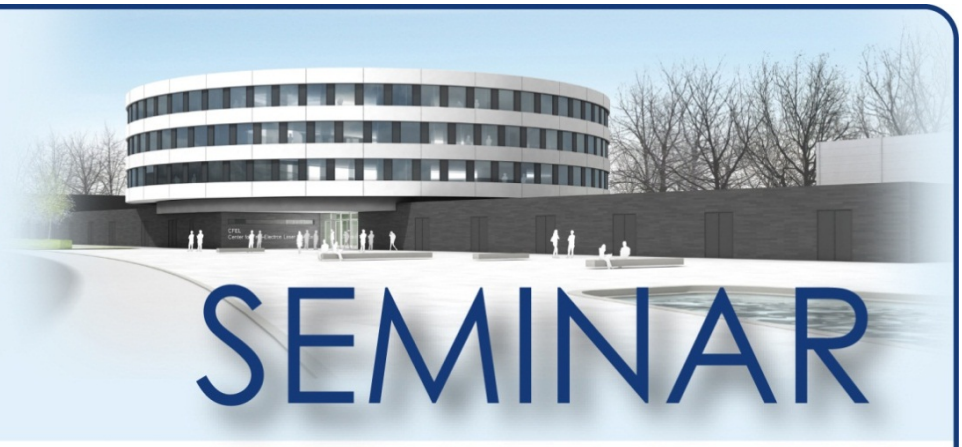
CFEL SCIENCE



SEMINAR

30th April 2025 - 2:00 p.m.

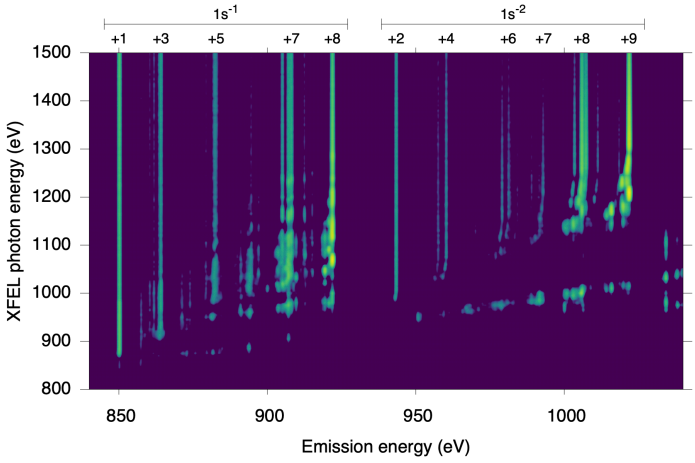
CFEL-bldg. 99, seminar room IV

Sang-Kil Son

Center for Free-Electron Laser Science, DESY, Germany

Non-equilibrium pathways to a hot plasma: multi-resonance excitation and plasma evolution dynamics

A transient plasma is formed when intense X-ray pulses interact with matter. Multiphoton ionization produces highly charged ions and hot electrons, and eventually reach a thermal equilibrium. I will present a joint theoretical and experimental study of X-ray multiphoton ionization dynamics and plasma evolution dynamics of neon gas interacting with intense X-ray pulses generated by European XFEL. The target density is low enough to model excitation mechanisms in the isolated-atom limit during the pulse, while it is high enough to observe collisional effects afterwards. Multiple resonance excitations are investigated in X-ray emission spectra from all Ne charge states as shown in the figure. I will also discuss how insights from atomic physics are applied to understand non-equilibrium plasma formation dynamics. Time-resolved X-ray emission measurement enables us to monitor how electrons cool down, reaching electron-ion thermalization. Our study of quantum-state-resolved X-ray multiphoton ionization dynamics opens up new opportunities for high-resolution X-ray spectroscopy of atoms and plasmas at high intensity.



Theoretical 2D map of X-ray emission from Ne ions

Host: Robin Santra – CFEL-DESY Theory Division