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Magnetic electron trapping generates efficient quasi-monoenergetic ion beam from laser-driven plasmas¹ SASIKUMAR PALANIYAPPAN, CHENGKUN HUANG, DONALD GAUTIER, CHRISTOPHER HAMILTON, JAMES COBBLE, Los Alamos National Laboratory, CHRISTIAN KREUZER, LMU Munich, RAHUL SHAH, JUAN FERNAN-DEZ, Los Alamos National Laboratory — Advanced ion accelerators, based on laserdriven plasmas, are potentially revolutionary because not only they are compact and affordable, but they also deliver lower transverse emittance and higher current density relative to conventional accelerators. However, these advanced ion beams still suffer from lower efficiency, lower peak energy, and wider energy spread that makes them unsuitable for many applications. Several pioneering studies, for more than a decade, have improved those beam properties mostly one at a time, but not all of them together. Here we demonstrate a laser-driven ion beam with all those beam properties enhanced simultaneously: laser-driven quasi-monoenergetic aluminum 11+ ion beam with 4% conversion efficiency (i.e., the ion beam contains 3Jof energy), 165 MeV peak ion energy, and ion energy spread as low as 7% obtained concurrently. The laser-plasma interaction is dominated by a relativistic plasma effect – called "relativistic transparency" – that enables efficient laser energy absorption by the plasma, followed by plasma channeling and self-generated plasma magnetic field. This combination leads to the improved conditions observed.

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