Laser-Cluster Interaction in an External Magnetic Field: Emergence of a Nearly Monoenergetic Weakly Relativistic Electron Beam

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Relativistic electron beam (REB) via laser-plasma interaction has diverse applications in the fundamental sciences and industries, e.g., the fast ignition technique of inertial confinement fusion and contruction of particle accelerators for medical applications.

In this work, we report the generation of a weak REB in the collision-less regime of laser-cluster interaction with an ambient magnetic field (B_{ext}) using a simple rigid sphere model and 3D hybrid particle-in-cell (PIC) simulation. The energy distribition in Fig.1 (left col.) indicates the enhancement of electron energy (ε_A) from ~2.4U_p (without B_{ext}) to ~70U_p near the relativistic electron cyclotron resonance (RECR). The angular distribution of these electrons in the position space (θ_r) demonstrates the emergence of a weakly relativistic conical-spiral narrow beam with

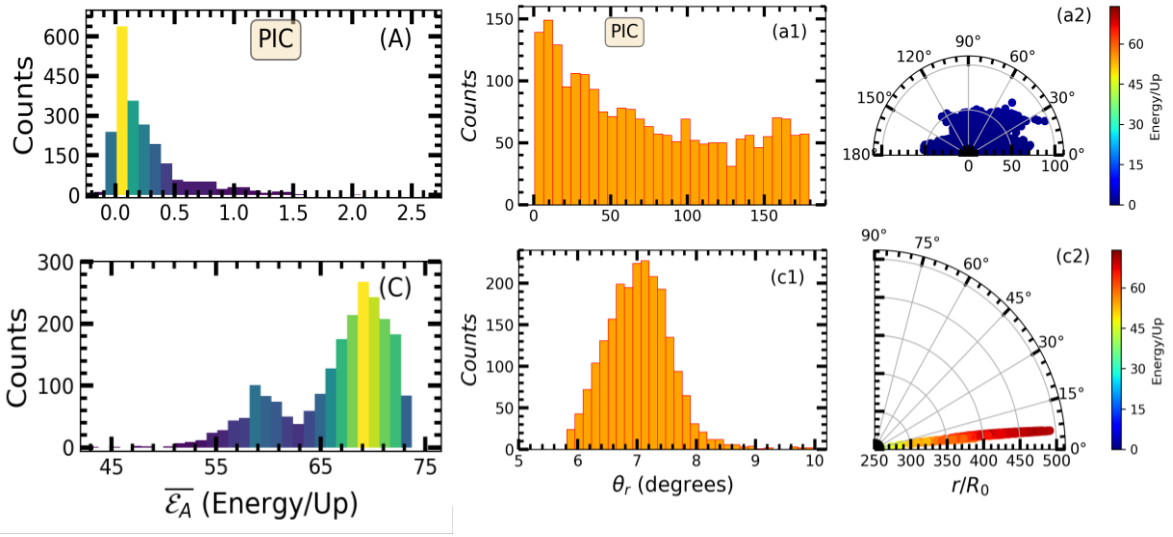

Fig.1: PIC results for a deuterium cluster for the laser intensity 7.13×10^{16}W/cm^2 and wavelength 800nm. The energy distribution without B_{ext} and with B_{ext} (A,B); the angular distribution θ_r(a1, b1); and the narrow spiral-cone like beam propagation in polar plots (a2,c2) are shown. At low B_{ext} (a1,a2) wide distribution $\Delta\theta_r$~(0-160^o), while at high B_{ext} near RECR (c1,c2) very narrow conical beam with $\Delta\theta_r$~4-5^o.

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