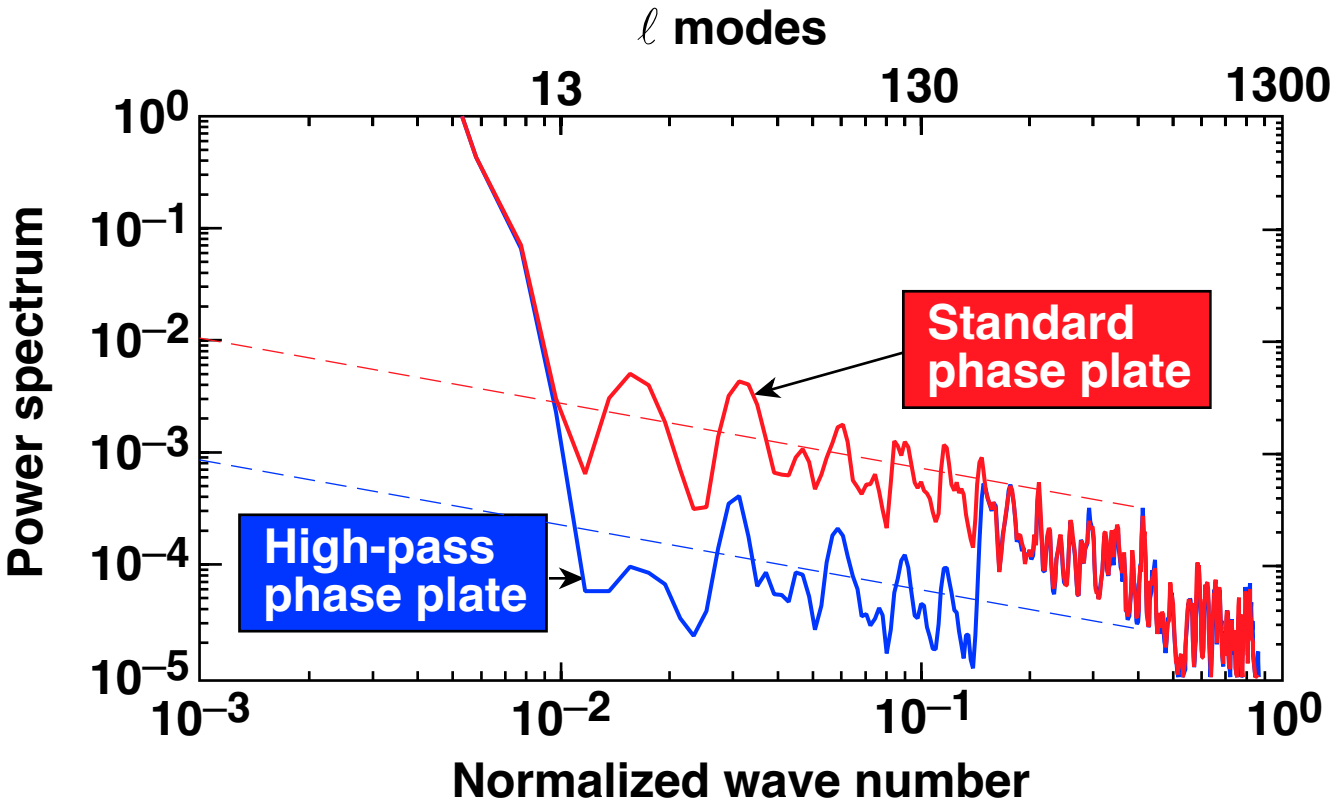
A Reduced-Autocorrelation Phase-Plate Design for OMEGA and the NIF



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Summary

High-pass phase plates provide an effective means to reduce the nonuniformity in low-ℓ modes

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High-pass phase plates:

- reduce the nonuniformity where SSD has a modest effect;
- work in the presence of typical near-field aberrations; and
- provide benefit for both OMEGA and the NIF.

Outline

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- High-pass phase plate design scheme
- Phase aberrations
- High-pass design for the NIF
- High-pass design for OMEGA

The high-pass phase-plate design process is initialized by filtering the far-field speckle pattern

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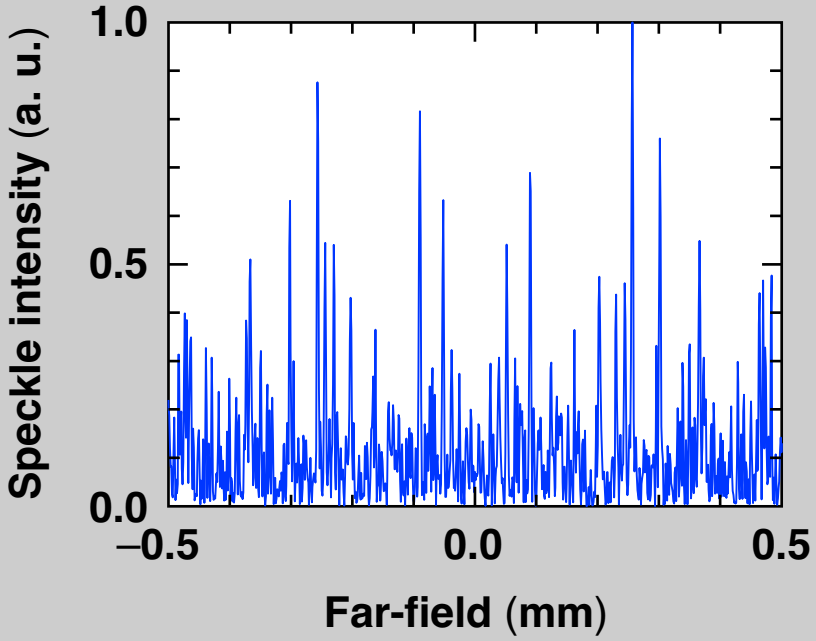
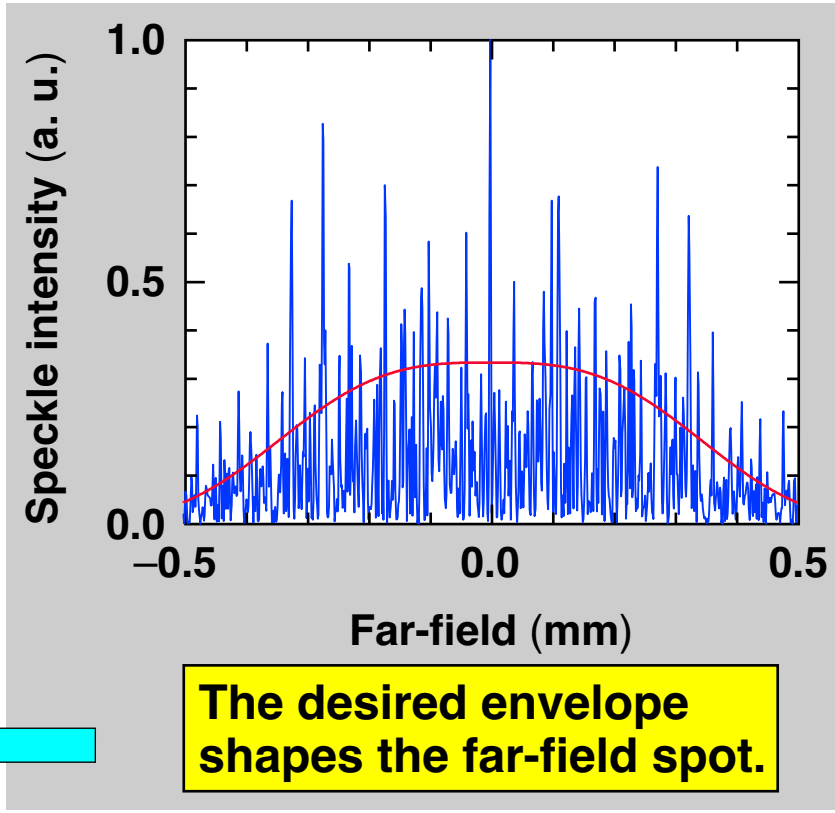
A uniform speckle field is generated.



The speckle is then high-pass-filtered.



The desired envelope shapes the far-field spot.

A phase-retrieval method generates a phase plate that matches the far-field spot shape and modified speckle spectrum.

TC5792

There are two methods to design reduced-autocorrelation phase plates

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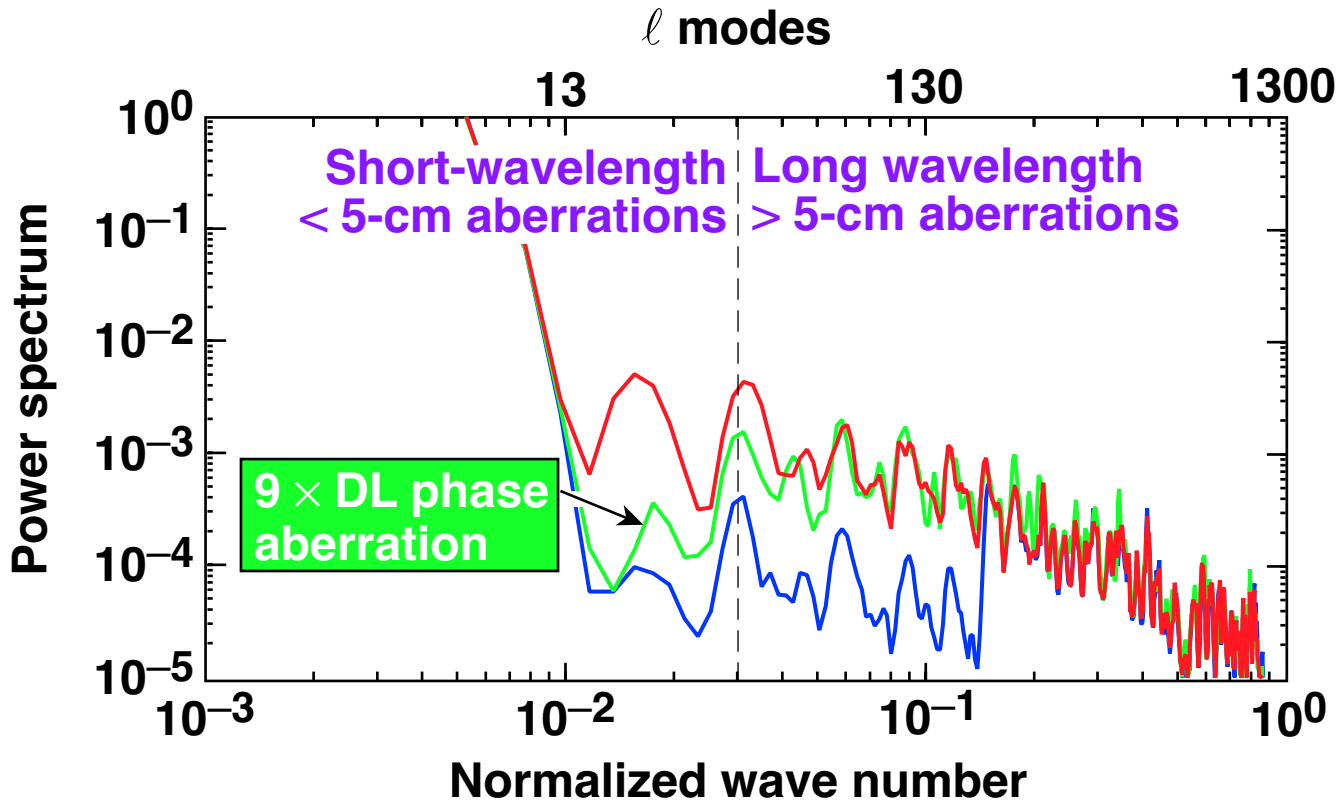
- The first method directly minimizes the local autocorrelation of the phase-plate elements:*
  - reduces the nonuniformity by a modest factor of 2; and
  - provides a far-field shape governed by the shape of the discrete elements.
- The second method directly high-pass filters the far-field speckle pattern:
  - reduces the nonuniformity by as much as factor of 5; and
  - produces a far-field shape that is user-selectable.

* R. Epstein and S. Skupsky, J. Appl. Phys. 68, 924 (1990).

A high-pass phase plate was designed for OMEGA to reduce all modes $\ell \leq = 200$

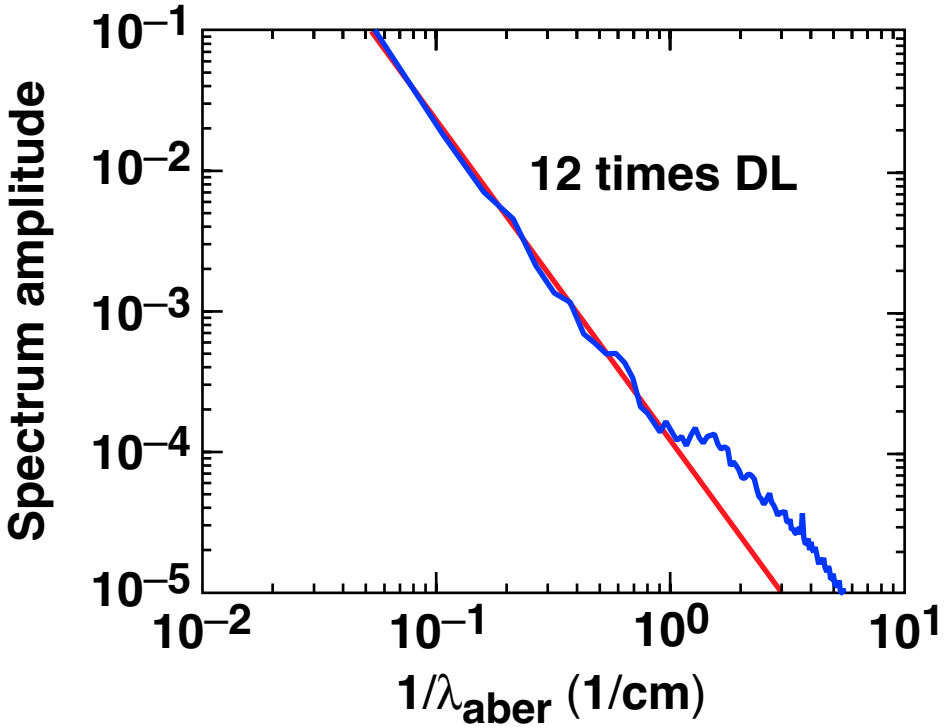


- Static phase aberrations reduce the benefit of the high-pass phase plates.
- Time-varying phase terms like SSD do not adversely affect the high-pass phase plates.

TC5793

The strength of a static phase aberration is expressed in terms of times diffraction limited (DL)

- The power spectrum has the assumed form $\propto \left(\frac{a}{\lambda^n}\right)^2$



$D_{95} \cong 83\ \mu m$

$D_{DL} = 6.9\ \mu m$

- The amplitude a is varied, and the strength of the aberration is measured in terms of times diffraction limited:

$$\text{times DL} = \frac{D_{95}}{D_{DL}}$$

TC5794

A factor-of-1.5 reduction in nonuniformity is still achieved in the presence of a strong phase aberration in the mode range $20 \leq \ell \leq 60$

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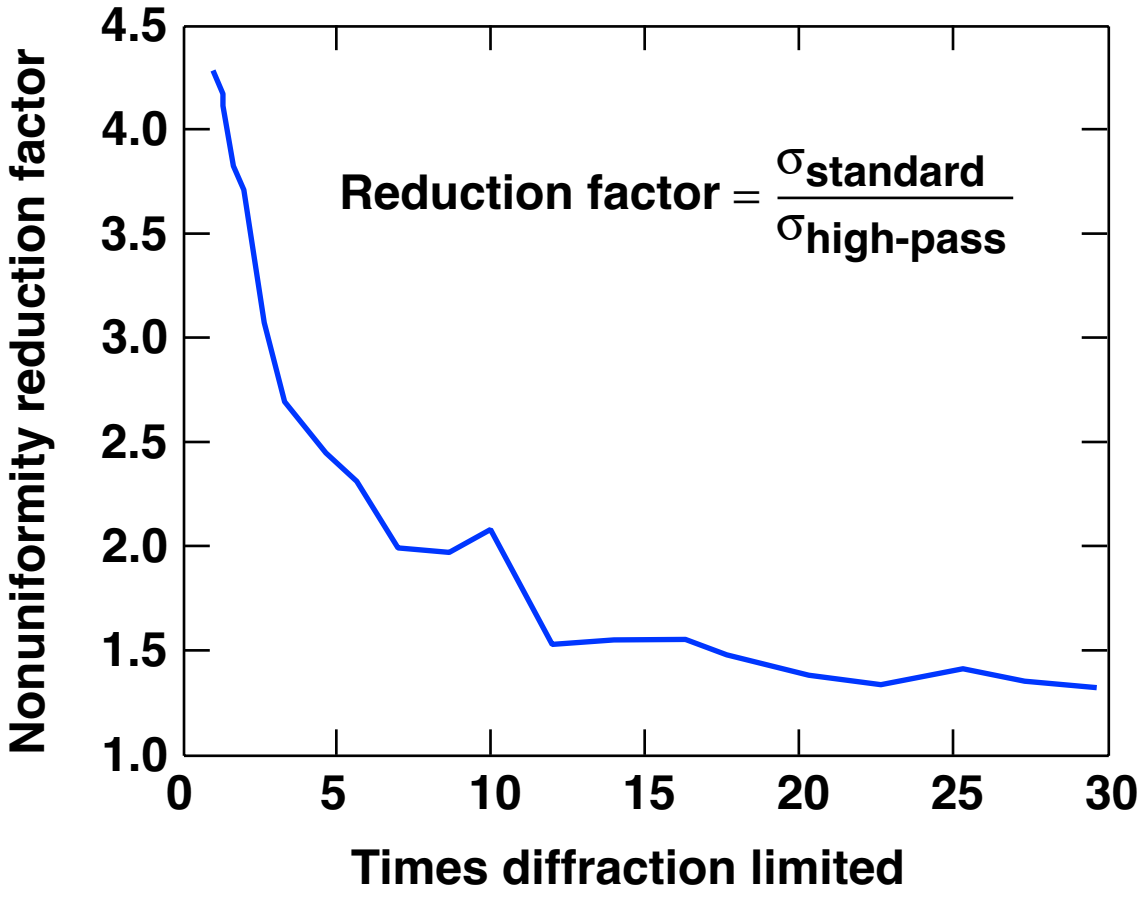
- NIF design
- When aberrations are present, the reduction factor decreases from 4 to 1.5.



TC5795

The nonuniformity reduction factor is relatively insensitive to the phase aberrations in the mode range $10 \leq \ell \leq 40$

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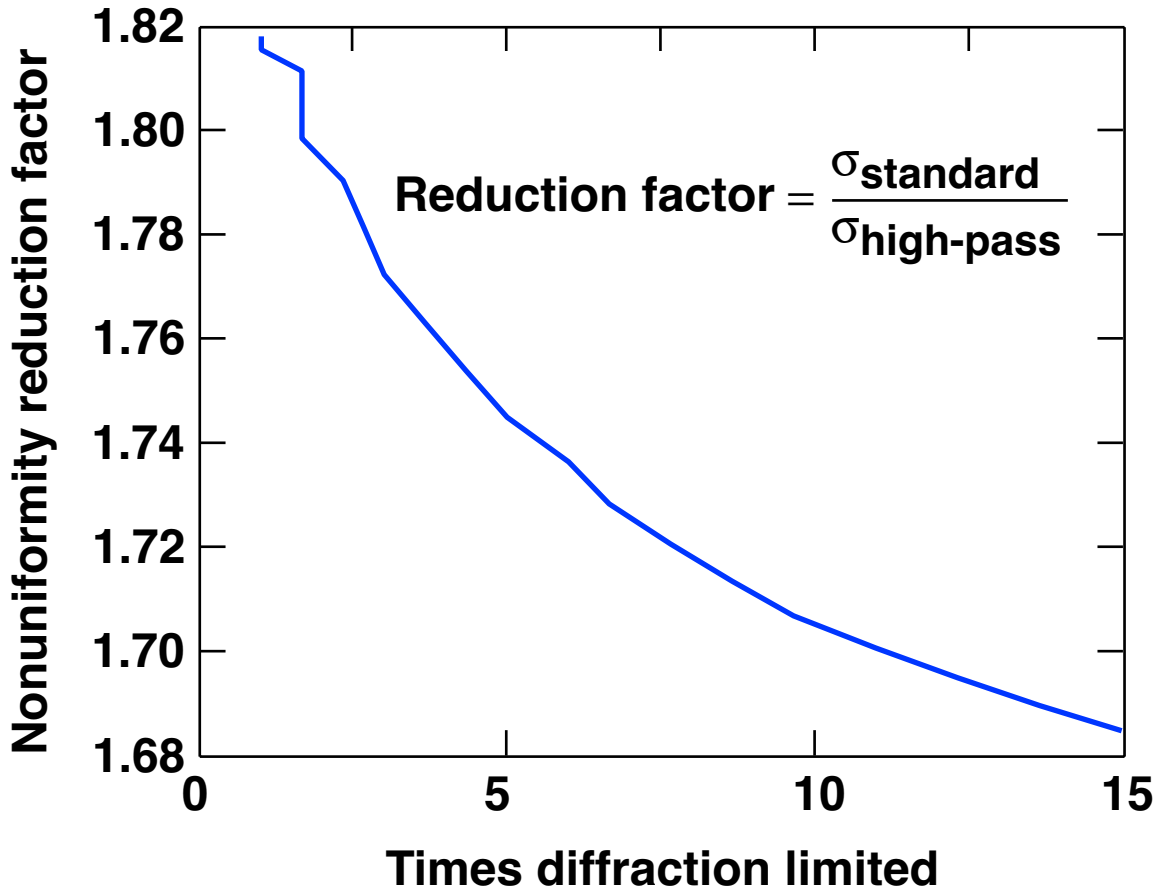
- OMEGA design



TC5796

An OMEGA far-field simulation with measured phase aberration yields a factor-of-2 reduction in the nonuniformity after 300 ps

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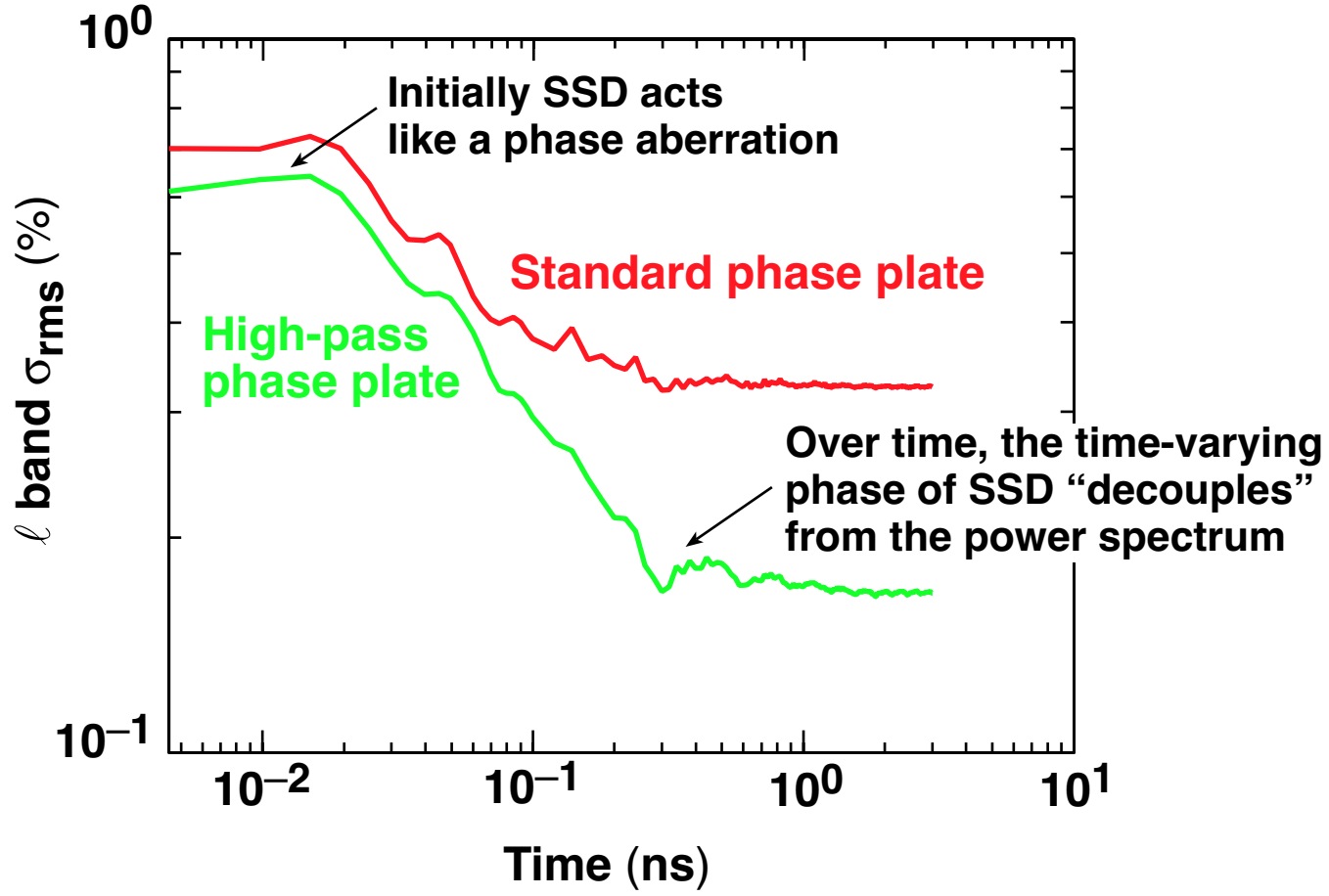
- 1-THz SSD and PS applied
- Measured near-field aberration applied: 12 times DL
- Summed over mode range $12 \leq \ell \leq 25$



TC5797

Summary/Conclusions

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