Speaker: Gunsu Yun (POSTECH)

Title: Looking inside the Sun through laboratory strongly coupled plasmas

Abstract:

Interiors of many celestial bodies such as suns, Jupiter-like planets, and white dwarfs are in a strongly coupled state [1-3], different from the conventional weakly coupled plasma states where the mean inter-particle Coulomb potential energy is smaller than the thermal energy ($k_B T$). Unlike the weakly coupled plasmas, collisions, the Debye shielding, photon confinement, and other basic processes are not well understood for strongly coupled plasma. To realize such state in laboratory, we have developed a laser plasma source in supercritical fluid (SCF) mediums chosen for higher density than gas and for the absence of solid/liquid-gas phase changes [4]. Discharges in noble species (He, Ar, Kr, Xe) SCFs as well as in mixture (e.g. Ar+H2, N2+O2) SCFs show a very high electron density $n_e \sim 10^{27}$ m^{-3}, which is attributed to the ionization potential depression (IPD) [5] down to the order of 1 eV. The dense plasma confines the photons very well and becomes a blackbody with the temperature $T_e \sim 1$ eV. The laboratory plasmas are strongly coupled and moderately degenerate, like the interior of our Sun (chromosphere). The strongly coupled plasma state sustains for about 100 ns, opening the possibility of studying basic collision and transport processes in the SC plasma regime [6]. Applications of the dense plasma for laser pulse compression and amplification are discussed.

References

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