Short-Pulse Stray Light Management

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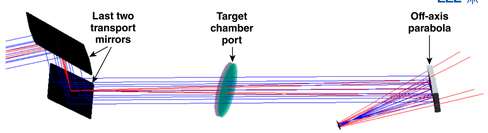
Summary/Conclusions

Reflections off of diagnostics in the path of the short-pulse beams create a threat that must be managed



- Diagnostic qualification requires stray light analysis and mitigation strategies when used opposite a short-pulse beam
- To prevent the retroreflection from damaging system optics, flat surfaces positioned within 360 mm of the short-pulse focal spot must either
  - be tilted an appropriate angle
  - or replaced with an appropriate shaped surface
    - conical surface with a 5.5° base angle
  - care taken not to direct short-pulse beam toward UV beam optics
    - *B*-integral limit determines how much short-pulse energy can impinge on UV optics

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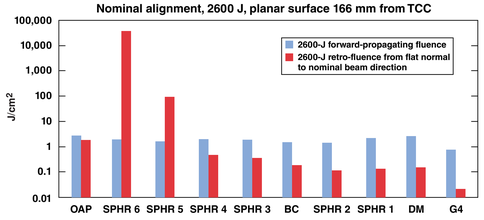
Threats are determined by calculating fluence on optics in the beam train compared to the incoming fluence

- Unsafe operation occurs when the reflected fluence exceeds the incoming fluence on an optic



In this example, SPHR 6 and SPHR 5 are considered threatened.

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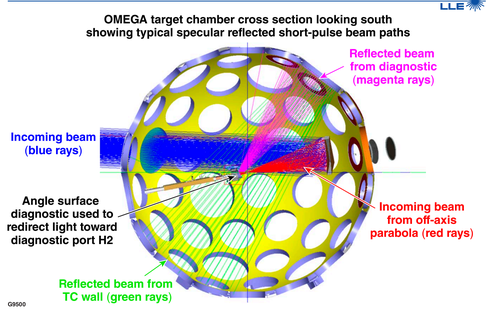
The mitigation strategy is to redirect the short-pulse reflection using angled surfaces on diagnostics and target positioners



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Example analysis results: ten-inch manipulator target positioner with LLNL target holder for OMEGA

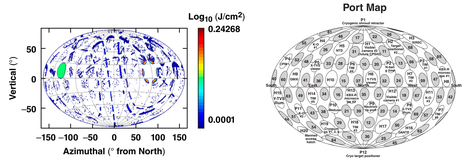
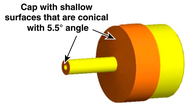


Table of *B*-integral limited fluences for OMEGA

	OMEGA EP pulse width τ (ns)		
	0.001	0.01	0.1
J/cm² onto UV optics	0.018	0.176	1.759

*B-integral calculations performed by System Science based on 2 radians maximum allowable *B*-integral



- Peak of 0.243 J/cm² for a 2600-J shot

Limit shots based on pulse width and energy level to prevent catastrophic damage to UV optics.

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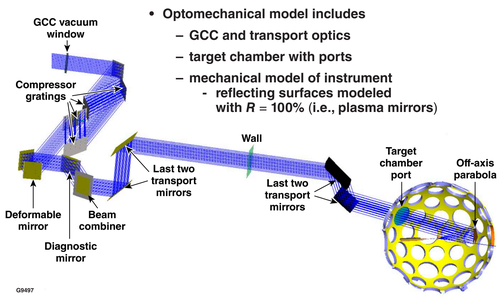
An extensive optomechanical model has been developed for both target chambers



- Optomechanical model includes
  - GCC and transport optics
  - target chamber with ports
  - mechanical model of instrument
    - reflecting surfaces modeled with *R* = 100% (i.e., plasma mirrors)

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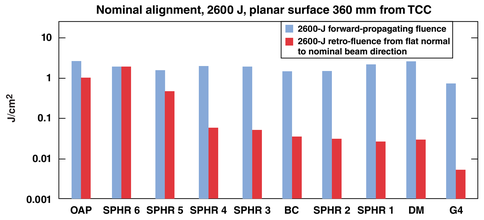
A safe keep-out distance from the target chamber center can be found to avoid damaging short pulse

- Safe operation is when the reflected fluence is less than or equal to the incoming fluence on an optic



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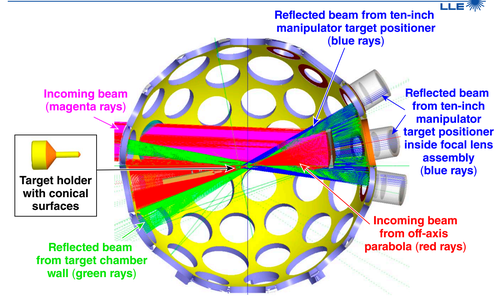
A secondary threat can exist when sufficient short-pulse light hits the UV optics after redirection



A 5.5° conical surface minimizes both threats.

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Example analysis results: ten-inch manipulator target positioner holder for OMEGA EP backlighter

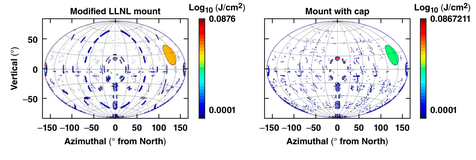
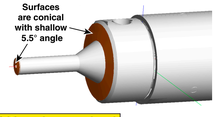


Table of *B*-integral limited fluences for OMEGA EP

	OMEGA EP pulse width τ (ns)		
	0.001	0.01	0.1
J/cm² onto UV optics	0.012	0.123	1.228

*B-integral calculations performed by System Science based on 2 radians maximum allowable *B*-integral



Limit shots based on pulse width and energy level to prevent catastrophic damage to UV optics.

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