

## Plasma-based studies with intense X-ray and particle beam sources

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R.W. LEE,<sup>1</sup> H.A. BALDIS,<sup>2</sup> R.C. CAUBLE,<sup>1</sup> O.L. LANDEN,<sup>1</sup> J.S. WARK,<sup>3</sup> A. NG,<sup>4</sup>  
S.J. ROSE,<sup>5</sup> C. LEWIS,<sup>6</sup> D. RILEY,<sup>6</sup> J.-C. GAUTHIER,<sup>7</sup> AND P. AUDEBERT<sup>7</sup>

<sup>1</sup>L-411 Lawrence Livermore National Laboratory, Livermore, CA, USA

<sup>2</sup>Institute for Laser Science and Applications / University of California, Davis, CA, USA

<sup>3</sup>Department of Physics, Clarendon Laboratory, Oxford University, Oxford, UK

<sup>4</sup>Department of Physics & Astronomy, University of British Columbia, Vancouver, BC, Canada

<sup>5</sup>Central Laser Facility, Rutherford Appleton Laboratory, Chilton, UK

<sup>6</sup>Physics Department, Queen's University Belfast, Belfast, Northern Ireland

<sup>7</sup>LULI UMR 7605 Ecole Polytechnique, CNRS/CEA, Université Paris VI, Paris, France

### Abstract

The construction of short pulse (<200 fs) tunable X-ray laser sources based on the X-ray free electron laser (XFEL) concept will be a watershed for plasma-based and warm dense matter research. These new fourth generation light sources will have extremely high fields and short wavelengths (~0.1 nm) with peak spectral brightnesses  $10^{10}$  greater than third generation sources. Further, the high intensity upgrade of the GSI accelerator facilities will lead to specific energy depositions up to 200 kJ/g and temperatures between 1 and 10 eV at almost solid-state densities, enabling interesting experiments in the regime of nonideal plasmas, such as the evolution of intense ion beams in the interior of a Jovian planet. Below we discuss several applications: the creation of warm dense matter (WDM) research, probing of near solid density plasmas, and laser–plasma spectroscopy of ions in plasmas. The study of dense plasmas has been severely hampered by the fact that laser-based methods have been unavailable and these new fourth generation sources will remove these restrictions.

**Keywords:** Advanced photon source; Plasma spectroscopic studies; Solid density plasmas; Warm dense matter