Contribution ID: **5** Type: **Talk**

Synthetic probing of ionization dynamics in the solid density plasmas driven by relativistic laser pulses using resonant SAXS

Friday 5 November 2021 13:35 (25 minutes)

Understanding the ionization dynamics is fundamentally important in the interaction of a relativistic laser pulse with a solid density target. In this talk, firstly we present the particle-in-cell (PIC) simulations with various collisional ionization and potential models, showing the target heating, magnetic instabiltiy and plasma resistivity are highly model-dependent \cite{Huang2016,Huang2017}. Secondly, we propose to probe the evolution of ionic density at specific bound-bound resonances by scanning the XFEL photon energy via established SAXS method, which is cable to access the spatial–temporal resolution down to few nanometers and femtoseconds simultaneously. The plasma opacity plays a key role of the XFEL absorption, which in turn affects the resonant SAXS pattern contributed by the imaginary part of ionic scattering form factor\cite{Kluge2016}. We present the calculation of plasma opacity using the atomic collisional-radiative code SCFLY and further simulate the synthetic resonant SAXS imaging pattern which shows strong asymmetric feature. Our recently performed experiment reveals the connection of the temporal evolution of the asymmetry signal and ionization dynamics \cite{Gaus2020}.

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Session Classification: Talks