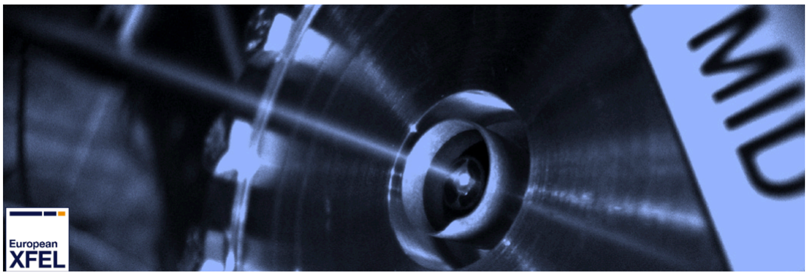

Contribution ID: **29** Type: **Talk**

Applications for Very Hard XFEL Radiation at First Light Fusion in Support of Projectile-Driven IFE Research

Wednesday 18 January 2023 11:25 (20 minutes)

First Light Fusion (FLF) is a private UK company investigating a novel approach to inertial fusion energy (IFE), through means of hyper-velocity projectile-driven impact. Using a combination of a proprietary shock pressure amplification technology and a metallic-cased fuel-containing target, we are pursuing the goal of achieving fuel gain [1] in a quasi-spherical, volume ignition configuration [2]. The drive for the system will be provided by our next generation pulsed power machine, M4, which is presently in the preliminary phase of its engineering design.

A key aspect of how FLF's end-to-end concept will be deployed involves the fielding of a physically coupled amplifier-target system, both components of which will be encased in a dense, high-Z metal shell. This is crucial to the operation of the amplifier and facilitates the hydrodynamic compression of the fuel and efficient radiation recycling to reduce losses from the fuel. Validation of the internal shock dynamics, thermal and radiative transfer and plasma microphysics modelling underpinning the function of these components, especially the implosion of the fuel-filled cavity, are thus of crucial importance. Furthermore, in an age where computer-driven design and
optimization techniques are playing increasingly prominent roles in tackling engineering and physics challenges, the need for high-quality, extensive constitutive data for a diverse range of materials is paramount. Hard X-rays in particular facilitate a number of state-of-the-art diagnostic techniques for gathering such data.

In this contribution we present a general overview of FLF's projectile-driven approach to IFE, some examples of how X-ray diagnostics have contributed to the early successes of our scientific programme, and how we are supporting diagnostic development to meet our future needs and challenges. Two applications of particular interest to this workshop are: 1) the fielding of a portable two-stage light-gas gun at the European Synchrotron Radiation Facility for the study of shock-driven cavity collapse [3]; and 2) exploring the potential of a novel, model-independent temperature diagnostic for matter under extreme conditions [4]. Both applications are ideally suited to hard XFEL radiation and would serve to strengthen the knowledge base supporting the next generation of our experiments.

References:

1. https://www.llnl.gov/news/nif-experiments-show-initial-gain-fusion-fuel
2. K. Molvig et al. "Low Fuel Convergence Path to Direct-Drive Fusion Ignition", Phys. Rev. Lett. 116, 255003 (2016).
3. E. M. Escauriza et al., "Collapse Dynamics of Spherical Cavities in a Solid Under Shock Loading", Sci. Rep. 10, 8455 (2020).
4. T. Dornheim et al., "Accurate Temperature Diagnostics for Matter Under Extreme Conditions", Nat. Commun. 13, 7911 (2022).

Primary author: DOYLE, Hugo (First Light Fusion Ltd)

Presenter: DOYLE, Hugo (First Light Fusion Ltd)

Session Classification: Applied materials and industrial applications

Track Classification: Applied materials and industrial applications