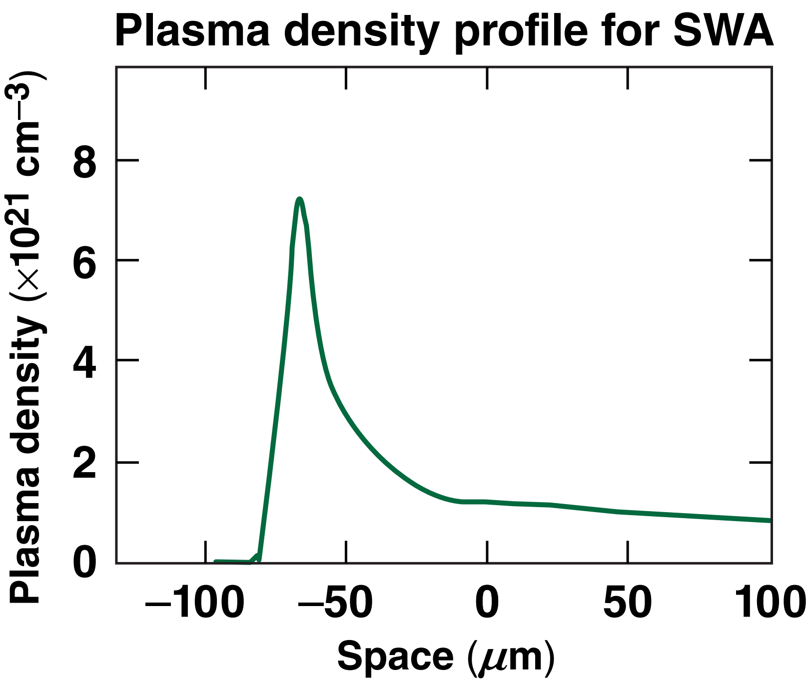
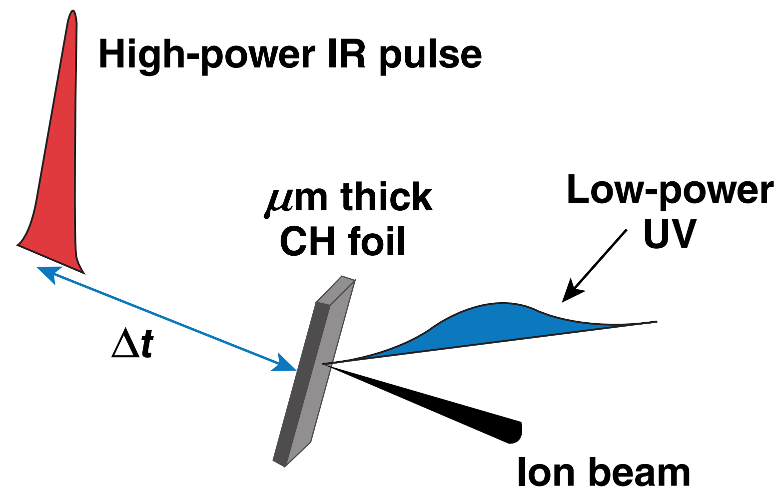
Shock-Wave Acceleration of Ions on OMEGA EP





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Summary

Scaling of the shock-wave acceleration (SWA) mechanism to the 1-μm OMEGA EP Laser System predicts 80- to 150-MeV/amu ions

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- Shock wave acceleration experiments at UCLA using
  - 10-μm laser in a H_2 gas jet
  - produced 20-MeV protons with narrow energy spreads
  - normalized vector potential $a_o < 2.5$
- Plasma profiles with a sharp rise to a near-critical peak density and a long exponential decay are key to successful SWA
- Hydro simulations show the appropriate plasma density profile for 1-μm lasers can be produced by preheating a thin 2-μm CH foil

Collaborators

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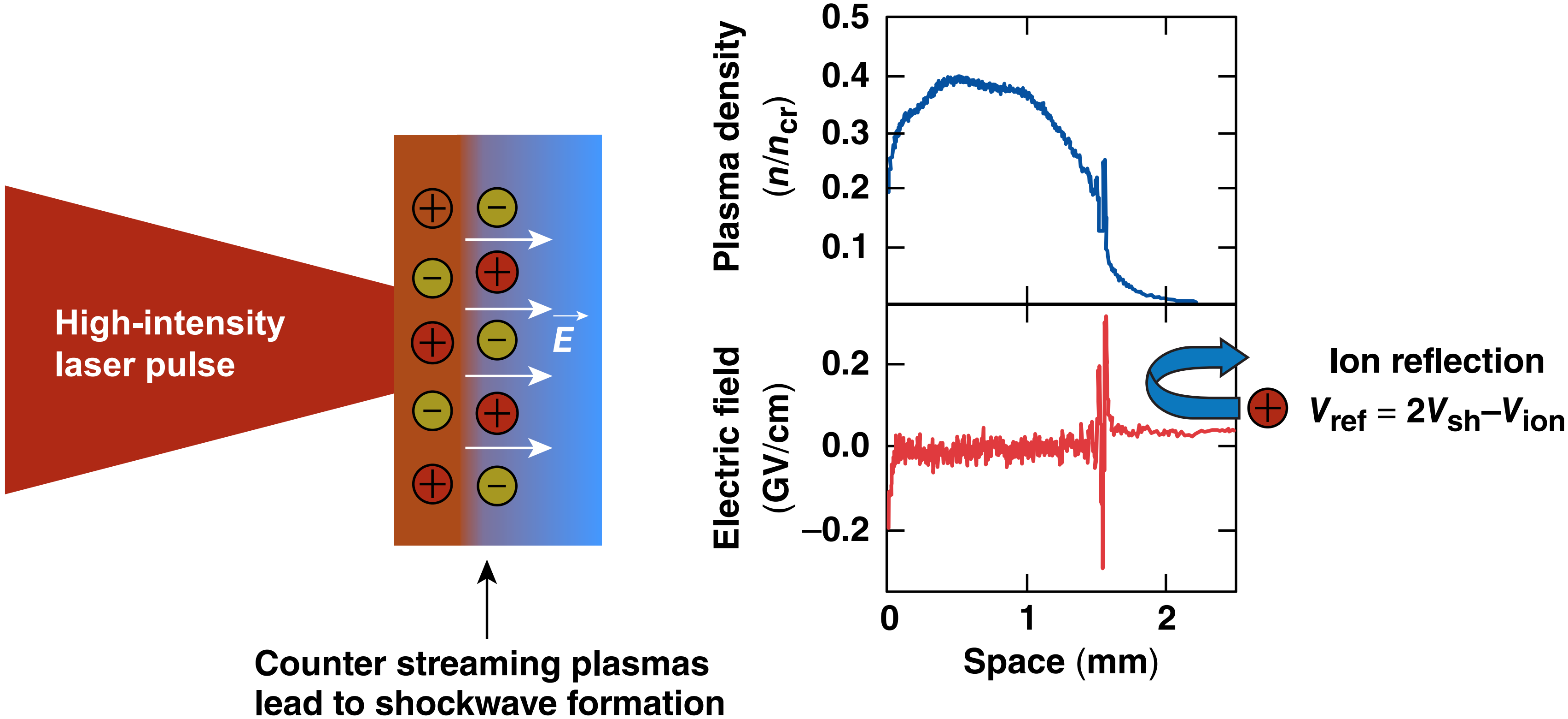
Lasers incident on overcritical plasmas can create conditions for shock-wave generation



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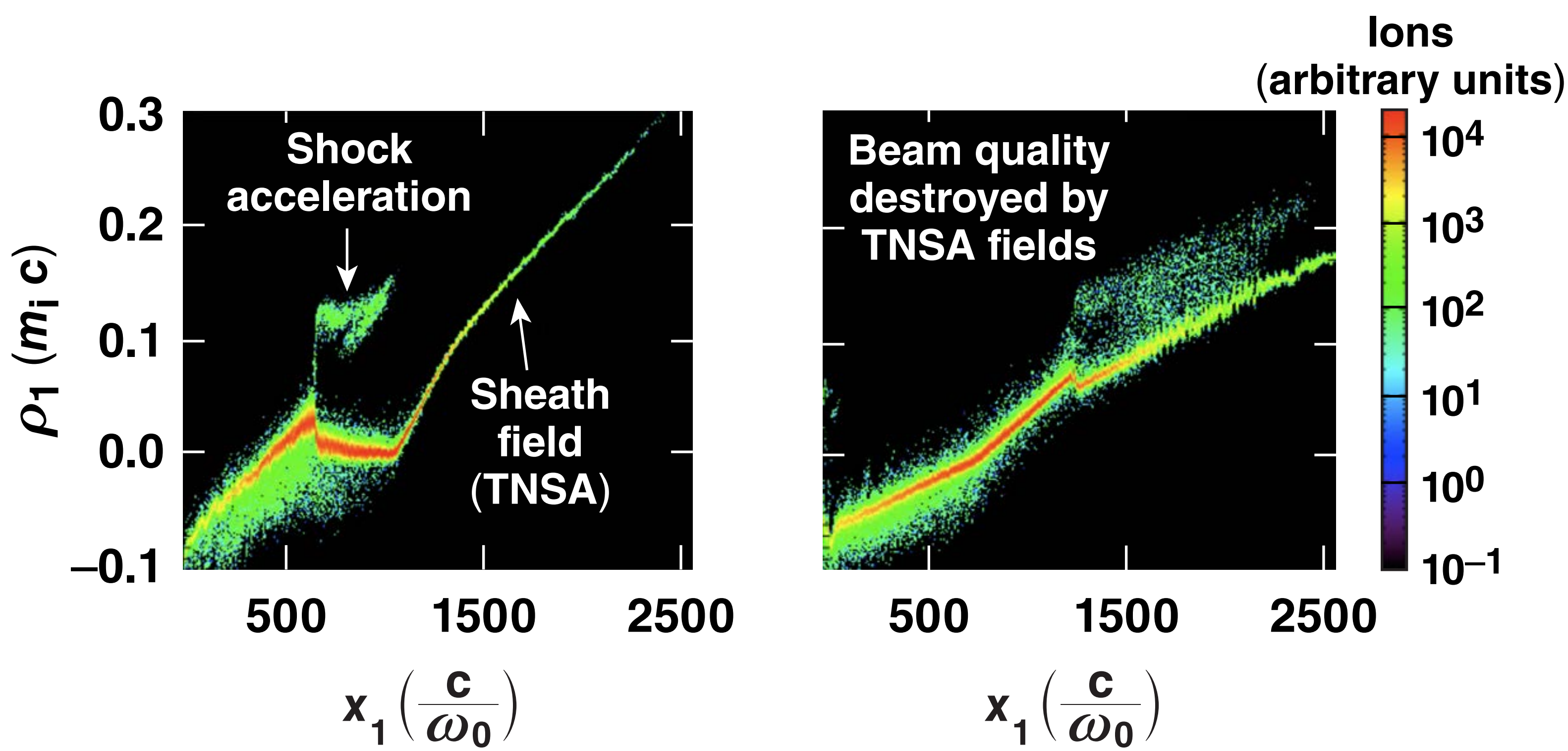
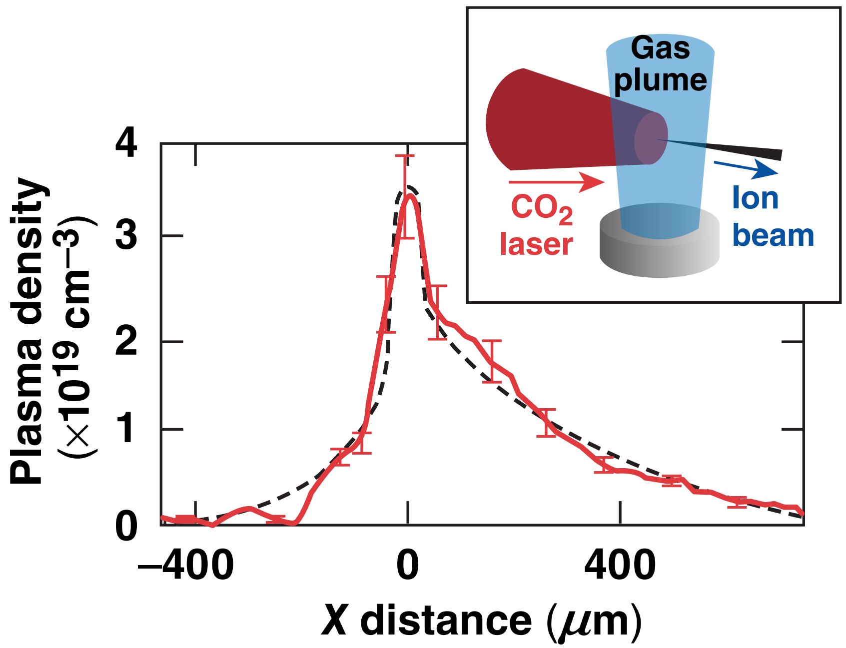
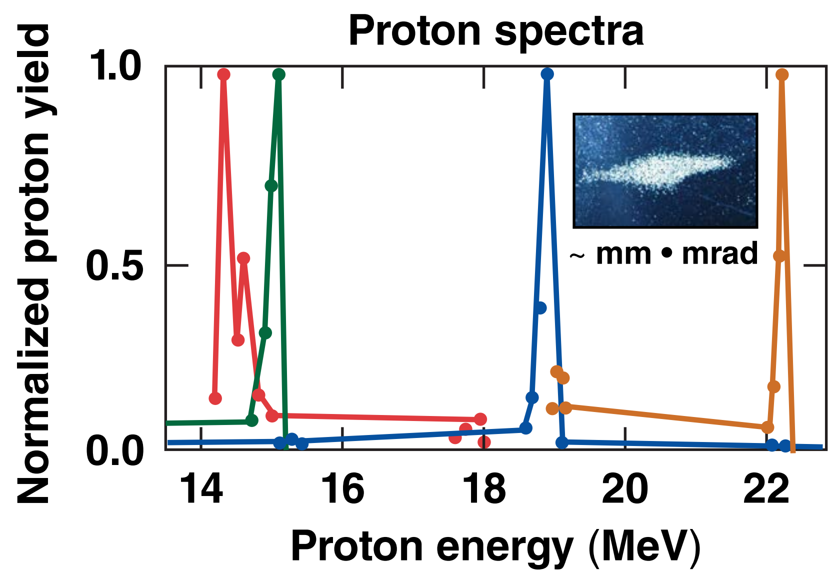
The plasma density profile strongly affects the spectrum of the accelerated ions



Sheath fields that exist at the sharp plasma vacuum boundary can smear the energy spread of accelerated ions.

To maintain a narrow energy spread, the plasma profile was tailored to reduce the sheath fields





CO_2 systems are limited in peak power as compared to 1-μm lasers.

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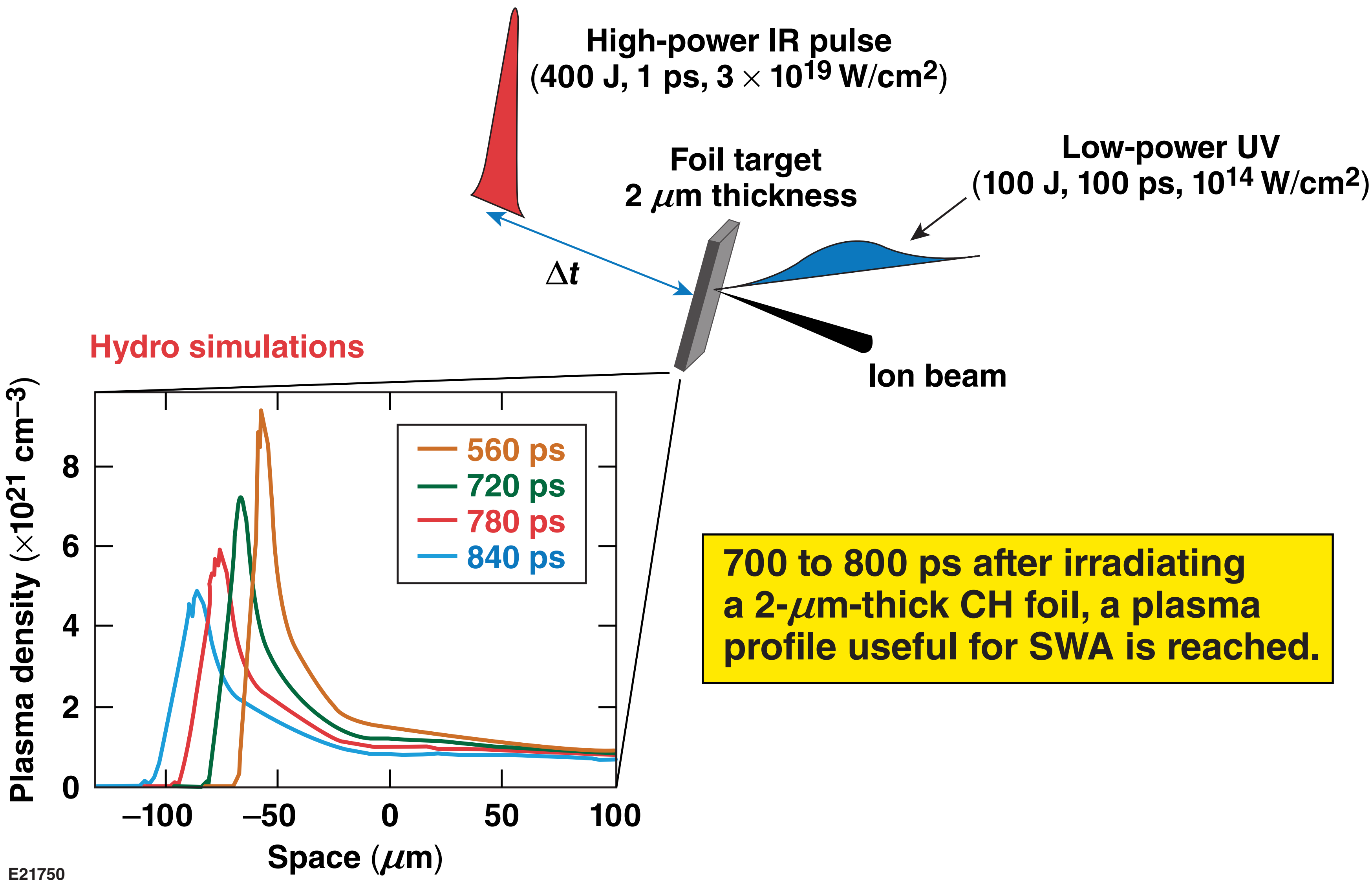
*D. Haberberger *et al.*, Nature Phys. 8, 95 (2012).

Scaling SWA to the 1-μm wavelength range requires a tailored high-density profile



700 to 800 ps after irradiating a 2-μm-thick CH foil, a plasma profile useful for SWA is reached.

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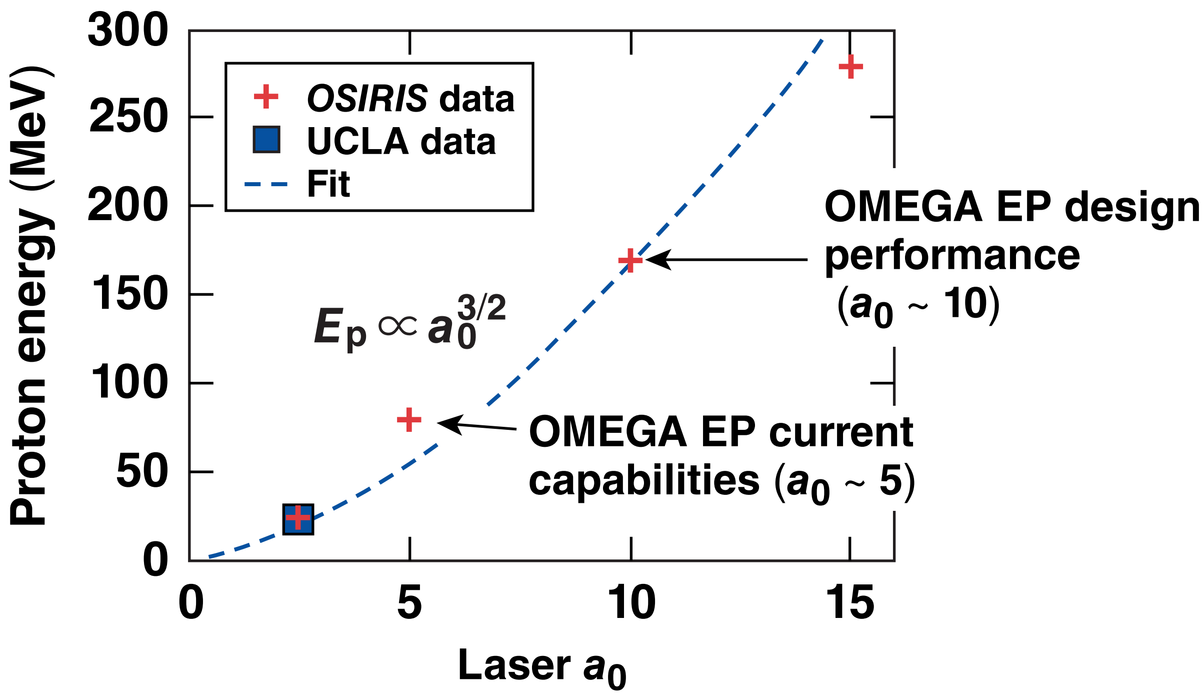
Simulations predict strong scaling of the SWA mechanism with laser intensity



Scaling the SWA mechanism to the 1-μm OMEGA EP Laser System allows for the production of narrow energy spread ion beams in the 100- to 200-MeV/amu range.

*F. Fiuza *et al*., "Laser-Driven Shock Acceleration of Monoenergetic Ion Beams," to be published in Physical Review Letters.

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Summary/Conclusions

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