Fr-9.
Intense femtosecond laser filamentation science in air
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Universal phenomena inside the filament core of a femtosecond Ti-sapphire laser pulse in air will be discussed. These include birefringence induced by the strong field inside the filament through cross-phase modulation in the otherwise isotropic air, intensity clamping prohibiting reaching very high intensity whatever one does, molecular alignment and the revival of rotational wave packets as well as population trapping (stabilization). This trapping phenomenon is believed to be a missing universal process in intense laser interaction with atoms and molecules. Super-excited states of molecules are observed which are proposed for the first time to be the trapped Rydberg and/or highly excited states in the continuum.

Fr-10.
Interaction of energetic ions with high-density plasmas
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The talk will review the importance of energetic ions in different inertial confinement fusion scenarios: i) heavy ion beams are very efficient drivers that can deliver the energy for compression in indirect as well as direct drive approaches; ii) the interaction of α-particles, that are created in a burning plasma, with the surrounding cold plasma is essential for creating a burn wave; iii) laser-produced ion beams are also a strong candidate to create the hot spot needed for fast ignition. In all applications the ions interact with dense matter that is characterized by strongly coupled ions and (possibly) partially degenerate electrons. Moreover, the coupling between beam ions and target electrons can be strong as well. Under these conditions, standard approaches for the beam-plasma interactions process are known to fail.
The presentation will demonstrate how advanced models for the energy loss of ions in dense plasmas can resolve the issues mentioned above. These models are largely built on quantum kinetic theory that is able to describe degeneracy and strong coupling in a systematic way. In particular, strong interactions require a quantum description for electron-ion collisions in dense plasma environments, which is done by direct solutions of the Schrödinger equation. Degeneracy and collective excitations can be included via the Lenard-Balescu description where strong interactions may be included via a pseudo-potential approach.
Finally, results are shown for all three fusion applications described above. The effects related to strong coupling and degeneracy mainly concern the end of the stopping range where the beam ion does not have enough energy to excite all possible degrees of freedom and, thus, certain processes are frozen out. However, we also find a significant reduction of the range for swift heavy ions in the GeV-range when stopping in dense matter is considered. The stopping range of α-particles in the highly compressed matter around the burning fusion core is however strongly increased due to degeneracy of the target electrons. This result implies the need for much larger hot spots than predicted by standard models. Similarly, the range of light ions considered for fast ignition is increased. This makes success of this efficient ICF approach harder to achieve, but already reflects the need for larger hot spots due to the larger spread of the α-particles heating.

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