Design of Platforms for Backlighting Spherical Implosions on OMEGA and the NIF

Without repointing

With repointing

400 μm

t = 2.8 ns   Shot 77085

t = 3.0 ns   Shot 79643
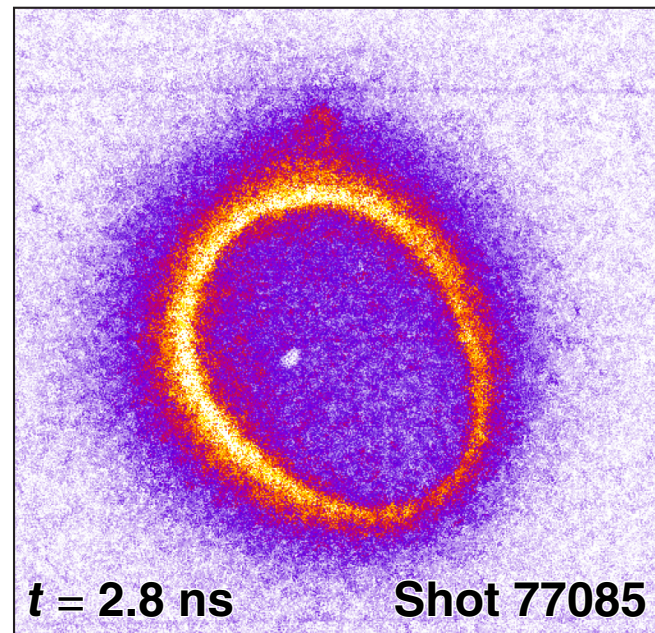
19 kJ
$Y_n = 5 \times 10^9$
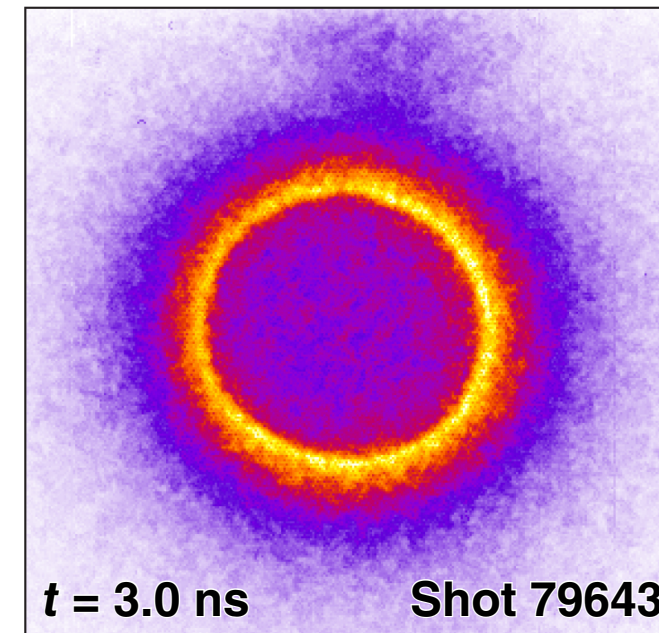
15 kJ
$Y_n = 1.2 \times 10^{10}$

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Summary

Designs have been developed for OMEGA and the NIF to allow for nearly symmetric implosions when beams are removed for backlighting

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- Using the hydrodynamics code *SAGE,* a design for OMEGA that adjusts beam pointings and energies has been demonstrated to give uniform 54-beam implosions

- An improved design for OMEGA removes the need for energy adjustments

- A design for the NIF allows for uniform implosions with two missing quads
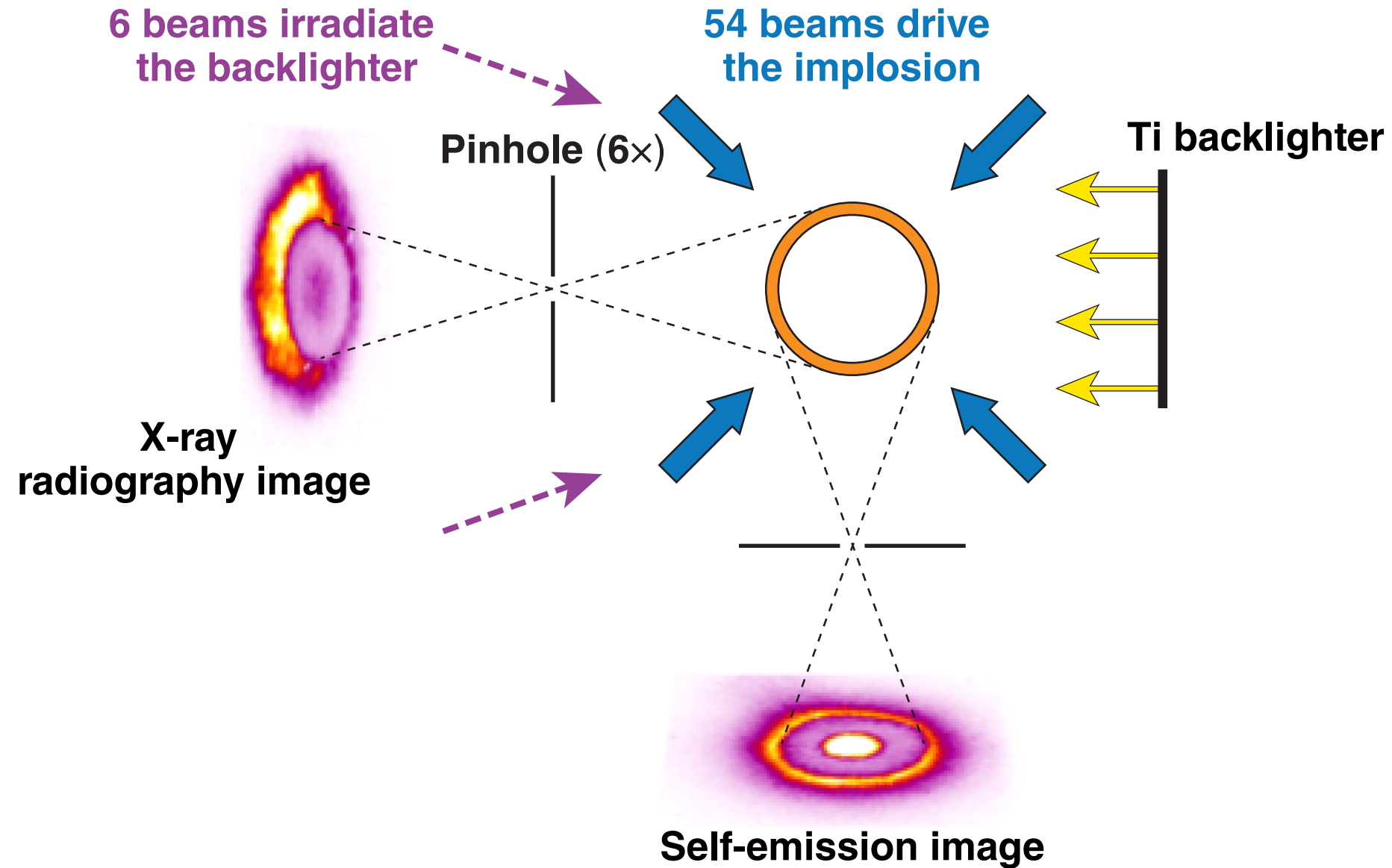
TC12964

Collaborators

**M. Hohenberger, W. E. Kehoe,* F. J. Marshall,
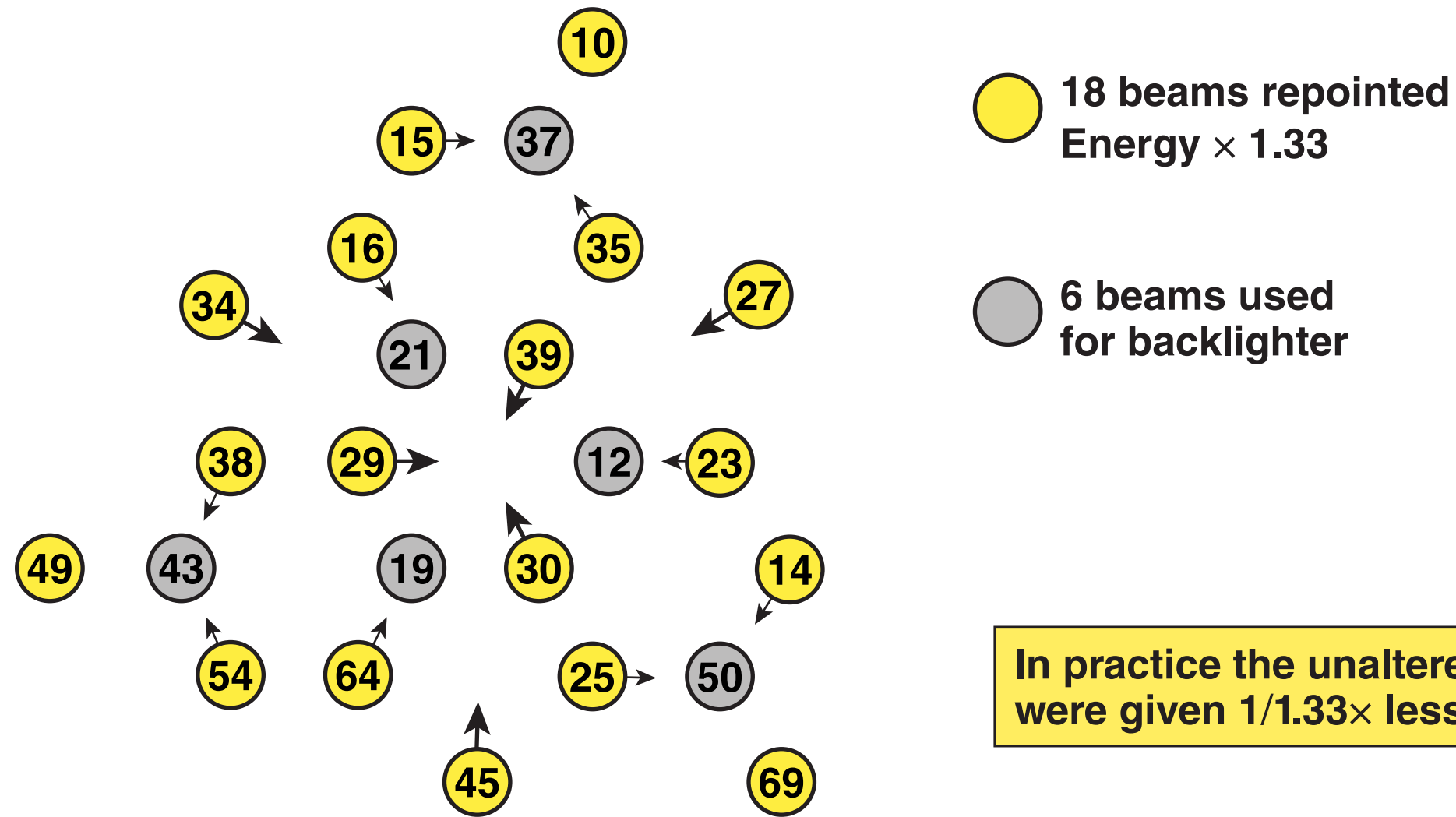D. T. Michel, P. B. Radha, and M. J. Rosenberg**

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*LLE Summer High School Program

In the OMEGA experiment, six beams irradiated the backlighter, leaving 54 beams to drive the implosion

6 beams irradiate
the backlighter

54 beams drive
the implosion

Pinhole (6×)

Ti backlighter

X-ray
radiography image

Self-emission image

18 OMEGA beams in the vicinity of the six backlighter beams were repointed and given 33% more energy than the other beams

18 beams repointed
Energy $\times$ 1.33

6 beams used for backlighter

In practice the unaltered beams were given 1/1.33$\times$ less energy.

With the optimized configuration the deposited energy is uniform to 0.74%

- Deposited energy ($\sigma_{rms} = 0.74\%$)

- $\sigma_{rms} = 0.40\%$ for 60 beams
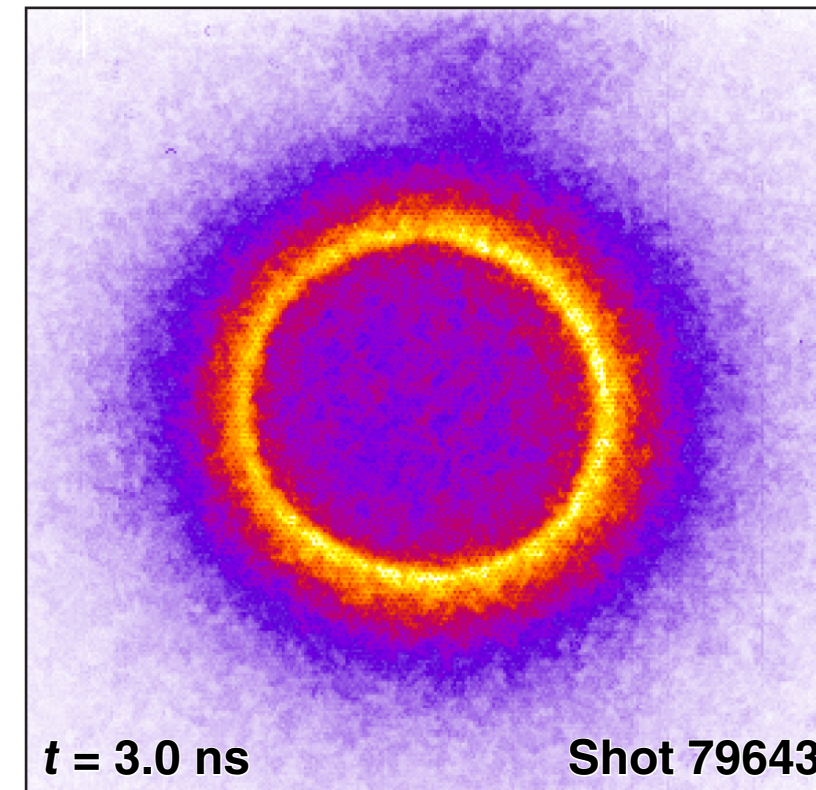
- $t = 2.5$ ns

Deviation from mean (%)
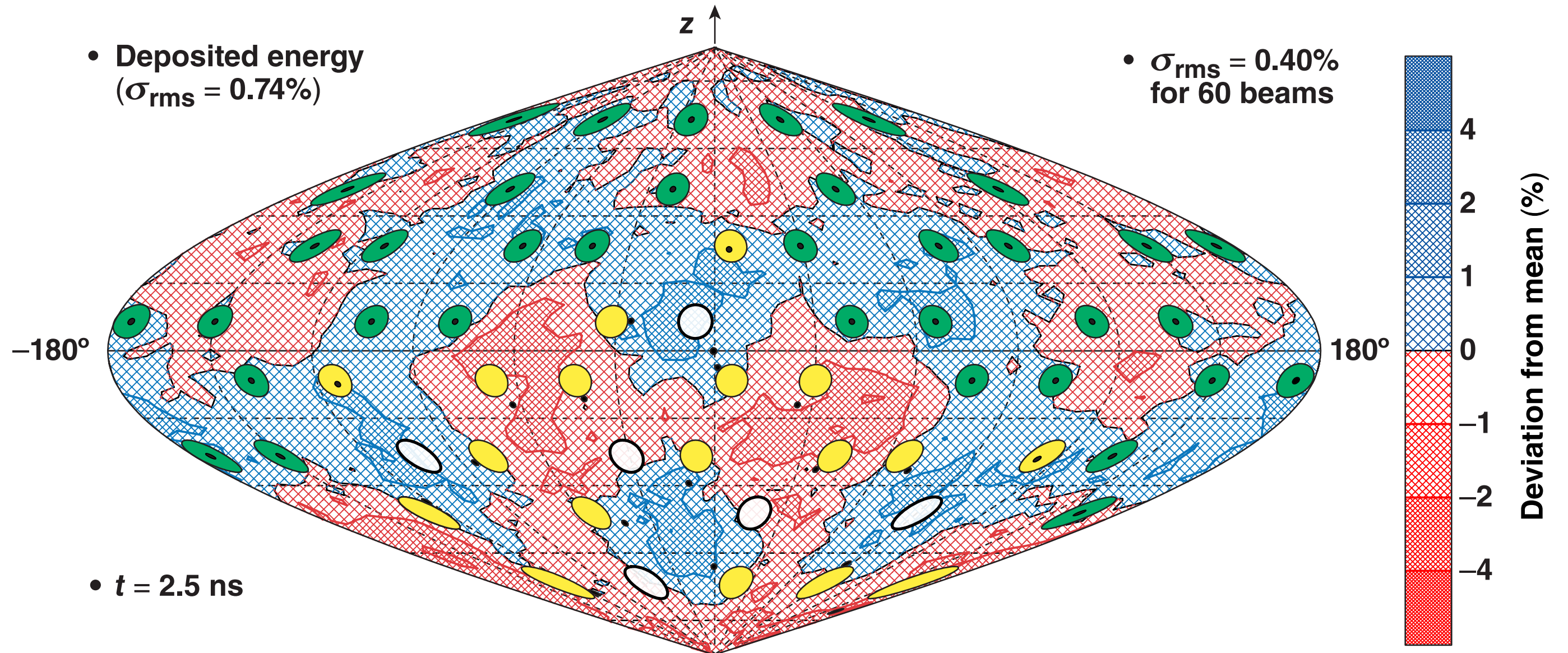
The symmetry of 54-beam implosions on OMEGA was greatly improved by adjusting the beam energies and pointings

Without repointing
($\sigma_{rms} \sim 17~\mu$m)

With repointing
($\sigma_{rms} \sim 3~\mu$m)

400 μm

t = 2.8 ns   Shot 77085
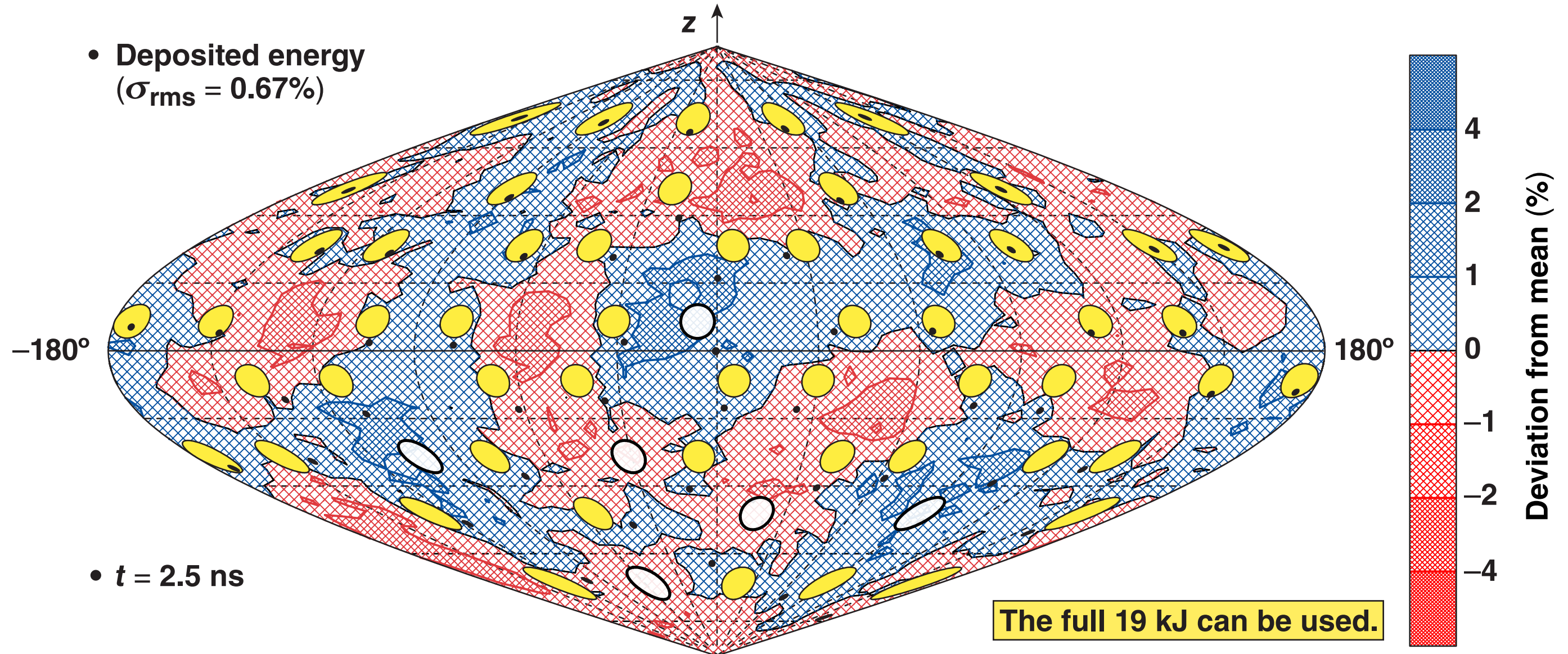
t = 3.0 ns   Shot 79643

19 kJ
$Y_n = 5 \times 10^9$

15 kJ
$Y_n = 1.2 \times 10^{10}$

TC12968
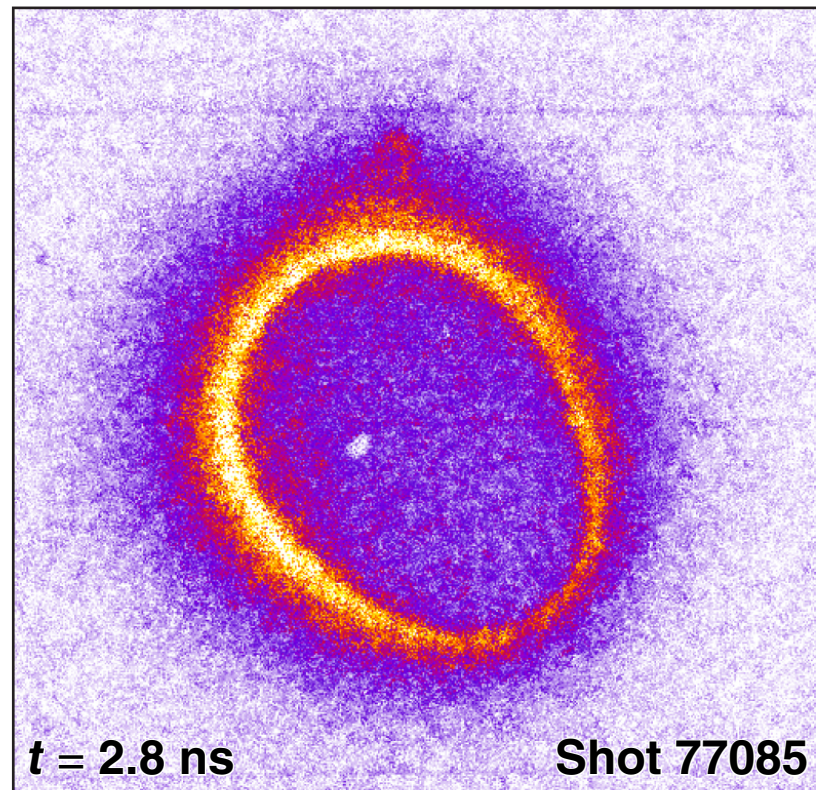
An improved design repoints all 54 beams without any energy adjustments

- Deposited energy ($\sigma_{rms} = 0.67\%$)

z

$-180°$ $180°$

- $t = 2.5$ ns

Deviation from mean (%)

4

2

1

0

−1

−2

−4

The full 19 kJ can be used.

Run W1175
TC12969

For backlighting experiments on the NIF using two quads, the energies and pointings of 16 surrounding beams were adjusted

- Center-of-mass radius (1.6% rms)

Backlighter quad

Energy $\times$ 1.5

z

$-180°$ $180°$

- $t = 6$ ns
  $\bar{r} = 630$ μm

- $d = 2200$ μm,
  100 μm CH

Backlighter quad

Deviation from mean (μm)

40

20

10

0

-10

-20

-40

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The Ring 3b beams deposit more energy near the backlighter quads

- Deposited energy (Ring 3b)

Backlighter quad

Backlighter quad

- t = 6 ns

Deposited energy (fraction of maximum)

1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65

The Ring 4 beams deposit less energy near the backlighter quads

- Deposited energy (Ring 4)

Backlighter quad

- $t = 6$ ns

Backlighter quad

−180°   180°

z

Deposited energy (fraction of maximum)

1.00
0.95
0.90
0.85
0.80
0.75
0.70
0.65
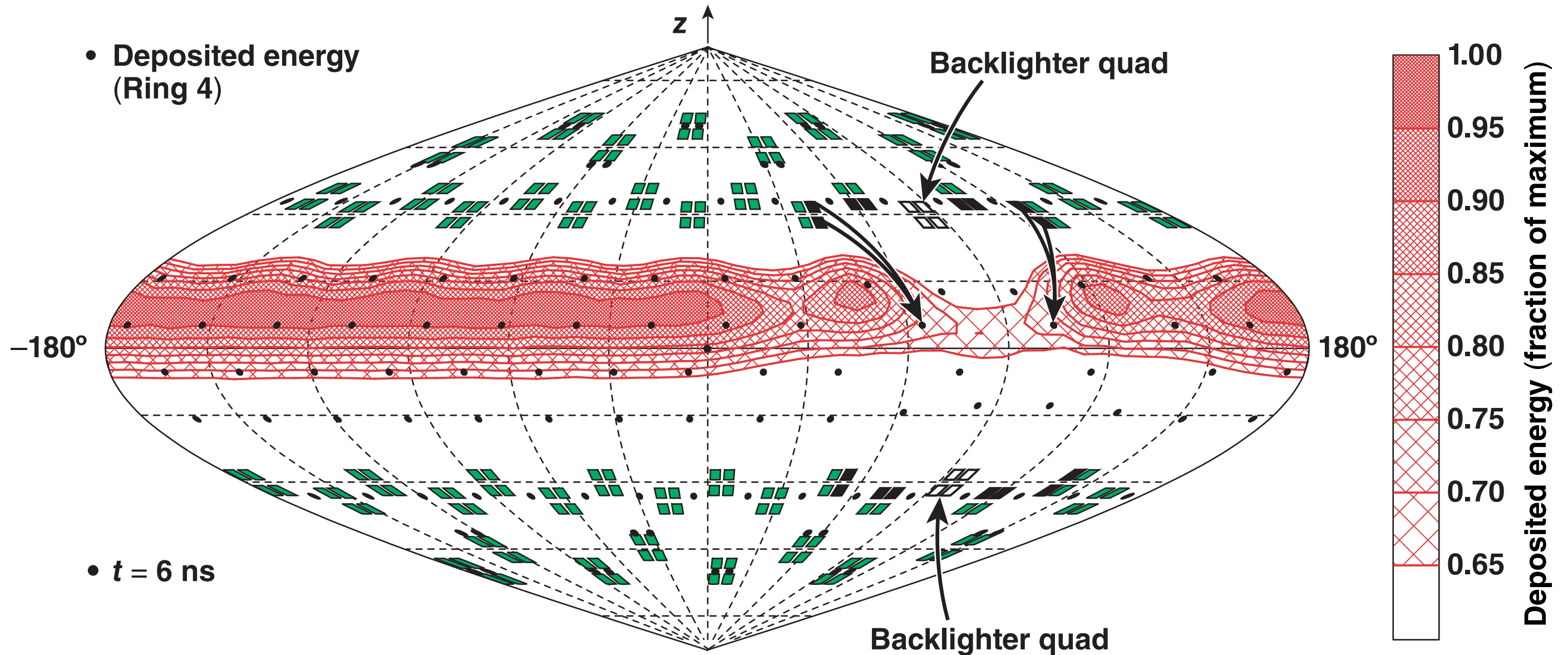
The total deposited energy is uniform near the backlighter quads with a residual nonuniformity pattern

- Total deposited energy

z

Backlighter quad

−180°   180°

Backlighter quad

- $t = 6$ ns

Deposited energy (fraction of maximum)

1.00
0.95
0.90
0.85
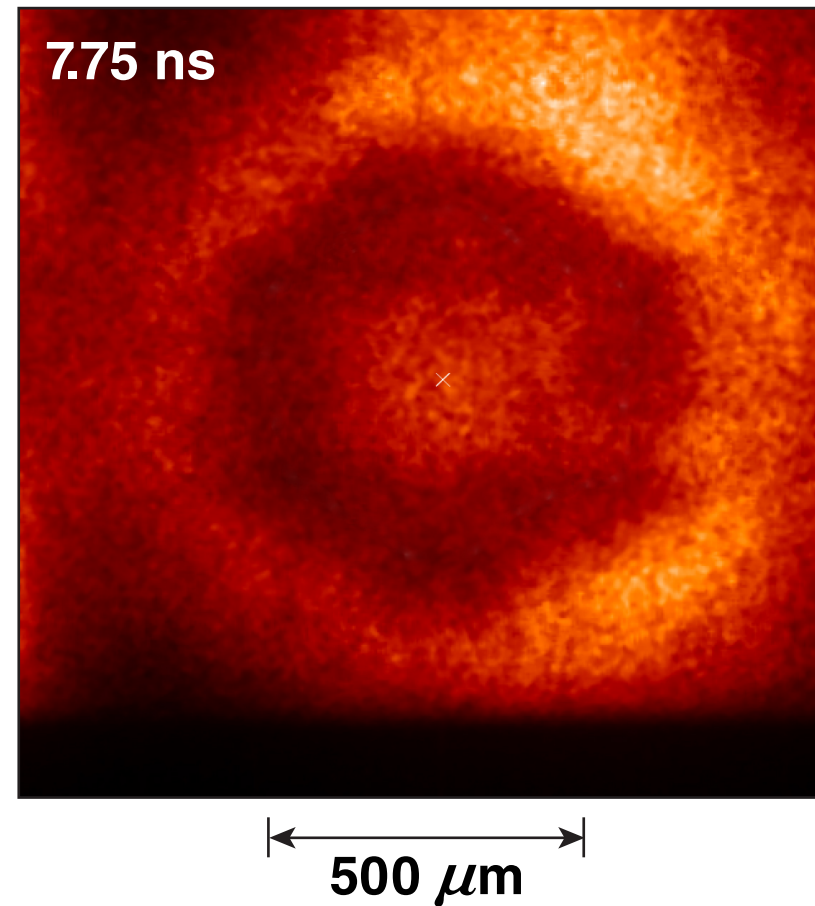0.80
0.75
0.70
0.65

Run 6388
TC12973

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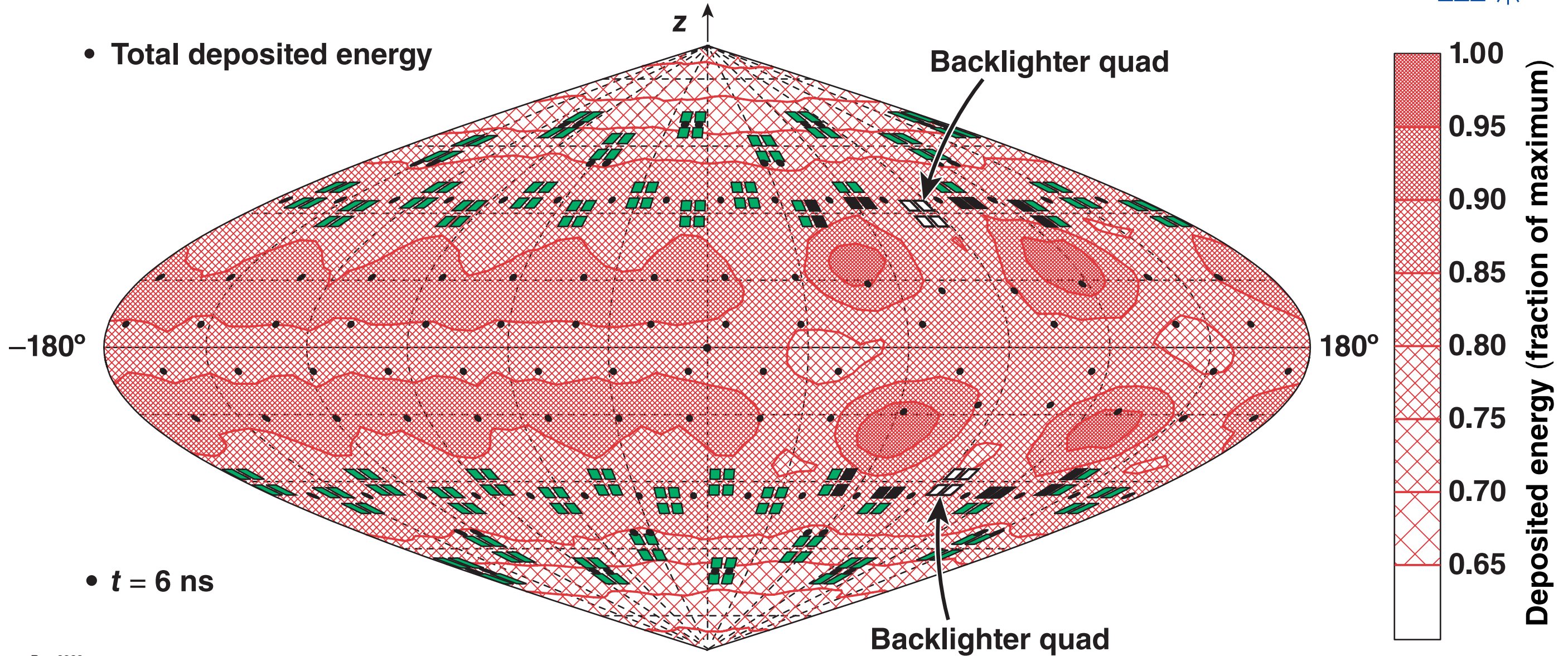
A self-emission image from the pole shows no evidence of nonuniformity caused by the missing backlighting quads

Self-emission
(polar view)

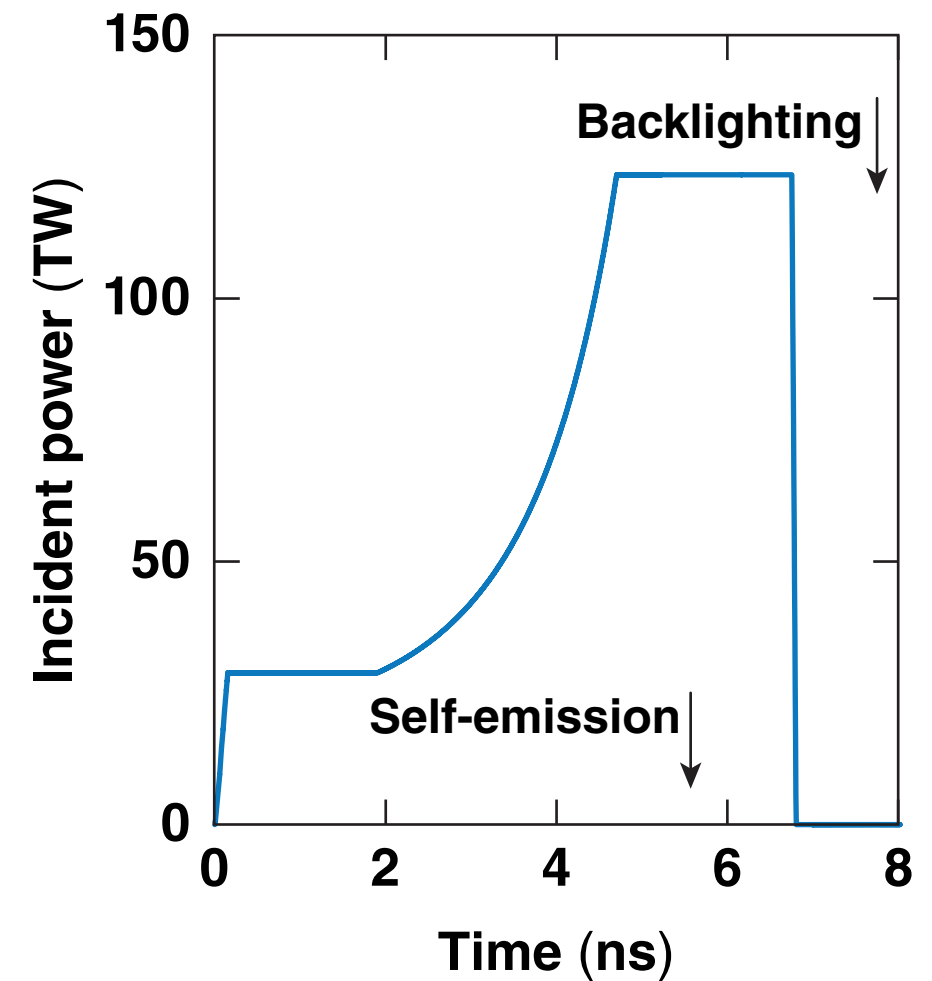5.57 ns

$\sigma_{rms} = 4.4\ \mu m$

1000 μm
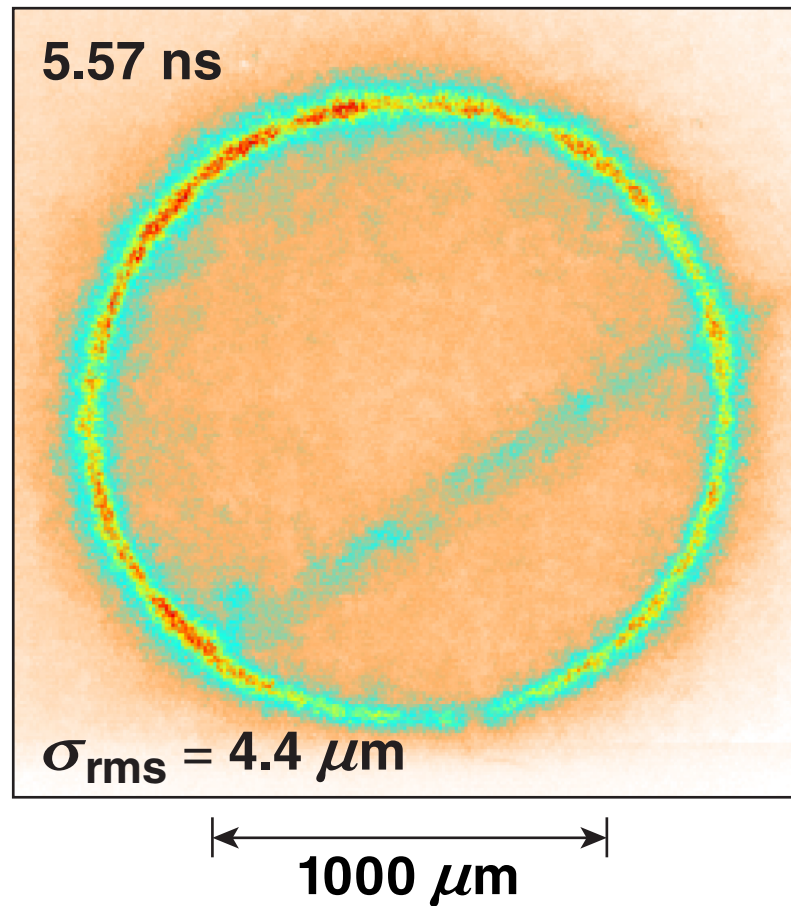
X-ray backlighting
(equatorial view)

7.75 ns

500 μm

Shot N140612-001

Backlighting

Self-emission

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