Exploration of Plasma Optics for Increasing NIF ARC Intensity

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The Advanced Radiographic Capability (ARC) [1] at the National Ignition Facility (NIF) is an entirely unique short-pulse laser system, with four separate petawatt-class beams that can be individually pointed and timed, with a total energy of 6 kJ in a 30 ps pulse duration. Due to the necessity of placing the final focusing parabola outside the 10 meter-diameter NIF chamber, the intensity of NIF ARC is limited by its long focal length: f/30 x f/60, producing a non-ideal spot size. This sets the intensity per beamlet to the low 10^{18} W/cm^2 range.

To increase laser intensities, increased laser energy and reduced pulselength are typically employed. Another possible route is to decrease the focused spot size by employing a smaller f-number (i.e., large) optic. However, the large and complex NIF chamber geometry does not easily allow a lower f-number optic or conventional parabola mirror to be placed closer to the target. In order to overcome this limitation, we propose the use of ellipsoidal plasma mirrors for fast focusing of the ARC laser light, thereby increasing the peak intensity. Here we will discuss the considerations for deploying such an optic on NIF ARC, and issues with plasma mirror survivability and reflectivity for these longer (10-30 ps) timescales.

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References

[1] J. K. Crane *et al.,* J. Phys: Conf. Ser. **244**, 032003 (2010)