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Dynamics of multiple interacting ultra-intense lasers in a plasma LUCAS SA, JORGE VIEIRA, RICARDO FONSECA¹, LUIS SILVA, GoLP/IPFN, Instituto Superior Tecnico, Universidade de Lisboa, Portugal, WARREN MORI, Department of Physics and Astronomy, University of California Los Angeles, Los Angeles, California, USA — Although light beams do not interact in vacuum, two intense lasers can interact with each other in a nonlinear medium, forming spiraling and braiding patterns when they carry angular momentum. Here, we analyse the interaction between N laser filaments. Using a variational approach based on the Non-Linear Schrödinger Equation with the lowest order relativistic mass correction, we obtained a mechanical analog of an exponential N-body problem for the beam centroids and spot-sizes. We found that the N beams can spiral in a circular motion around the center of mass analog and determined orbital parameters and trapping criteria for this motion. Furthermore, the lasers could form a solar system, with N-1 beams orbiting a high-power one. The predictions for both models were tested in Particle-in-Cell simulations, in which other effects, namely non-instantaneous spatiotemporal non-linearities, can be compared to the relativistic mass correction. Finally, the initial configuration of the beams could follow from filamentary processes, with the filamentation of an orbital angular momentum carrying laser originating the spiralling and braiding motions of the filaments.

¹DCTI, ISCTE - Instituto Universitario de Lisboa, Portugal

Lucas Sa Inst Superior Tecnico (IST)

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