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Laser Wakefield Acceleration of positrons in the blowout regime

Wednesday, 16 September 2015 12:00 (30 minutes)

Exotic lasers are beams with orbital angular momentum and are described by higher order Laguerre Gaussian modes. These lasers have been leading to transformative scientific advance in applications ranging from ultrafast communications and super-resolution microscopy to quantum computing and astrophysics. This talk addresses how lasers with orbital angular momentum could be used to tackle important questions in plasma-based acceleration. Using three-dimensional particle-in-cell simulations in Osiris and theory we show that exotic laser beams with orbital angular momentum can drive doughnut shaped plasma wakes in strongly non-linear regimes. We show that these wakefields can self-trap and accelerate ring electron bunches to high energies. These shaped electron bunches perform betatron oscillations around the doughnut bubble centroid, which can influence x-ray betatron radiation emission. These results then suggest novel pathways to tailor the transverse profile of relativistic beams produced in plasma accelerators. Unlike the spherical blowout regime, doughnut shaped wakefields can also be used to accelerate positrons to high energies. We then provide a solution to a key challenge in plasma-based accelerators critical for future plasma based linear colliders. We will describe how these lasers could be produced in the laboratory.

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