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Investigation of collective electron dynamics in relativistically transparent laser-foil interactions ROSS GRAY, DAVID MACLELLAN, BRUNO GONZALEZ-IZQUIERDO, HAYDN POWELL, University of Strathclyde, DAVID CARROLL, Central Laser Facility, CHRISTOPHER MURPHY, University of Edinburgh, LUCA STOCKHAUSEN, CLPU, DEAN RUSBY, GRAEME SCOTT, Central Laser Facility, ROBBIE WILSON, University of Strathclyde, NICOLA BOOTH, DAN SYMES, STEVE HAWKES, Central Laser Facility, RICARDO TORRES, CLPU, MARCO BORGHESI, Queen University Belfast, DAVID NEELY, Central Laser Facility, PAUL MCKENNA, University of Strathclyde —
The interaction of an intense laser pulse with a solid target produces high energy electrons at the target-vacuum boundary. For sufficiently high laser intensities and thin targets, the electrons become relativistic and rapidly expand into vacuum, lowering the peak electron density. The combined increase in the relativistically-corrected critical density and the reduction in the target electron density results in the onset of relativistic induced transparency (RIT) during the laser pulse, enabling the remainder of the pulse to propagate through the target and further interact with the accelerated electrons. We report on measurements of the collective dynamics of laser driven electrons in the RIT regime. The 2D profile of the beam of accelerated electrons is shown to change from an ellipse aligned along the laser polarization direction in the case of limited RIT, to a double-lobe structure aligned perpendicular to it, for a larger degree of RIT. The temporal dynamics of the interaction are investigated via PIC simulations. The implications of RIT for laser-driven ion acceleration is also explored.

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