Target Physics Update

L. John Perkins, Max Tabak, John Lindl, Jeffrey Latkowski,
David Bailey, Judy Harte
Lawrence Livermore National Laboratory

With thanks to:
M. Herrmann (LLNL), A. Schmitt, S. Obenschain (NRL)

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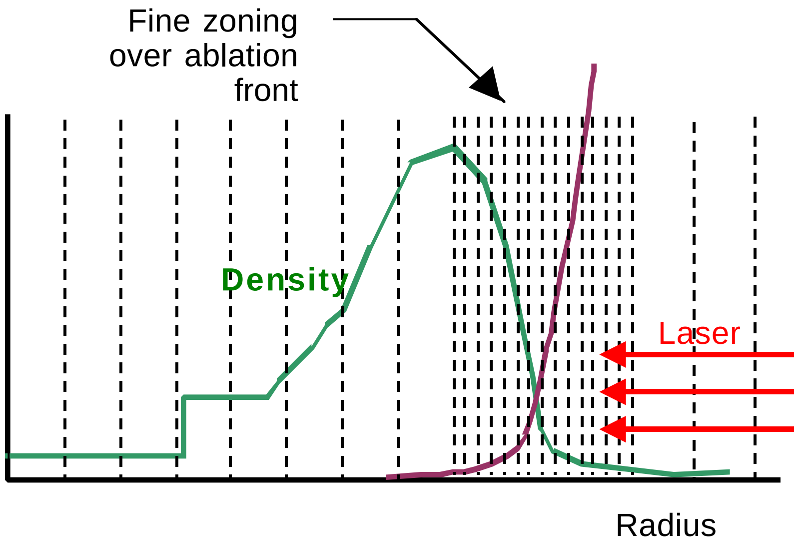
Target Update

‡ 2-D Stability Studies

- We are applying LASNEX to 2D stability studies for both the small, plastic shell NRL target and the new Pd target. Growth rates agree well with semi-analytic 1D models
- The new Pd target appears to exhibit a initial growth pedestal at early times.

‡ Traveling Rezoner

- We are using a traveling rezone package in LASNEX for 1-D and 2-D use
- It permits fine resolution of the ablation front and ∇T_e for direct-drive targets

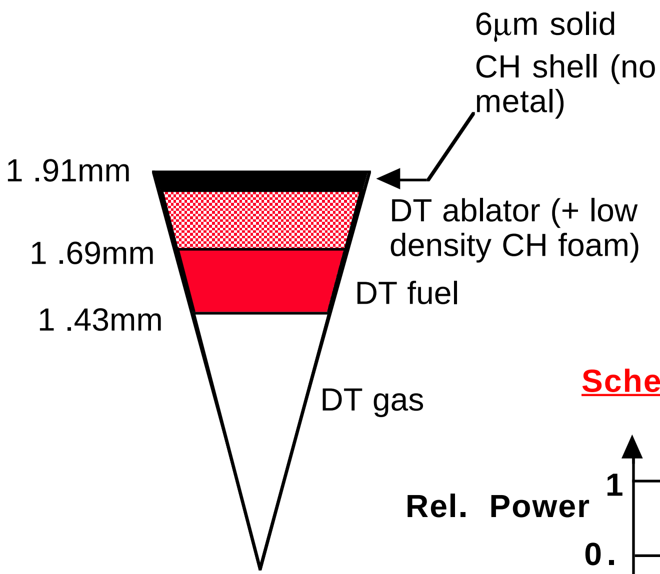


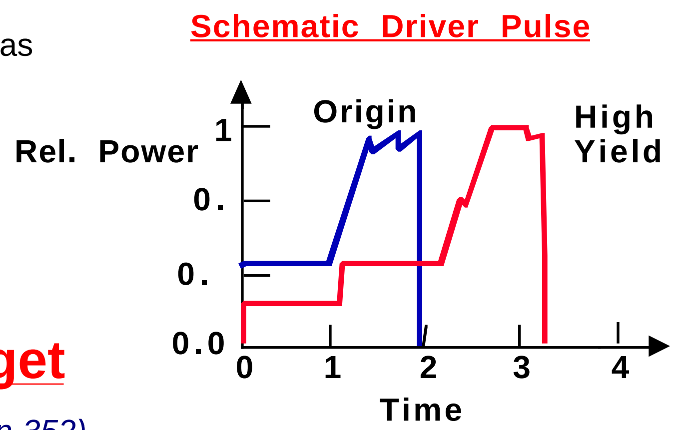
‡ New 400MJ Target

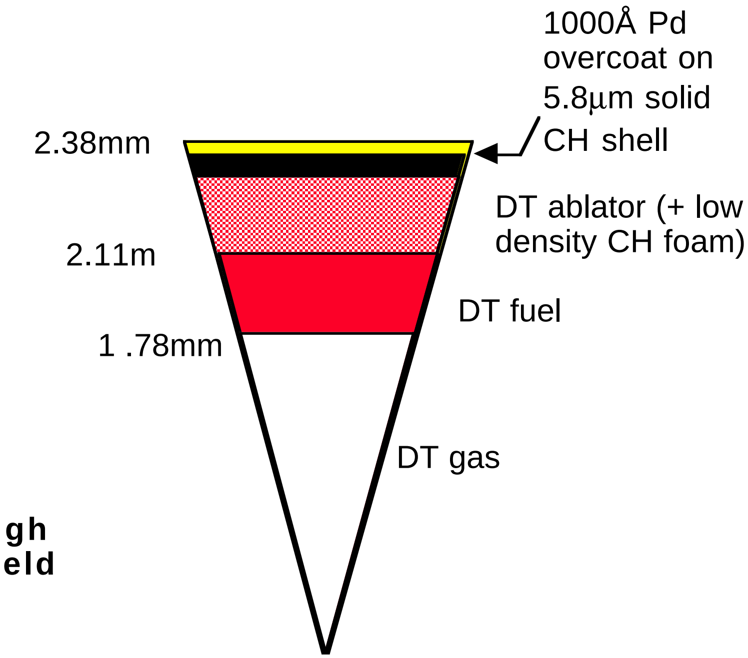
- We have performed 1D studies on the new 400MJ Pd-shell NRL target, confirming gains, yields and 1-D timing predicted by NRL
- 2-D single mode studies are now commencing in collaboration with A. Schmitt (NRL)

‡ Escape Threat Spectra

- We are assessing the effect of buffer gas (10mTorr) on output spectra
- Debris and low velocity ions are absorbed with the result of a larger thermal and X-ray load to the wall.
- But higher energy light ions still reach the wall (⇒higher gas pressures?)







Small NRL Target

- **Yield = 188MJ** *(run 352)*
- **Gain = 118 ($E_{absorbed}$=1.59MJ)**
- **Maximum ρR = 2.04 g/cm^2**
- **KE margin = 52%**

High Yield NRL Target

- **Yield = 397MJ** *(run 500)*
- **Gain = 160 ($E_{absorbed}$=2.46MJ)**
- **Maximum ρR = 2.53 g/cm^2**
- **KE margin = 68%**

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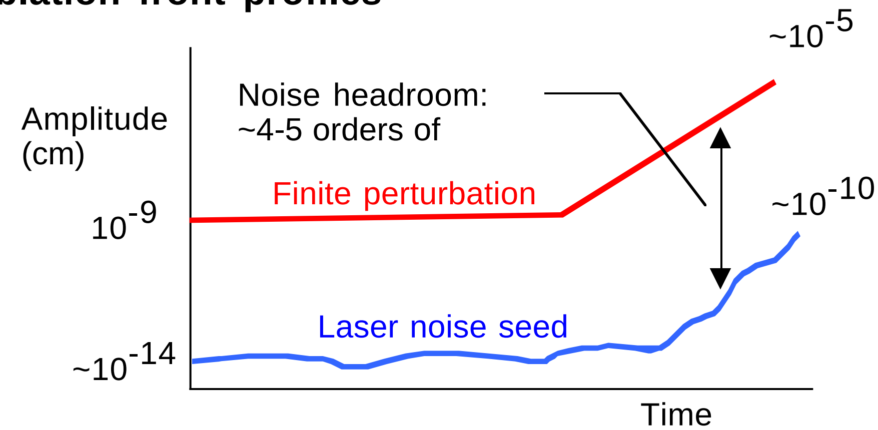
LASNEX is Being Applied to the 2D Stability of Direct Drive Targets

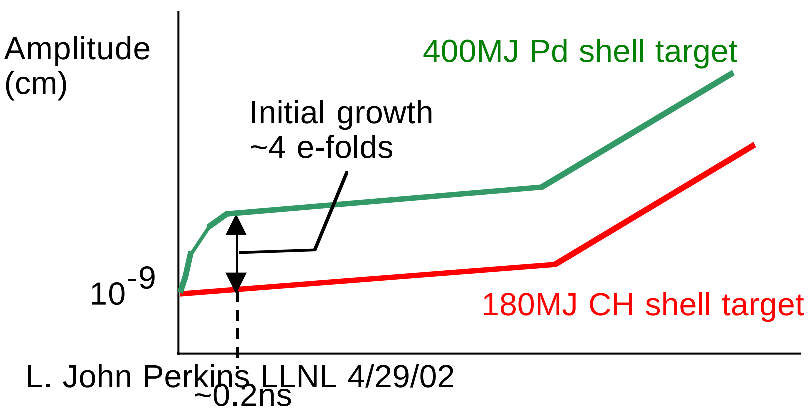
‡ We have applied LASNEX to model 2D single-mode stability of NRL direct drive targets for for mode numbers up to $l = 2\pi R/\lambda = 100$. Present work is attempting to extend this to $l \sim 200$ by attention to mesh stiffness and resolution of ablation front profiles

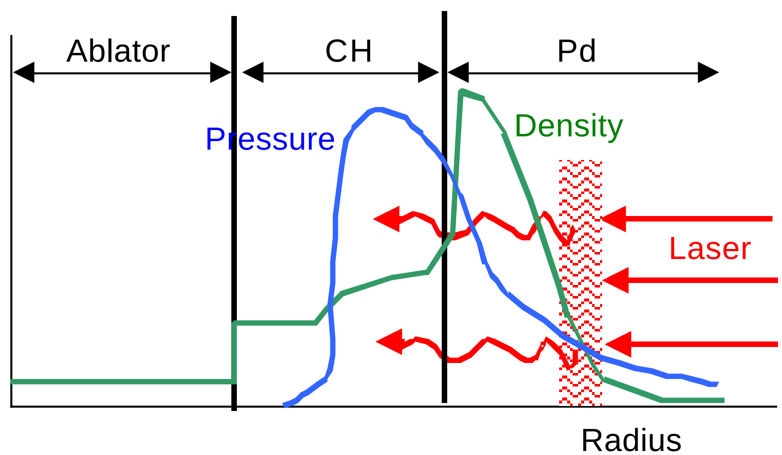
‡ Attention has been paid to reducing numerical noise inherent in laser energy deposition. We are now able to demonstrate full, time-dependent implosions to ignition in 2D with laser ray-trace in operation from t=0. Late time noise been reduced to $\leq 10^{-10}$cm, comparable to that observed with indirect-drive targets driven by uniform temperature x-ray sources.



‡ Our 2D Growth rates agree well with the Betti-Goncharov semi-analytic 1D model (see over)

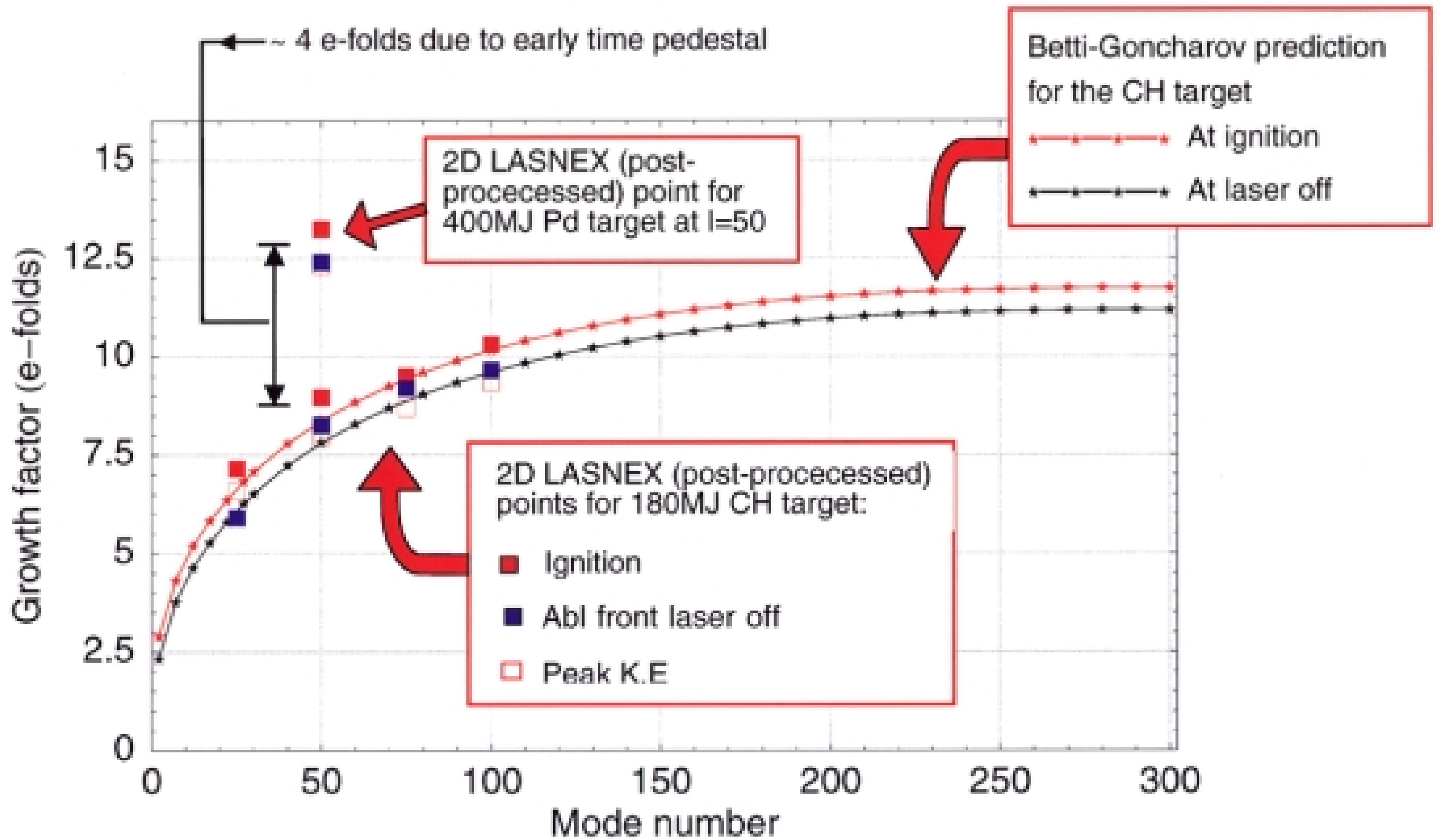
‡ The 400MJ Pd target seems to exhibit an early time growth pedestal due to Pd radiation deposition in the CH. NRL has observed this in their codes but not experiments. Is it real?





2D Single Mode Growth Factors for 180MJ CH Target and 400MJ Pd Target

- **Results for CH target agree well with predictions from the Betti-Goncharov model using input from 1-D profiles**



Effect of 6.5m of 10mTorr Xe Gas on Escape Spectra of 400MJ Target

- Effect of 6.5m of 10mTorr Xe buffer gas (= 7×10^{-8} g/cc = 4.6×10^{-5} g/cm^2) is to trade debris ion (hydro) kinetic energy for increasing thermal and X-ray loads. The high energy, low-Z fast burn products are, however, relatively unaffected

	Target + 6.5m Xe Gas @ 5μs (MJ)	Bare Target @ 0.1μs (MJ)
X-rays	**51.5** ***(13%)***	**6.07** ***(2%)***
Neutrons	**279** ***(70%)***	**279** ***(70%)***
Gammas	**0.0172** ***(0.004%)***	**0.0169** ***(0.004%)***
Burn product fast ions:	**50.9** ***(13%)***	**52.2** ***(13%)***
Protons	*1.55*	*1.56*
Deuterons	*13.5*	*13.6*
Tritons	*12.4*	*12.5*
^{3}He	*0.072*	*0.074*
^{4}He	*23.4*	*24.5*
^{12}C, ^{13}C, ...	*4.6×10^{-6}*	*2.0×10^{-4}*
Debris ions kinetic energy:	**4.63** ***(1%)***	**60.0** ***(15%)***
Residual thermal energy:	**13.6 (3%)**	**0.045** ***(0.01%)***
Residual burn products:	**0.35**	**1.51**
Laser energy absorbed:	**2.37**	**2.37**

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Total out **402MJ** **401MJ**

NB: Charged particle slowing down models include Li-Petrasso-equivalent formalism (i.e when $V_{fast\text{-}ion} \sim V_{e,\ thermal}$), but not electron collective effects

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Near-term Tasks

- ‡ **2-D Stability Studies**
  – Complete single mode stability studies of the small CH-shell target to l=150 (200?)
  – Investigate early time and late time growth characteristics of the 400MJ Pd shell target

- ‡ **Traveling Re-zoner**
  – Exercise traveling re-zoner for higher mode, 2D stability for both the small CH and large Pd targets

- ‡ **DPSSL Target**
  – Commence 1-D and 2-D target design for a DPSSL-driven, direct drive target

- ‡ **Escape Threat Spectra**
  – Continue to assist chamber design folks with threat spectra runs and analyses. Will a buffer gas work?