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Evolution of relativistic transparency in nanometer-scale targets

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When a multi-terawatt laser pulse is incident onto a nanometer-scale target, strong electron heating and plasma expansion occurs. As the plasma expands, the target experiences a change in electron density which affects the type of interaction occurring. Of particular interest is the regime of relativistic transparency, when the target density drops below the relativistic critical density, γn_{crit}, and laser light is able to penetrate and transmit through the target.
When a 45 fs terawatt laser pulse with a_0 of 12.5 is incident onto a nanometer scale target, information on the plasma dynamics can be obtained from the optical diagnostics. In particular, the percentage of reflected and transmitted light as well as their spatial profiles is shown to be a good indication of electron density and target heating. Supporting simulations show rate of electron heating varying from 0.1 –1.7 MeV for different polarisations and targets in the range of 2-100nm. A strong correlation with plasma expansion is also seen. These results will be discussed and will be presented alongside analytical expectations.

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