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NEW ADVANCES IN SHORT-PULSE LASER FOR LEO ENVIRONMENT: EXPERIMENTAL INVESTIGATION IN LASER/MATERIAL INTERACTIONS FOR SPACE DEBRIS REMOVAL

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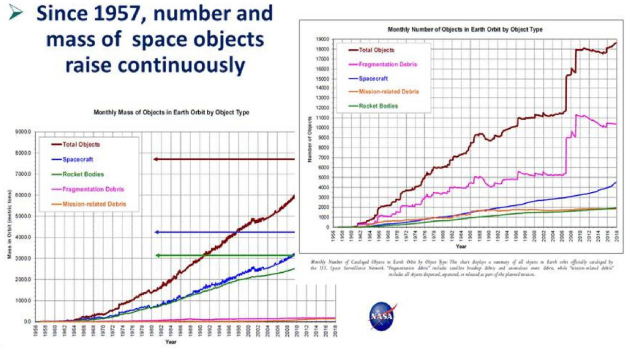
Spacecraft: to use the 'laser-matter interactions' to accelerate a 'target' substrate
Laser irradiation parameters show that a short wavelength and short pulse duration can lead to a maximized coupling coefficient C_m and thus highest momentum transfer and minimized thermal load.

Multi-faceted Challenge

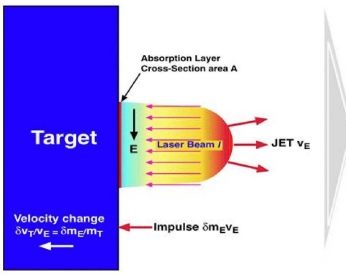
Motivation: orbital population ever increasing

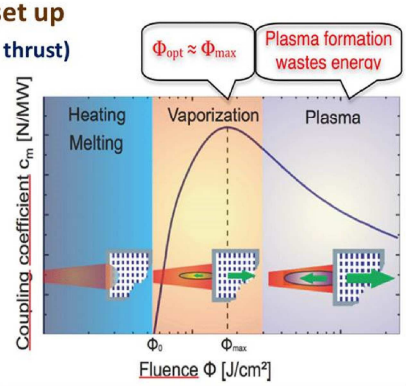
- Since 1957, number and mass of space objects raise continuously



Idea: laser as a mechanical set up

- Optimum fluence (i.e. maximum thrust) coincides with plasma threshold

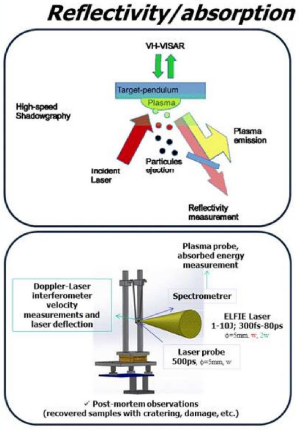


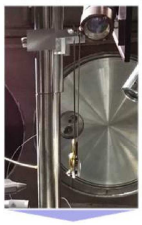


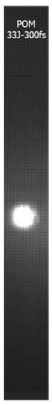
Post-choc thermal scale & In-situ coupling of diagnostics

In-situ diagnostics

Ballistic pendulum & PDV & Reflectivity/absorption measurement



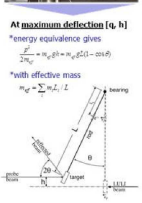




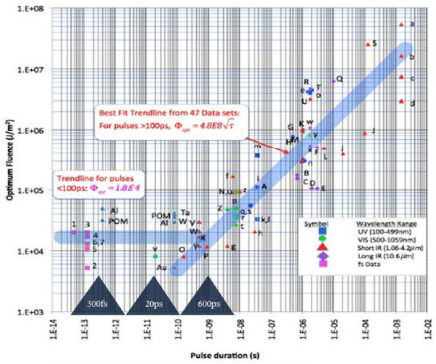
At maximum deflection [q, h]

*energy equivalence gives

*with effective mass



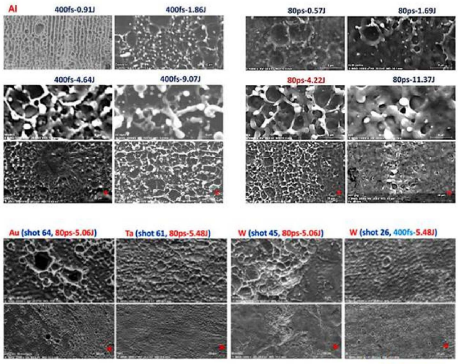
Optimum fluence: state of the art



Where we can get data with ELFIE

Post-choc thermal scale

Microstructural analysis (SEM FEI XL30 ESEM LaB6)

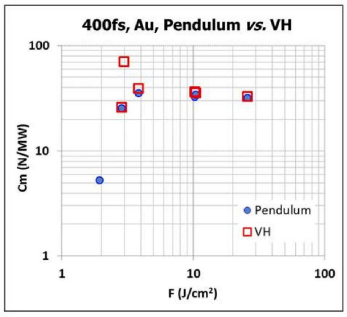


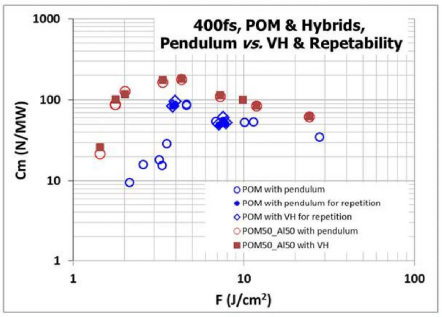
'Freezed drop': a thermal scale

✓ Melting point
*POM: 175 °C
Al: 660 °C
Au: 1064 °C
Ta: 3017 °C
W: 3422 °C

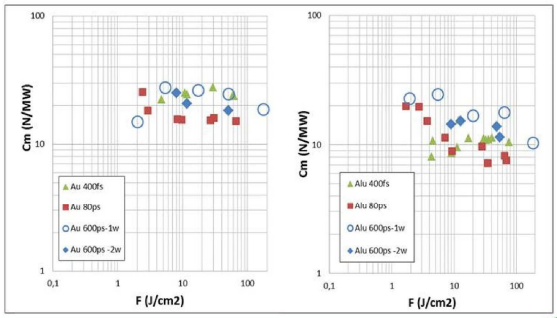
*polyoxymethylene

Validation of the ballistic pendulum vs. VH & Repetability





To go to Multi-materials & Multi-energies concerns



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2. C.R. Phipps, C. Bonnal, F. Masson, M. Boustie, L. Berthe, M. Schneider, S. Baton, E. Brambrink, J.M. Chevalier, L. Videau, S.A.E. Boyer, "*Transfers from Earth to LEO and LEO to Interplanetary Space using Lasers*". Acta Astronautica, 146, 92, 2018 (doi: 10.1016/j.actaaastro.2018.02.018)

Photonic Associates, LLC

Acknowledgments

LULI projects campaigns 2017-18: ELFIE 16-TW-F6, 17-TW-F4, 18-TW-F4