Modelling the Effect of a 10^{17}, fs Prepulse with Planar and Nanowire Targets

Emma Hume[1] (eh993@york.ac.uk) Kate Lancaster[1], Petra Koester[2], Robbie Scott[3], John Pasley[1]

1 York Plasma Institute, University of York, Heslington, York, YO10 5DQ, United Kingdom
2 Intense Laser Irradiation Laboratory, INO-CNR, Pisa, Italy
3 Central Laser Facility, STFC Rutherford Appleton Laboratory, Harwell Oxford, Oxfordshire OX11 OQX, United Kingdom

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1. Introduction

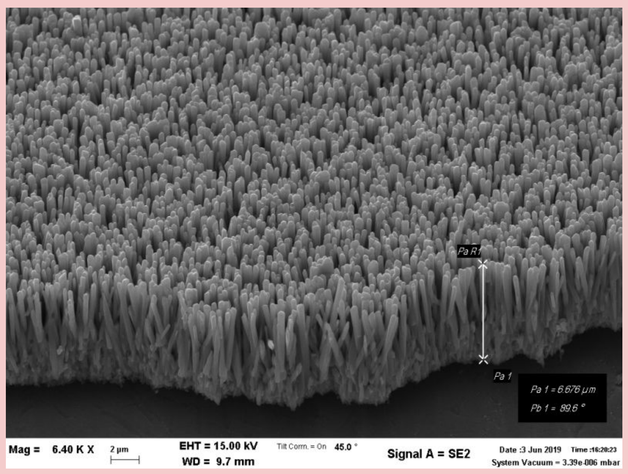

Figure 1: SEM image of nanowire target

- Nanowire targets have been shown to exhibit enhanced absorption compared to planar targets [1]
- Experiment at ILIL [2] used nanowire coated and planar Ti targets
- Laser intensity = 2.4 x 10^{21} W/cm^2

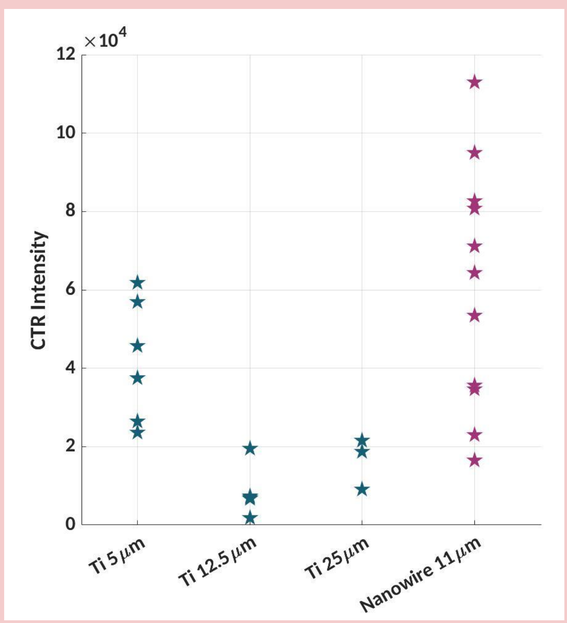

Figure 2: Intensity of CTR emission measured from each shot, plotted for each target type

2. Prepulse

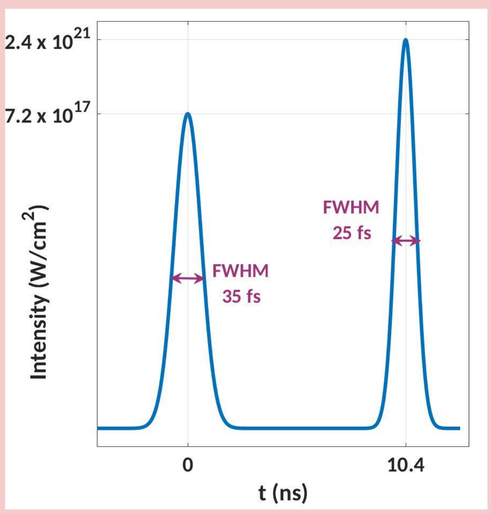

Figure 3: Laser profile implemented for the experimental campaign (not to scale)

3. FLASH: Planar Targets

- FLASH [3] is a 2D Eulerian hydrodynamic code
- Laser deposition modelled by inverse Bremsstrahlung → add exponential density profile
- Exponential decay length and maximum power adjusted until pressure profile matched HYADES [4] output, see Fig. 4

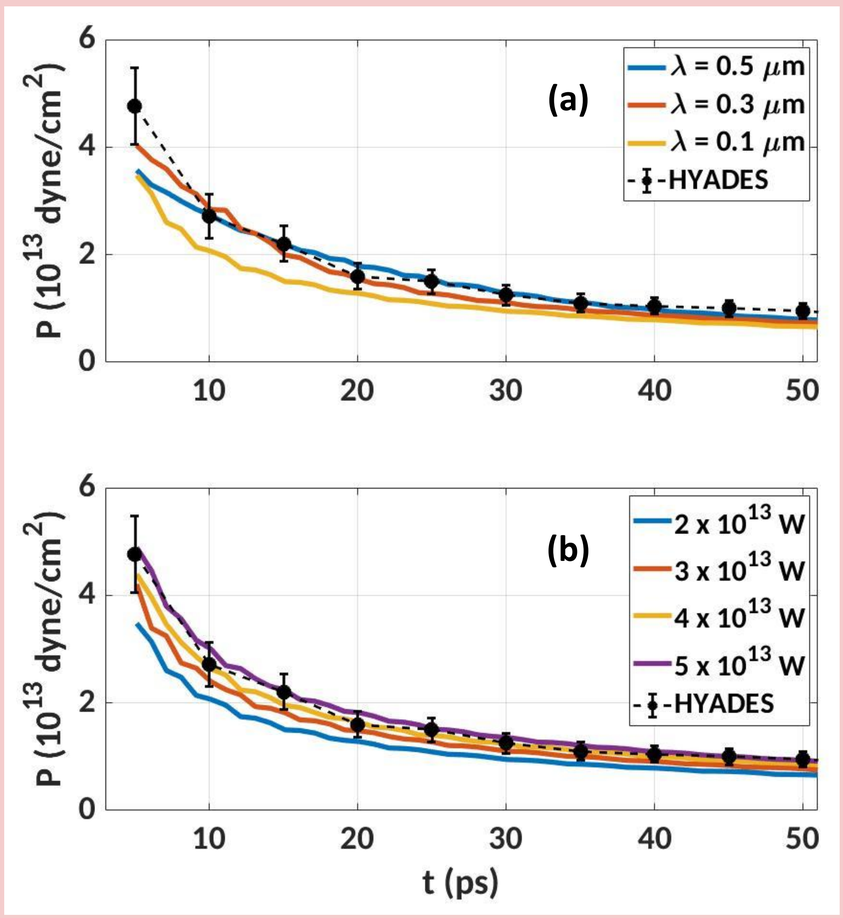

Figure 4: Maximum pressure profiles for (a) changing exponential decay length for P_{peak} = 2 x 10^{13} W and (b) changing peak power for λ = 0.1 µm

4. FLASH: Nanowire Targets

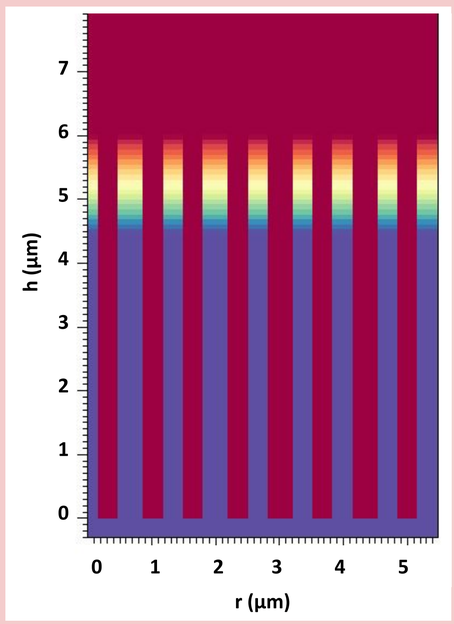

Figure 5: Density profile of nanowire target front surface with preplasma added to wire gaps

- Preplasma with exponential decay length of 0.1 µm added in wire gaps as in Fig. 5
- Power profile scaled up until energy deposited equalled that for planar targets
- Note the use of cylindrical geometry in these simulations

5. Density at 10.4 ns

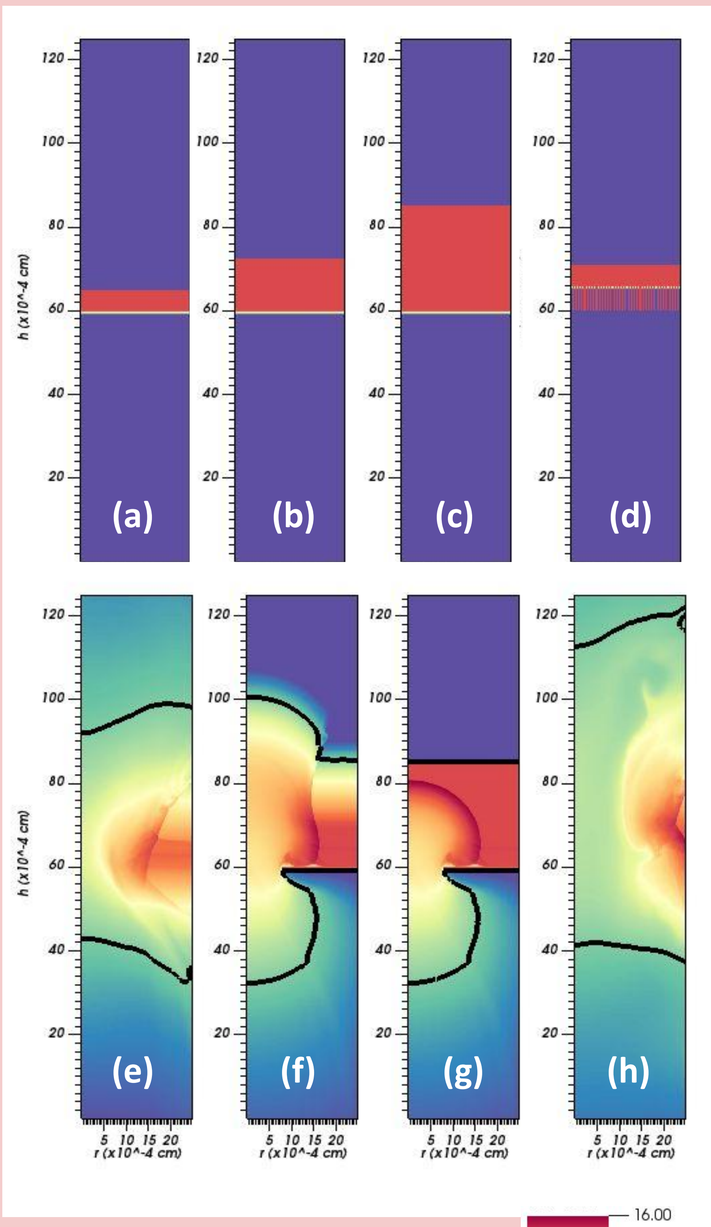

Figure 6: Densities of Ti targets at (a-d) prepulse irradiation time and (e-h) 10.4 ns later at main pulse irradiation time as modelled by FLASH. Critical density contour is shown in black for the targets at 10.4 ns

- Density profiles at main pulse interaction time show thinner targets have been significantly deformed
- Shock breakout has not occurred by this time for the Ti 25 um targets

6: Summary

- FLASH simulations were used to determine the effect of a 10^{17} W/cm^2 prepulse on planar and nanowire targets
- An exponentially decaying preplasma was needed to increase laser absorption
- Results show all targets deformed, however rear surface for Ti 25 um planar foil remains unperturbed

References

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[4] J. Larsen and S. Lane, J Quant. Spectrosc. Radiat. Transfer **51**, 179 (1994)

Acknowledgements

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