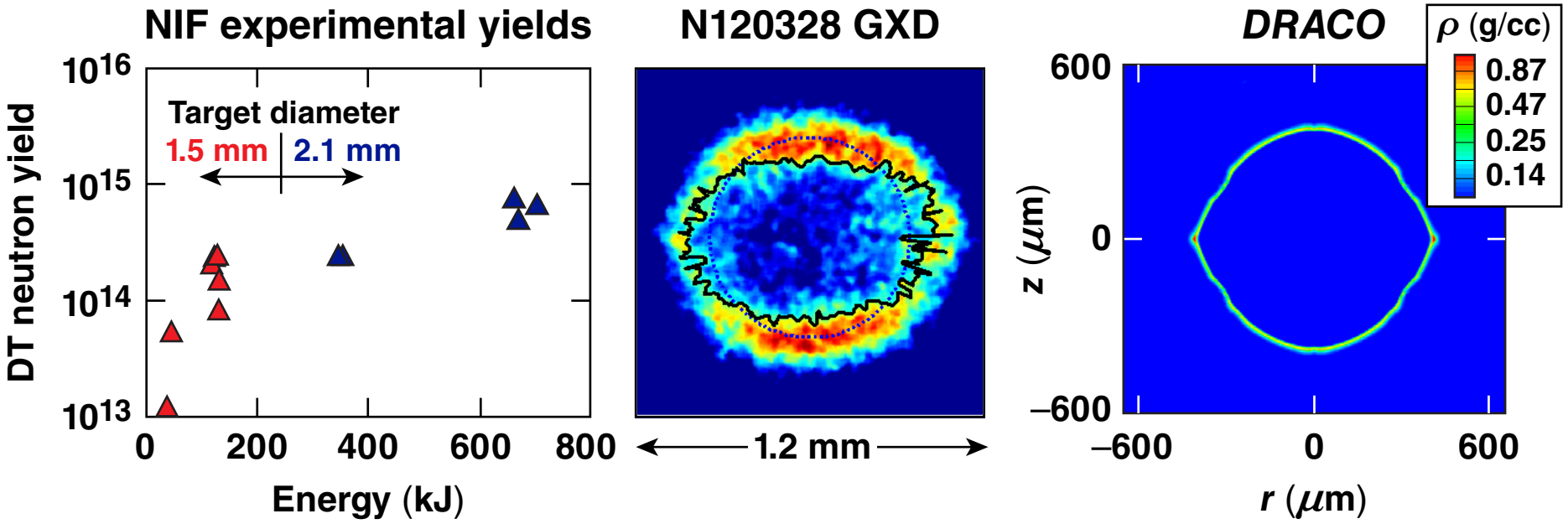
Drive-Symmetry Studies of NIF Exploding-Pusher Experiments



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Summary

Direct-drive exploding-pusher (XP) experiments have demonstrated a reproducible neutron platform

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- Early-time imaging indicates discrepancies with the simulation predictions for target drive in XP shots
- Symmetry analysis has led to a revamped illumination platform that provides improved equatorial drive and reduced overall fuel motion
- Fuel-velocity constraints make the current 1.5-mm-class XP platform unsuitable for commissioning the fixed nuclear activation diagnostics (FNADs)

Collaborators

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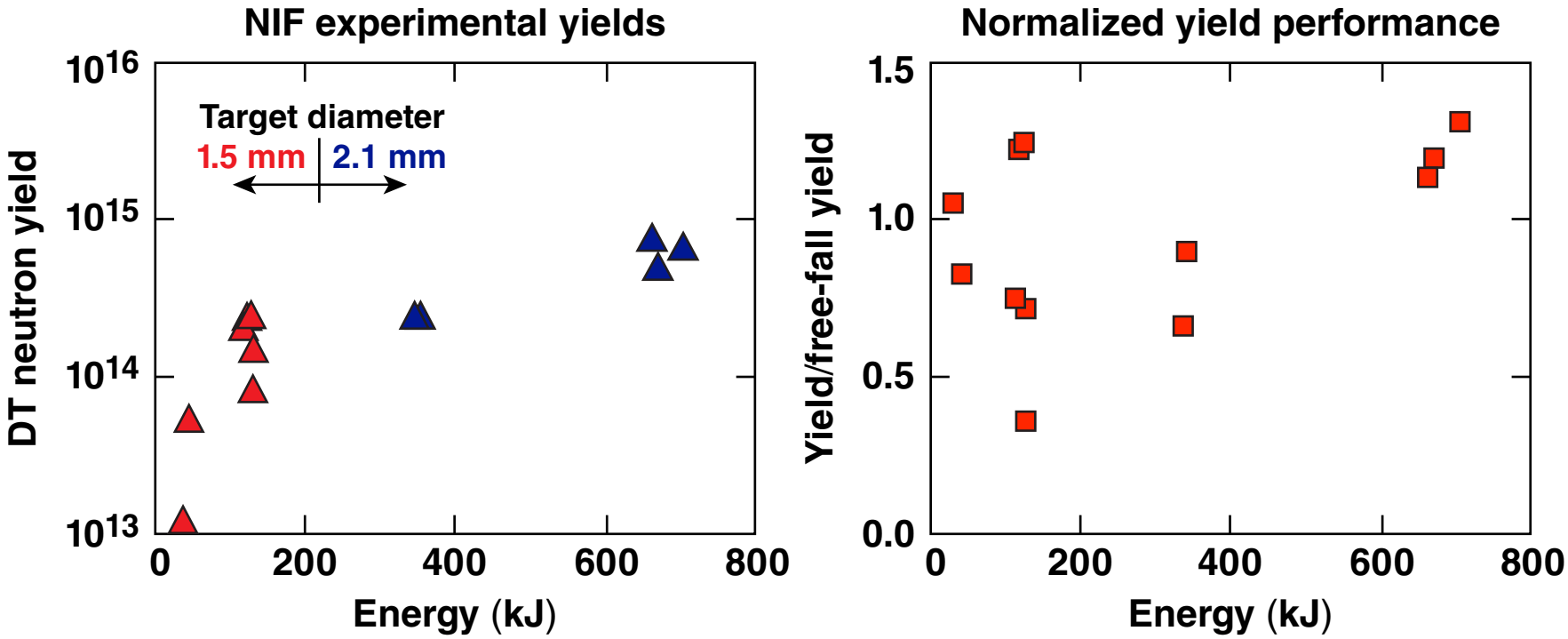
The majority of NIF XP DT yields fall to within ±50% of the 1-D *LILAC* free-fall (FF) yields



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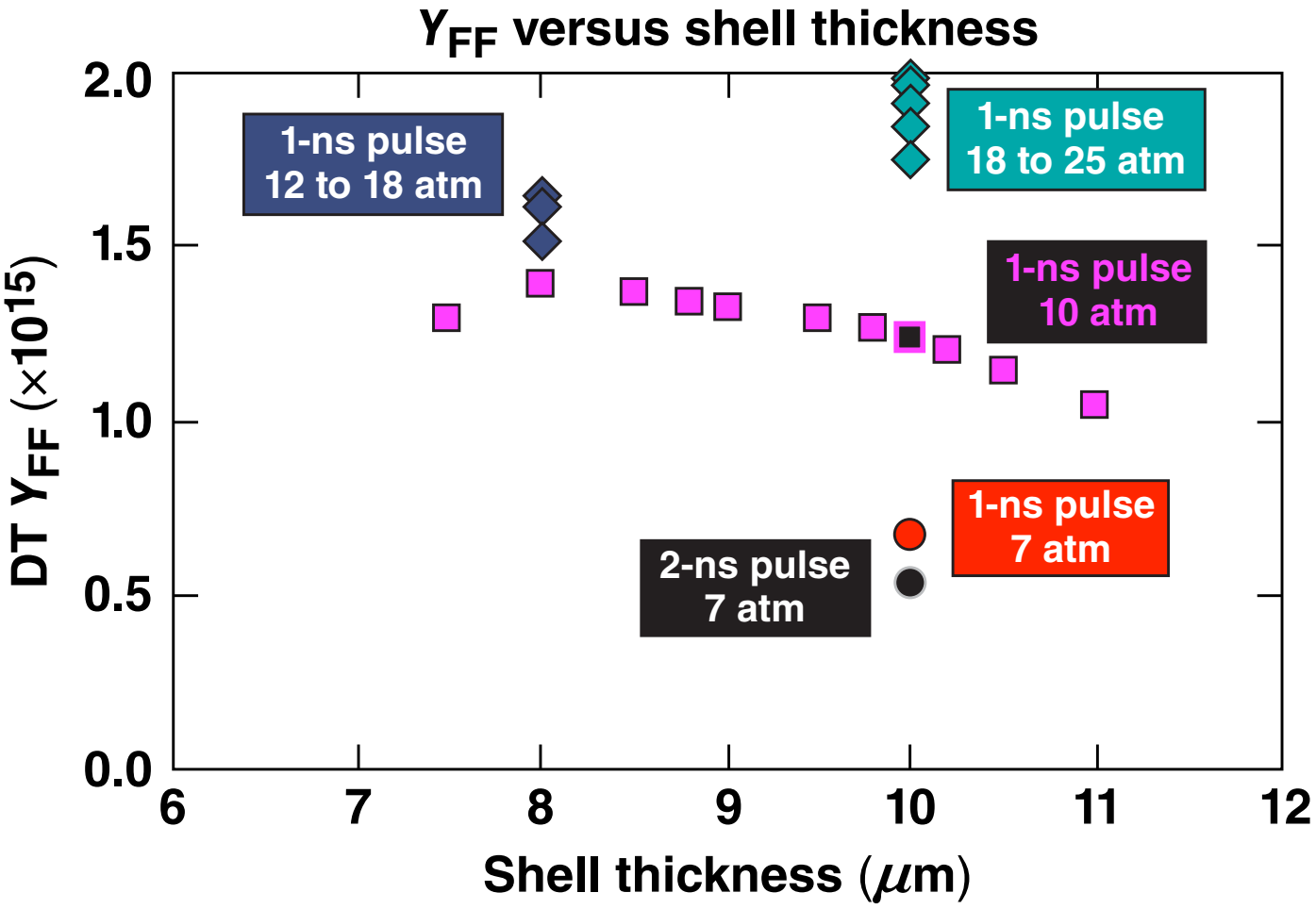
Using Y_{FF} as the performance metric, the path to reaching 1×10^{15} yields has been set



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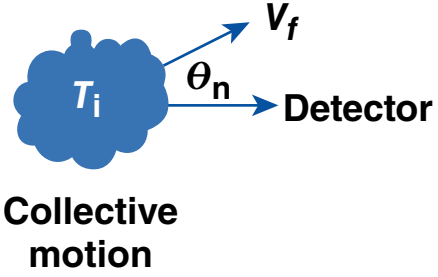
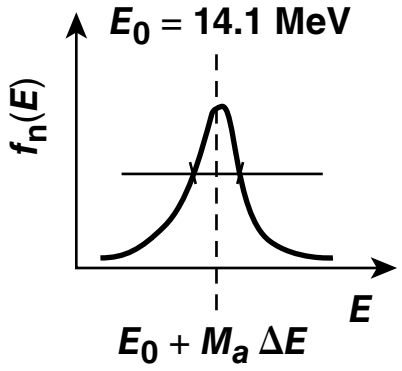
T. J. B. Collins, JO4.00010, this conference.

Flat-fielding the fixed nuclear activation diagnostics (FNADs) places strict limits on fuel velocity

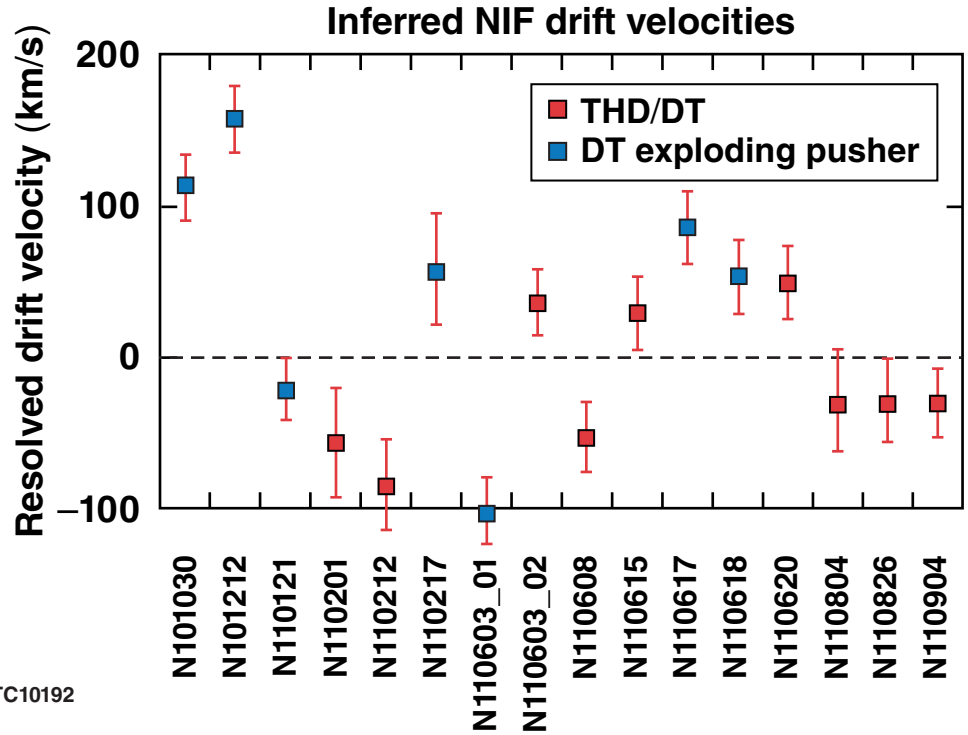


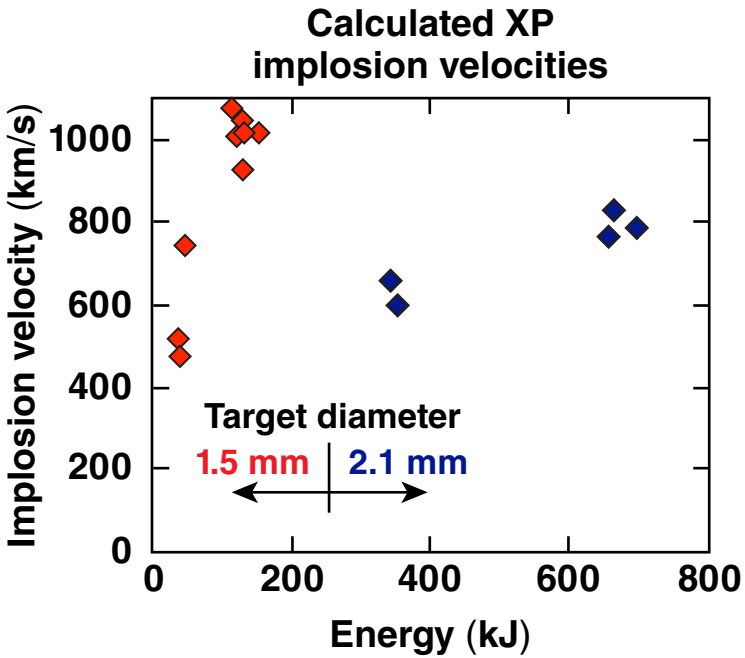


$$f(E) = \exp\left[-\left(\frac{E - E_0}{\Delta E} - M_a \cos\theta_n\right)^2\right]$$

$$M_a = \frac{V_f}{c_s}, c_s = \sqrt{\frac{T_i}{m_i}}$$

$M_a \Delta E$ ~150 keV for V_f ~ 100 km/s





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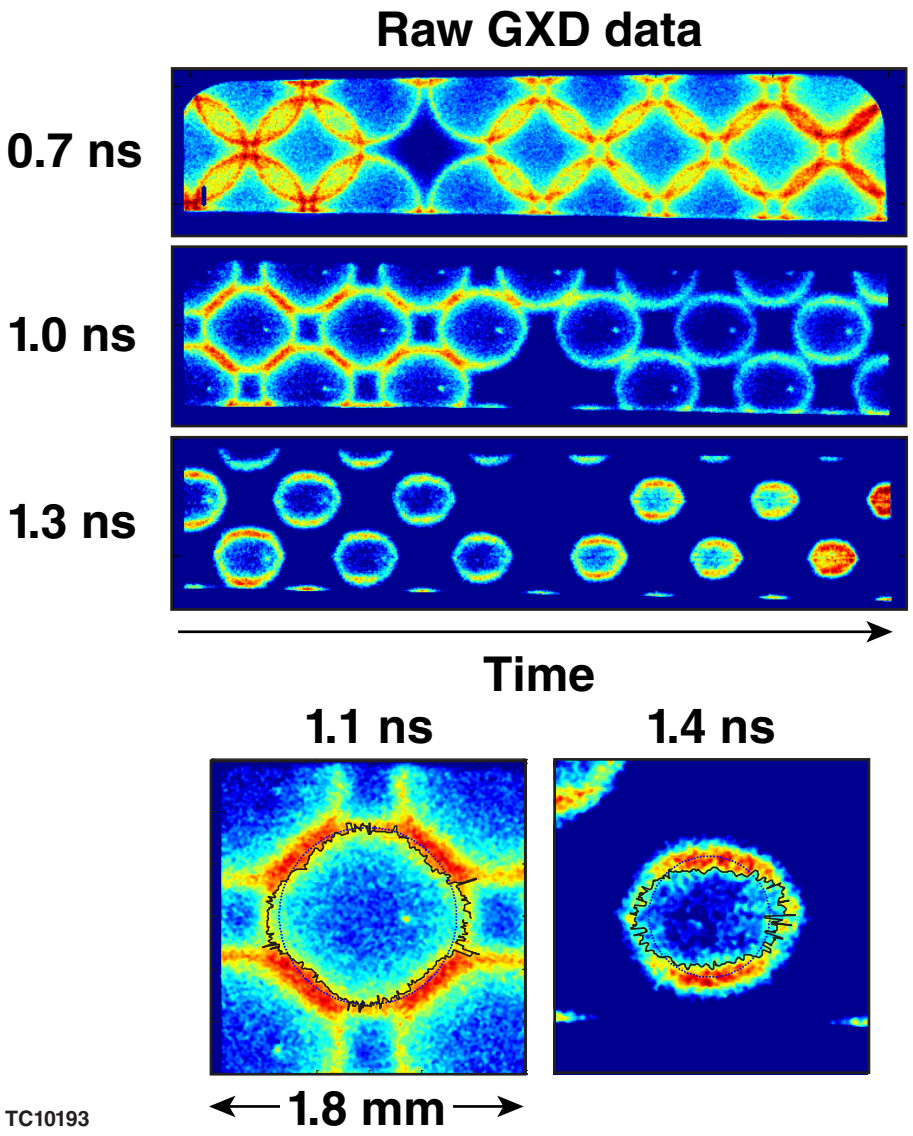
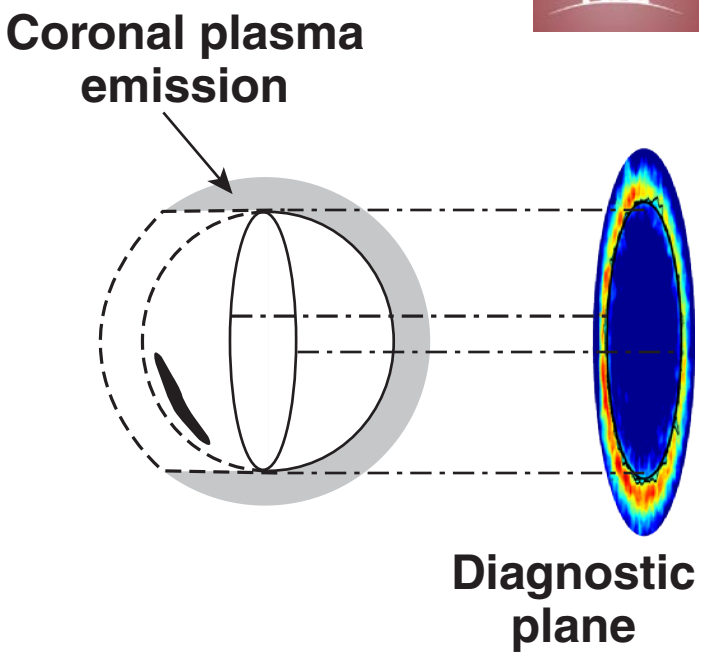
Self-backlighting* analysis was applied to gated x-ray detector (GXD) images of shot N120328



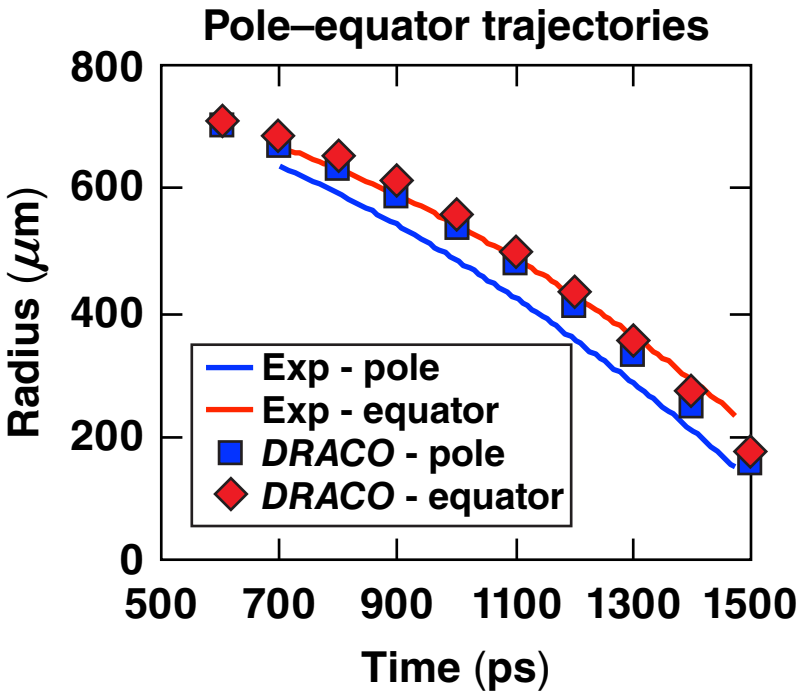


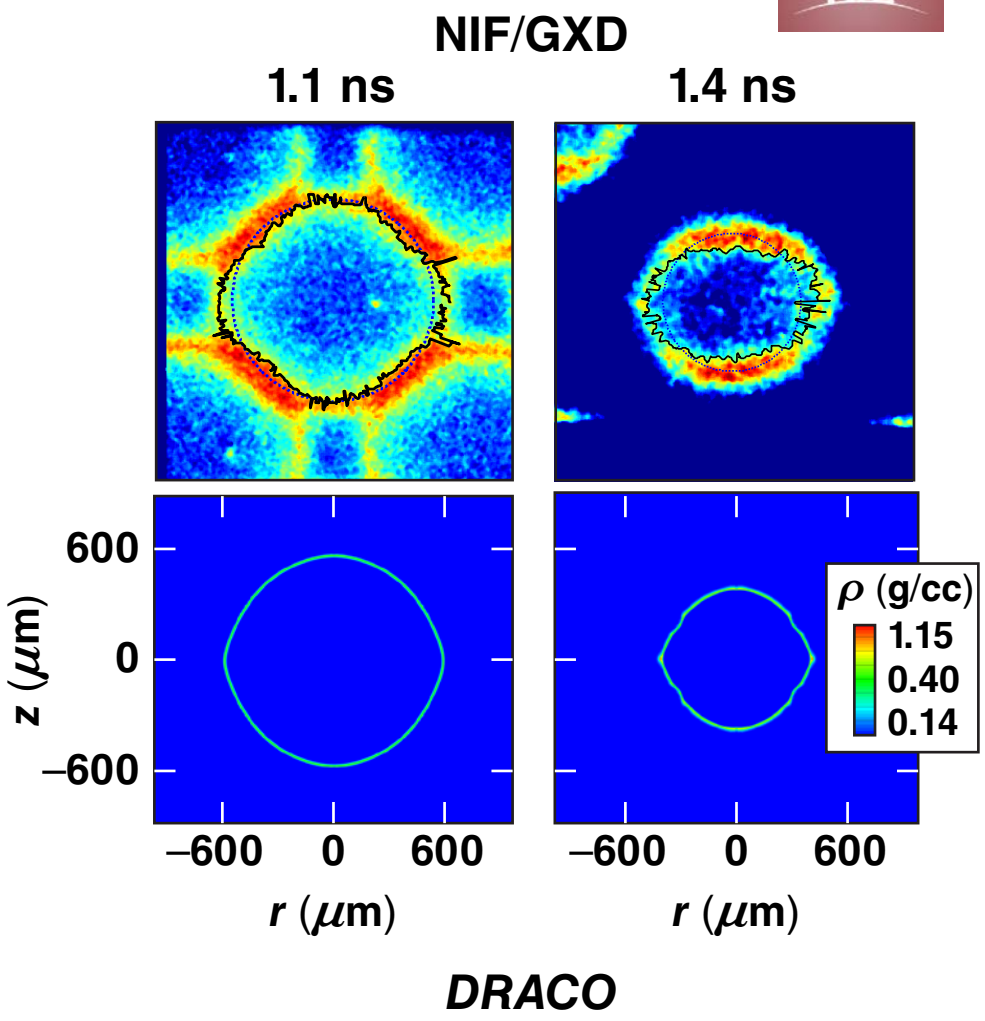
- Absorption length for 1 keV is 10 to 15 μm for 1 g/cc CH

TC10193

*D.T. Michel *et al.*, Rev. Sci. Instrum. 83, 10E530 (2012).

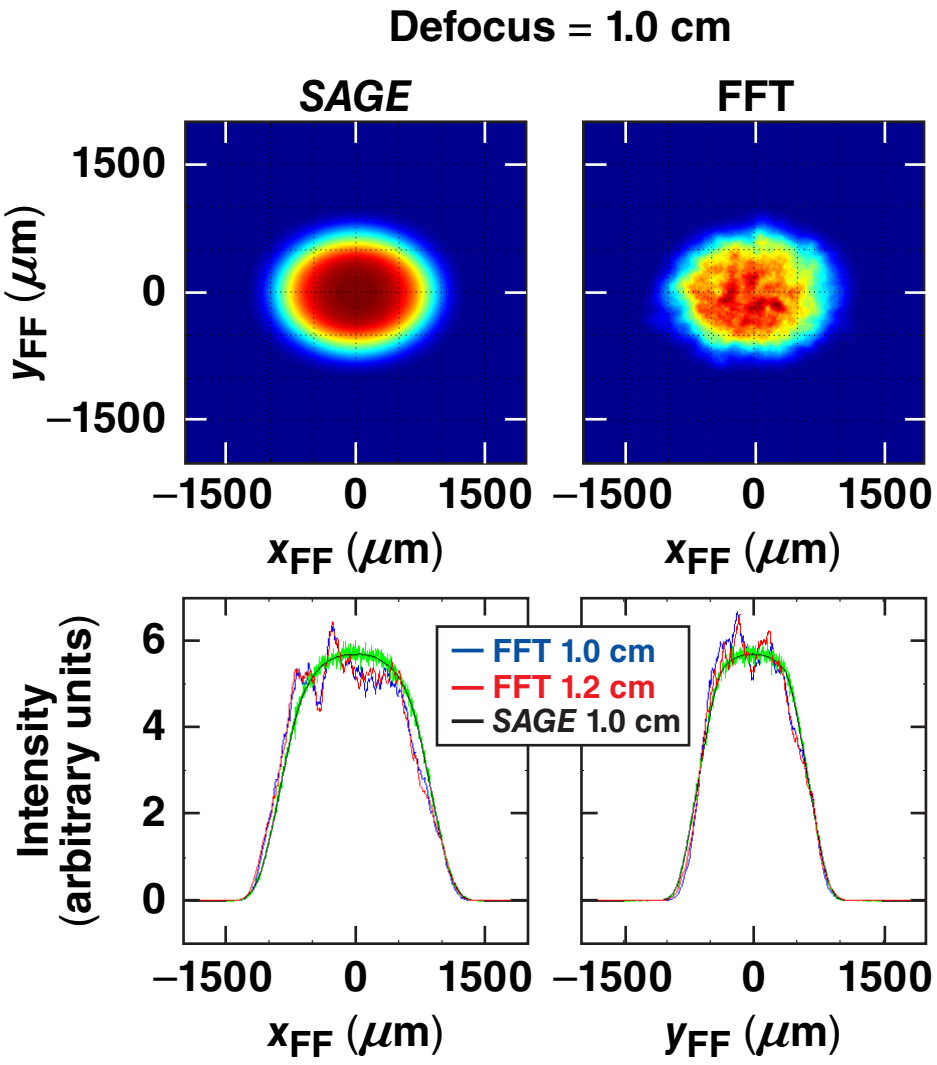
DRACO simulations of N120328 do not reproduce the asymmetry observed in GXD images





TC10194

Symmetry studies have led to a redesign of the illumination platform for the 1.5-mm-class target

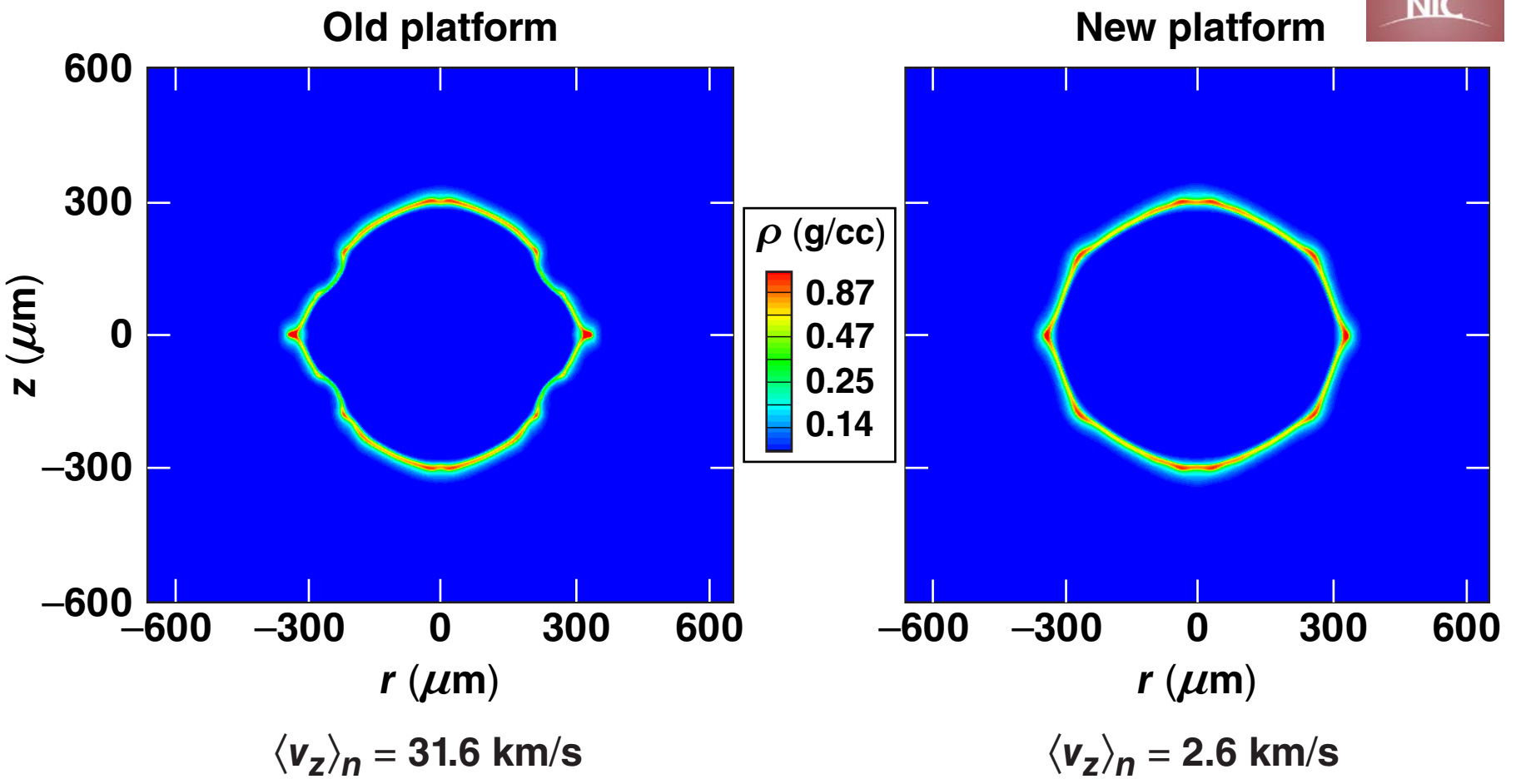


Ring	New design		
	Vertical shift (μm)	Defocus distance (cm)	Energy weight
1	–30	1.0	1.0
2	–30	1.5	1.0
3A	20	1.0	0.9
3B	–350	1.8	0.9
4A	–500	0.0	1.25
4B	–550	0.0	1.25
	Total energy = 136.5 kJ		

TC10195

R. S. Craxton, JO4.00012, this conference.

The new illumination platform provides better energy drive near the equator and lowers the fuel motion



$\langle v_z \rangle_n$ = 31.6 km/s

With measured power imbalance
$\langle v_z \rangle_n$ = 62.6 km/s

$\langle v_z \rangle_n$ = 2.6 km/s

With measured power imbalance
$\langle v_z \rangle_n$ = 53.2 km/s

TC10196

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