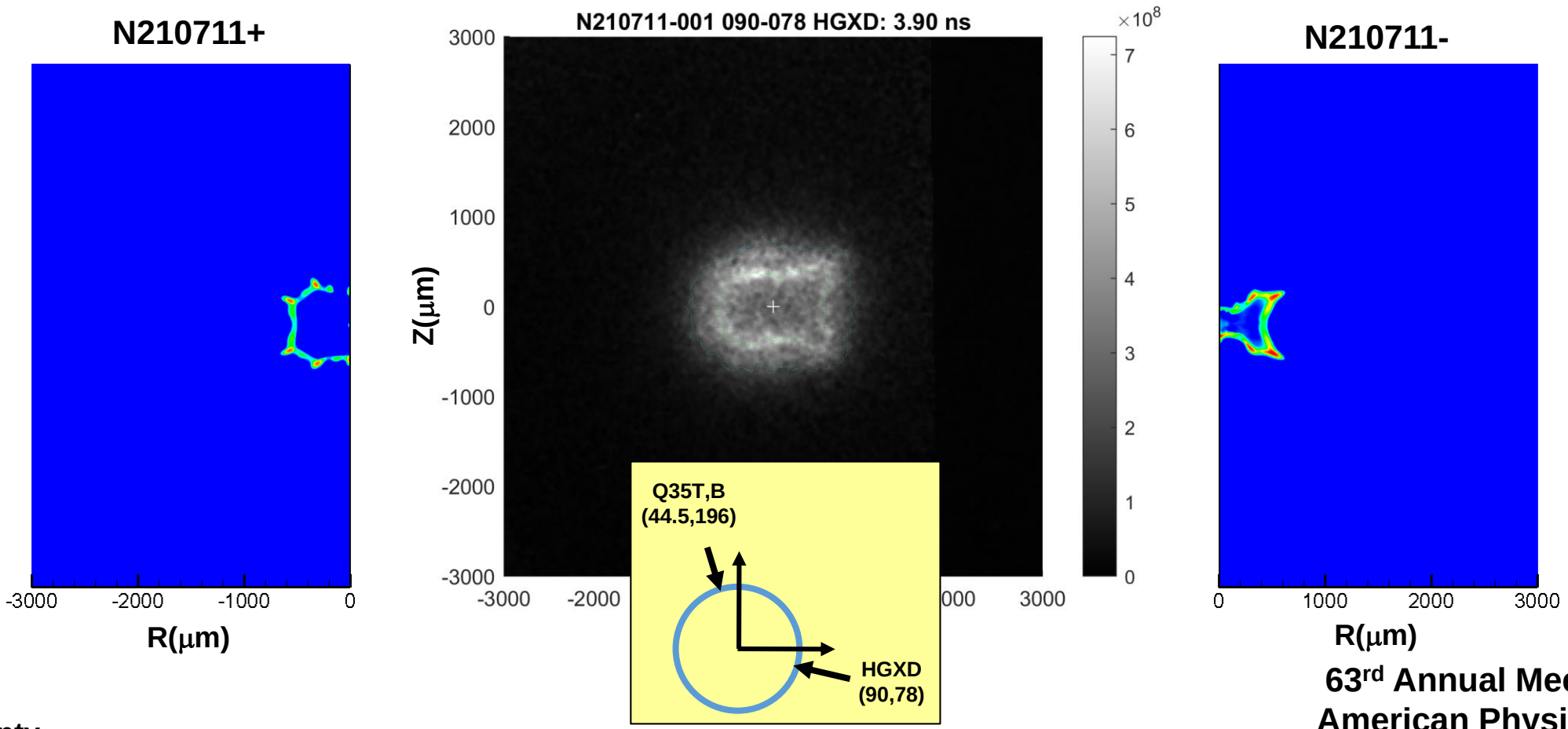
Examining the Role of Cross-Beam Energy Transfer in NIF Direct-Drive Exploding-Pusher Experiments



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Division of Plasma Physics
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Summary

Facets of NIF Direct-drive exploding pusher implosions exhibit strong dependence on CBET with relatively small changes (~8%) in laser energy

- **Shot N210711 (“Diamond Orange”) was designed to test HDC ablators for use in the Neutron Source Working Group (NSWG).**
- **A dropped NIF bundle (8 beams) had the target being effectively driven by two separate laser pulses.**
- **Absence of 8 NIF beams led to significant target asymmetry exacerbated by CBET in the under-driven target hemisphere.**
- **The lower target drive on the one side of the target leads to lower plasma exhaust velocity which is conjected to couple into the CBET resonance parameter increasing the CBET locally.**

Collaborators

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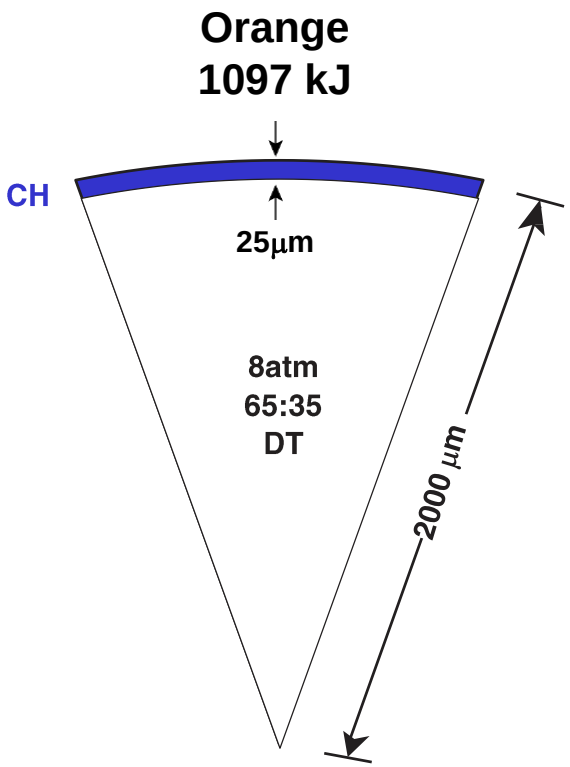
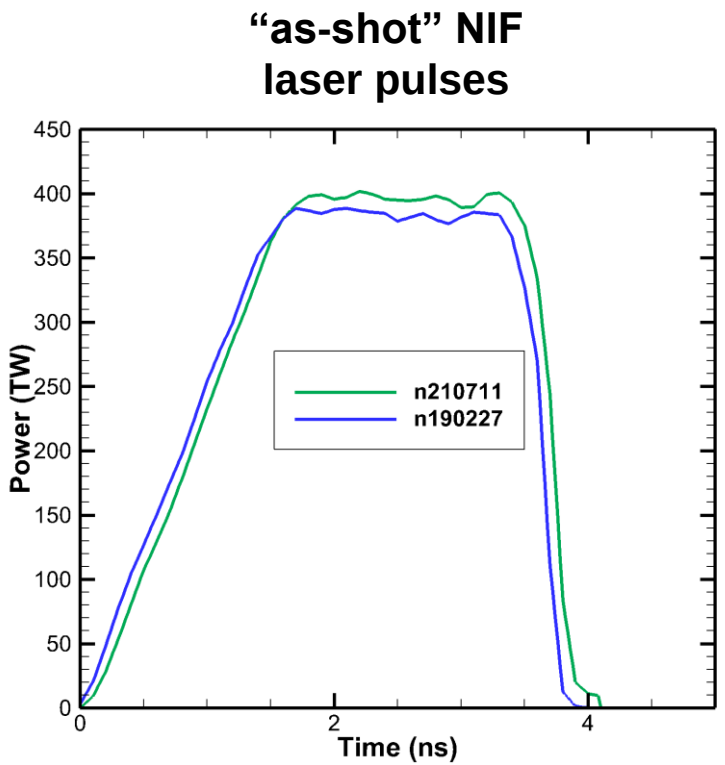
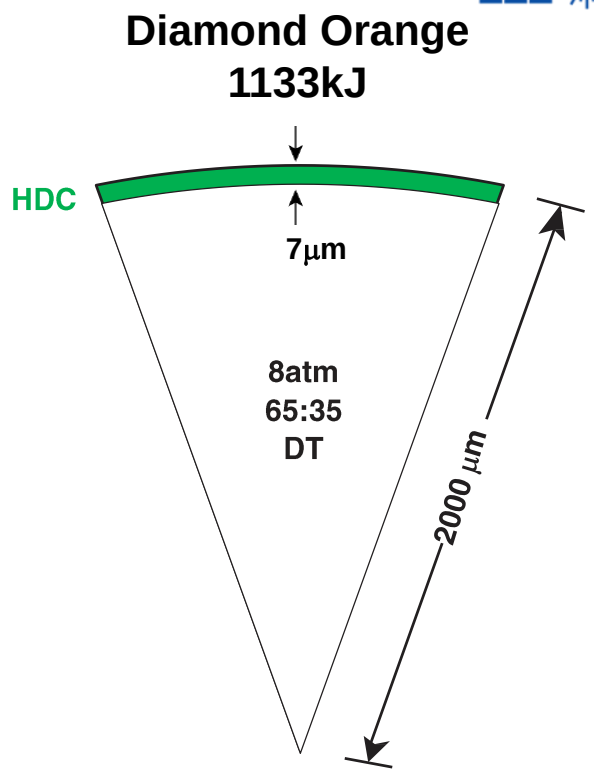
Lawrence Livermore National Laboratory

Diamond Orange was designed to investigate a mass-equivalent, HDC ablator using the same laser parameters from N190227 ("Orange")

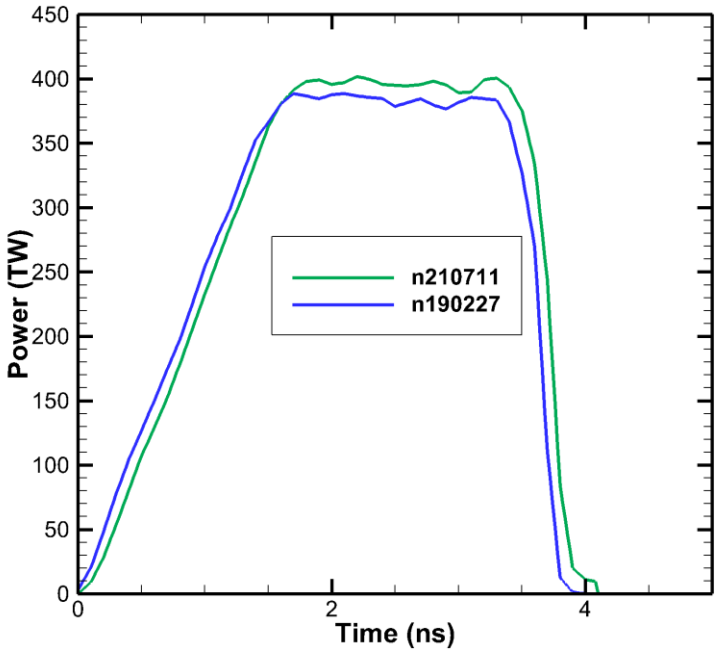






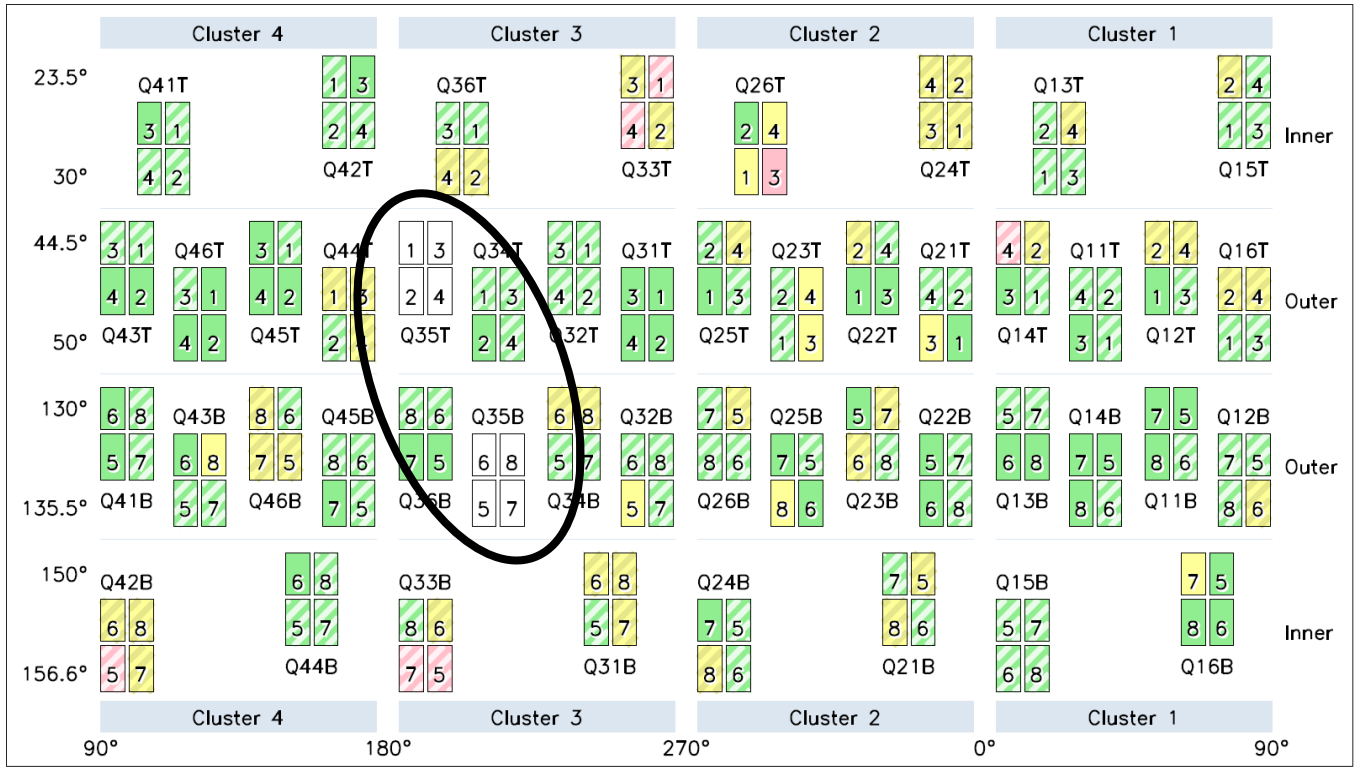
HDC ablators provide better laser coupling and can withstand higher fuel pressures

Accurate comparison of Diamond Orange and Orange pulse shapes needs to address the dropped beams in Diamond Orange



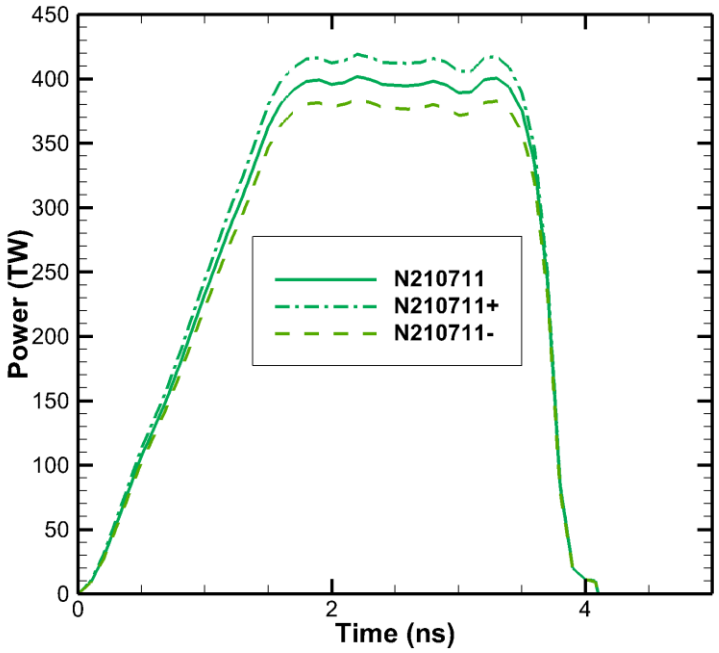
LPOM Quality of Shot Metric, Beamline Location Map

N210711-001-999, H_Surv_ExPsh_PD_S04a



LEH QoS ((Measured - Request) / Request) [%]

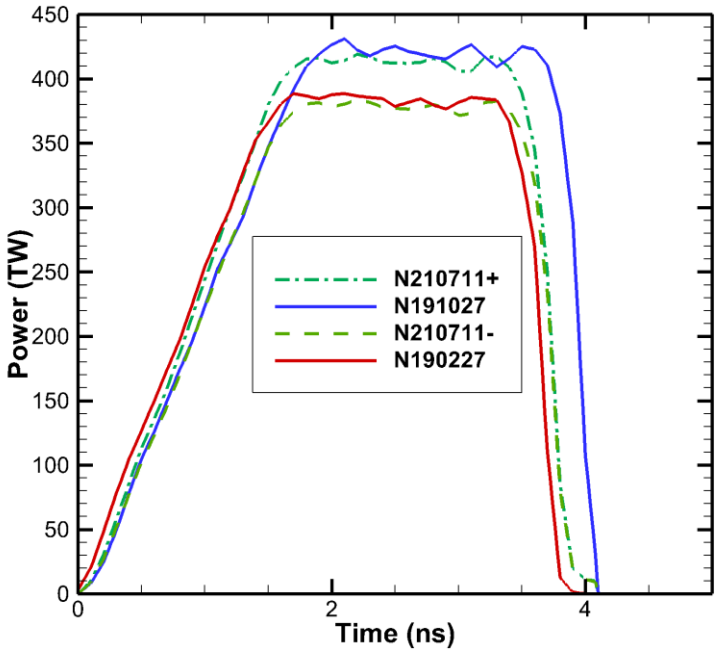
By adding or subtracting complimentary beams, one can construct pulse shapes for 2D simulations that effectively drive each hemisphere



LPOM Quality of Shot Metric, Beamline Location Map
N210711-001-999, H_Surv_ExPsh_PD_S04a

LEH QoS ((Measured - Request) / Request) [%]

This analysis indicates that one half of Diamond Orange is being driven like Orange, while the other half sees the pulse from N191027 (“Cutie”)



LPOM Quality of Shot Metric, Beamline Location Map

N210711-001-999, H_Surv_ExPsh_PD_S04a

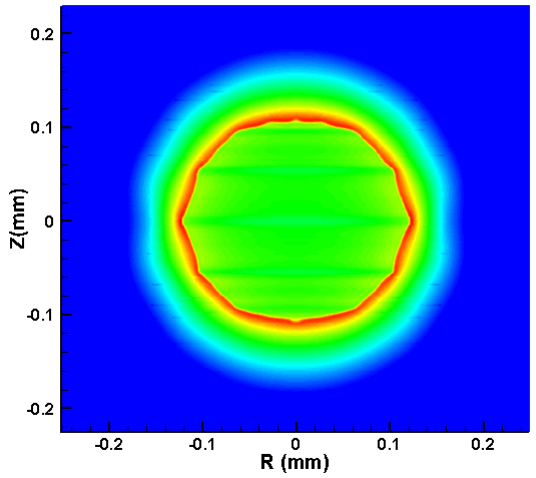
LEH QoS ((Measured - Request) / Request) [%]

Cutie is at the heart of an investigation into the effect that CBET has on target morphology of shots with energies between 800 and 1200kJ

Both implosions were performed with the same pointing/defocusing and wavelength detuning

N200715
800kJ

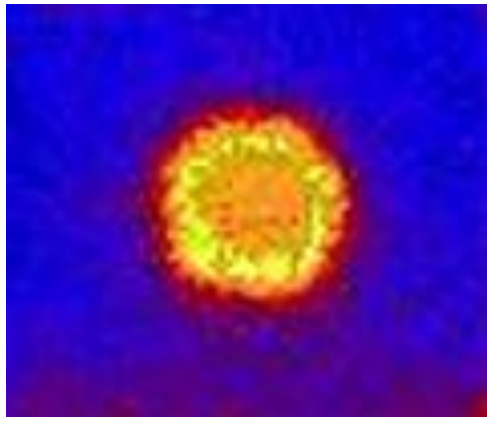
DRACO Spect3D



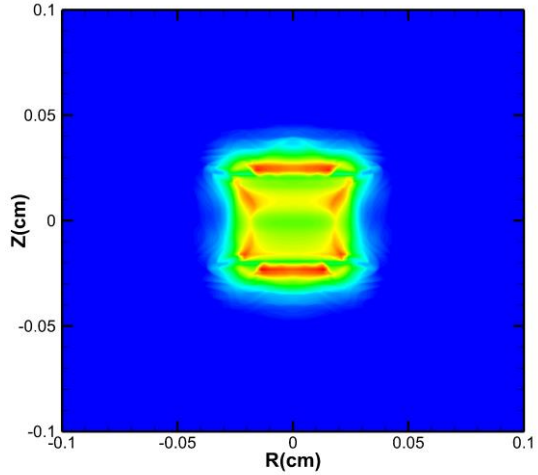
HGXD

N191027
1200kJ

HGXD

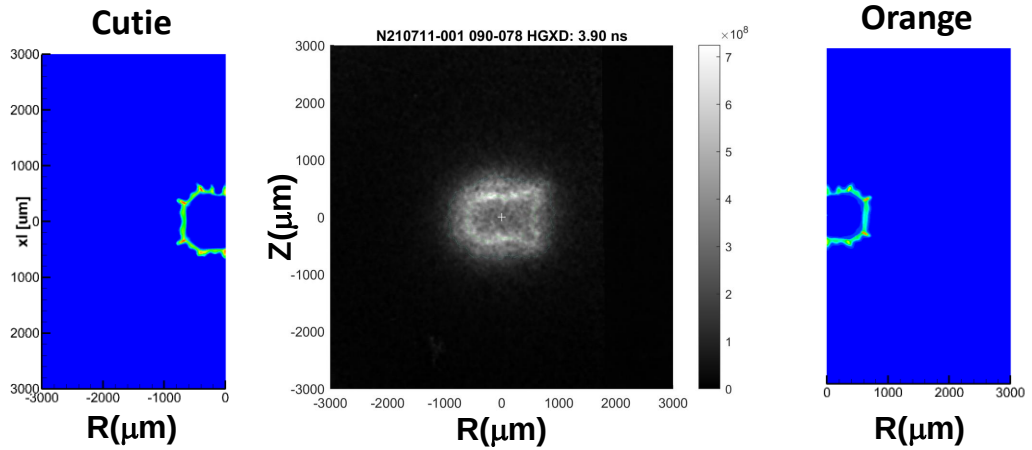


DRACO Spect3D



Orange and Cutie have returned some of the highest NSWG yields to date and are well modeled by DRACO

Shot	Yield ((1X15)		Tion (keV)		Bang time (ns)		Burn width (ps)	
	Exp	Sim	Exp	Sim	Exp	Sim	Exp	Sim
N181014	3.56	3.87	6.30	8.59	5.52	4.92	618	320
N190224	5.97	6.97	7.65	10.29	4.88	4.41	502	322
Orange	11.10	11.20	8.94	9.65	4.22	4.25	452	300
N190317	5.01	4.83	7.37	8.20	4.58	4.38	607	402
N190707	4.81	4.94	11.14	12.00	2.71	2.84	311	202
Cutie	11.90	12.20	10.22	10.72	4.31	4.23	421	311



All simulations performed with non-local electron transport and CBET with pump depletion

Diamond Orange did not perform like an average of Orange and Cutie, only returning about half of the predicted yield

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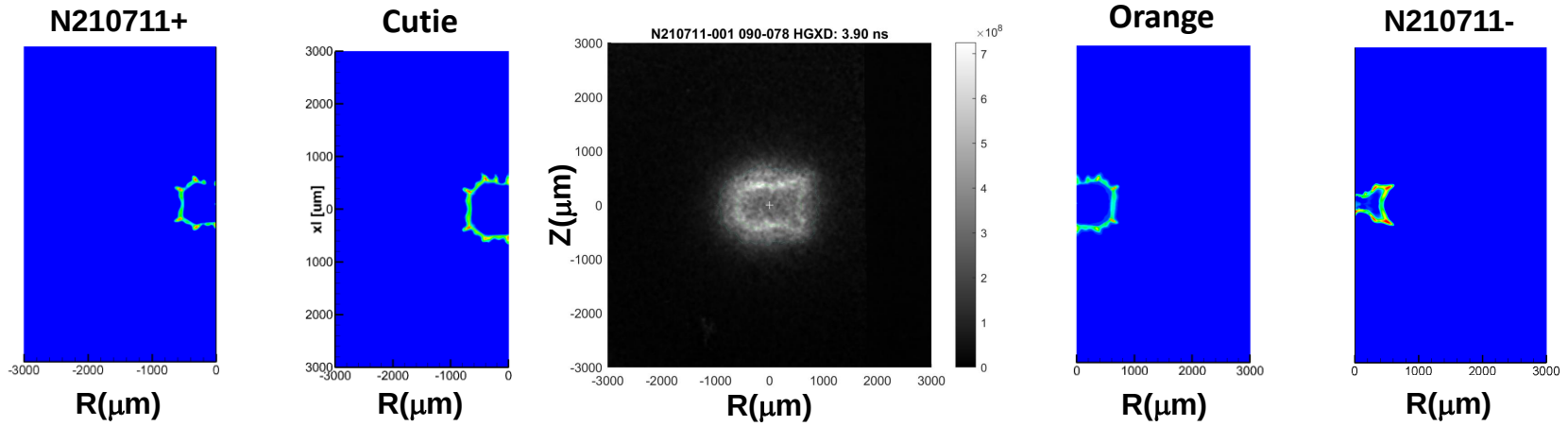
Cutie	11.90	12.20	10.22	10.72	4.31	4.23	421	311
Diamond Orange	6.10	6.91	8.59	11.64	4.32	3.93	409	250



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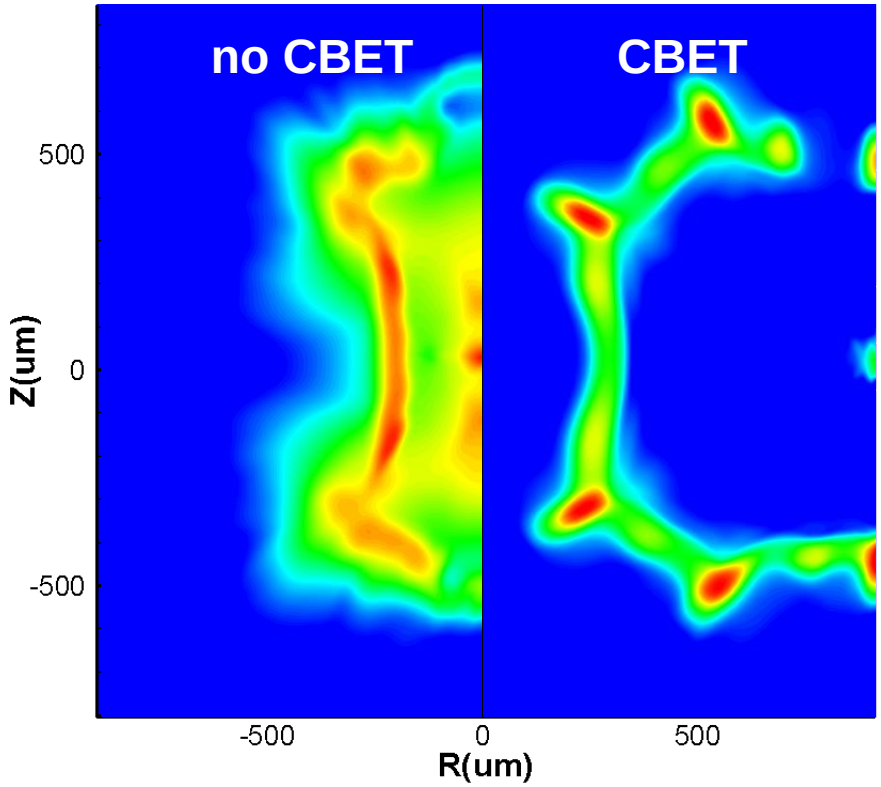
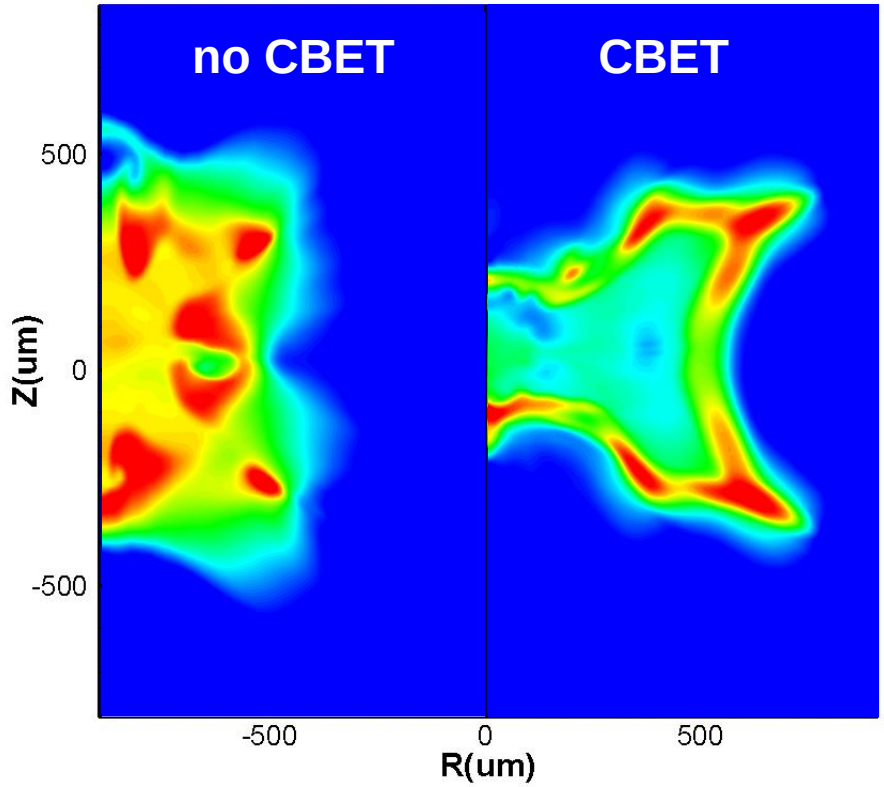
Diamond Orange simulations, with and without CBET, indicate a much larger effect of CBET on the side of the target with the dropped beams

Full power

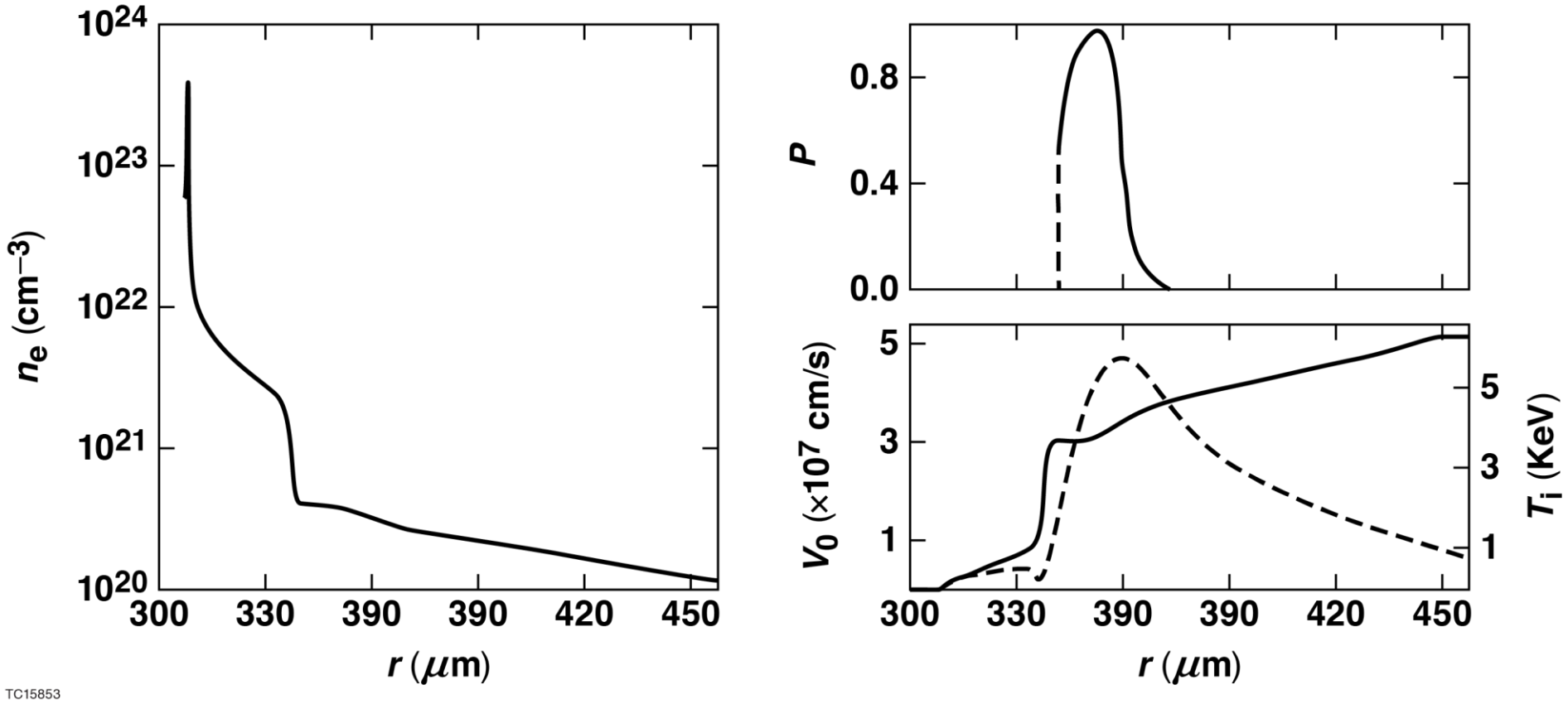


Dropped bundles



Randall's model indicates variations in the plasma flow near the sonic point can either increase or decrease the resonance function P

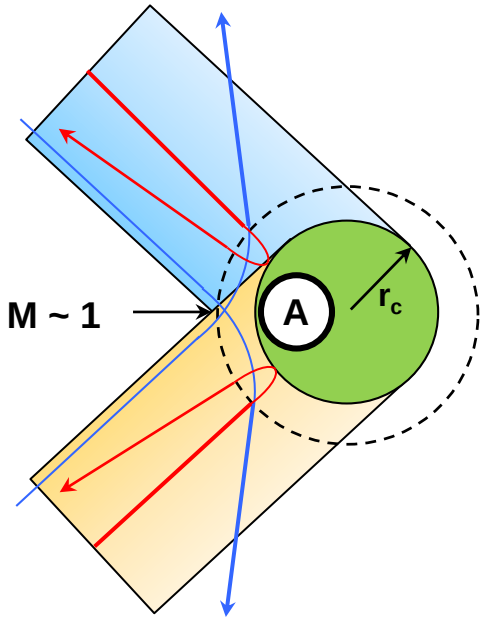
C. J. Randall, J. J. Thomson, and K. G. Estabrook, Phys. Rev. Lett. 43, 924 (1979)



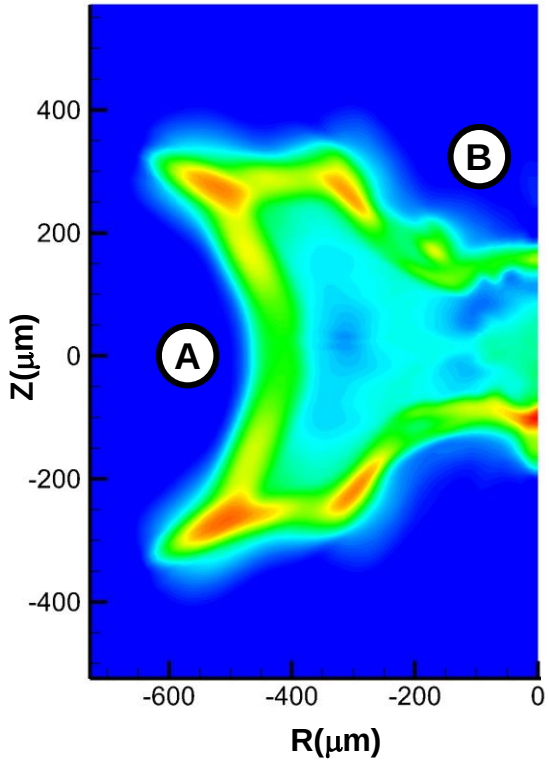
A new diagnostic is being implemented in Draco to examine the resonance function P

Further understanding of the variability of the resonance function is required to determine the overall role of CBET in this experiment

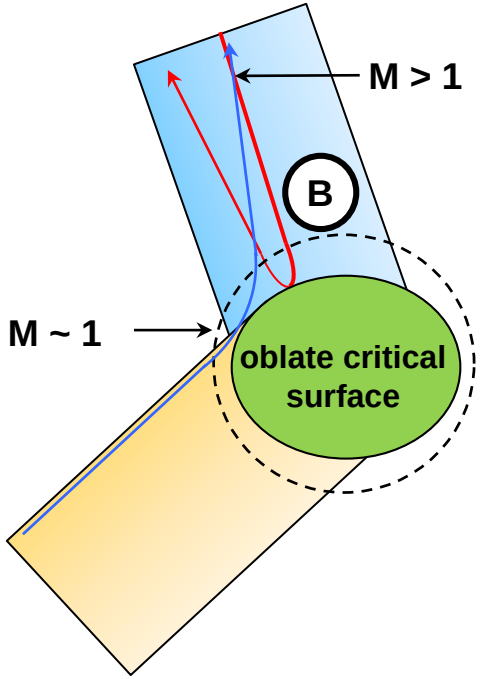
Outer cone/Outer cone



N210711-dropped bundles



Outer cone/Inner cone



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