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Effect of an external axial magnetic field on the TNSA accelerated ions

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Target normal sheath acceleration (TNSA) is one of the least demanding scheme, in terms of laser pulse requirements, for laser-plasma based acceleration of protons/ions. It was observed in [1] that if the normally incident laser pulse is replaced by two obliquely incident pulses, each with half the energy (and intensity) of the original laser pulse, there is a significant enhancement in the cutoff energy of protons and ions alike. On the other hand, application of an external kilo-Tesla magnetic field along the propagation direction of the normally incident laser pulse is also known to enhance the cutoff energy of protons/ions [2]. In the current work, based on two-dimensional particle-in-cell (PIC) simulations, we first provide a detailed insight of the physical mechanism involved in the TNSA based acceleration of protons in the presence of a kilo-Tesla level external magnetic field. We further investigate the effect of the two-pulse configuration in the presence of the external magnetic field. It is found that two oblique laser pulses along with a kilo-Tesla level magnetic field applied normal to the rear surface of the flat TNSA target result in a significant improvement in the protons/ions cutoff energies as compared to the case of a single laser pulse of double the intensity.

References

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[2] A. Arefiev et al., New J. Phys. 18, 105011 (2016)
[3] I. Khan and V. Saxena, arXiv:2406.08821 (2024)