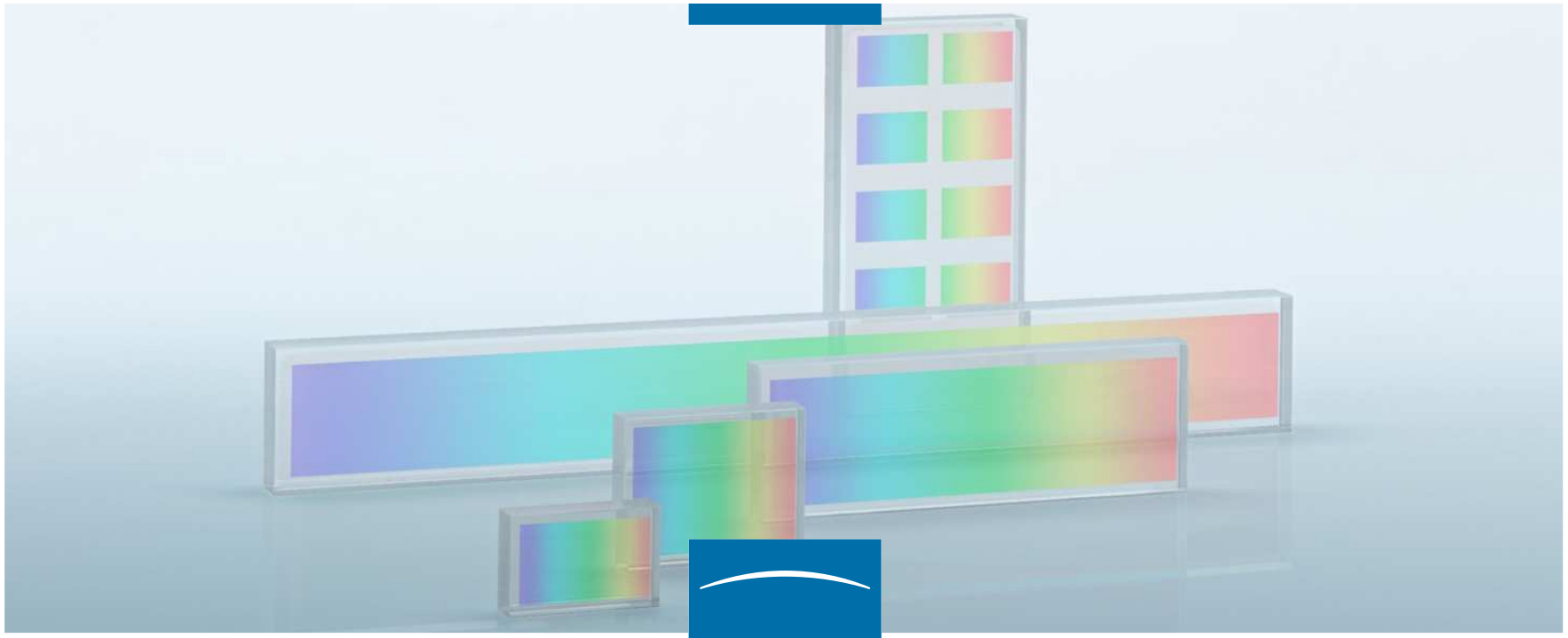


e²® Transmission Gratings

Efficiency Enhanced PCGs for Enhanced Laser Performances

Jenoptik Optical Systems GmbH | Microoptics

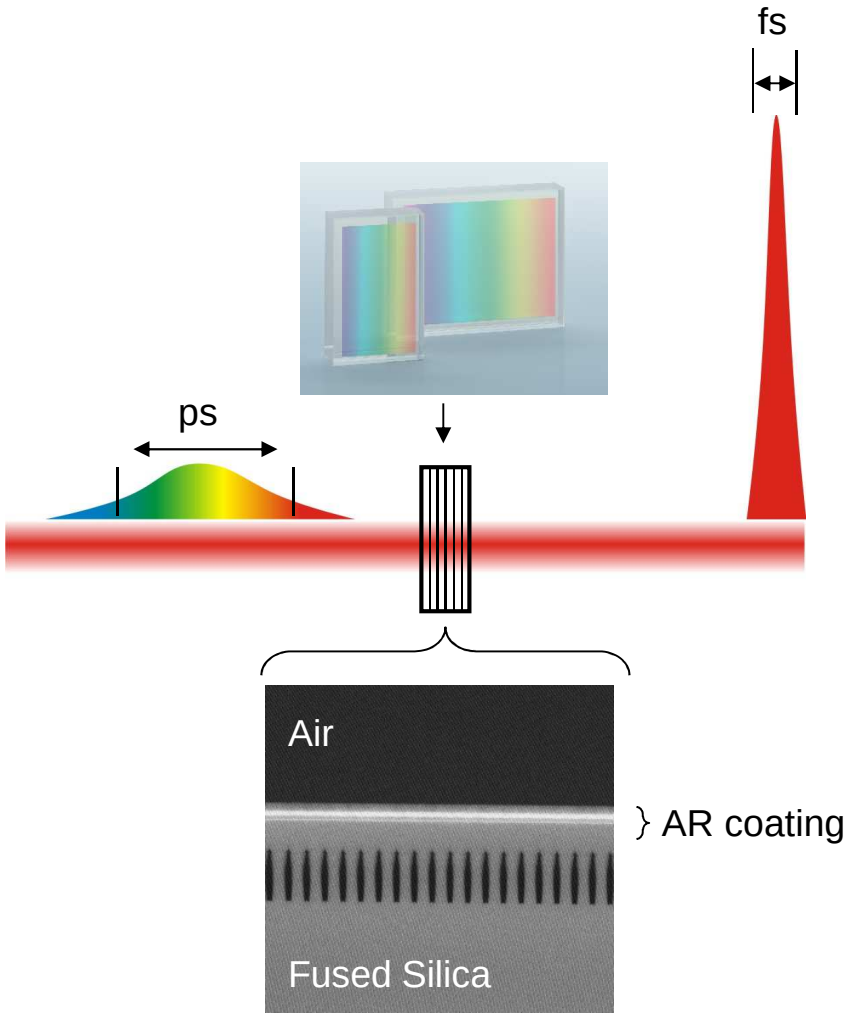
e²® Pulse Compression Transmission Gratings

Features

- All dielectric monolithic element with embedded microstructures
- Customized design for your applications
- Efficiency close to 100%
- Standard Grating size (CA) up to 140 mm x 140 mm (larger size on demand)
- Groove density up to 3000 l/mm
- High damage threshold and thermal stability
- Low wavefront distortion (high quality substrate and no lithographic stitching)
- Grating structure protected against mechanical damages and contamination
- AR coating on both sides

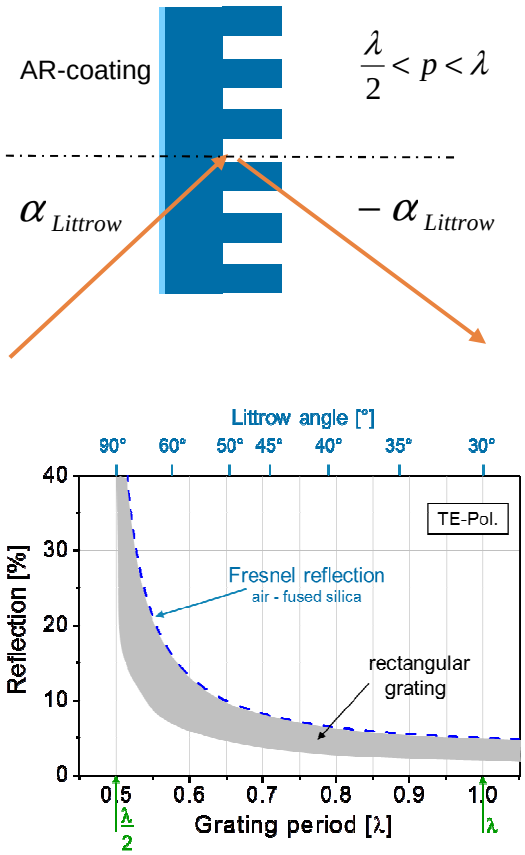
Applications

- Pulse compression in ultrafast laser systems
- Wavelength selection, tuning and bandwidth narrowing of high power lasers

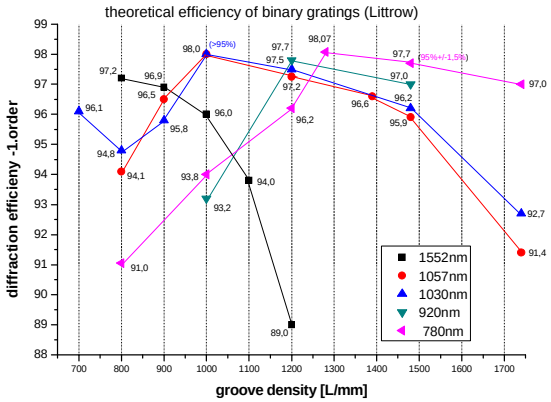


Standard Pulse Compression Grating (PCG): Performances and limits

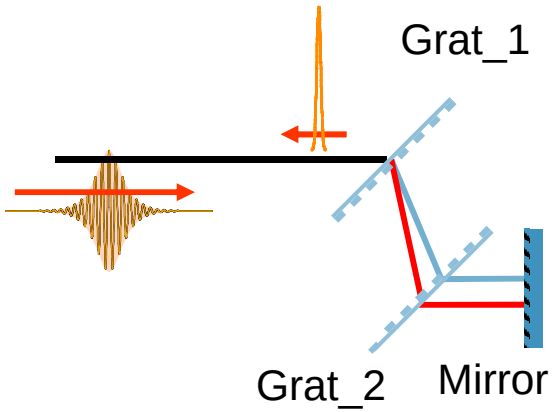
Fresnel Reflections reduce achievable efficiency



Theoretical Efficiency at Littrow angle vs. Groove Density for different wavelenghts



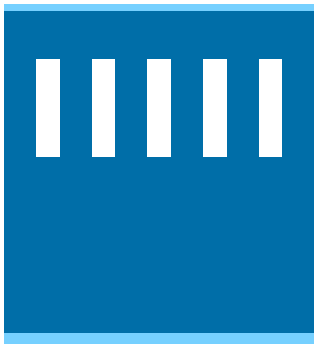
Effect of PCGs on Laser Power Performances within a typical 4-pass pulse compression setup



Example: a pair of 90% efficiency PCGs leads already to ~35% laser efficiency loss

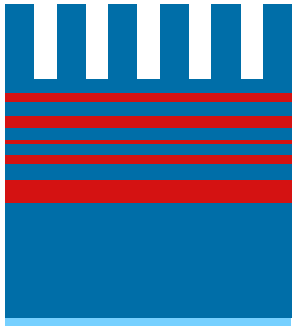
Improvement of the diffraction efficiency of a transmission pulse compression grating

Encapsulated Grating



- All dielectric Fused Silica element
- Efficiency enhanced thanks to reflections reduction
- Comparable technology effort

Grating on top of AR stack layer

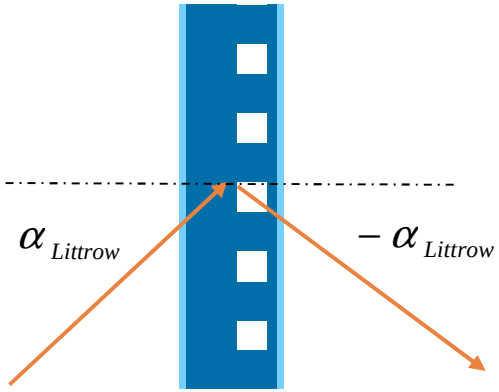


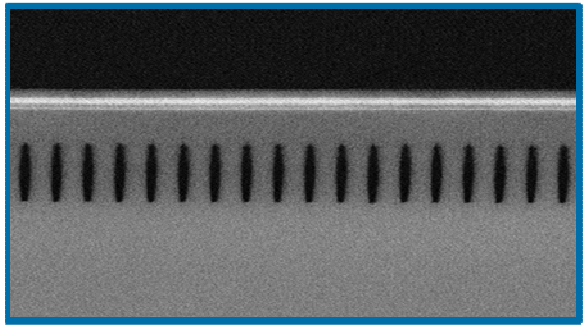
- Grating structures etched in Fused Silica bulk mask
- Embedded microstructures, protected against external damages
- Reduction of e-field enhancement on the pillars, typical trigger of LID (Laser Induced Damage)
- AR-coating on both sides

- Grating structures etched in SiO_2 layer
- Open microstructures, not protected against external damages
- e-field enhancement on the pillars, typical trigger of LID
- AR-coating on planar side and under the grating structure

e²® - PCGs vs Standard Fused Silica PCGs: Efficiency Exemplary Results

AR-coating on both sides

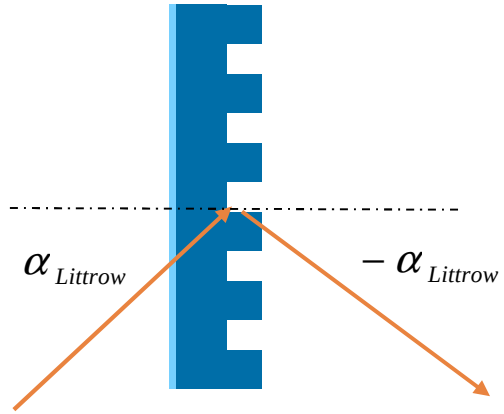


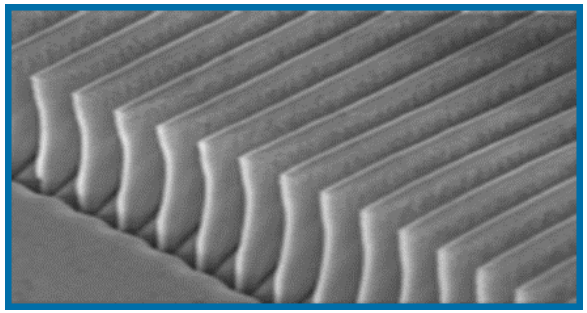


Measured Diffraction Efficiency:
99 ± 1 %

Wavelength [nm]	1000-1100
Polarization	TE
Line density [lines/mm]	1750

AR-coating on planar side



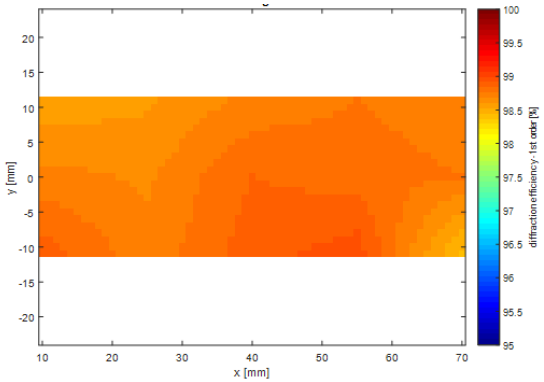


Measured Diffraction Efficiency:
90 ± 1 %

In a typical 4-Pass Pulse Compression Setup, through the e²® PCG the laser output increases by about 30%.

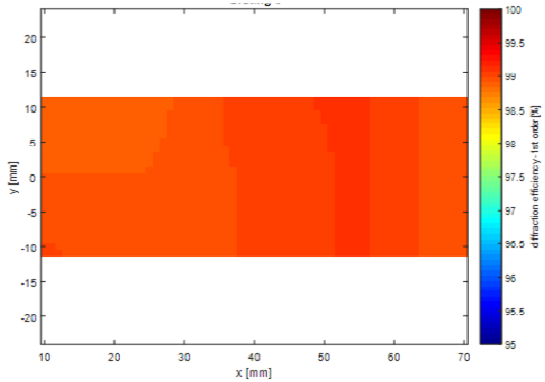
e2® - Transmission PCG: Efficiency Mapping @ Littrow angle

Grating 1,2: 78 x 22 mm², 1750 lines/mm
on 6.35 mm thick substrate



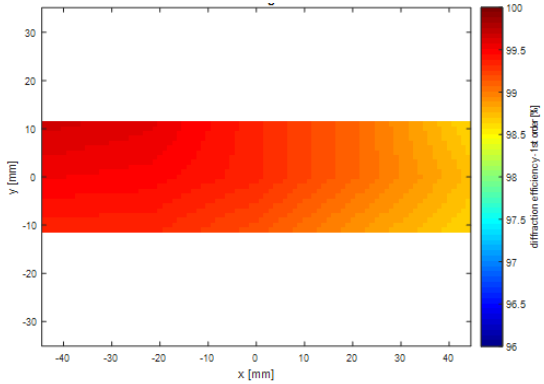
Max = 99,5 %
Min = 98,7 %

Measured @ 1030 nm



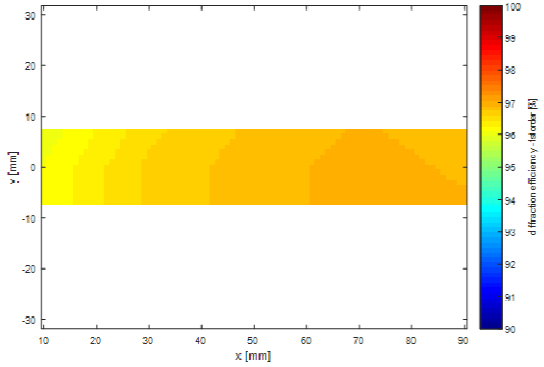
Max = 99,5 %
Min = 99,1 %

Grating 3: 90 x 25 mm², 1700 lines/mm
on 6.35 mm thick substrate



Max = 99,6 %
Min = 98,6 %

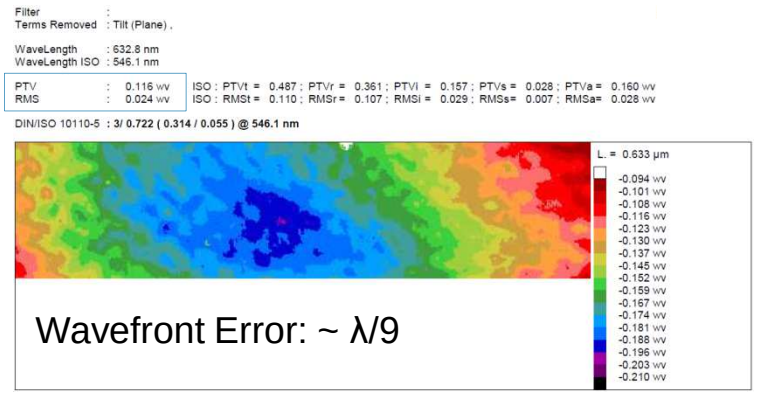
Grating 4: 100 x 20 mm², 1700 lines/mm
on 9 mm thick substrate



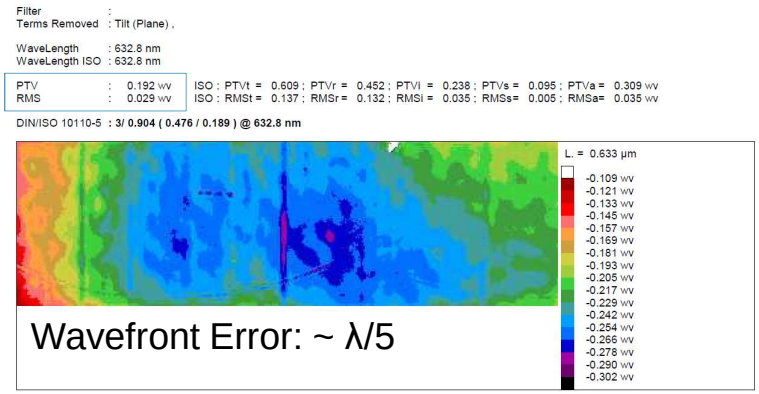
Max = 97,5 %
Min = 96,0 %

e²® Transmission PCG: Wavefront Distortion Exemplary Results

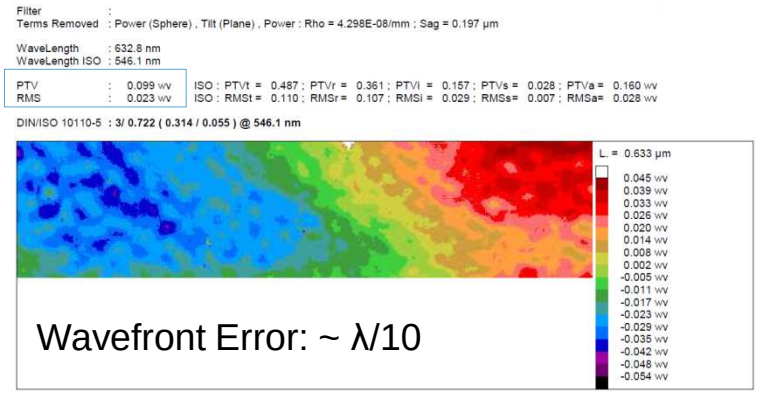
Normal incidence:



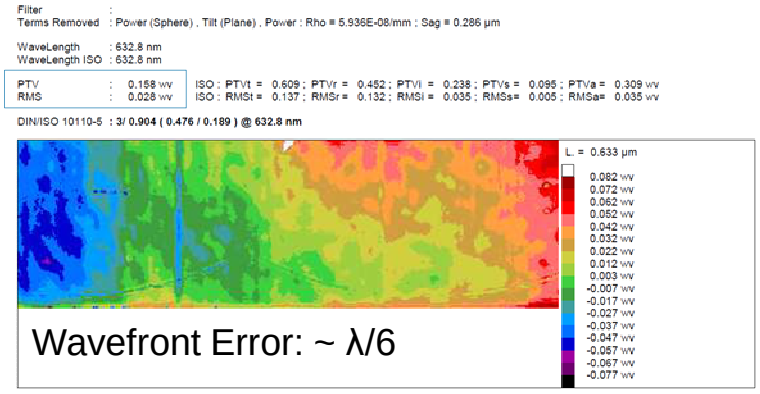
Incidence at Littrow angle 32,5°:



Normal incidence – removed spherical aberration:

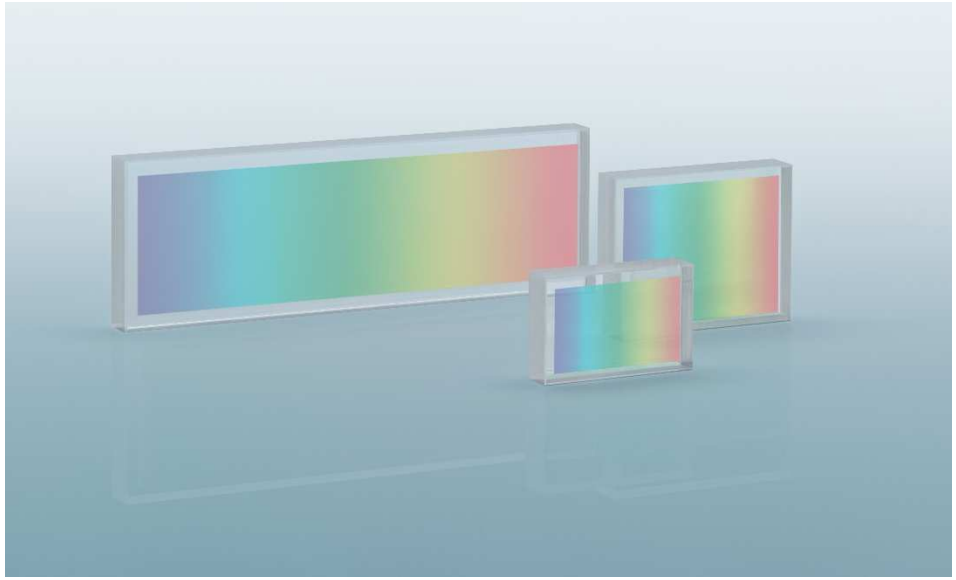


Incidence at Littrow angle 32,5° – removed spherical aberration:



e²® - Transmission PCG: Customers Feedback

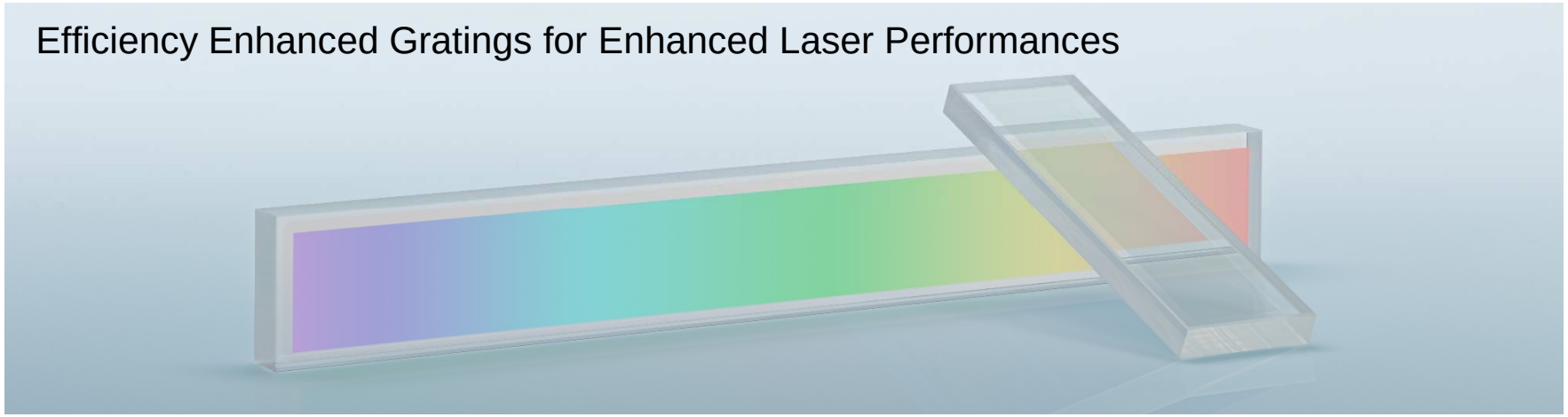
- Measured Efficiency up to 99,7%
- 4-Pass Compressor Efficiency up to 95%
- Very good pulse quality
- Low M² degradation
- Low astigmatism evolution observed
- No overheating observed
- Max Power Density > 1 TW/cm²



LIDT > 0.6 J/cm² @150fs

LIDT > 1.4 J/cm² @638fs

Contact



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