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Baseline Unconverted Light Management Plan (Indirect Drive Configuration)

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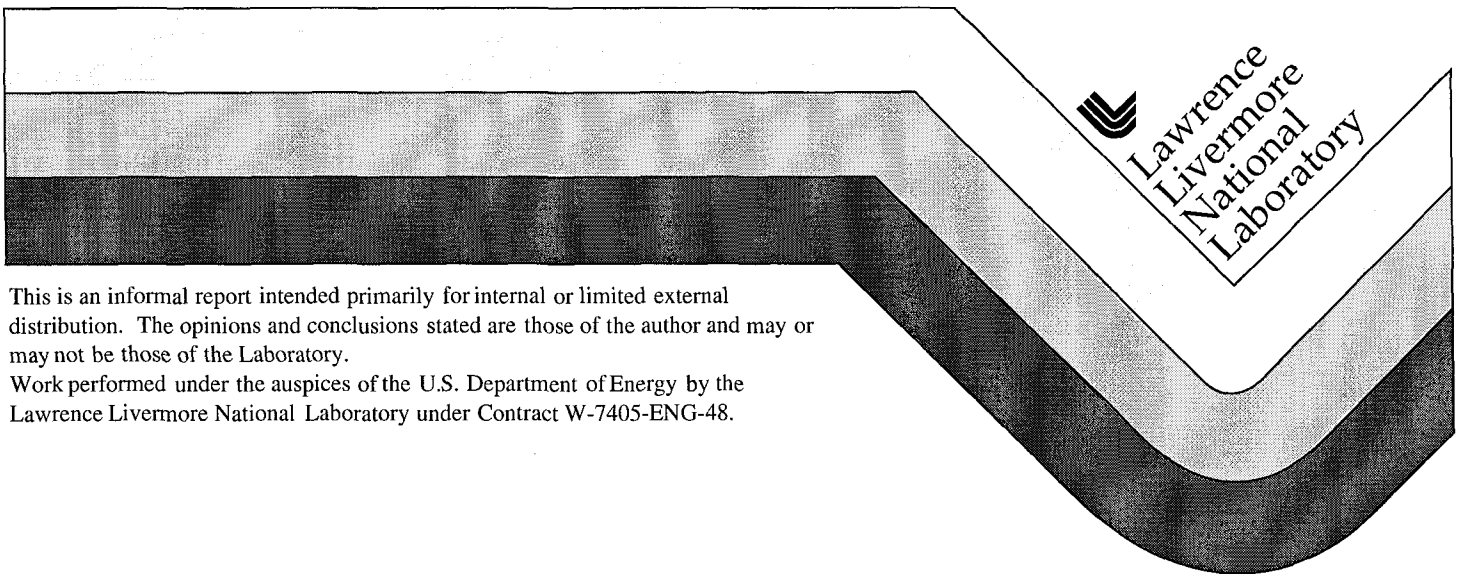

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From: Dan Kalantar and Sham Dixit

Subject: Baseline Unconverted Light Management Plan (Indirect Drive Configuration)

This document defines the baseline plan for the management of unconverted light in the NIF target chamber. It includes a detailed description of the characteristics of the diffractive optics (color separation grating) and their orientation for each beam. The resulting unconverted light distribution is then described in a form that will ease experiment planning.

Unconverted light management on the NIF

The NIF target chamber is subject to large fluences of unconverted 1w and 2w laser light. The distribution of this unconverted light is to be managed by using a color separation grating. The optic containing this grating pattern shall have a transmission efficiency at 3w of >95%, averaged over the full area of the beam. The grating may occupy a sub-aperture portion of the beam. It shall have a zero order transmission efficiency <1% at 1w and 2w, and should have a transmission efficiency <0.5% at 1w and 2w.

The baseline format and orientation for the grating pattern on the diffractive optic plate are determined based on experimental considerations:

1. Confine the distribution of unconverted light to two wedge segments in the midplane of the target chamber. These wedge segments are determined based on the following requirements
   - maintain the diagnostic lines of sight for soft x-ray power diagnostics and orthogonal DIM views in the target chamber midplane clear from unconverted light
   - maintain the target positioner clear from unconverted light.
   - maintain the vertical DIM view clear of unconverted light
2. Deflect the unconverted light from the LEH for a standard ignition hohlraum, leaving at least 6 mm diameter clearance.
3. Deflect the unconverted light in a manner that does not adversely affect the NIF target chamber itself.

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Baseline color separation grating

The baseline color separation grating format and installation orientation are described below. This baseline may be modified to accommodate specific experiments, but changes should be reviewed to ensure compatibility with the target area and target chamber requirements.

Format

The color separation grating pattern shall occupy a circular sub-aperture portion of the beam with a 15 cm diameter, centered on the beam. The grating pattern is to be located on one of the diffractive optics plates located in the diffractive optics cassette. The pattern is to be a split grating design that disperses the light in two directions with a grating period of 1115 μm, as illustrated in Figure 1.

Orientation

The orientation of the grating pattern is determined for each beamlet so as to distribute the unconverted light in the midplane of the target chamber in 2 segments of approximately 45° extent, as shown in Figure 2. The coordinates used to define the CSG orientation are the local FOA coordinates described in NIF Drawing No. AAA96-104900-OC, and represented here in Figure 3.

Location

The baseline plan is to locate the color separation grating pattern on the reverse side of the diffractive optic plate used for the beam sampling grating.

There is a reflection symmetry between adjacent beamlets within each final optics assembly. As a result, there are two separate designs for the beam sampling grating for each orientation of the color separation grating. The separate BSG/CSG combinations required under the Baseline Unconverted Light Management Plan are listed in Table 1.

The assignment for BSG/CSG installation for all beams is listed in Table 2 for the indirect drive NIF configuration.

Table 1: Listing of the BSG/CSG configurations required for the NIF under the Baseline Unconverted Light Management Plan.

PartNo.	Quantity	CSG orientation	BSG type
1	24	-72.5°	Left
2	24	-72.5°	Right
3	24	-27.5°	Left
4	24	-27.5°	Right
5	24	17.5°	Left
6	24	17.5°	Right
7	24	62.5°	Left
8	24	62.5°	Right

Table 2: CSG/BSG assignment for each beam.

Quad No.	Beam port	Theta – target chamber coord's (°)	Phi – target chamber coord's (°)	Grating orient'n – beam coord's (°)	Beams	BSG type	BSG/ CSG type (Table 1)
Q11T	17	50	39.67	-72.5	1, 3	Left	1
					2, 4	Right	2
Q12T	10	44.5	62.455	-72.5	1, 3	Left	1
					2, 4	Right	2
Q13T	5	30.58	34.33	-72.5	1, 3	Left	1
					2, 4	Right	2
Q14T	9	44.5	16.29	-27.5	1, 3	Left	3
					2, 4	Right	4
Q15T	1	23.5	78.75	62.5	1, 3	Left	7
					2, 4	Right	8
Q16T	18	50	84.38	62.5	1, 3	Left	7
					2, 4	Right	8
Q21T	24	50	354.38	-27.5	1, 3	Left	3
					2, 4	Right	4
Q22T	16	44.5	332.46	17.5	1, 3	Left	5
					2, 4	Right	6
Q23T	23	50	309.38	17.5	1, 3	Left	5
					2, 4	Right	6
Q24T	4	23.5	348.75	-27.5	1, 3	Left	3
					2, 4	Right	4
Q25T	15	44.5	286.3	62.5	1, 3	Left	7
					2, 4	Right	8
Q26T	8	30	303.75	17.5	1, 3	Left	5
					2, 4	Right	6
Q31T	22	50	264.38	62.5	1, 3	Left	7
					2, 4	Right	8
Q32T	14	44.5	242.46	-72.5	1, 3	Left	1
					2, 4	Right	2
Q33T	3	23.5	258.75	62.5	1, 3	Left	7
					2, 4	Right	8
Q34T	21	50	219.67	-72.5	1, 3	Left	1
					2, 4	Right	2
Q35T	13	44.5	196.29	-27.5	1, 3	Left	3
					2, 4	Right	4
Q36T	7	30.39	214.33	-72.5	1, 3	Left	1
					2, 4	Right	2

Quad No.	Beam port	Theta – target chamber coord's (°)	Phi – target chamber coord's (°)	Grating orient'n – beam coord's (°)	Beams	BSG type	BSG/ CSG type (Table 1)
Q41T	6	30	123.75	17.5	1, 3	Left	5
					2, 4	Right	6
Q42T	2	23.5	168.75	-27.5	1, 3	Left	3
					2, 4	Right	4
Q43T	11	44.5	106.3	62.5	1, 3	Left	7
					2, 4	Right	8
Q44T	20	50	174.38	-27.5	1, 3	Left	3
					2, 4	Right	4
Q45T	12	44.5	152.46	17.5	1, 3	Left	5
					2, 4	Right	6
Q46T	19	50	129.38	17.5	1, 3	Left	5
					2, 4	Right	6
Q11B	50	130	50.52	62.5	1, 3	Left	7
					2, 4	Right	8
Q12B	58	135.5	73.705	-72.5	1, 3	Left	1
					2, 4	Right	2
Q13B	49	130	5.62	17.5	1, 3	Left	5
					2, 4	Right	6
Q14B	57	135.5	27.545	62.5	1, 3	Left	7
					2, 4	Right	8
Q15B	69	156.5	11.25	17.5	1, 3	Left	5
					2, 4	Right	6
Q16B	65	150	56.25	62.5	1, 3	Left	7
					2, 4	Right	8
Q21B	68	149.42	325.67	-27.5	1, 3	Left	3
					2, 4	Right	4
Q22B	64	135.5	343.71	17.5	1, 3	Left	5
					2, 4	Right	6
Q23B	56	130	320.33	-27.5	1, 3	Left	3
					2, 4	Right	4
Q24B	72	156.5	281.25	-72.5	1, 3	Left	1
					2, 4	Right	2
Q25B	63	135.5	297.55	-27.5	1, 3	Left	3
					2, 4	Right	4
Q26B	55	130	275.62	-72.5	1, 3	Left	1
					2, 4	Right	2

Quad No.	Beam port	Theta – target chamber coord's (°)	Phi – target chamber coord's (°)	Grating orient'n – beam coord's (°)	Beams	BSG type	BSG/ CSG type (Table 1)
Q31B	67	150	236.25	62.5	1, 3	Left	7
					2, 4	Right	8
Q32B	62	135.5	253.71	-72.5	1, 3	Left	1
					2, 4	Right	2
Q33B	71	156.5	191.25	17.5	1, 3	Left	5
					2, 4	Right	6
Q34B	54	130	230.62	62.5	1, 3	Left	7
					2, 4	Right	8
Q35B	61	135.5	207.55	62.5	1, 3	Left	7
					2, 4	Right	8
Q36B	53	130	185.62	17.5	1, 3	Left	5
					2, 4	Right	6
Q41B	51	130	95.62	-72.5	1, 3	Left	1
					2, 4	Right	2
Q42B	70	156.5	101.25	-72.5	1, 3	Left	1
					2, 4	Right	2
Q43B	59	135.5	117.55	-27.5	1, 3	Left	3
					2, 4	Right	4
Q44B	66	149.42	145.67	-27.5	1, 3	Left	3
					2, 4	Right	4
Q45B	60	135.5	163.71	17.5	1, 3	Left	5
					2, 4	Right	6
Q46B	52	130	140.33	-27.5	1, 3	Left	3
					2, 4	Right	4

Figure 1: Baseline color separation grating format. The grating is located on a circular region at the center of the beam. The grating pattern is split to disperse the light from the two halves in opposite directions.

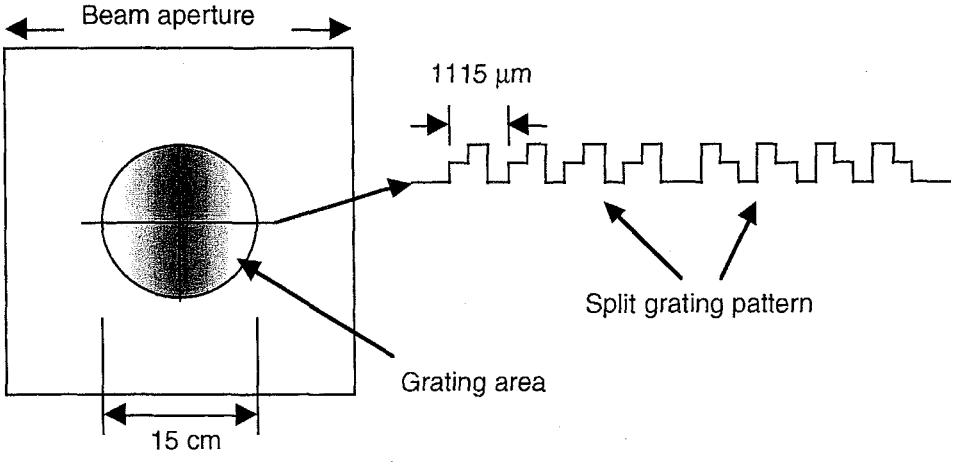


Figure 2: Distribution of unconverted light in the midplane of the target chamber. Up to the 10th order diffracted unconverted light is shown. The light is restricted to two segments of approximately 45° extent. The chamber map and diagnostic lines of sight are shown for reference only and are not to scale.

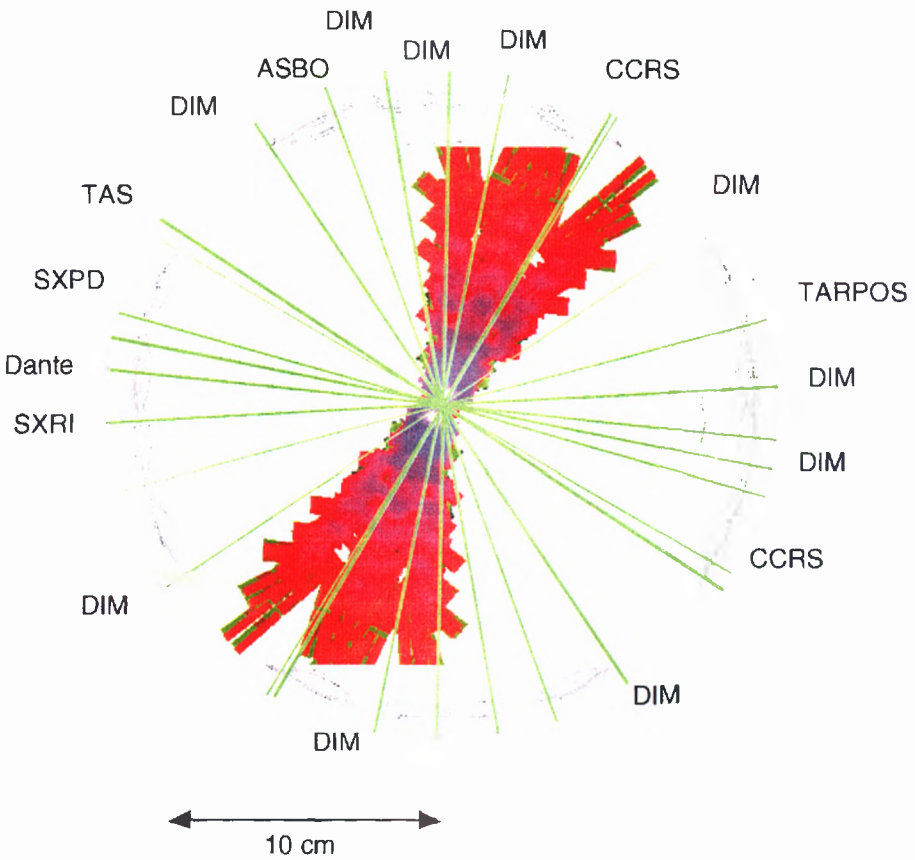
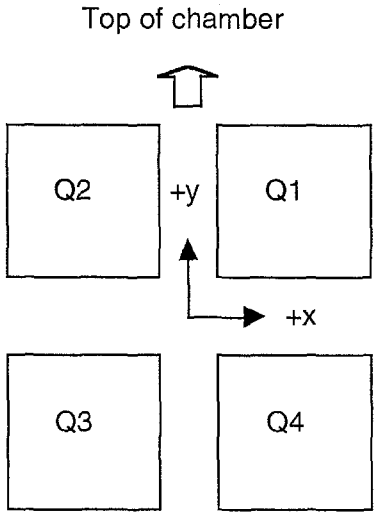


Figure 3: Coordinate system for defining the CSG orientation in Tables 1 and 2. The angle of the grating is defined as the angle of the dispersion direction with respect to the x-axis in the FOA coordinates.

a) Coordinates for a quad of beams



b) CSG grating orientation