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Title: Development of ultra-fast laser-driven x-ray probes with high intensity for Warm Dense Matter probing

Abstract:

Warm dense matter (WDM) is an intermediate state of matter at the transition from a solid to an ideal plasma with characteristic medium-to-high temperatures (0.1−100 eV), solid densities and pressures >Mbar. It is common inside the cores of large planets, crusts of ageing stars, laser-matter interactions or as a transition state during capsule implosion in inertial confinement fusion (ICF). Under such conditions quantum degeneracy and ion coupling are significant making the theoretical description of WDM very challenging. WDM is also extremely difficult to diagnose experimentally due to its high density and relatively low temperature, thus active x-ray probes are required. Recently, ultra-fast probing with x-ray sources for radiography and x-ray Thomson scattering is now of a great interest, in particular to study transport properties of WDM in relevance to astrophysical phenomena, has become of a great interest to the community. Laser-driven K-alpha sources have proven to be excellent for this purpose, in particular for high energy laser experiments, however due to relatively low conversion efficiency in comparison to He-alpha and Ly-alpha sources, their applicability is limited. Recent theoretical studies have shown that adding micro-scale structures to the laser-driven solid foils generating the x-rays can significantly enhance the flux of such sources. So far, experimental studies of the use of these micro-structured targets have been limited. In this talk, recent experiments developing bright x-ray sources driven by short-pulse lasers will be presented and potential applications outlined.