Abstract Submitted
for the DPP17 Meeting of
The American Physical Society

Magnetic field generation in rotating plasma waves driven by co-propagating OAM lasers[1] YIN SHI, Imperial College London, JORGE VIEIRA, GoLP/Instituto Superior Tecnico, RAOUL TRINES, BOB BINGHAM, Central Laser Facility-STFC/RAL, BAIFEI SHEN, Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, ROBERT KINGHAM, Imperial College London — We present a new magnetic field generation mechanism in underdense plasma due to rotating plasma waves driven by co-propagating Laguerre-Gaussian (LG) beating orbital angular momentum (OAM) laser beams with both a different frequency and also different twist index. In this plasma wave, particles oscillate elliptically in the transverse plane with an azimuthally dependent phase. We therefore call it a transverse rotating plasma wave (TRPW). The distribution and evolution of density and electric field in the transverse plane has some special characteristics. We present a linear fluid model of TRPW and also a high order analysis of the electrical current based on particle motion. To the second order, there is a net rotating current leading to the onset of an intense axial magnetic field (up to 0.4 MG), which persists over a long time in the plasma (ps scale). It is different from Inverse Faraday effects. Our analytical predictions are confirmed in three-dimensional particle-in-cell simulations using EPOCH. This new method of magnetic field creation may find applications in charged beam collimation and controlled fusion.

[1]Dr Yin Shi is a Newton International Fellow. This work is supported by the Royal Society. This work used the ARCHER UK National Supercomputing Service.

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Date submitted: 21 Jul 2017 Electronic form version 1.4