraße 8-10
Yellow Tower „B“, 5th floor, SEM.R. DB gelb 05 B

Markers of Ignition: Nuclear Diagnostics for Inertial Confinement Fusion

In inertial confinement fusion (ICF) capsules filled with Deuterium and Tritium fuel are compressed using lasers to reach temperatures and pressures necessary for fusion reactions to occur. Los Alamos National Laboratory's (LANL) Physics Division provides the primary nuclear diagnostics to study ICF implosions at the National Ignition Facility (NIF) – the most powerful ICF facility in the world. In recent breakthrough ignition experiments LANL diagnostics have shown markers of the burning plasma under extreme conditions. This transition into the ignition era is setting new challenges for diagnostics but allowing researchers a glimpse into never before accessed physics regimes.
Gas Cherenkov Detectors (GCD) have been a work horse for measuring thermonuclear burn history in ICF for over a decade. GCD performs high bandwidth measurements providing crucial benchmarks for simulations and experiments such as fusion bang time and fusion burn width. LANL has recently led a multi-institutional collaboration to successfully improve temporal resolution of GCD by a factor of 10 by developing a Pulse Dilation - Photomultiplier Tube. During the first burning plasma shot at NIF, the new diagnostic recorded the narrowest burn-width ever, showing the transition to a new alpha heating dominated physics regime.
The neutron imaging system visualizes the burning hot spot shape in 3D. Two neutron energy-gated lines-of-sight determine the cold fuel density surrounding the burning fuel. The first gamma imaging system in ICF creates the opportunity to measure the remaining ablator position and density. Together, these complex diagnostics make up a complete nuclear imaging suite which opens a window into the shape characteristics of fusion implosions. The nuclear imaging diagnostic has significantly advanced our understanding of performance limitations in ICF and is now providing images of the first successful ignition shots.

Dr. Hermann Geppert-Kleinrath is a leading expert for Gas Cherenkov Detector measurements and pulse dilation technology. His work includes providing gamma reaction histories for Inertial Confinement Fusion experiments at the National Ignition Facility, OMEGA and the Z-machine, including fusion burn history measurements and ablator performance, as well as understanding and quantifying signatures from nuclear reactions. His reaction history data is a crucial metric for performance of high yield experiments in ICF and a key in proving the transition into the ignition regime. He has authored more than 30 publications with over 800 citations in peer reviewed academic journals. He holds a PhD in Quantum Physics from Vienna University of Technology.

Dr. Verena Geppert-Kleinrath is a leader in the area of nuclear imaging for inertial confinement fusion. She also serves as the P-1 Dynamic Imaging and Radiography deputy group leader at LANL. She and her team have successfully developed 3D neutron and gamma imaging, and radiography diagnostics for the National Ignition Facility (NIF), the OMEGA laser facility, and the Nevada National Security Site. Her nuclear imaging diagnostics have delivered key performance metrics for recent high yield implosions on NIF – significantly advancing the ICF field. She also leads the team that performed ICF ion temperature imaging at OMEGA for the very first time in 2021. She has authored over 50 publications in internationally circulated academic journals with over 1000 citations. She holds a PhD in Nuclear Physics from Vienna University of Technology.

All interested colleagues are welcome to this seminar lecture
(45 min. presentation followed by discussion).

Friedrich Aumayr
(LVA-Leiter)

Georg Harrer
(Seminar Chair)