Contribution ID: **3** Type: **not specified**

Laser ion acceleration using gold nanorods

Monday 23 June 2025 15:10 (20 minutes)

This work investigates how integrating gold nanorods into laser targets enhances laser-driven ion acceleration. By exploiting the localized surface plasmon resonance (LSPR) of gold nanorods, we improve the coupling of femtosecond Ti:Sapphire laser pulses to the target. Numerical simulations reveal that resonant plasmonic excitations in the nanorods substantially intensify local electromagnetic fields and field gradients, concentrating laser energy near the nanostructures. This enhanced energy deposition increases the maximum ion energies compared to conventional flat targets, enabling more efficient ion acceleration within the preplasma region. We analyze key mechanisms, including Coulomb explosion and plasmonic ponderomotive acceleration, and demonstrate that tailoring nanoparticle geometry and arrangement is critical for optimizing near-field enhancement. These results present a promising route to more compact and efficient ion sources, supporting future advances in laser-driven fusion.

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