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Mysteries of Lasers in Space

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Laser–induced plasma jets are an effective and versatile method to reposition space vehicles. Applications include launching, reorbiting and deorbiting. Because spacebased laser systems for this purpose are expensive, it is critical to know the maximum amount of momentum transferred to a vehicle per unit of laser energy. This „momentum coupling coefficient"Cm (N-s/J) mainly depends on five parameters: target material, average ionization state of the plasma jet, and laser intensity, pulsewidth and wavelength. Correctly modeling this peak value as well as the required laser parameters on target can be quite complicated.
In this paper we present a simple way to accurately estimate Cm in advance of detailed modeling which depends only on three parameters: target atomic mass, plasma ionization state and laser wavelength. Implicitly, one also chooses the shortest practical wavelength and pulse duration considering diffraction, hardware limitations and existing laser interaction data. In many cases, these considerations lead us to choose the Nd third harmonic at 355nm and 0.1-1ns. We will support predictions with published experimental data.
Our second emphasis will be to discuss laser beam arcanities: relativistic electric field intensities that occur with short high energy pulses, and typical errors in calculating intensity delivered at long range L when the Fresnel number F=a2/(Lλ) is near unity.
Our third purpose will be to summarize the state of the art in efficient pulsed lasers.

Author: PHIPPS, Claude (Photonic Associates LLC)

Presenter: PHIPPS, Claude (Photonic Associates LLC)

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