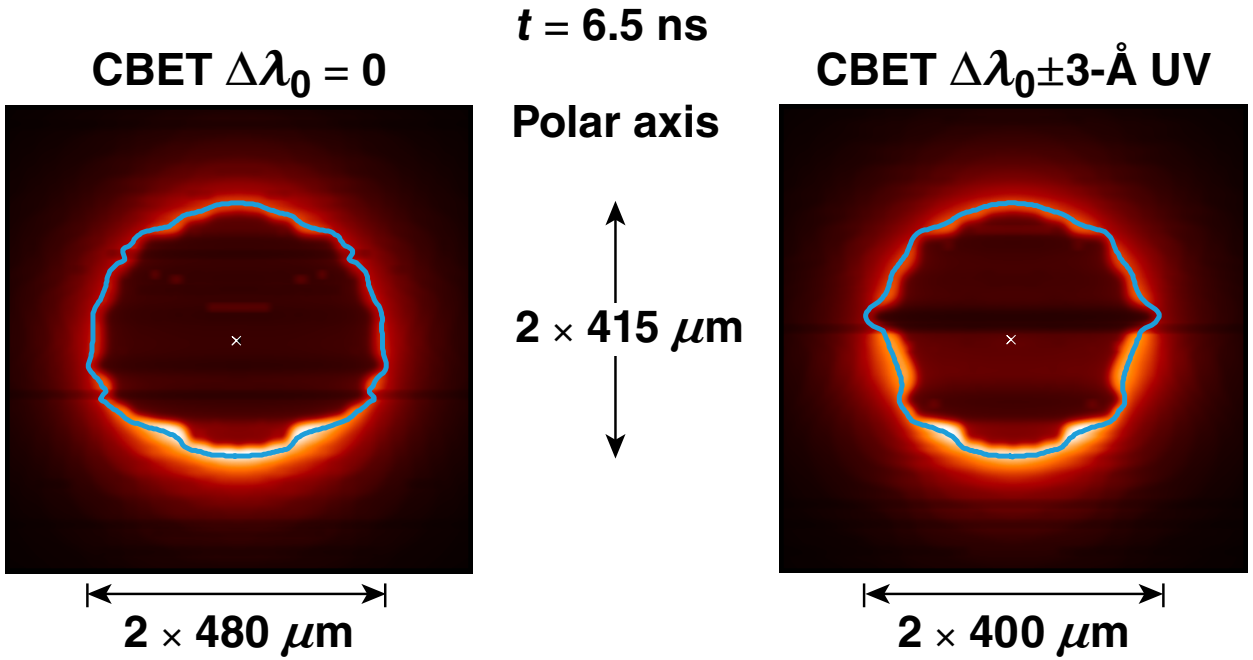
Cross-Beam Energy Transfer Mitigation Strategy for Polar Drive at the National Ignition Facility



Wavelength detuning using the National Ignition Facility's (NIF's) current configuration.

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Summary

Simulations indicate that hemispheric detuning is a promising cross-beam energy transfer (CBET) mitigation scheme achievable at the National Ignition Facility (NIF)

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- The CBET effect increases scattered light through the stimulated Brillouin scattering (SBS) of outgoing rays that removes energy from incoming high-energy rays
- The current NIF configuration allows for initial testing of the hemispheric-detuning CBET mitigation scheme
- Hemispheric detuning on the equator is accomplished using NIF's current configuration by swapping beam repointings in one hemisphere

Collaborators

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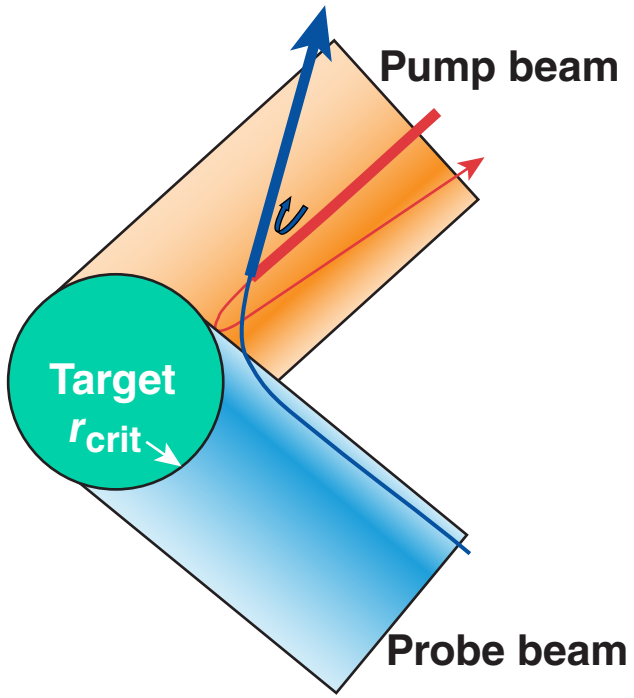
Successful wavelength detuning shifts the resonance location sufficiently to mitigate CBET

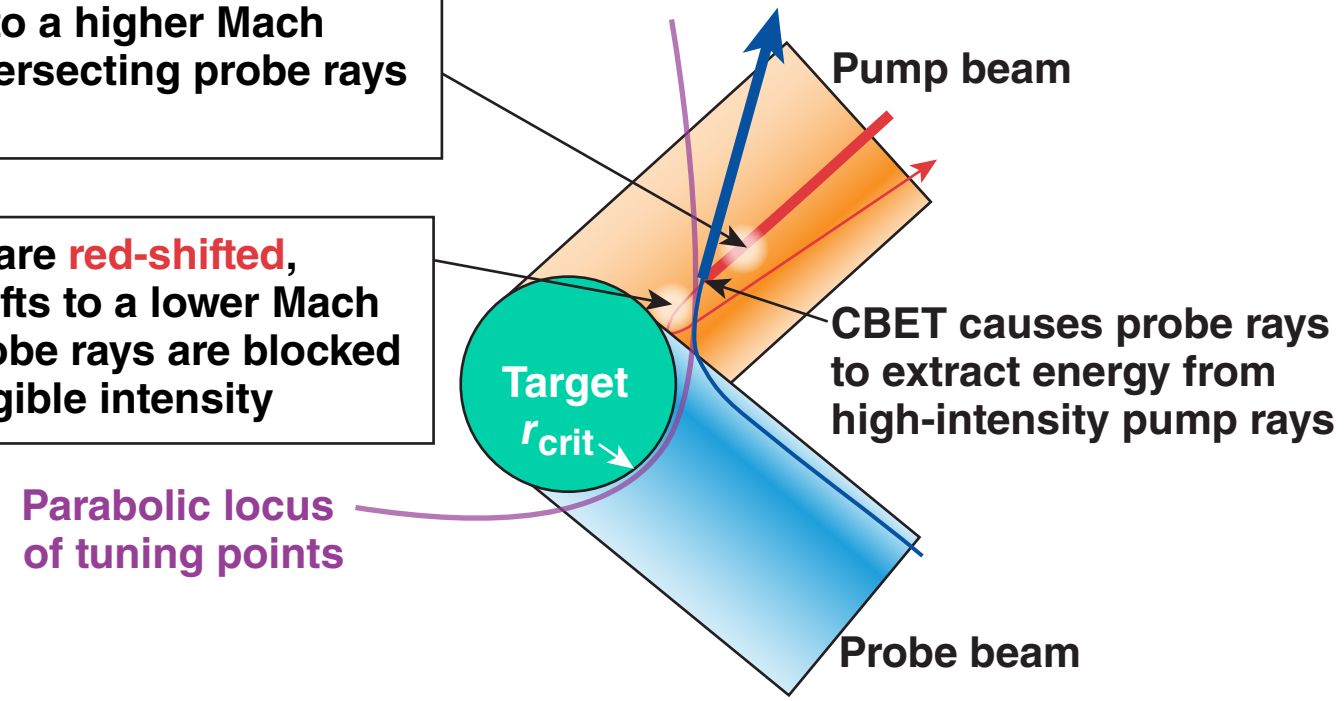


- CBET causes probe rays to extract energy from high-intensity pump rays

Successful wavelength detuning shifts the resonance location sufficiently to mitigate CBET

When probe rays are blue-shifted, the resonance shifts to a higher Mach number where intersecting probe rays are negligible

When probe rays are red-shifted, the resonance shifts to a lower Mach number where probe rays are blocked and/or have negligible intensity

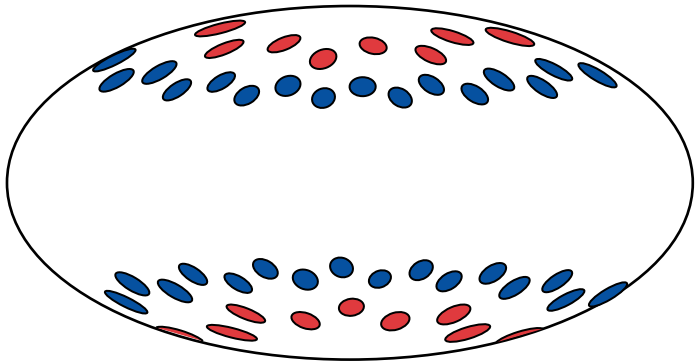


- The magnitude of $\Delta\lambda_0$ determines the mitigation duration
  - works for both symmetric and PD
  - tailoring the spot shape will help limit the required $\Delta\lambda_0$

TC1766a

The current NIF port-color arrangement can achieve hemispheric detuning CBET mitigation if one hemisphere's port repointings are swapped

Port-color arrangement

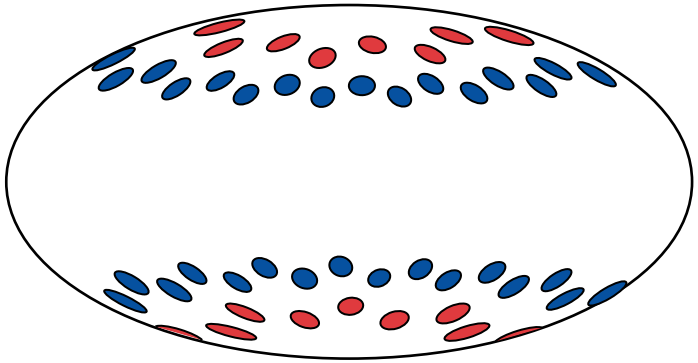


- **Two colors are assigned in NIF's current configuration: Cones 1 and 2 are red-shifted; Cone 3 is blue-shifted**

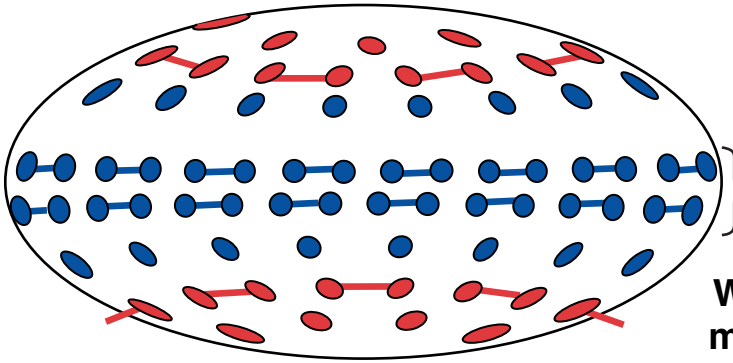
The current NIF port-color arrangement can achieve hemispheric detuning CBET mitigation if one hemisphere's port repointings are swapped

UR LLE

Port-color arrangement



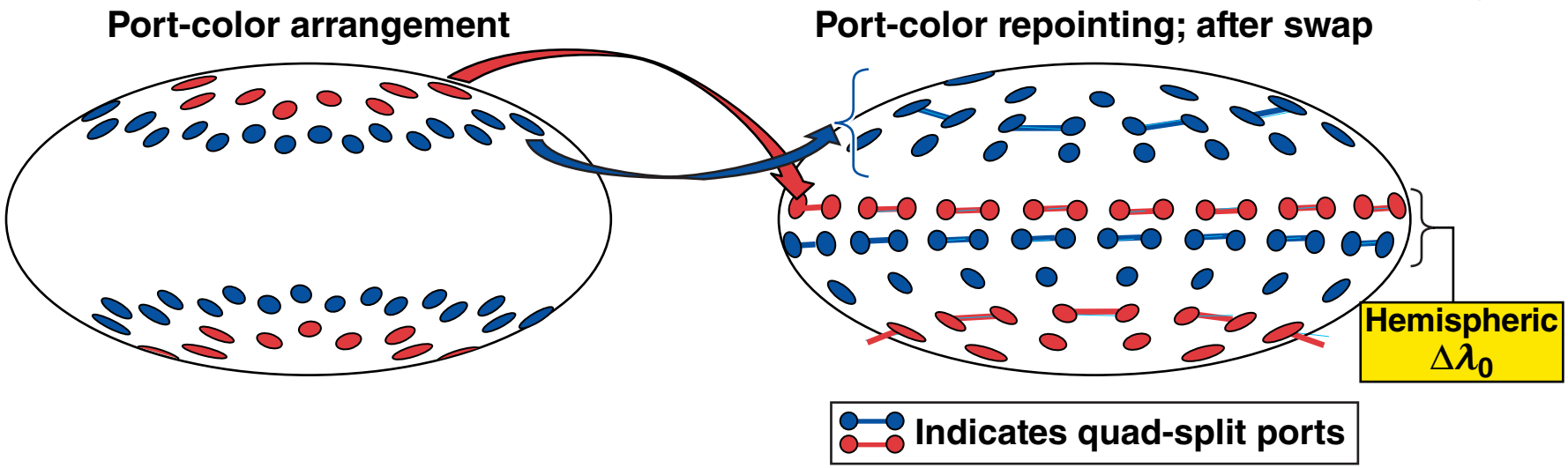
Port-color repointing; normal PD



- Two colors are assigned in NIF's current configuration: Cones 1 and 2 are red shifted; Cone 3 is blue shifted
- When ports are repointed in the typical PD manner, identical colors cover the equator
  - this configuration will not mitigate CBET

TC11736a

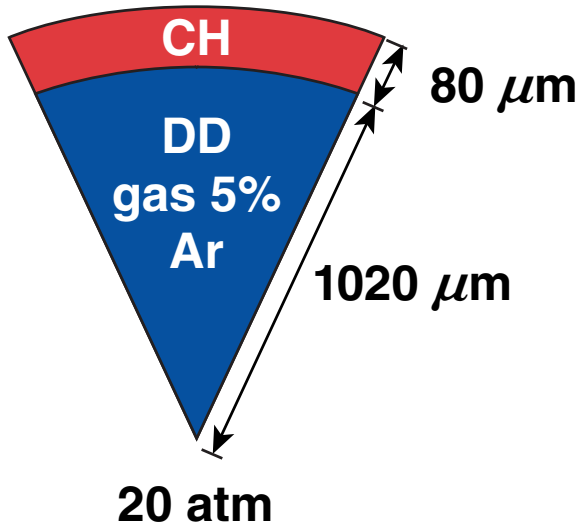
The current NIF port-color arrangement can achieve hemispheric detuning CBET mitigation if one hemisphere's port repointings are swapped

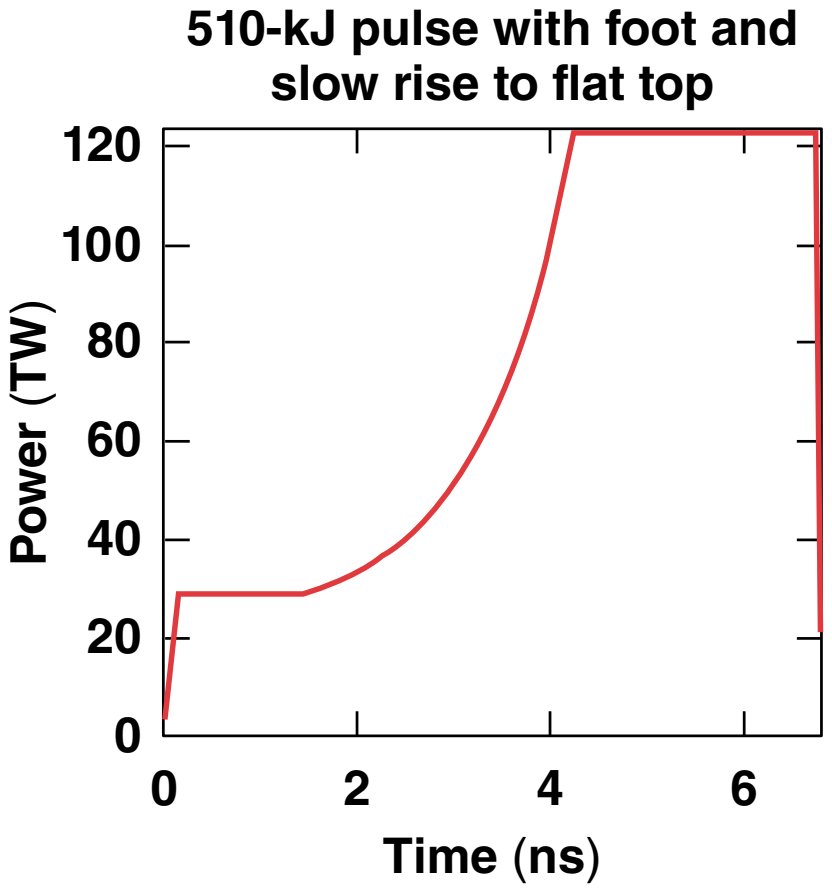


- Each latitude (north–south) has the same port configuration; e.g., number and quad split
- North–south asymmetry is balanced using
  - different pulse shapes
  - different polar pointings

TC11736b

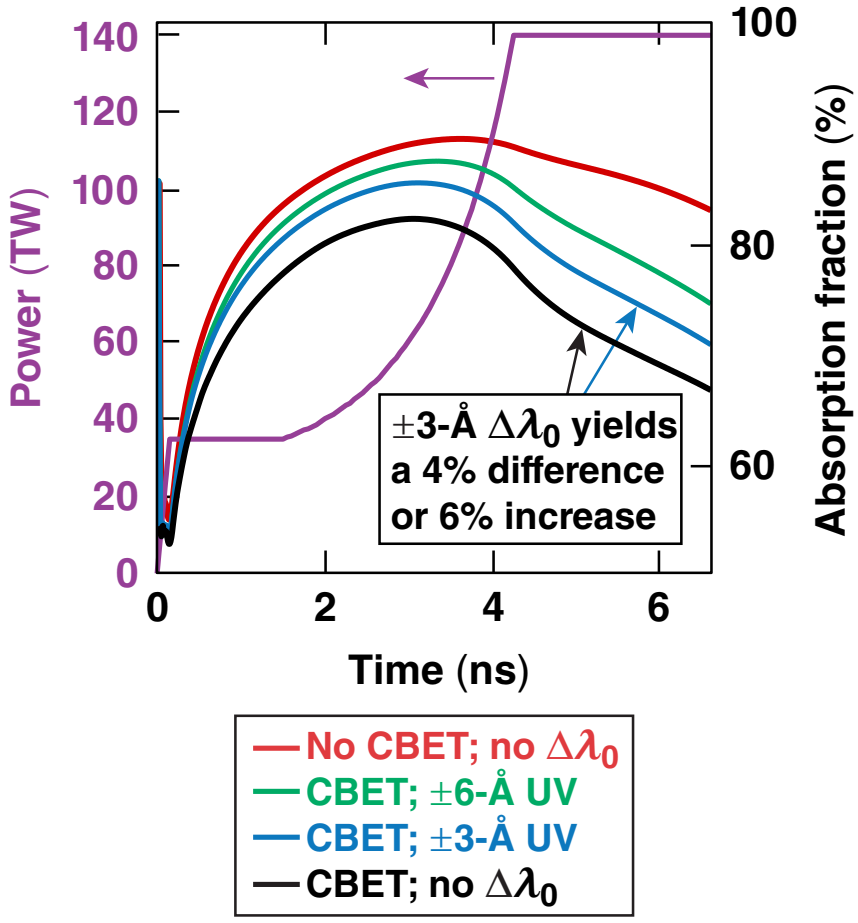
NIF shot N130731 was used as the simulation's basis for the hemispheric-detuning CBET mitigation scheme using the current NIF configuration

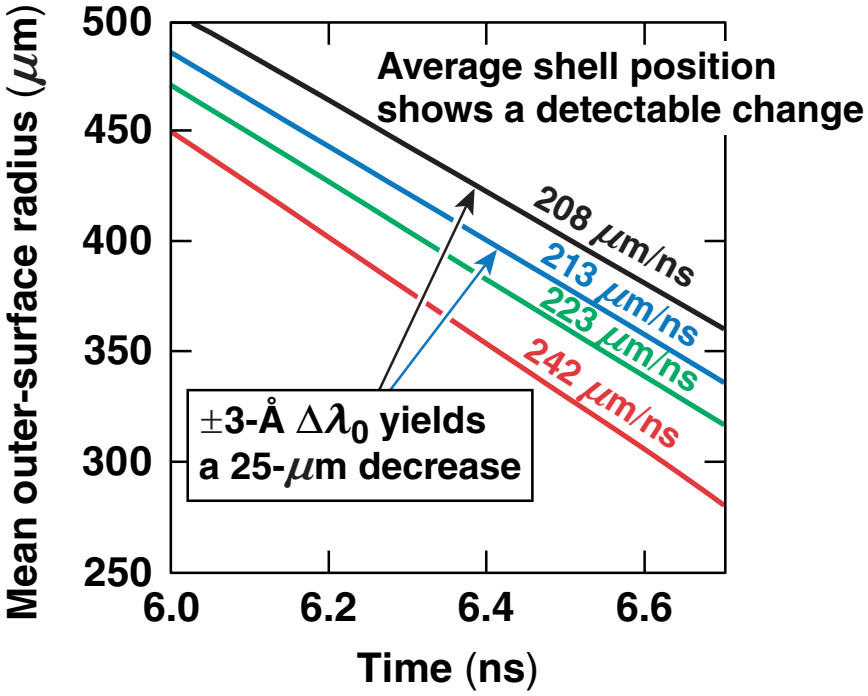




TC11340

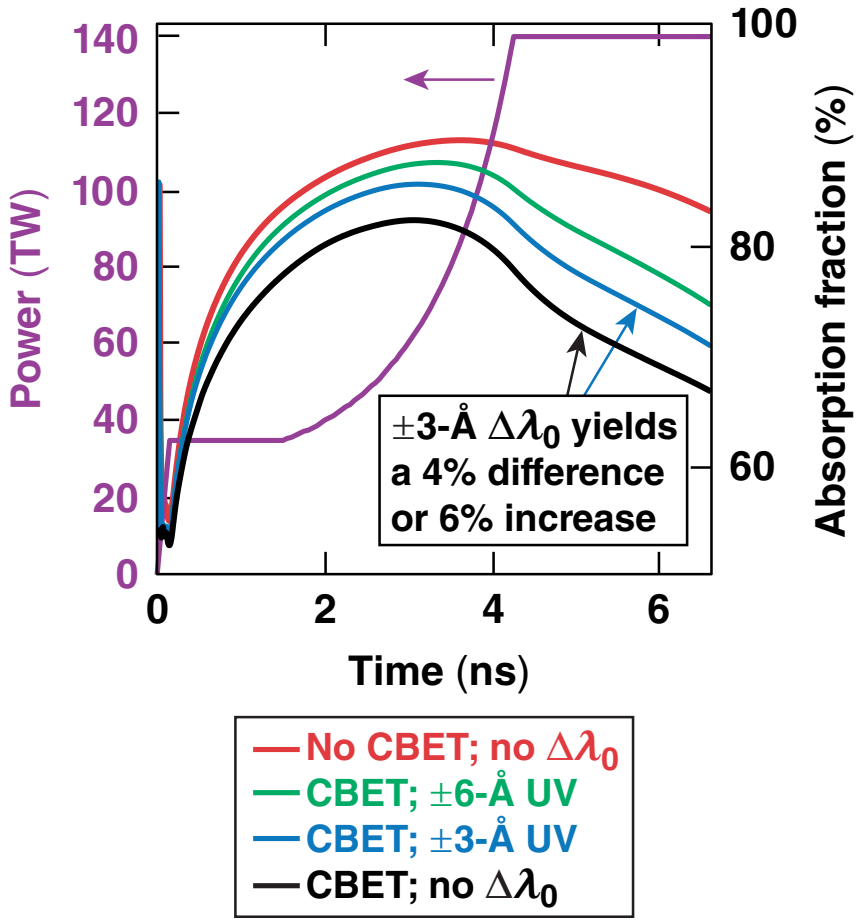
The current NIF configuration can achieve hemispheric $\Delta\lambda_0$, which increases the total absorption and shell velocity

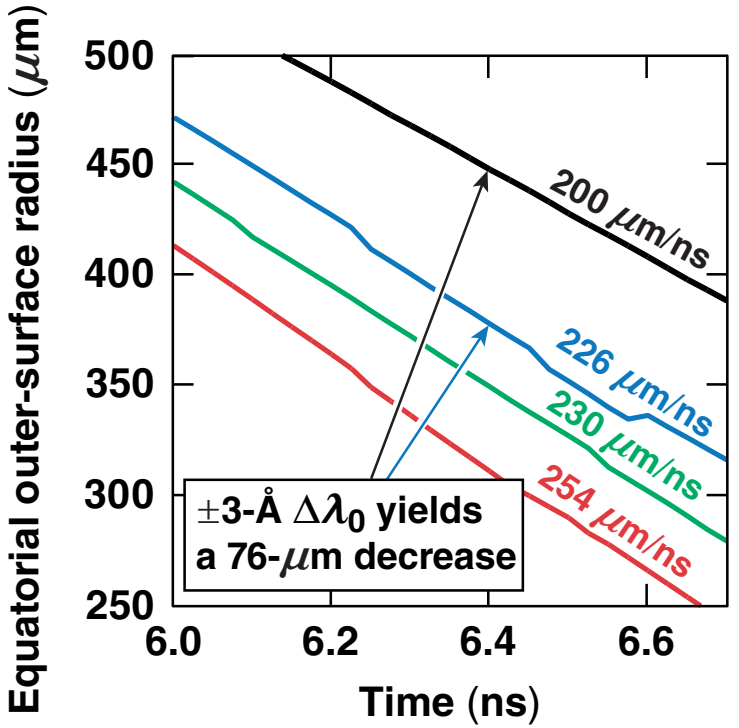




TC11737

The current NIF configuration can achieve hemispheric $\Delta\lambda_0$, which increases the total absorption and shell velocity



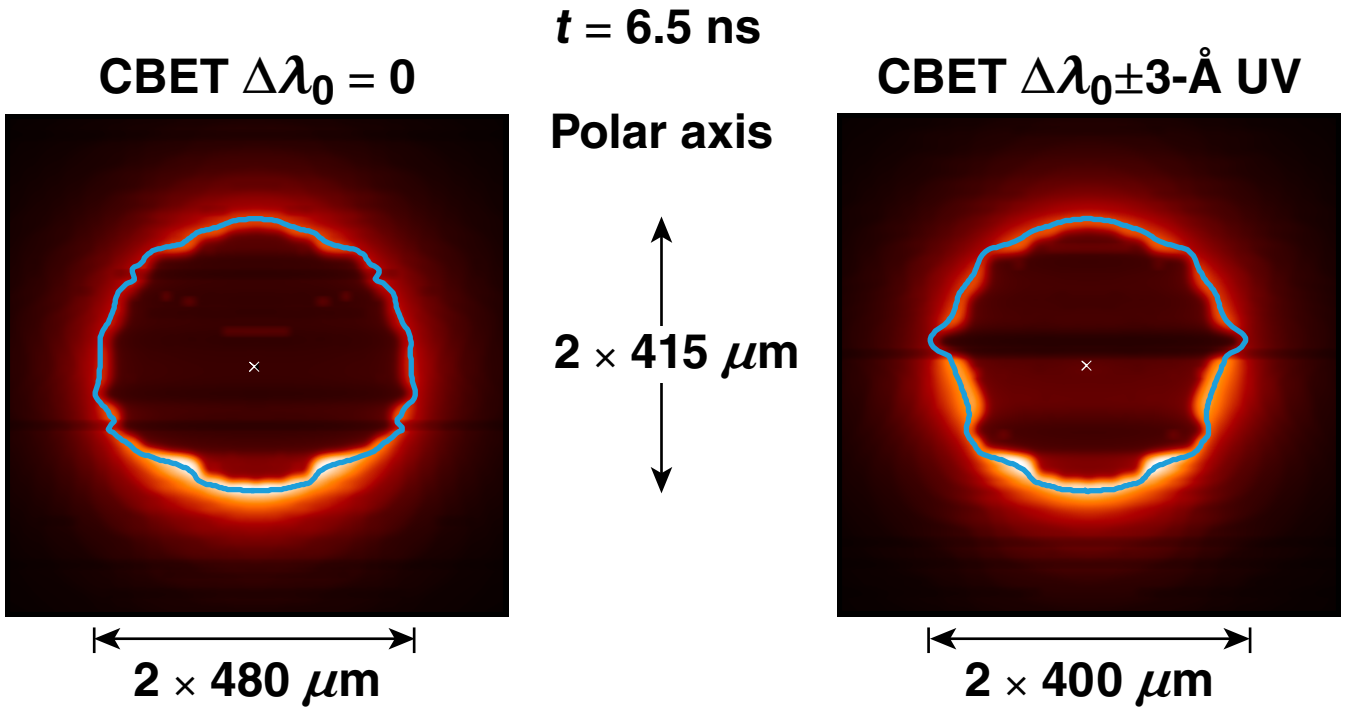


- Hemispheric detuning primarily affects the equatorial drive

TC11737a

Simulated self-emission images illustrate the predicted measurable effect of initial hemispheric detuning tests

Hemispheric detuning using the NIF's current configuration



- **The initial hemispheric detuning CBET mitigation enhances equatorial the drive as predicted; d*R* ~ 80 μm**

TC11743

The near-backscatter imaging plates are positioned to detect the changes from initial hemispheric detuning tests

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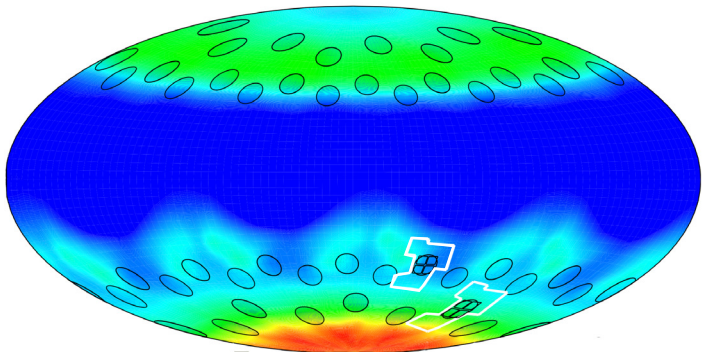
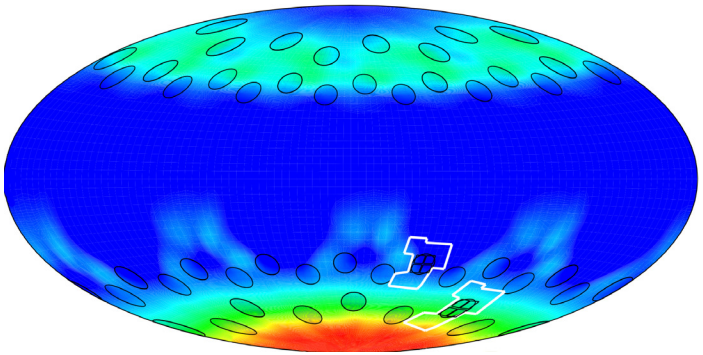
Hemispheric detuning using the NIF's current configuration

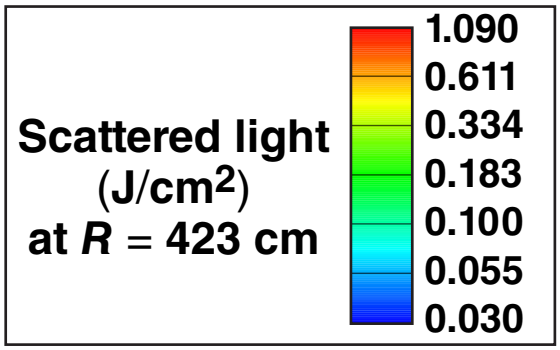
t = 6.7 ns

CBET $\Delta\lambda_0 = 0$



CBET $\Delta\lambda_0 \pm 3$-Å UV





TC11635

Summary/Conclusions

Simulations indicate that hemispheric detuning is a promising cross-beam energy transfer (CBET) mitigation scheme achievable at the National Ignition Facility (NIF)

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