# Parametric description of laser-generated ion plasma gratings

H. Peng[1,2], C. Riconda[1], M. Grech[1], S. Weber[3]

[1] *LULI Sorbonne Université, CNRS, École Polytechnique, CEA , 75005 Paris, France,*

[2] *Shenzhen Technology University, Shenzhen, Guangdong, China*

[3] *ELI-Beamlines, Inst. of Phys. of the Czech Ac. of Science, 18221 Prague, Czech Republic*

Laser-generated plasma gratings are dynamic optical elements for the manipulation of coherent light at high intensities, beyond the damage threshold of solid-stated based materials. They can be formed by a periodic ponderomotive potential generated by two identical counter-propagating lasers. Their formation, evolution and final collapse require a detailed understanding, lacking so far. We present a fluid model that allows to predict the peak value and formation time of the gratings[1]. The model is benchmarked against kinetic simulations, and its limit of validity identified. A single parameter is found to determine the behavior of the grating and distinguish three fundamentallly different regimes for the ion dynamics once kinetic effects become important : completely reflecting, partially reflecting/partially passing, and crossing. Combining fluid and kinetic results, criteria for the peak value and life-time of the grating can be found. A novel application of this transient plasma grating exploits its finite lifetime to affect the wave dispersion relation. As a result, different set-up are identified that can result in laser frequency downshift or spectral splitting. The former can be used for Raman amplification in plasma and the latter for dual color x-ray generation by Thomson/Compton scattering.

## References

[1] H. Peng, C. Riconda, M. Grech, J.-Q. Su, and S. Weber, Phys. Rev. E **100**, 061201(2019)