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# Near-100 MeV protons via a laser-driven transparency-enhanced hybrid acceleration

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The range of potential applications of compact laser-plasma ion sources motivates the development of new acceleration schemes to increase achievable ion energies and conversion efficiencies. Whilst the evolving nature of laser-plasma interactions can limit the effectiveness of individual acceleration mechanisms, it can also enable the development of hybrid schemes, allowing additional degrees of control on the properties of the resulting ion beam. We report on the experimental demonstration of efficient proton acceleration to energies exceeding 94 MeV via a hybrid scheme of radiation pressure-sheath acceleration in an ultrathin foil irradiated by a linearly polarised laser pulse. This occurs via a double-peaked electrostatic field structure, which, at an optimum foil thickness, is significantly enhanced by relativistic transparency and an associated jet of super-thermal electrons. The range of parameters over which this hybrid scenario occurs is reported, as are new routes to its optimisation and control.

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