

1D to 2D front crossover in laser-induced shockwaves modeling

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Research Team

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Main Ultrashort Lasers Applications

- New materials and nano-structuring
- Laser Ablation in Liquids (LAL)
- **Laser Shock Peening (LSP)**
- Additive technologies

LSP takes place due to nonlinear residual deformations after passage of a plastic shock wave which changes the state of the substance.

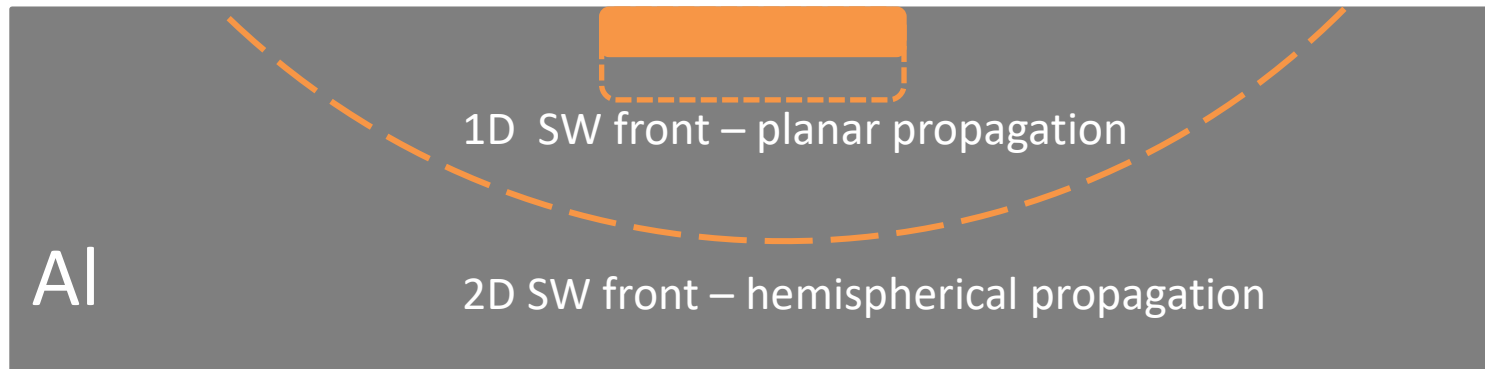
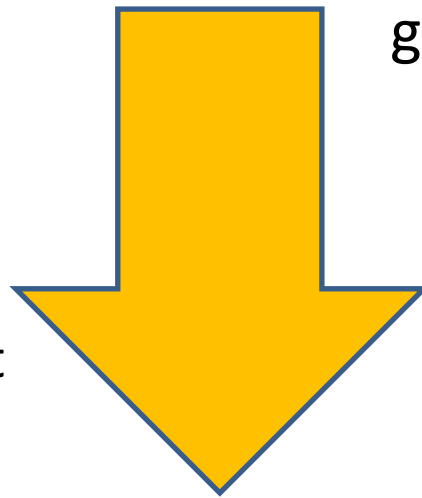
Single-pulse volume target irradiation problem

Single ultrashort gaussian pulse

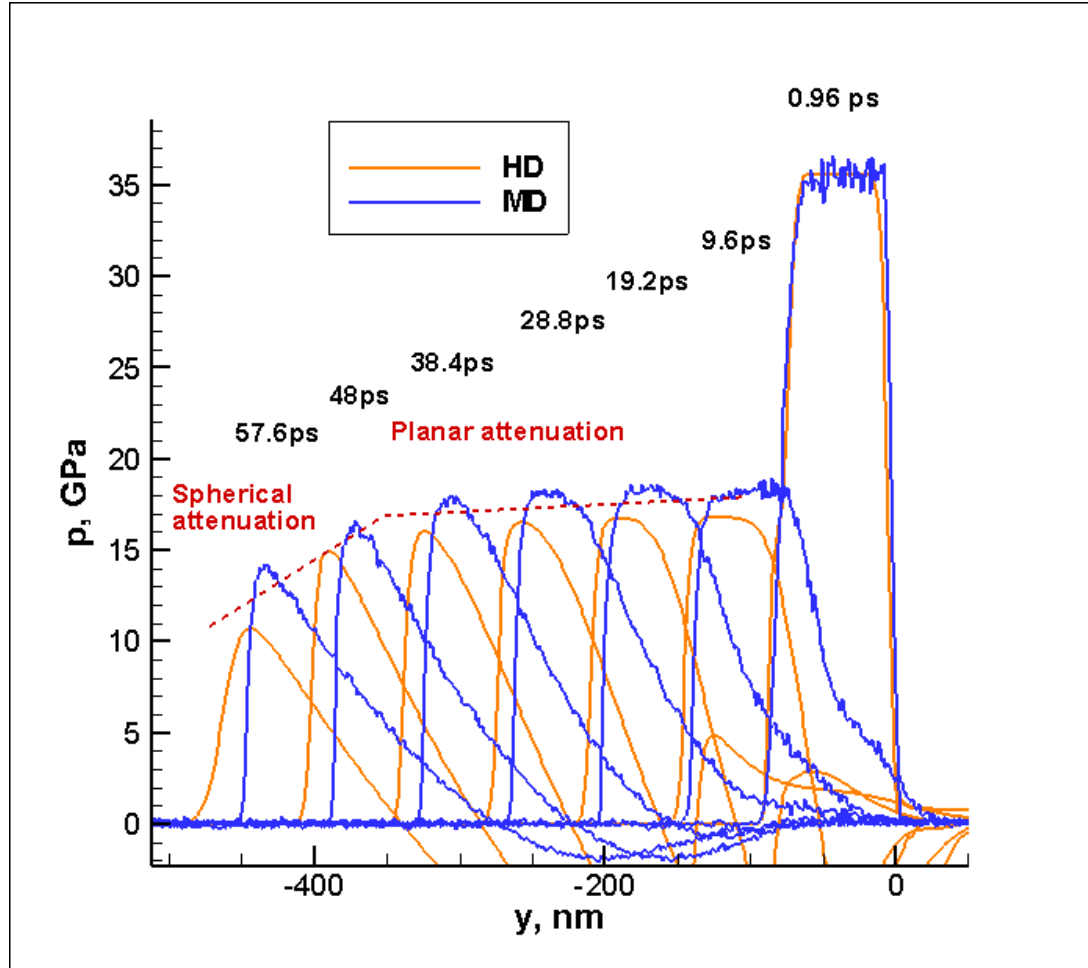
Focal spot

1:1000 in experiment

1:5 in modeling

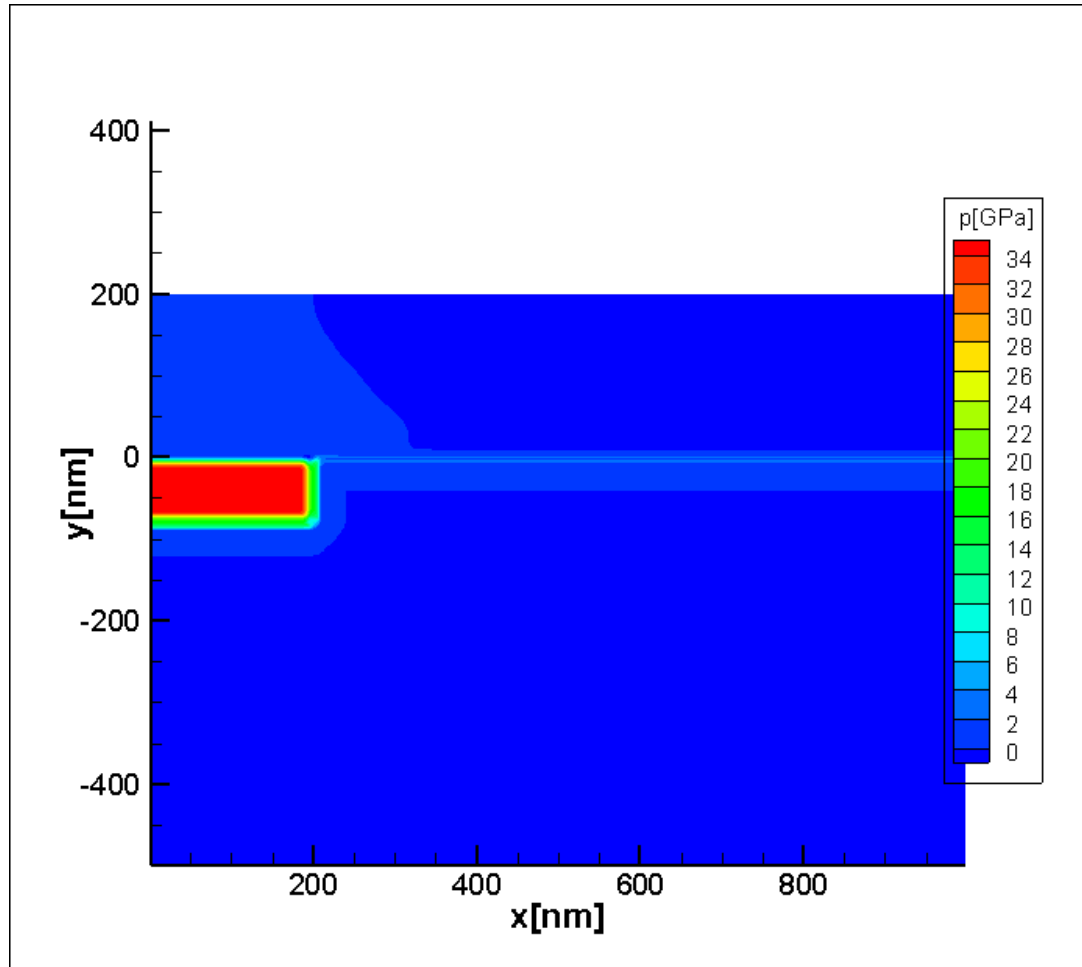


Results: MD and HD comparison



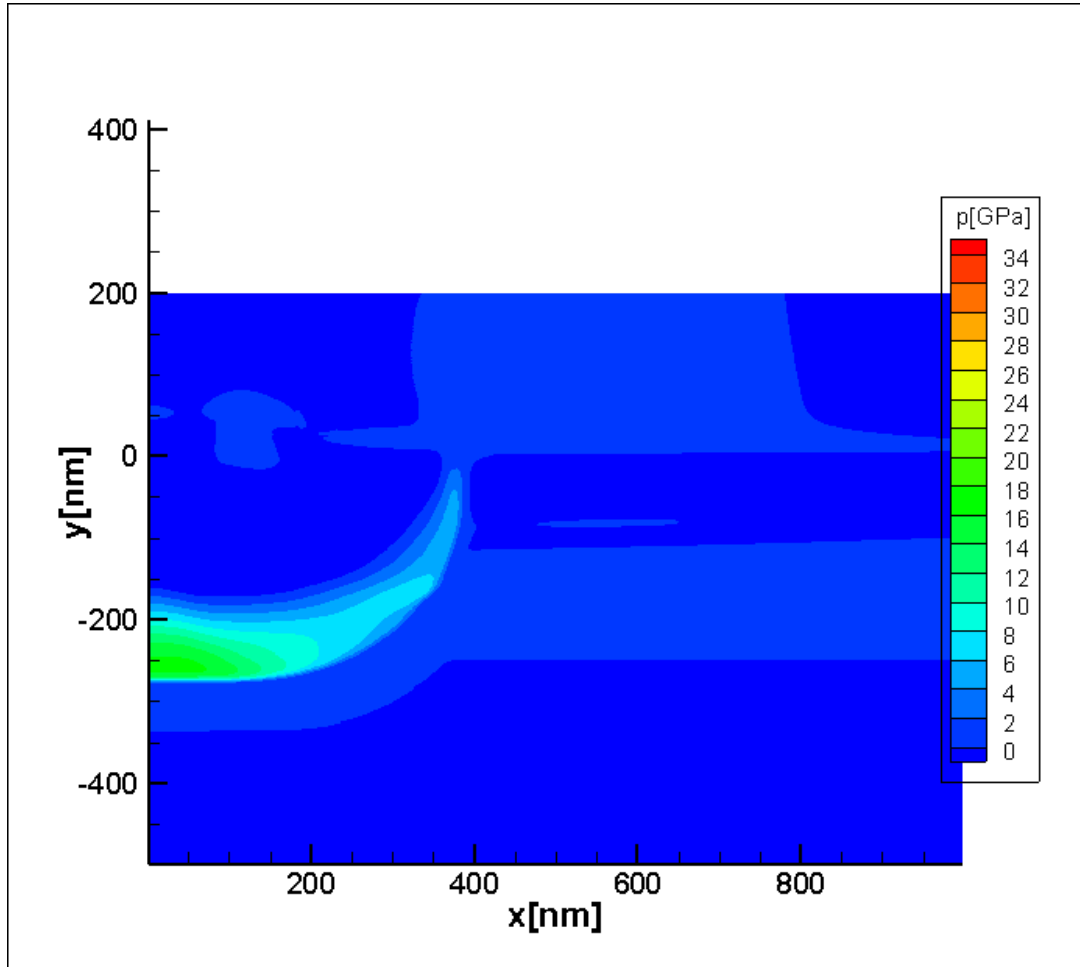
- ~10% mismatch in the fronts speed
- Attenuation mode change due to 1D-2D crossover

Results: Planar propagation mode



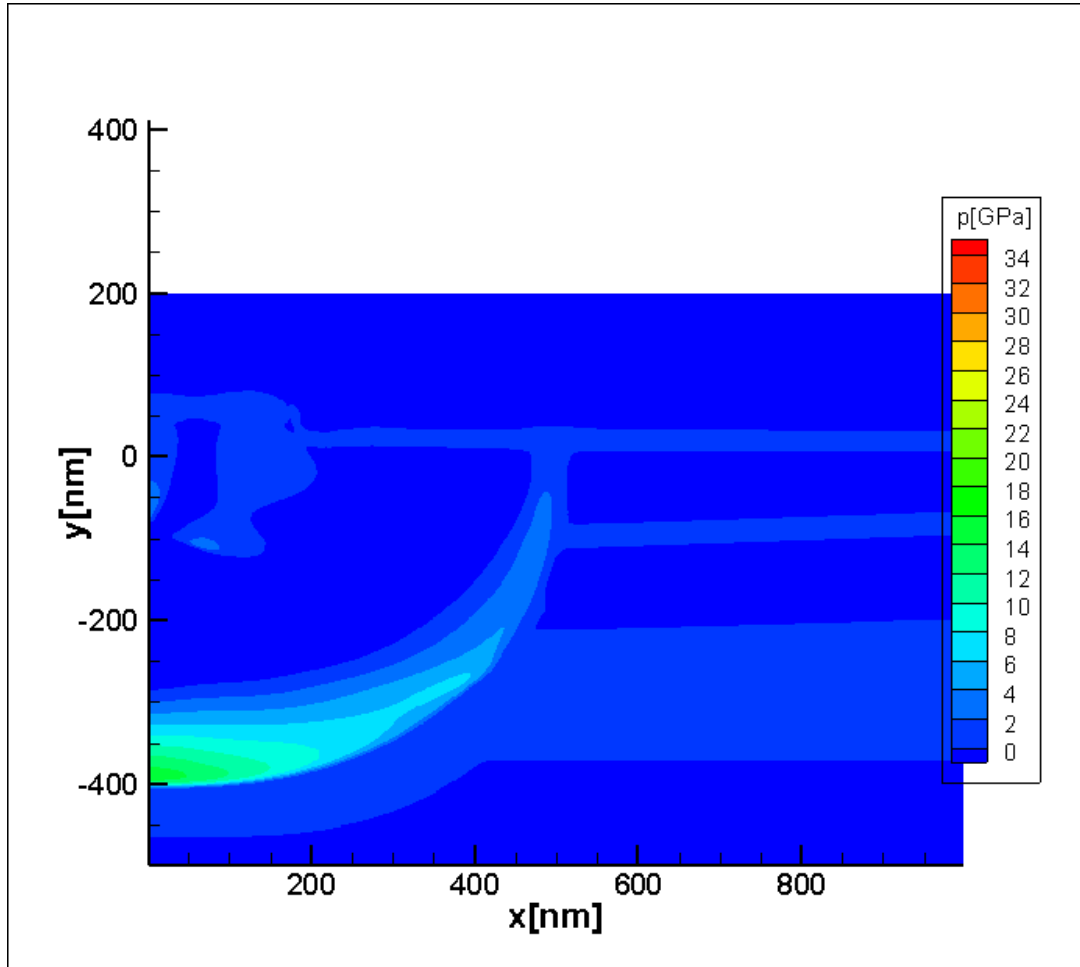
$t = 0.96$ ps

Results: Transition mode



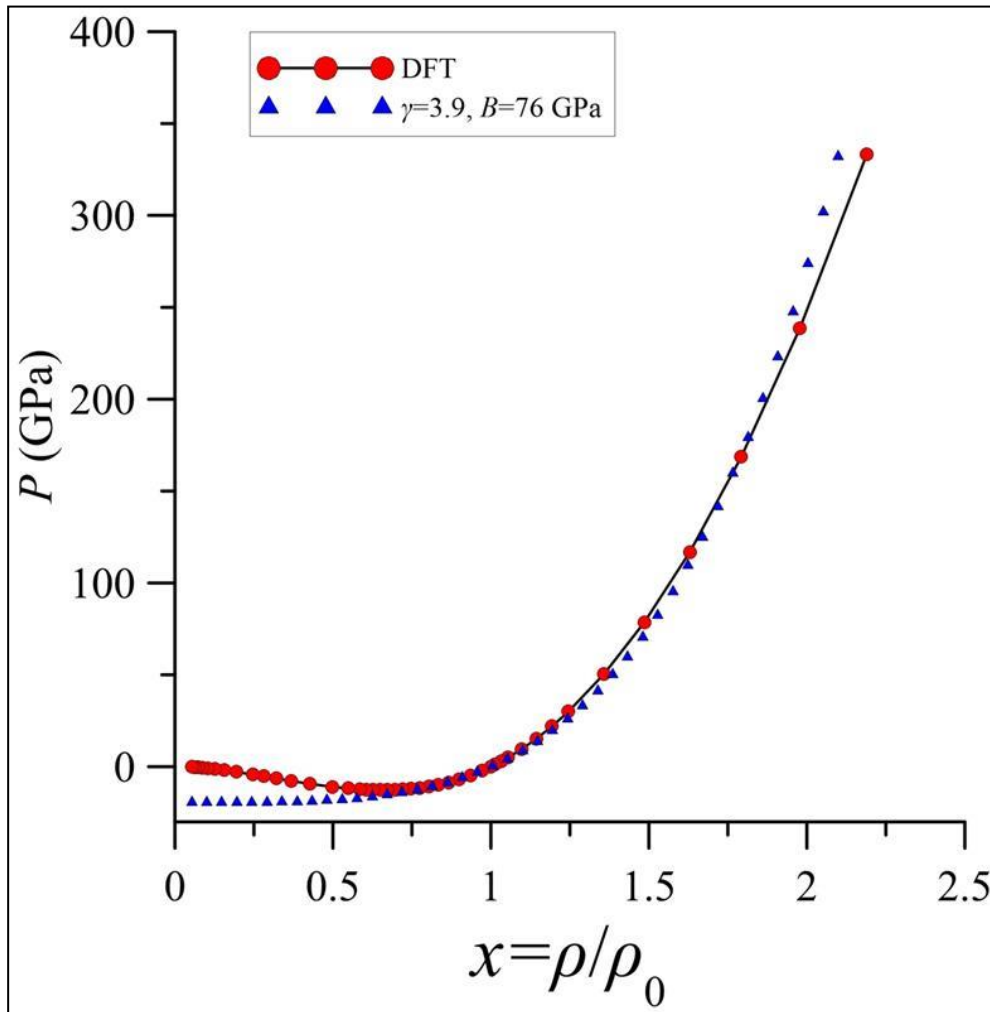
$t = 19.2$ ps

Results: Hemispherical mode



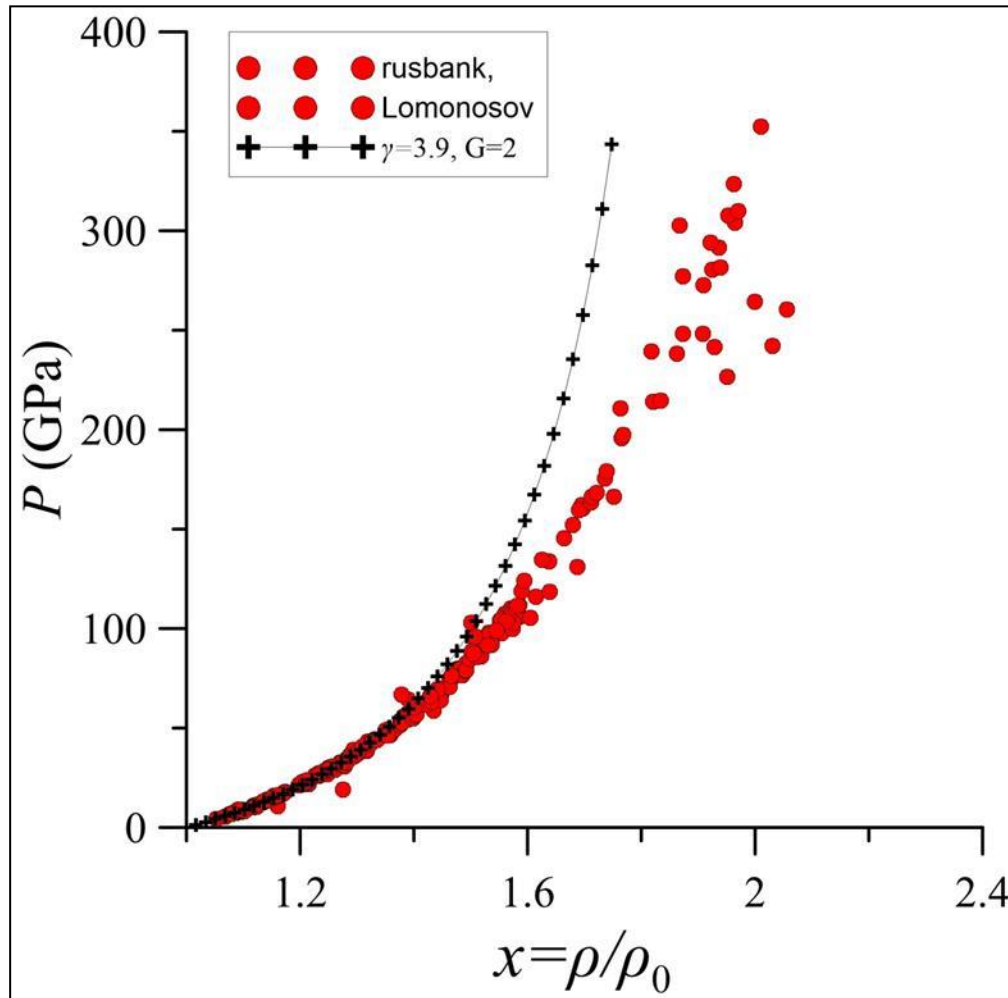
$t = 48$ ps

Mie-Gruneisen EOS Approximation



Cold curve

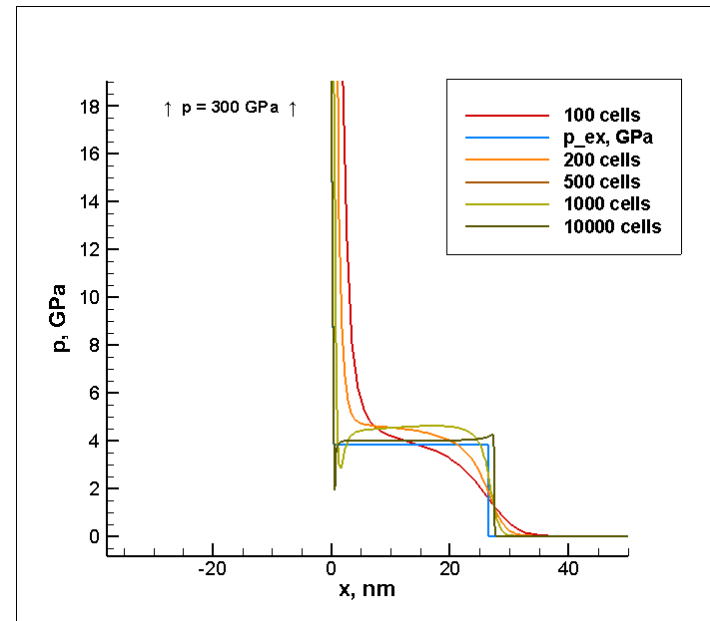
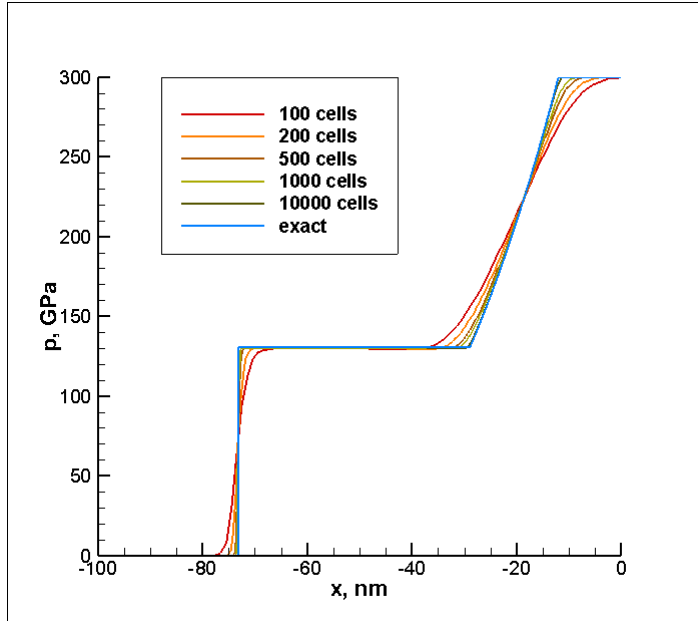
Mie-Gruneisen EOS Approximation



Shock Hugoniot

Hydrodynamic model and code

- 2D Euler equations (planar) + HLL + MUSCL-2
- Mie-Gruneisen EOS for Al
- Riemann problem convergence tests



The end