A shock ignition scheme using an indirect drive x-ray source

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I. Motivation

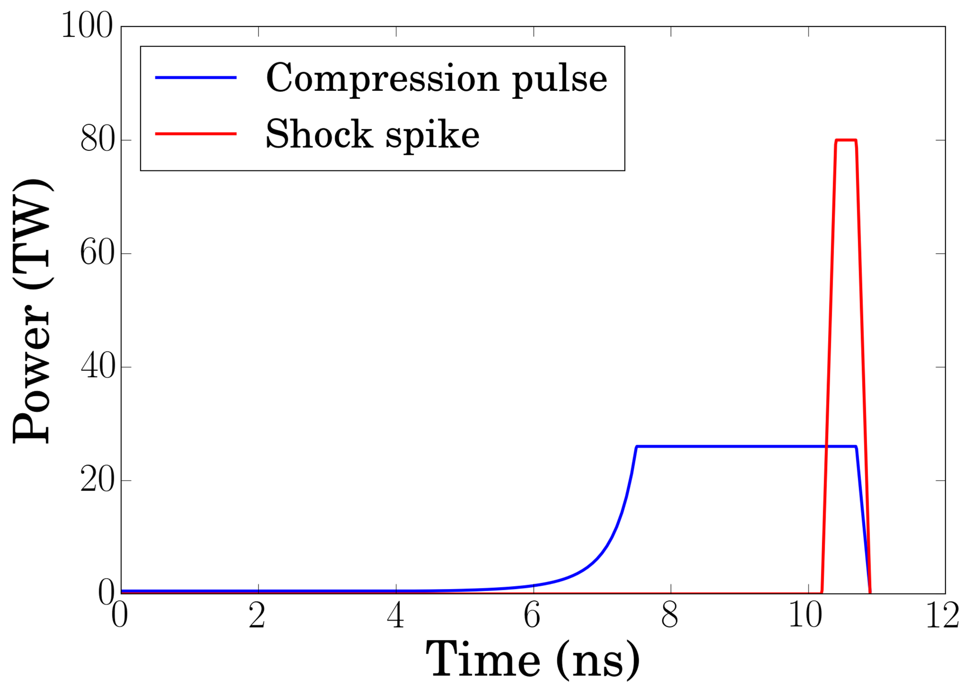

Figure 1 – A shock ignition power deposition profile [2]

- Shock ignition is an alternative Inertial Confinement Fusion ignition scheme [1] [2]
- Lower implosion velocities makes it resistant to hydrodynamic instabilities
- Lower total drive energy means potentially higher gains

- The facilities capable of achieving shock ignition intensities are set-up for indirect drive
- Modification to direct drive experiments could be costly and time consuming
- An indirect drive shock ignition scheme could help realise experiments in the near future

Figure 2 – An image of the laser banks at the National Ignition Facility

II. Ablation Pressure in HYADES

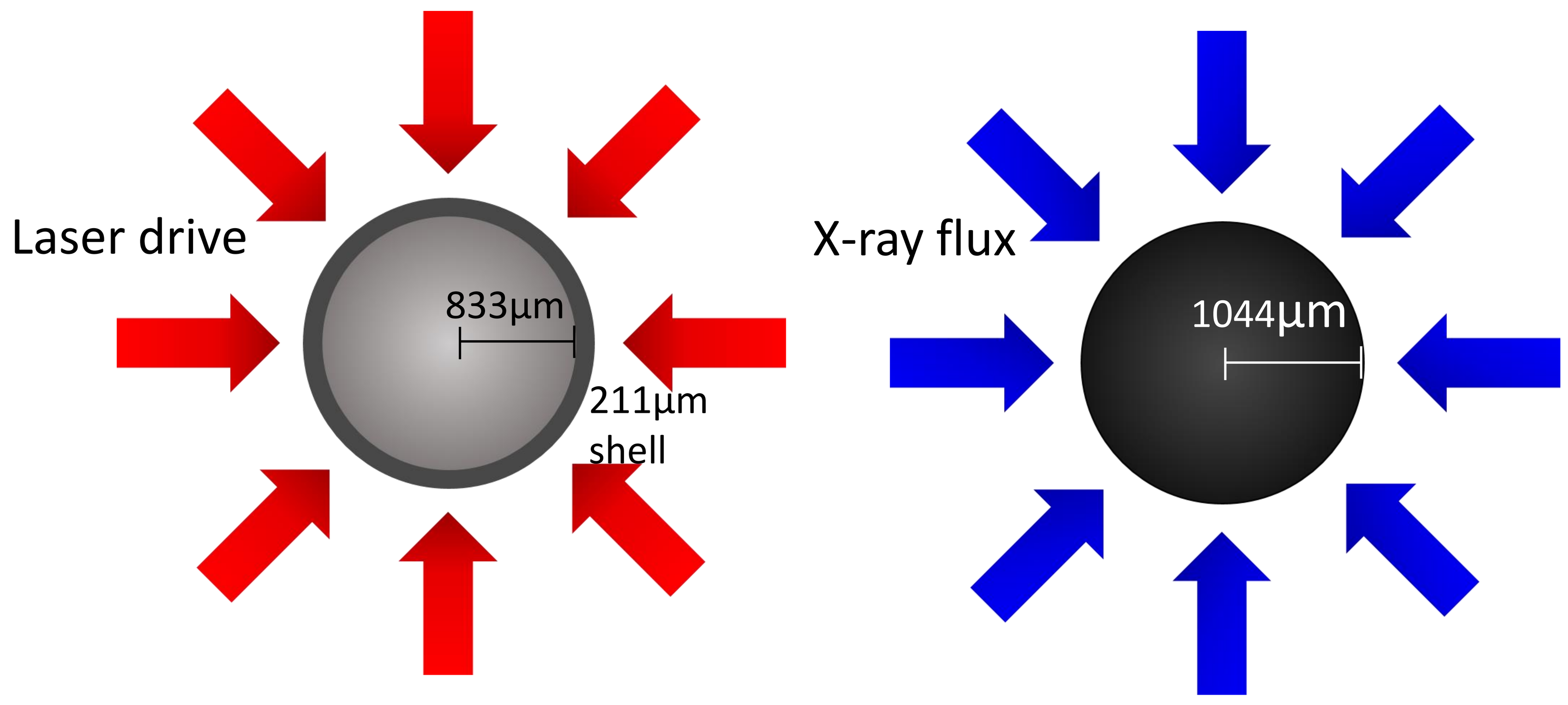

Figure 3 – Diagram of direct drive on a spherical DT capsule (left). Diagram of x-ray drive on a spherical Be surface (right)

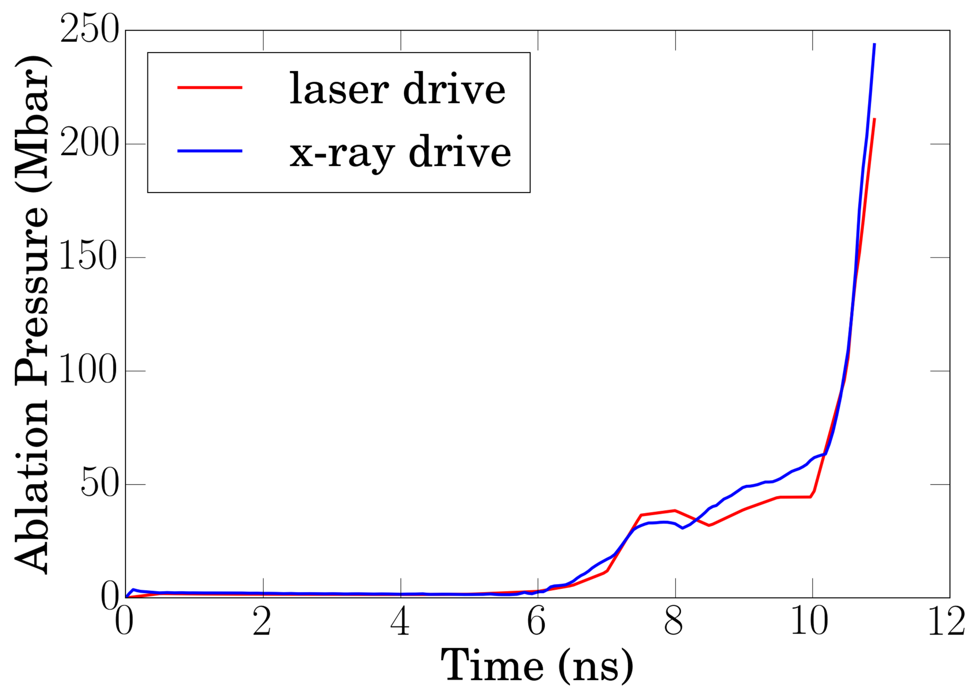

Figure 4 – Ablation pressures produced by laser and x-ray drive profiles

- 1D simulations using HYADES investigated ablation pressure
- The pressure produced by the laser profile in fig 1 on a spherical DT target was simulated
- Ablation pressure can be scaled to an x-ray flux using $P_a = 6.6T_r^{7/2}$
- The ablation pressure from the laser and x-ray drive are compared in fig 4

III. Hohlraum coupling in h2d

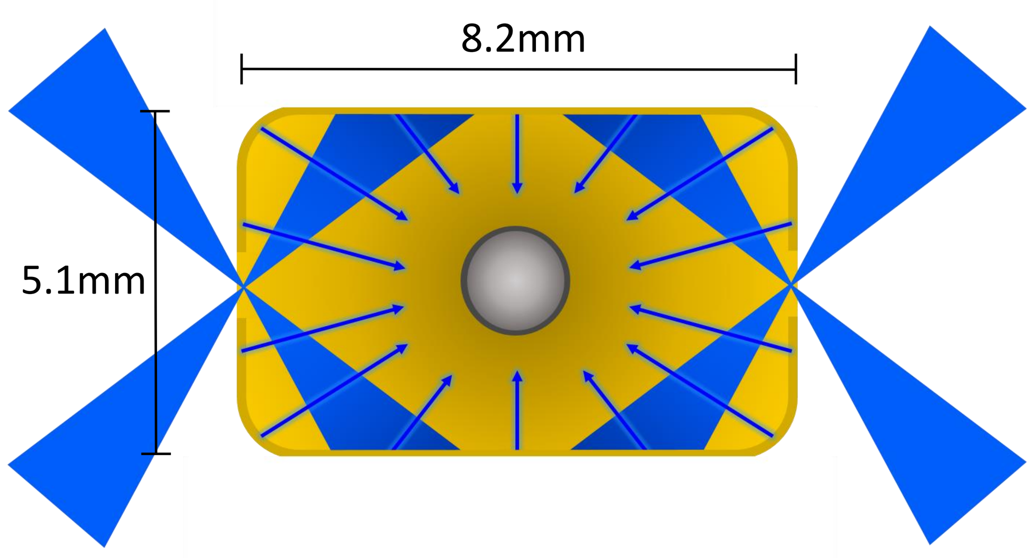

Figure 5 – Diagram of the h2d simulation investigating hohlraum coupling

- 2D simulations were run using the code h2d
- 0.351μm laser heated a NIF scale-1 hohlraum
- Hohlraum temperatures of 300eV were achieved with a 400TW peak laser pulse
- Steep rises in x-ray flux can be produced for shock ignition applications

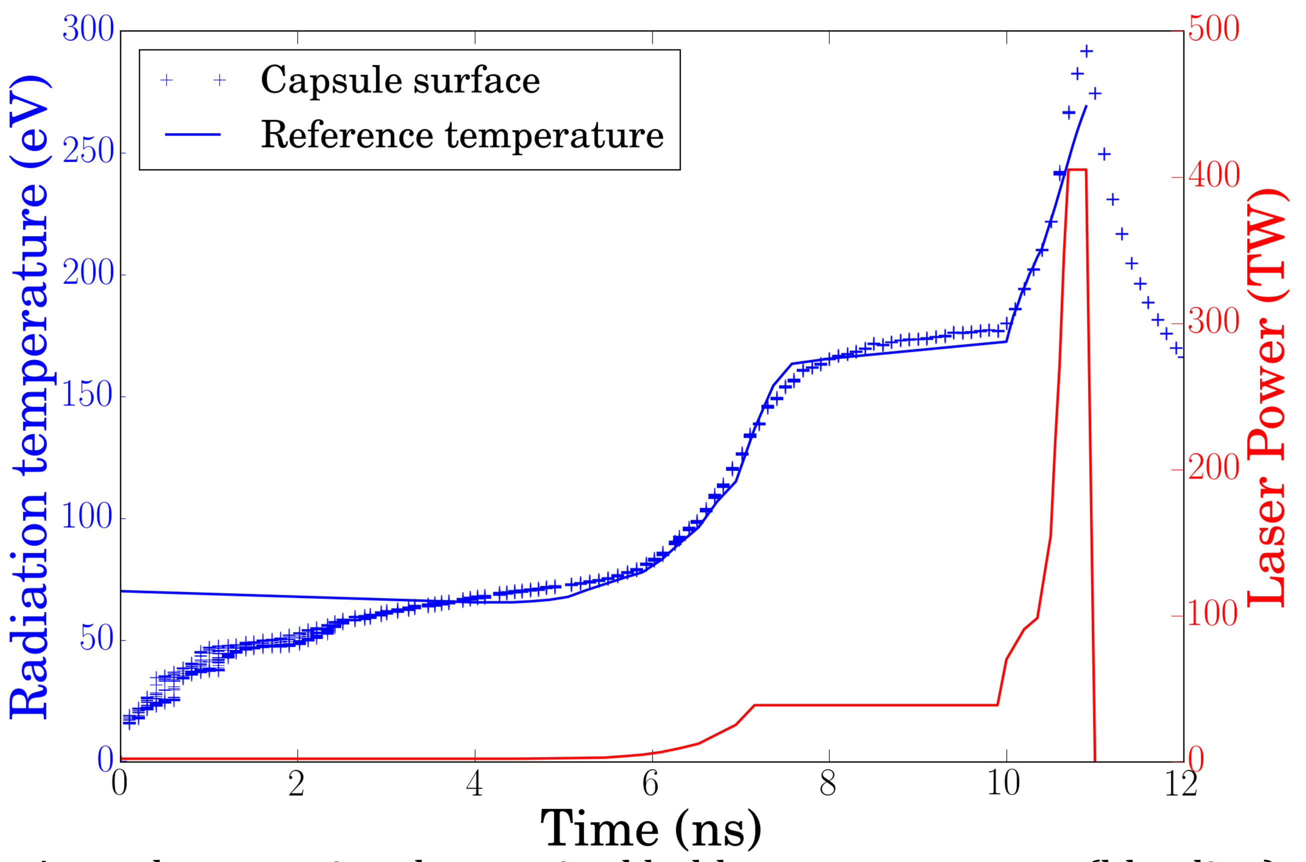

Figure 6 – A graph comparing the required hohlraum temperature (blue line) to the temperature achieved in the simulations (blue crosses) with the laser power profile (red)

IV. Benchmarking

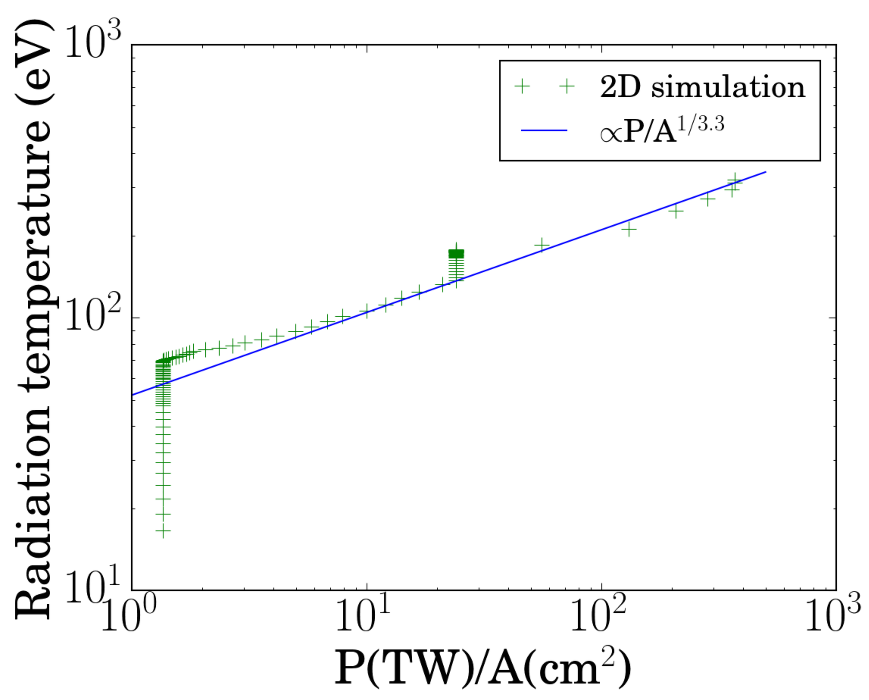

Figure 7 – The scaling of laser power to hohlraum radiation temperature

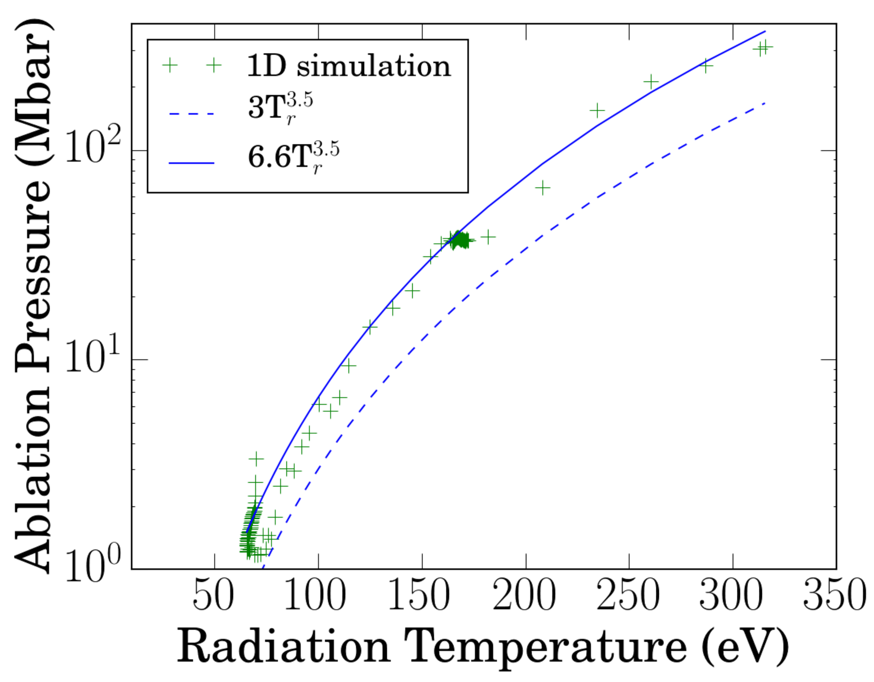

Figure 8 – The scaling of hohlraum radiation temperature to ablation pressure

- The scaling of ablation pressure and radiation temperature were compared to scaling laws and experimental results
- The simulations in the study agree well with the scalings presented in references 4 and 5.

Acknowledgements

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References

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