# Laser Wakefield Acceleration of Ions with a Transverse Flying Focus

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The extreme electric fields created in high-intensity laser-plasma interactions could generate energetic ions far more compactly than traditional accelerators. Despite this promise, laser-plasma accelerators have remained stagnant at maximum ion energies of 100 MeV/nucleon for the last twenty years. The central challenge is the low charge-to-mass ratio of ions, which has precluded one of the most successful approaches used for electrons: laser wakefield acceleration. Here we show that a laser pulse with a focal spot that moves transverse to the laser propagation direction enables wakefield acceleration of ions to GeV energies in underdense plasma. Three-dimensional particle-in-cell simulations demonstrate that this relativistic-intensity "transverse flying focus" can trap ions in a comoving electrostatic pocket, producing a monoenergetic collimated ion beam. With a peak intensity of $10^{20}$ W/cm$^2$ and an acceleration distance of 0.44 cm, we observe a proton beam with 23.1 pC charge, 1.6 GeV peak energy, and 3.7% relative energy spread. This approach allows for compact high-repetition-rate production of high-energy ions, highlighting the capability of more generalized spatio-temporal pulse shaping to address open problems in plasma physics.