CFEL SCIENCE

SEMINAR

03rd May 2017 - 2:00 p.m.

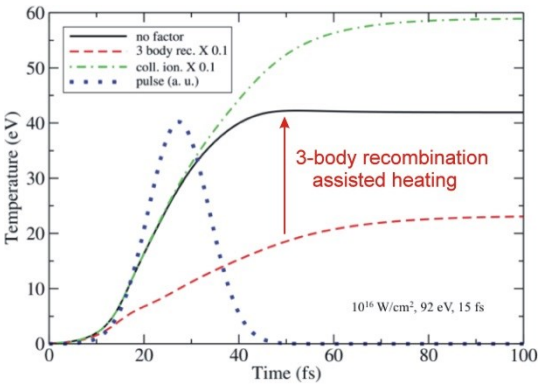
CFEL-bldg. 99, seminar room IV

Frank B. Rosmej

Sorbonne Universités, Pierre et Marie Curie UPMC, France; LULI, Ecole Polytechnique, CNRS, CEA, France; Moscow Institute of Physics and Technology, Russia

An introduction to the atomic physics of XFEL interaction with matter

The seminar provides an introduction to the atomic physics of the interaction of X-ray Free Electron Laser (XFEL) radiation with matter. Unlike optical lasers, where energy absorption is essentially realized by inverse Bremsstrahlung and parametric instabilities, the primary absorption mechanism of XFEL is photoionization of atomic shells. Due to the large photon energy (up to 20 keV), XFEL radiation photoionizes mainly inner atomic shells thereby creating exotic states [1-3]: hollow atoms/ions, hollow crystals.



The atomic physics processes related to these exotic states are essential to understand XFEL interaction with matter and the temporal evolution from a solid to Warm Dense Matter (WDM). Generalized atomic physics processes are introduced [4] that provide a consistent link from cold solid matter to dense plasmas. They also generalize the so-called Auger electron heating that has been identified with spectroscopic analysis [5].

Finally, critical remarks to recent ionization potential depression analysis are given.

References

[1] F.B. Rosmej: “Exotic states of high density matter driven by intense XUV/X-ray Free Electron Lasers”, "Free Electron Laser", InTech 2012, editor S. Varró, p. 187 - 212, ISBN 978-953-51-0279-3.

[2] F.B. Rosmej, R. Dachicourt, B. Deschaud, D. Khaghani, M. Dozières, M. Smîd, O. Renner: "Exotic X-ray Emission from Dense Plasmas", J. Phys. B: Review Special Topics 48, 224005 (2015).

[3] F.B. Rosmej, R.W. Lee: “Hollow ion emission driven by pulsed x-ray radiation fields”, Europhysics Letters 77, 24001 (2007).

[4] B. Deschaud, O. Peyrusse, F.B. Rosmej: "Generalized atomic physics processes when intense femtosecond XUV- and X-ray radiation is interacting with solids", Europhysics Letters 108, 53001 (2014).

[5] E. Galtier, F.B. Rosmej, D. Riley et al.: “Decay of crystalline order and equilibration during solid-to-plasma transition induced by 20-fs microfocused 92 eV Free Electron Laser Pulses”, Phys. Rev. Lett. 106, 164801 (2011).

Host: Robin Santra – CFEL-DESY Theory Division