Diagnosing surface heating in relativistic laser plasma interactions using GISAXS

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High field surface plasmons have recently attracted attention in producing the ultracompact sources electron accelerators and intense XUV sources via High order Harmonic Generation[1]. While these sources allow a diagnosis of the far field of the surface plasmons, an understanding of their transport and the consequent heating in the near field remains challenging. Propagating in a nm thin skin layer on the solid density plasma surface, these surface plasmons present the peculiar problem of requiring a probe with nm depth sensitivity in the solid density region - thus ruling out optical and proton imaging techniques.

Here, we present our results employing Hard X-ray Free Electron Lasers to probe sub-relativistic intensity laser driven solid density plasma surfaces. We irradiate Hard X-ray pulses at Grazing Incidence and monitor the Small Angle X-ray Scattering (GISAXS). This method, previously developed by us for laser ablation studies[2], allows us to obtain sensitivity to nm electron density fluctuations, with a picosecond resolution. We measure the dynamics of electron density correlations due to target neutralization inside a multilayered solid target, at several distances away from the laser irradiation spot. We infer the speed of the lateral heating front to be >0.77c. Finally, we present preliminary measurements of the surface heating due to resonantly generated surface plasmons.

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References

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