CFEL SCIENCE

Colloquium

6th February 2015 - 14:00

CFEL, Building 99 - Seminar Room I-III

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Stagnation layers at the collision front between counter-streaming plasma plumes: formation, properties and potential applications

When two expanding laser produced plasmas collide there are two extreme outcomes – in one case the plasmas stagnate and a hard and well defined layer of material is formed as material from the constituent plasma plumes accretes at the collision plane [1,2] – at the other extreme the plasma plumes interpenetrate and the interaction is considered to be essentially due to collisionless shocks [3]. They are of growing importance in many fields, e.g., in e.g., hohlraum studies [3] and pulsed laser deposition [4]. A stagnation layer at the collision plane between a pair colliding plasmas is shown in figure 1.

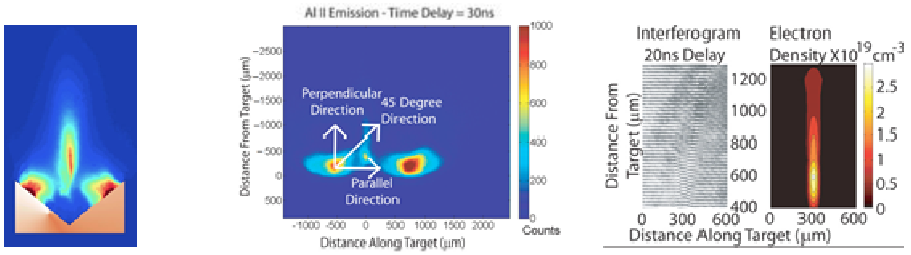

Figure: Time integrated image showing seed plasmas and stagnation layer (left). Ditto but time and spectrally resolved showing Al+ emission some 30 ns after seed plasma formation (middle). Interferogram and extracted electron density along the stagnation layer(right).

The talk will focus on the creating and diagnosing stagnation layers and also point out some of their unique features (time synchronised, free standing, droplet-like, shape controllable, temperature and density controllable, increased dwell time over single plasmas, etc.) which might make them of interest for experiments at intense VUV and X-ray FELs. One avenue we will explore in the near future is co-synthesis of nanoparticles with colliding MALDI/LIAD plumes to induce biomolecular stagnation.

[1] P Yeates, C Fallon, E T Kennedy and J T Costello, Physics of Plasmas 20, 093106 (2013)
[2] K F Al-Shboul, S S Harilal, S M Hassan, A Hassanein, J T Costello, T Yabuuchi, K A Tanaka and Y Hirooka, Physics of Plasmas 21, 013502 (2014)
[3] J. S. Ross et al., Phys. Rev. Lett. (2013) 110 145005
[4] E. Irissou, F. Vidal, T. Johnston, M. Chaker, D. Guay, A. N. Ryabinin, J. Appl. Phys. (2006) 99 034904

Host: Andreas Maier, UHH-ASG