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Spectral Shaping in Laser-Ion Acceleration by Multispecies Effects

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Laser-accelerated ions typically exhibit an exponential energy spectrum up to a characteristic cut-off energy, which is a signature of target normal sheath acceleration (TNSA) [1]. This broad energy distribution inherent to TNSA poses a significant limitation for applications requiring well-defined ion energies, such as proton therapy [2] and the fast ignition concept in inertial confinement fusion [3].

By introducing multiple ion species into the target material, modulations in the TNSA-driven ion spectrum can be achieved. During the acceleration, the differing charge-to-mass ratios of these species can result in a separation in space and energy [4]. This enables enhanced control over the energy spectrum and particle numbers for the light as well as the heavy ions. Simulations indicate that energy transfer between species may contribute to these effects, further emphasizing the potential for precise control of both ion populations.

I will introduce the concept of laser-ion acceleration using multi-species targets, discuss the potential advantages of such target compositions based on results from multidimensional particle-in-cell (PIC) simulations, present the current status of target fabrication, and outline planned experiments to further investigate this approach.

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[2] V. Malka et al., Med. Phys., 31: 1587-1592 (2004).
[3] J.J. Honrubia et al., J. Phys.: Conf. Ser. 244 022038 (2010).
[4] V.T. Tikhonchuk et al., Plasma Phys. Control. Fusion 47 B869–B877 (2005).

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