Laser-driven collisionless shock acceleration of protons

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Experimental and numerical results have shown that collisionless shock acceleration is promising for generation of high energy proton beams. There are many potential applications for such beams, for example: isotope generation for medical applications, ion therapy and proton radiography. In this work, we use 1D1P Eulerian Vlasov-Maxwell simulations to study shock wave acceleration. Vlasov-Maxwell modeling allows for high resolution of the distribution function and is highly suitable in cases where effects of low-density tails in the distribution function need to be resolved accurately.

We find that combining collisionless shock acceleration with a strong, quasi-stationary sheath-field may be a way to reach even higher maximum proton energies and optimize the ion spectrum. We show that a layered plasma target with a combination of light and heavy ions leads to a strong quasi-static sheath-field, which induces an enhancement of the energy of shock-wave accelerated ions, without broadening their energy spectrum, if the heavy ion layer has high density [1].

References

[1] B. Svedung Wettervik, T. C. Dubois and T. Fülöp, Vlasov modelling of laser-driven collisionless shock acceleration of protons, submitted to Phys. Plasmas `http://arxiv.org/abs/1512.06644`