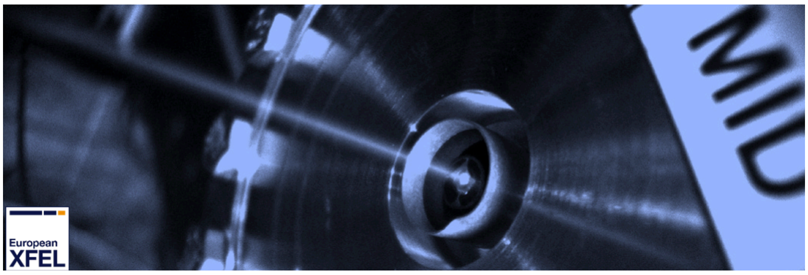

Contribution ID: **60** Type: **Talk**

X-ray spectroscopy, diffraction and imaging techniques for high energy density matter enabled by very hard X-rays at XFELs

Friday 20 January 2023 09:35 (20 minutes)

The combination of X-ray free electron lasers with energetic and intense pulsed lasers has started to revolutionize the experimental investigation of matter at high energy densities comparable to the interiors of planets and stars and numerous applications transiently requiring such conditions. With future sources possibly going beyond the current world record set by EuXFEL at 25 keV, new methods for characterizing matter of extreme energy density will become available. This includes very high q-range diffraction experiments for most precise characterization of the liquid structure of dense plasmas and highly complex crystalline phases predicted at high pressures and temperatures. Moreover, the powerful technique of X-ray Raman spectroscopy can be extended to heavier elements such as iron, while allowing simultaneous precision X-ray diffraction measurements. Furthermore, beyond 25 keV, X-ray absorption of light elements is no longer dominated by the photo effect but by Compton scattering. This may allow the implementation of Compton radiography experiments for dense plasmas providing valuable information on density while enabling complementary scattering diagnostics on the same experiment. In addition, higher energy X-rays will be able to penetrate thick sample sandwiches as required from some shock experiments or material damage studies in bulk samples made of heavy elements. Finally, the use of high-energy X-rays will allow to shield diagnostics more efficiently from parasitic radiation including ultra-intense drive laser system in the regime of relativistic laser-matter interaction. However, most effectively using these techniques will require some development for dedicated diagnostics (e.g.,efficient high-energy X-ray spectrometers) and driver systems (e.g., kJ laser shock driver with decent repetition rate). I will discuss the scientific opportunities of increased XFEL photon energies for HED sciences in light of associated technical challenges.

Primary author: KRAUS, Dominik

Presenter: KRAUS, Dominik

Session Classification: High pressure, warm dense matter, electron dynamics, strong field science

Track Classification: High pressure, planetary, and geology science, electron dynamics, warm dense matter, relativistic laser plasmas, strong field science