SBU Update on Coupling of Lagrangian Particle and M3D-C1 Codes for Pellet Simulation

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Problem formulation

M3D-C1 simulation:

- DIII-D Shot 160606 at 2990 ms
- 1 mm pure Neon pellet
- 80 m/s radial injection
- 2 cm poloidal deposition (highly resolved)

2D run

- **/global/cscratch1/sd/blyons/abl_2D/**

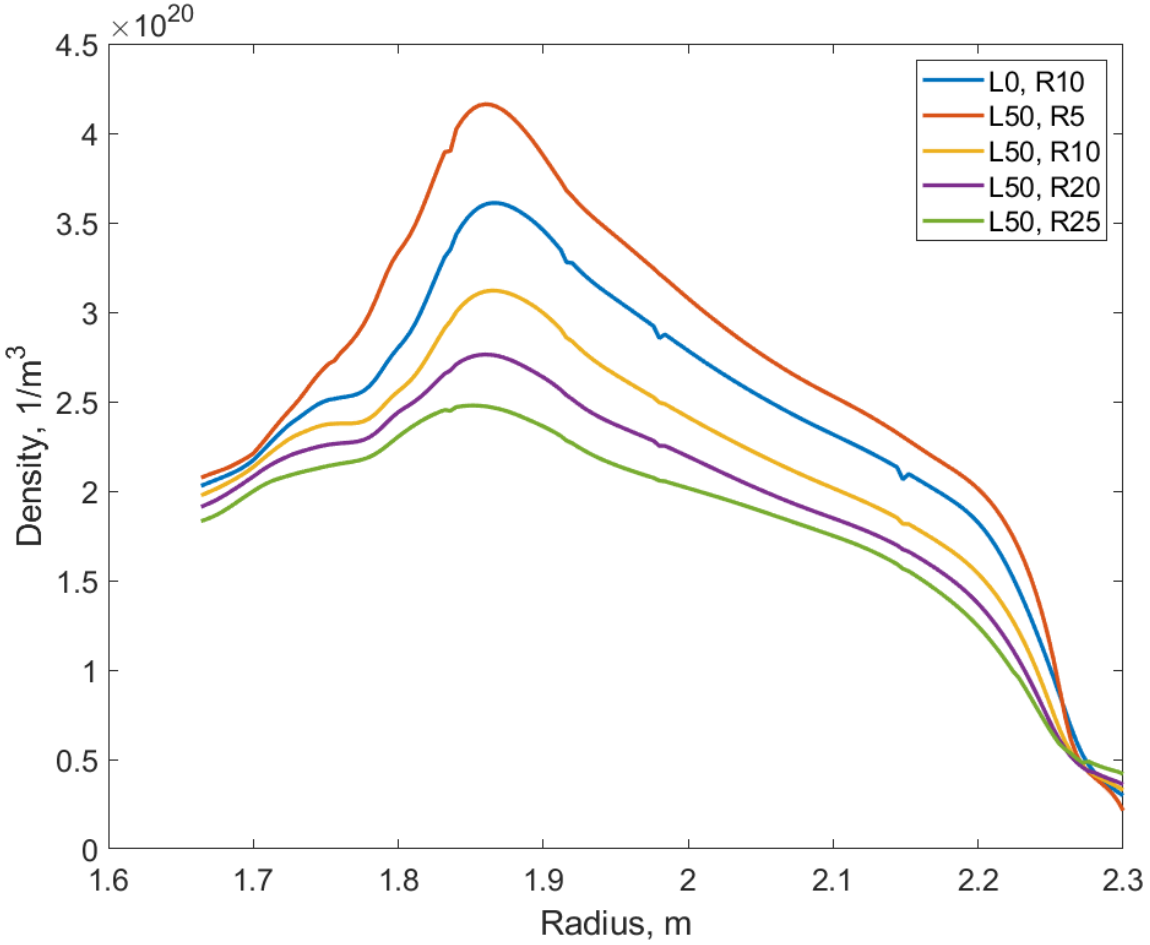
3D run (8 planes)

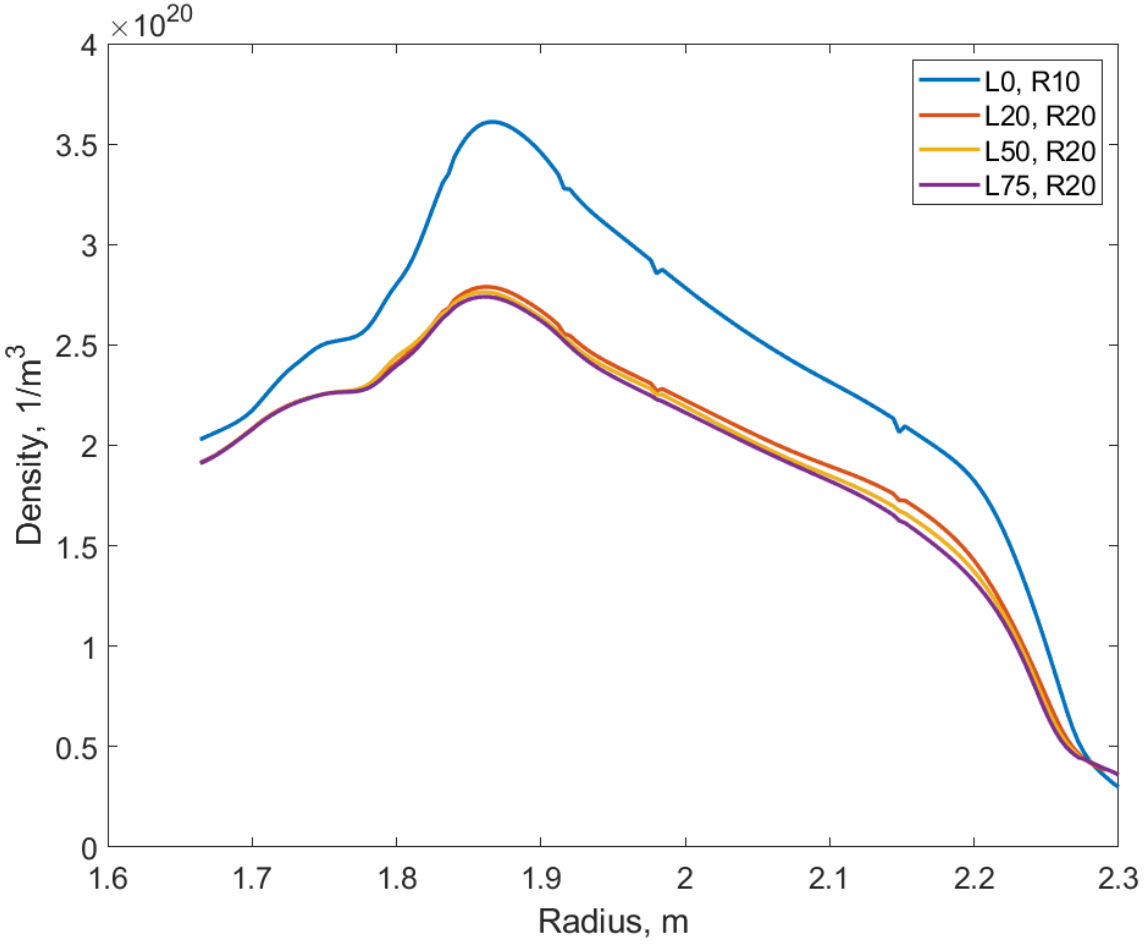
- Toroidal half-width 1.5 m (~p/8)
- Non-disruptive!
- **/global/cscratch1/sd/blyons/abl_Ne1mm_np8**

Lagrangian Particle simulation:

- Using the script provided by Brendan Lyons, we examined the sensitivity of plasma states to the location and size of the averaging domain
- Using ne(t), Te(t), B(t) near the ablating pellet (but not affected by the analytic source term) we performed LP simulations and compared ablation rates

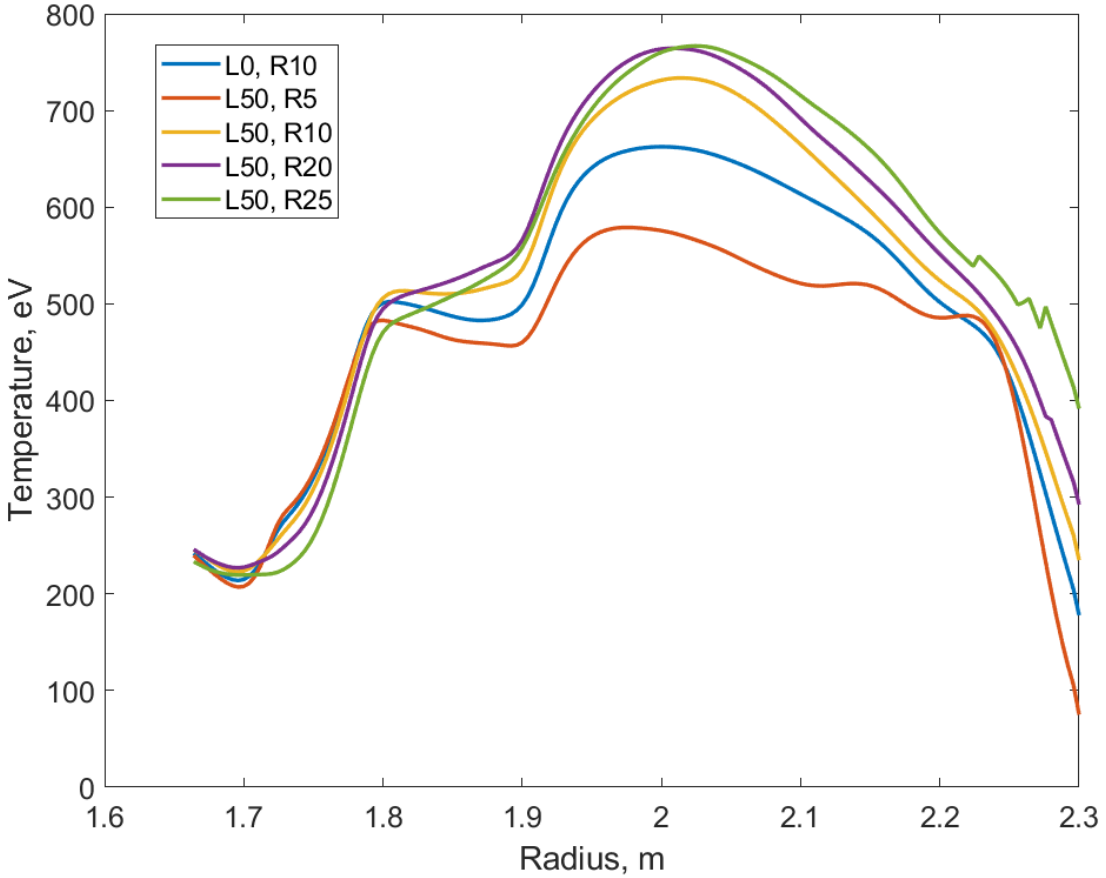
M3D-C1 Data Analysis: radial and longitudinal density dependence

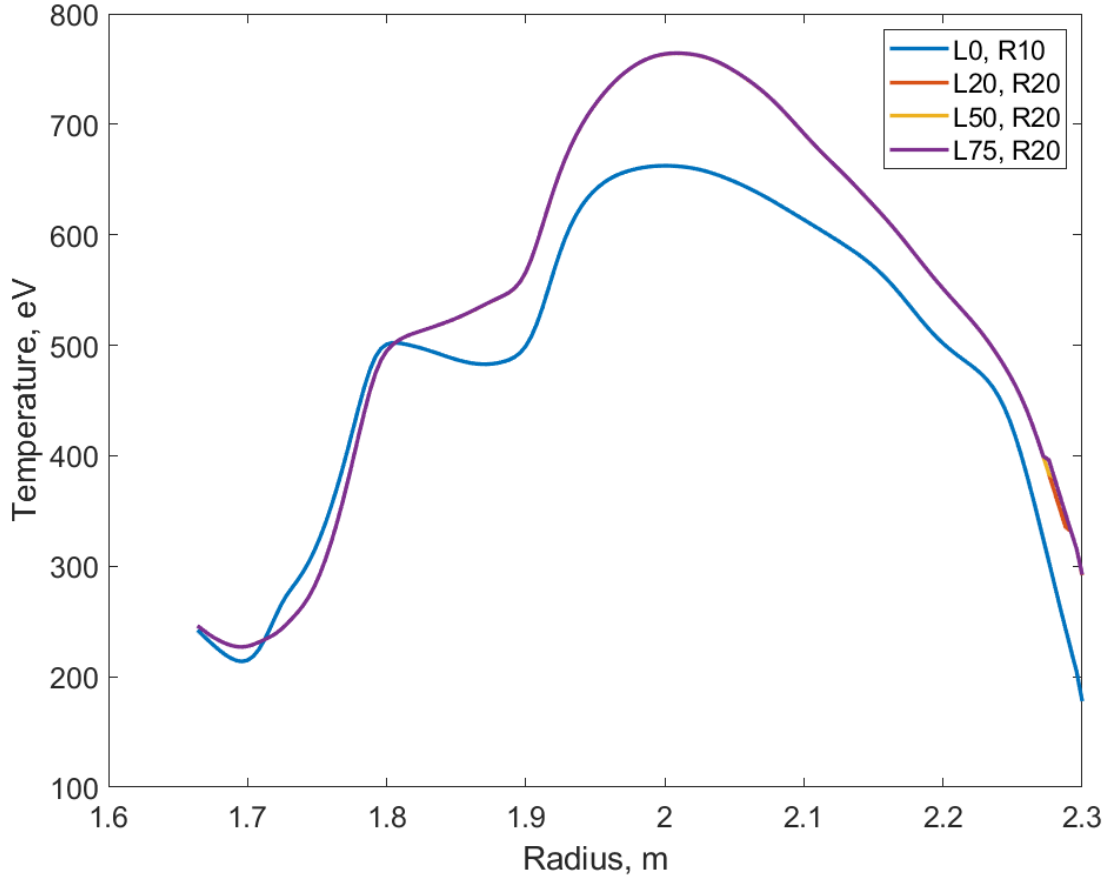




- Labels L N1, R N2 mean that plasma states were averaged in R=N2(cm) radius disk at L = N1 (cm) distance from the pellet in both directions
- Density is very sensitive to the disk radius and not sensitive to the longitudinal displacements
- Blue line, averaging in 10 cm radius disk at the pellet location, was added for the reference

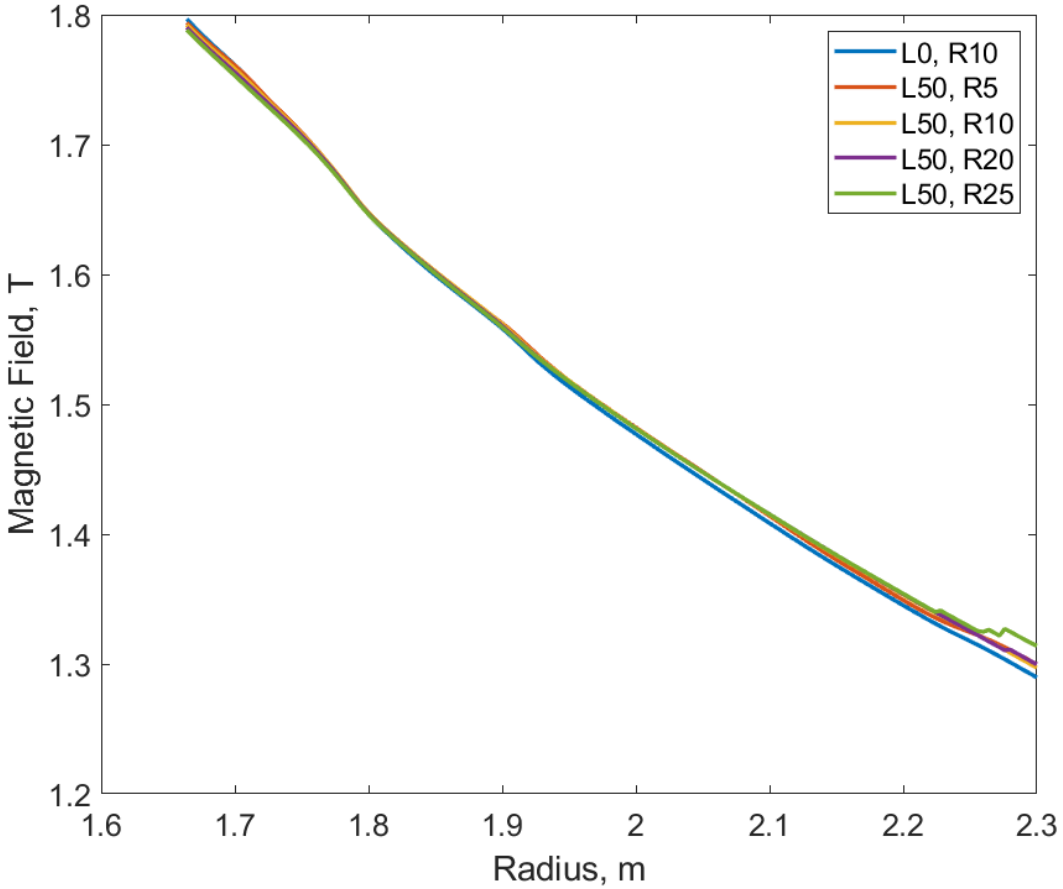
M3D-C1 Data Analysis: radial and longitudinal temperature dependence

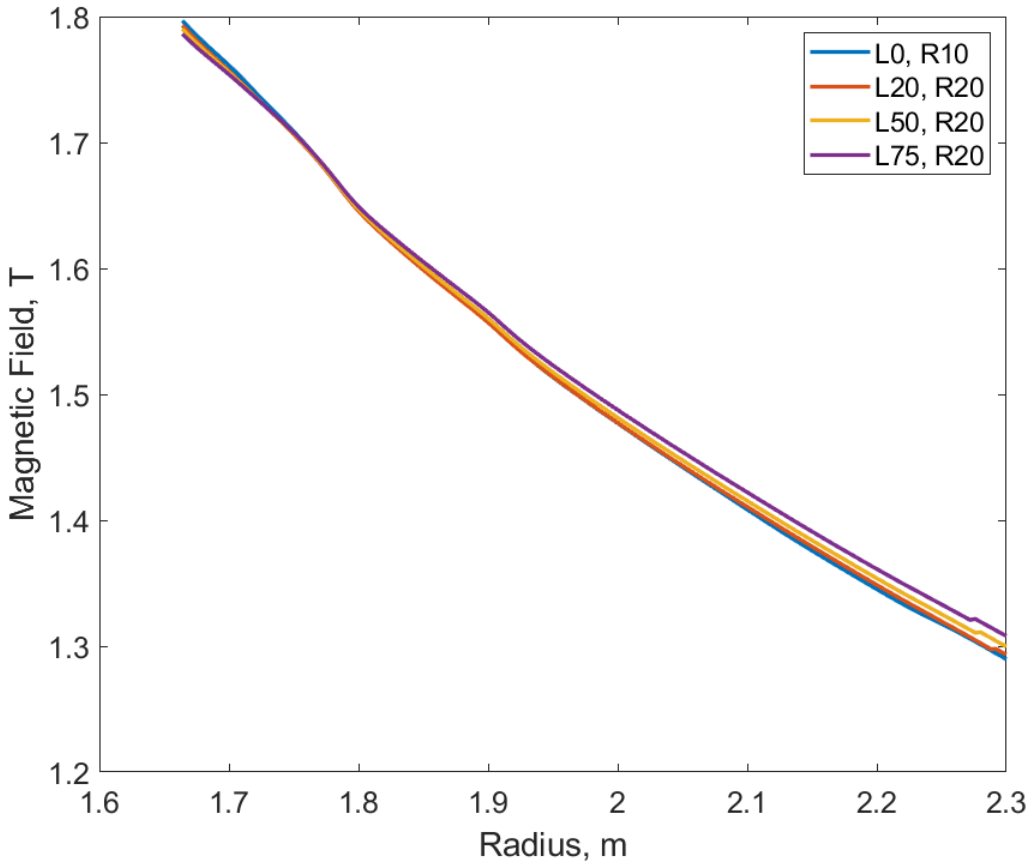




- Temperature is very sensitive to the disk radius and not sensitive to the longitudinal displacements
- As before, blue line, averaging in 10 cm radius disk at the pellet location, was added for the reference

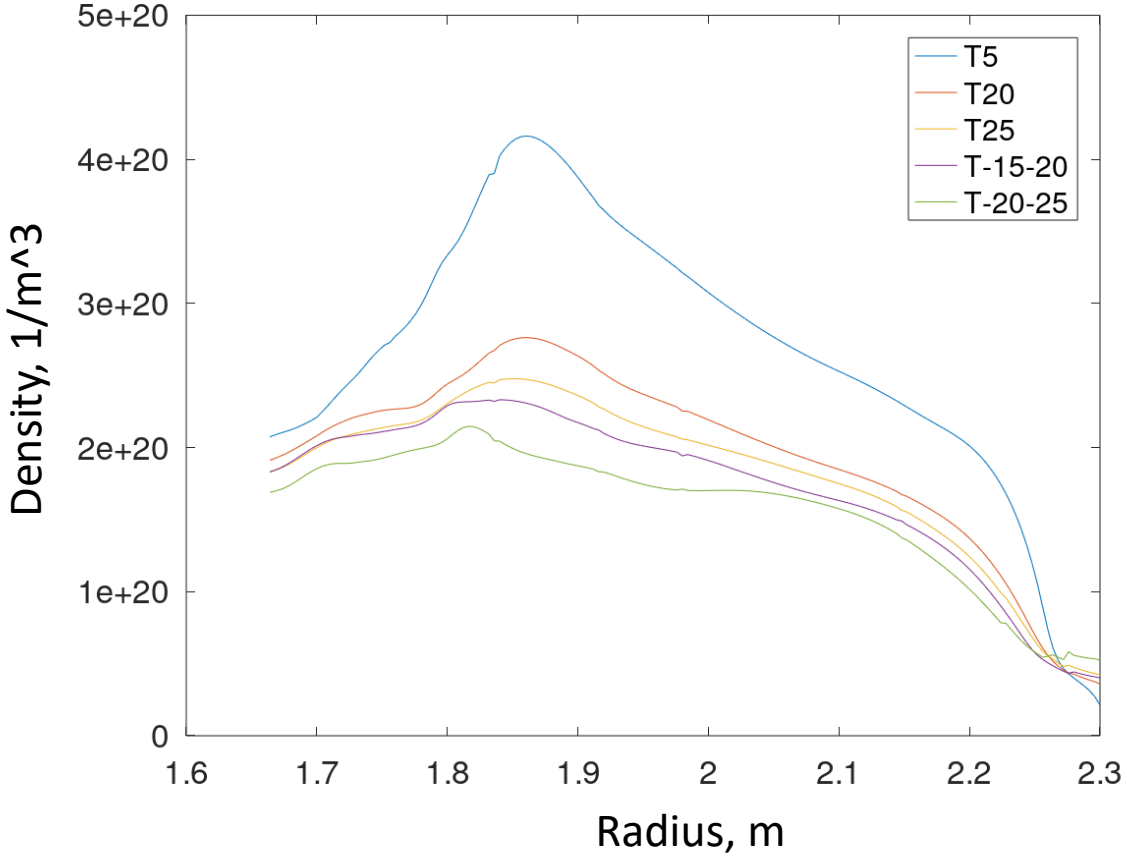
M3D-C1 Data Analysis: radial and longitudinal magnetic field dependence

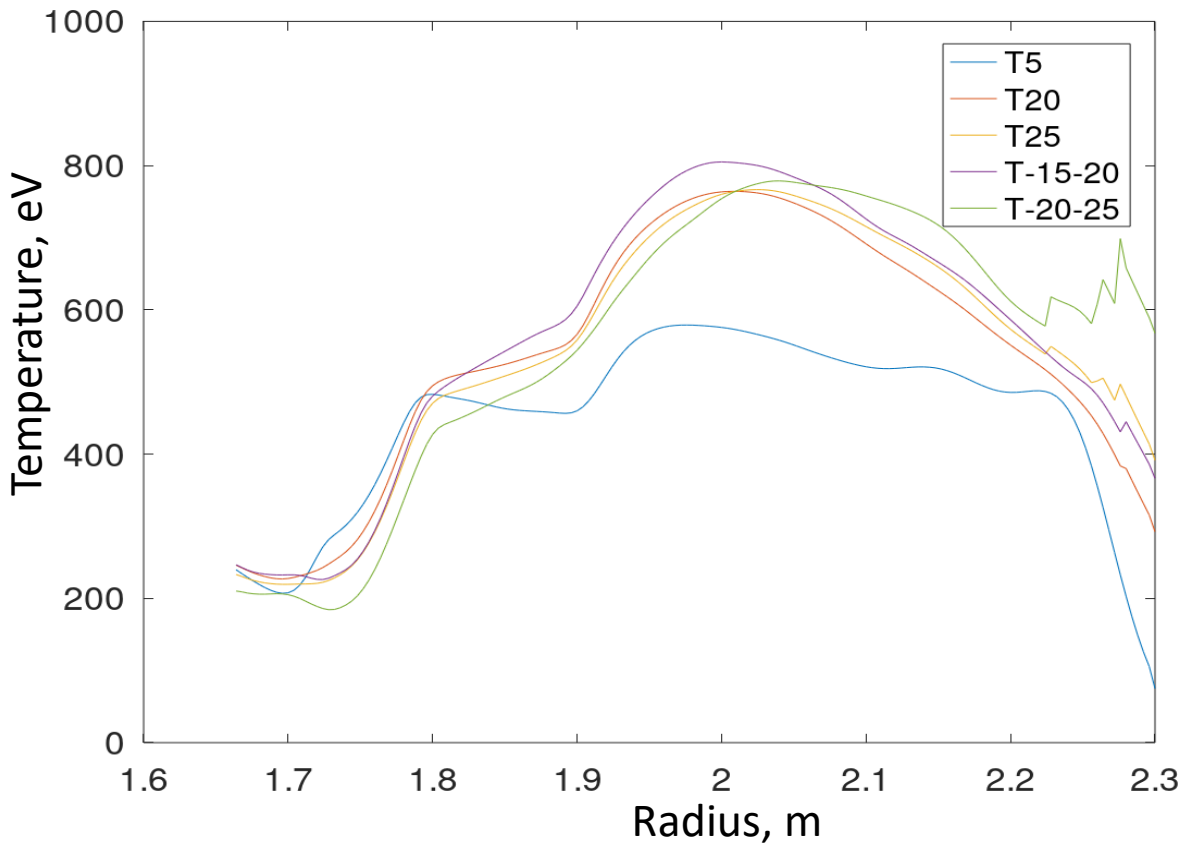




- Magnetic field is neither sensitive to the disk radius nor to the longitudinal displacements

M3D-C1 Data Analysis: averaging in disks vs rings

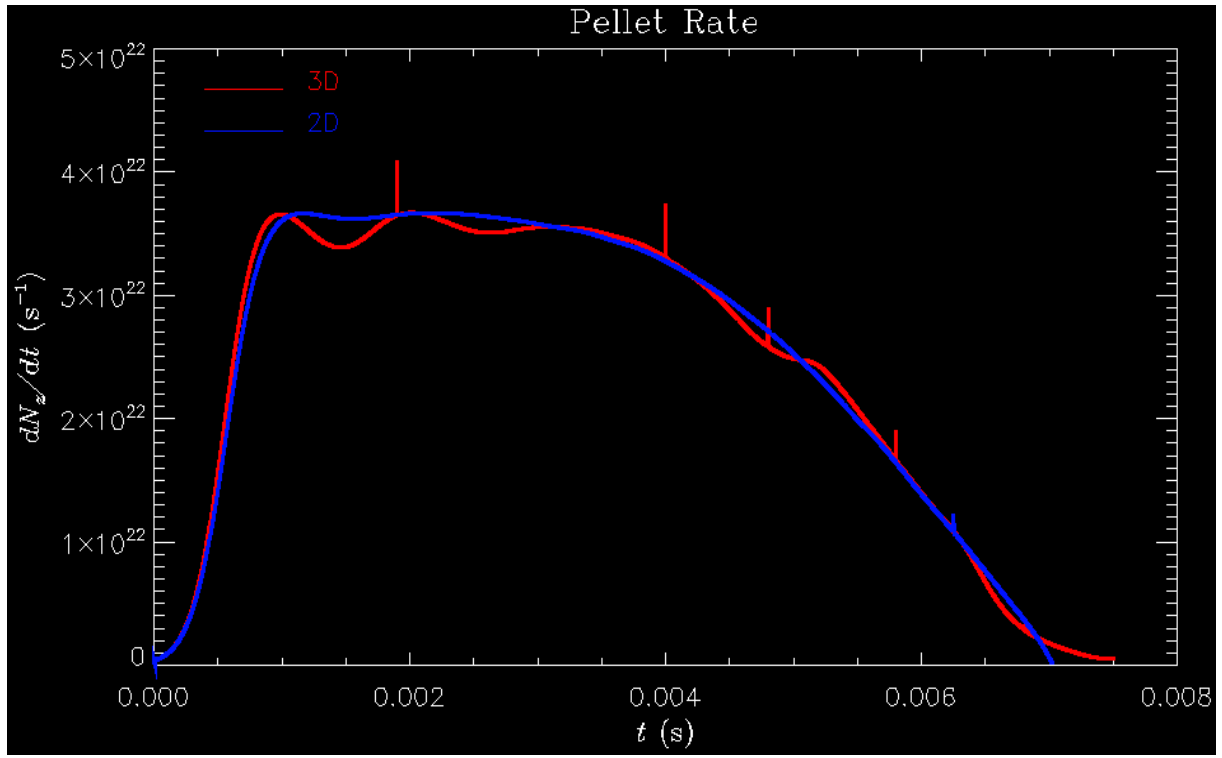


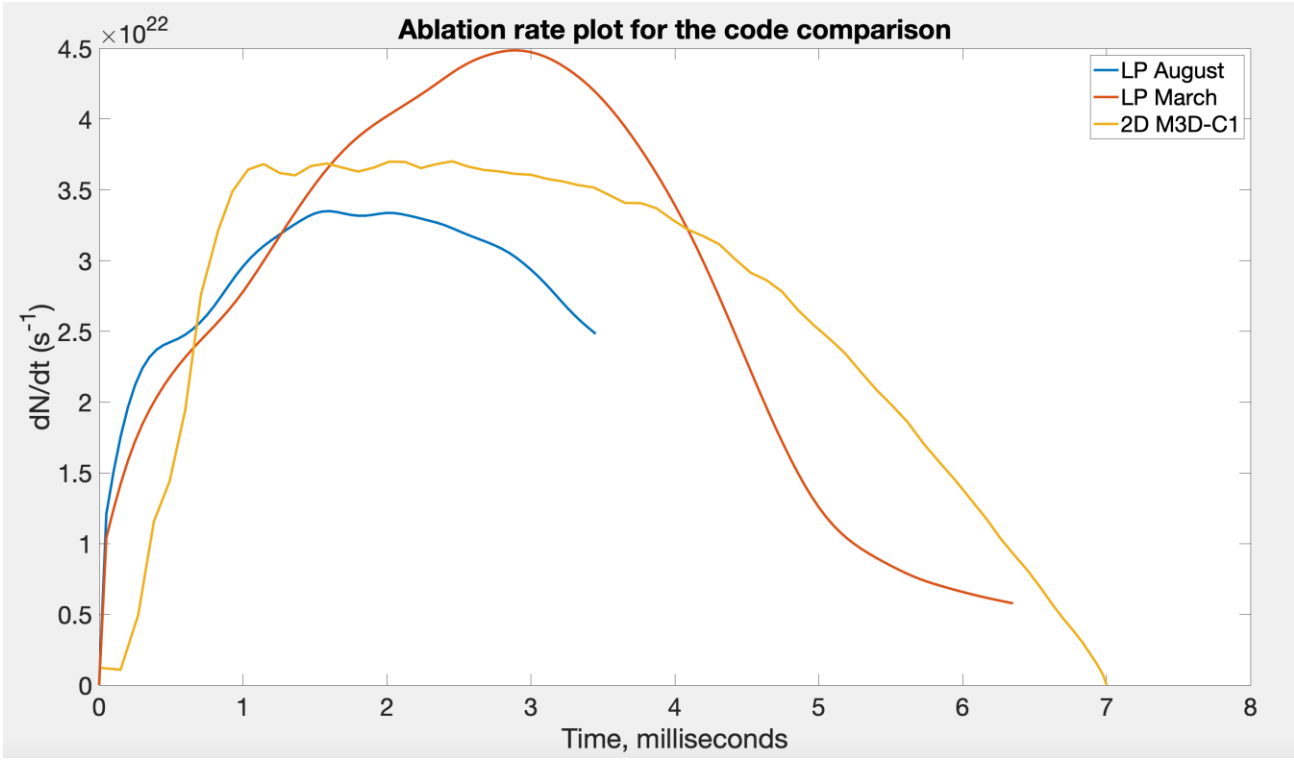


Data averaged in the ring from 15 to 20 cm in radius (the green line) were used in production simulations presented on the next slides.

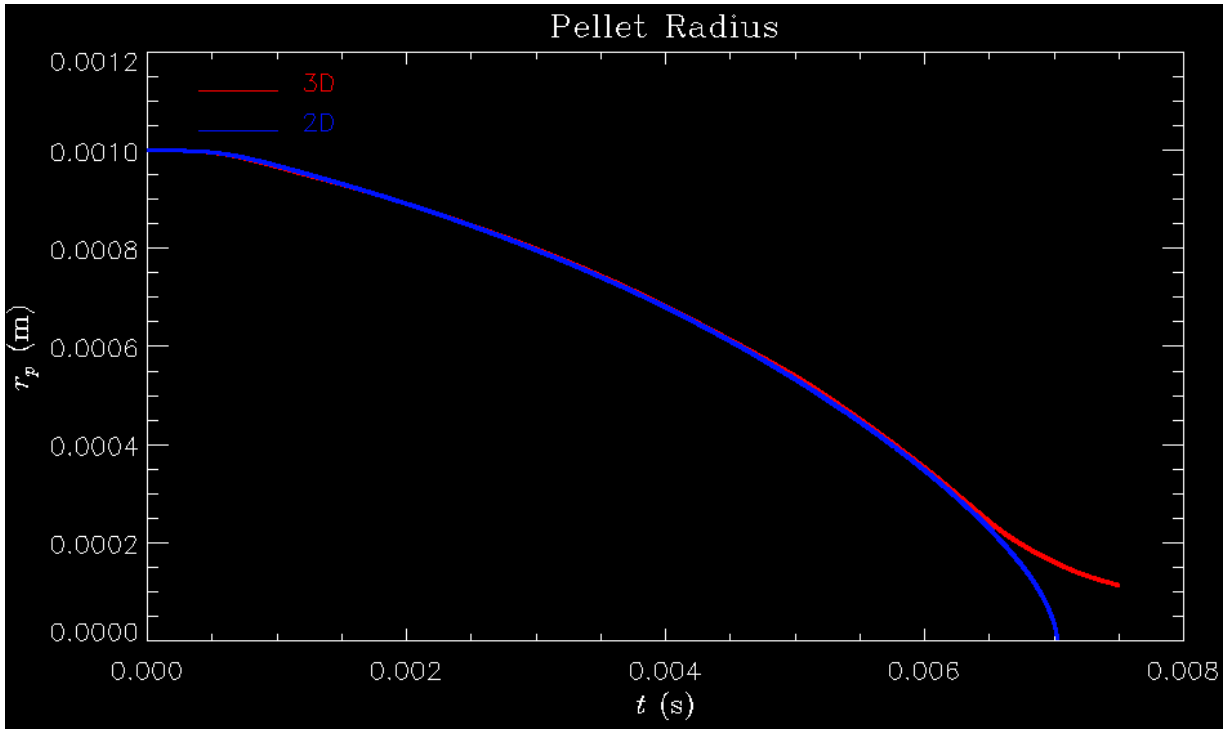
We have also tested the LP code using M3D-C1 data averaged in the 10 cm radius disk at the pellet location (blue lines on slides 3 and 4)

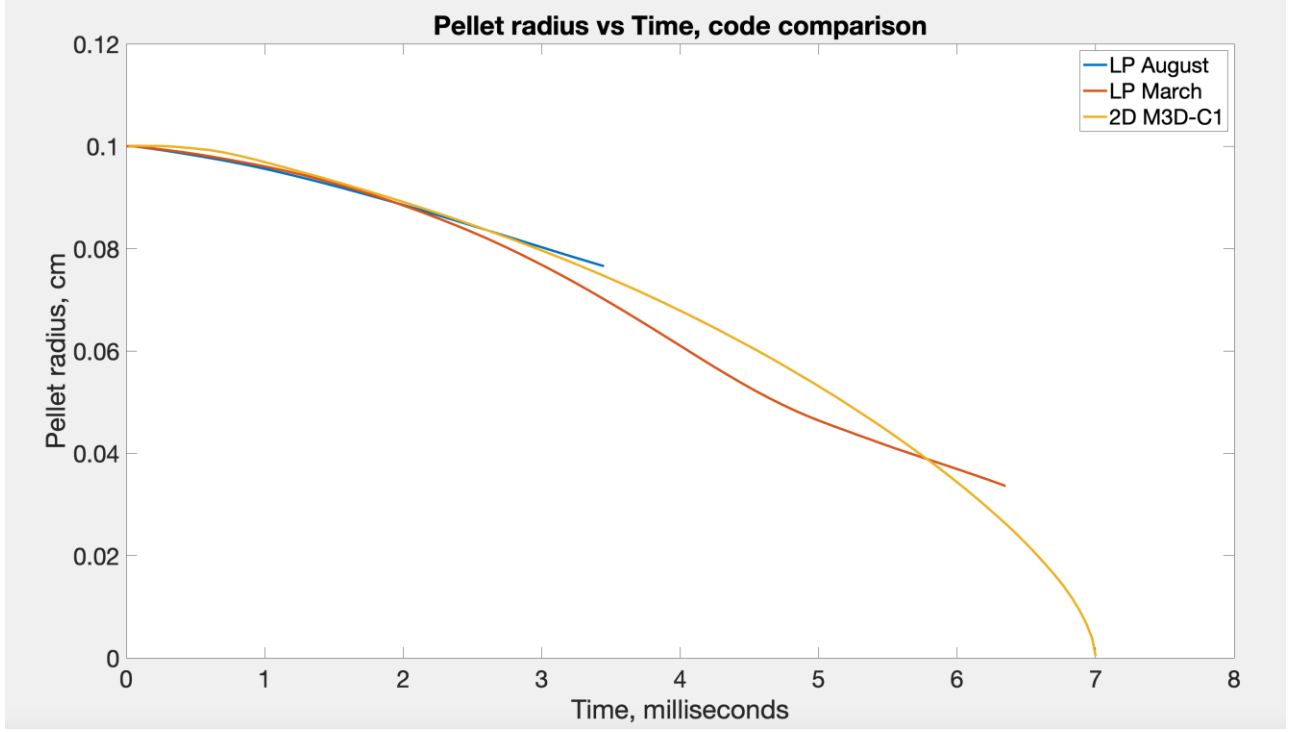
Ablation Rate vs Time



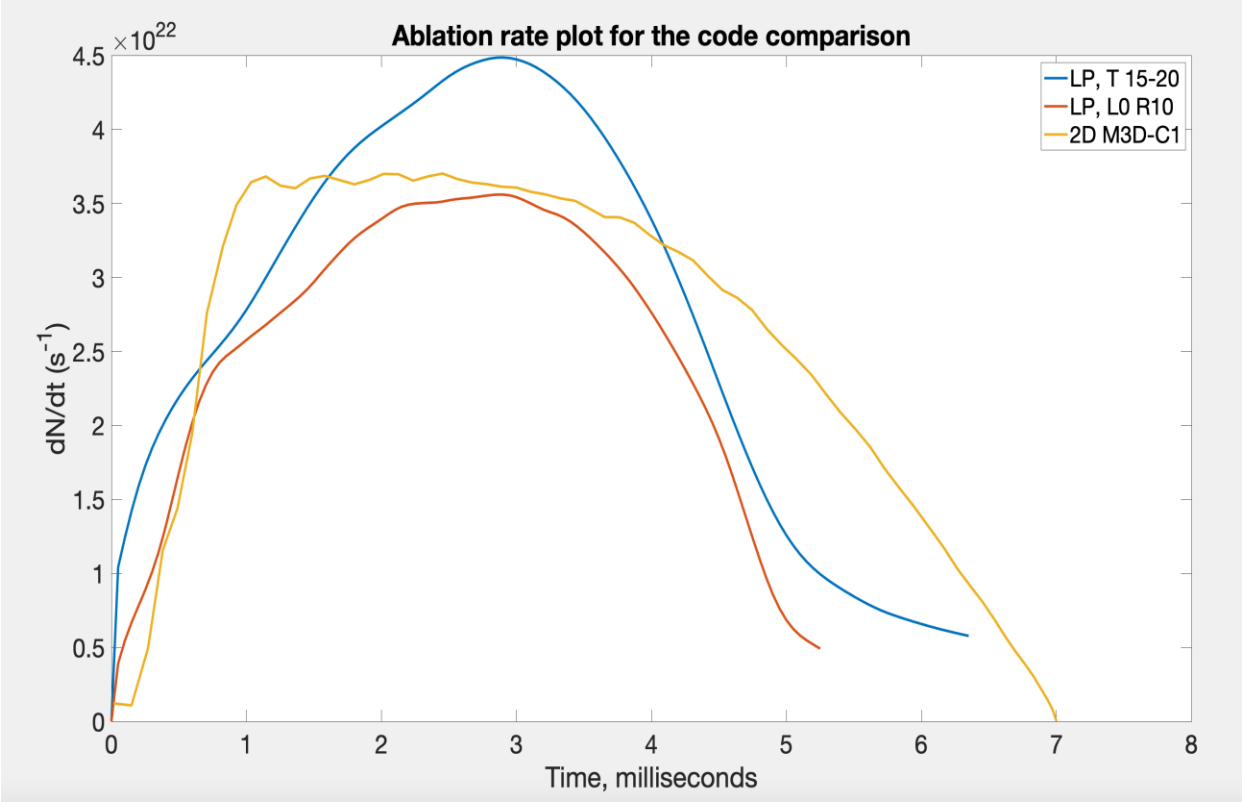


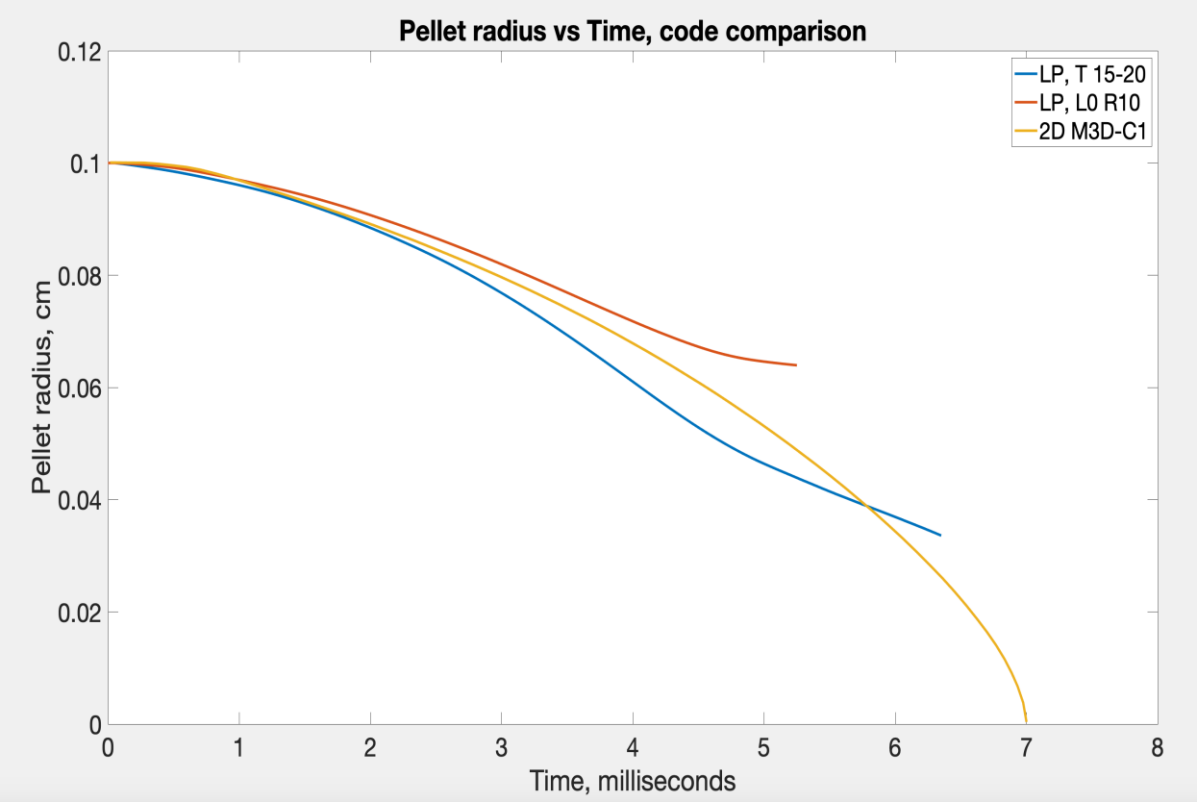
Pellet Radius vs Time





New simulation added that uses plasma states averaged in 10 cm disk at pellet location





An additional test was performed to check if LP agrees with M3D-C1 if plasma states are averaged averaged in 10 cm disk at pellet location (red line)

- In terms of the ablation rates, red (new LP test) and yellow (M2d-C1) lines are close initially and at ~3 ms
- As expected, the red curve is always below the blue line (that uses our best estimates of plasma states)

- **t = 1 ms:** r_p = 0.096 cm (LP). M3D-C1 results are r_p = 0.0967 cm and G = 1.2209 g/s.

	Te (eV)	B (T)	ne (1/cc)	G (g/s)	G (Scaling Law, g/s)
Full LP Simulation	549.37	1.34	9.49e13	0.932	-
Steady State LP	549.37	1.34	9.49e13	0.978	-
Steady State LP	481.91	1.33	1.58e14	0.7065	0.89

- **t = 3 ms:** r_p = 0.077 cm (LP). M3D-C1 results are r_p = 0.079 cm and G = 1.2087 g/s.

	Te (eV)	B (T)	ne (1/cc)	G (g/s)	G (Scaling Law, g/s)
Full LP Simulation	776.04	1.44	1.73e14	1.499	-
Steady State LP	642.36	1.43	2.48e14	1.196	1.233

- **t = 5 ms:** r_p = 0.046 cm (LP). M3D-C1 results are r_p = 0.054 cm and G = 0.8531 g/s.

	Te (eV)	B (T)	ne (1/cc)	G (g/s)	G (Scaling Law, g/s)
Full LP Simulation	605.25	1.56	2.17e14	0.4213	-
Steady State LP	499.24	1.56	3.46e14	0.4334	0.357