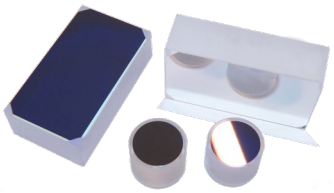
venteon optics

Optics designed for ultra-short pulses

Laser Quantum
A Novanta Company

- Group delay dispersion compensation mirrors
- Enhanced silver mirrors
- CaF_2 and fused silica glass wedge pairs
- 50:50 ratio beam splitter
- Designed specifically for few-cycle pulse management



Overview

Laser Quantum's **venteon optics** range of mirrors, wedges and splitters are designed specifically for beam path control and Group Velocity Dispersion (GVD) compensation of few-cycle laser pulses.

DCM mirror pairs

Choosing the right mirrors

The DCM mirrors are all manufactured to the same high quality specifications, however, each mirror is suited to a different application dependent on compensation vs. wavelength. See Fig. 1 to choose the correct mirrors for your research.

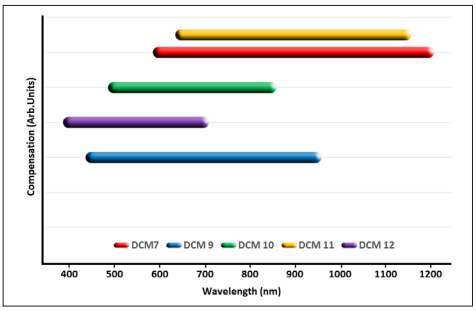
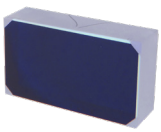


Fig. 1 DCM mirror wavelength and compression performance

The DCM products are dispersion compensating mirror pairs used for the compensation of positive dispersion affecting femtosecond laser pulses (Fig. 2 to 11). The unique design enables reflectivity greater than 99% over the whole supported spectral bandwidth next to a defined negative dispersion. Using these mirrors in a pulse compressor in combination with CaF_2 wedges pair/glass material it is possible to compress the pulses nearly to the supported transform limit according to the lasers spectral bandwidth.



Compared to other methods used for GVD compensation, the use of high damage-threshold DCM mirrors results in a compact and robust designs for ultra-short pulse laser oscillators or compressor setups with octave-spanning spectral bandwidth. This can be achieved with a minimum of optical components and without complex and often narrow-band and inefficient prism or grating sequences.

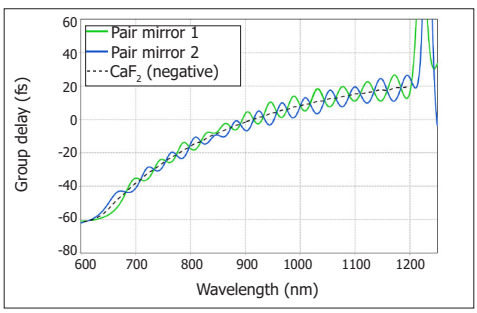


Fig. 2 DCM7 pair group delay of individual mirrors (green/blue solid) in comparison to the compensation target (4.4 mm CaF_2, black dashed).

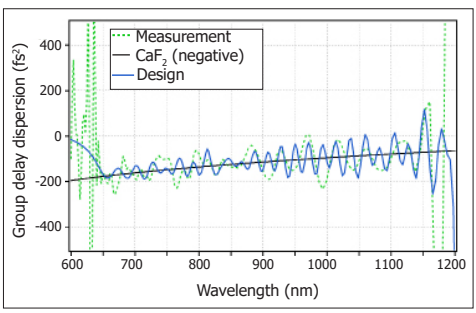


Fig. 3 DCM7 reflected group delay dispersion measurement of mirror pair (green dashed) in comparison to the design data (blue solid) and the compensation target (4.4 mm CaF_2, black solid).

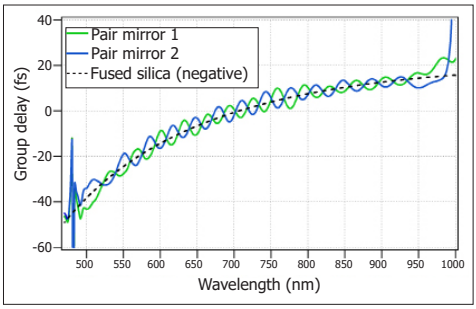


Fig. 4 DCM9 pair group delay of individual mirrors (green/blue solid) in comparison to compensation target (1.2 mm fused silica glass, black dashed).

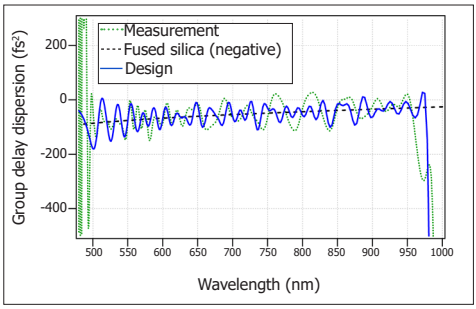


Fig. 5 DCM9 reflected group velocity dispersion measurement of mirror pair (green dashed) in comparison to design data (blue solid) and compensation target (1.2 mm fused silica glass, black dashed).

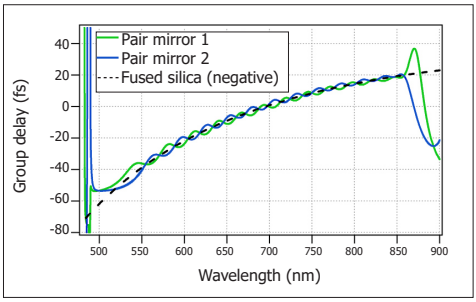


Fig. 6 DCM10 pair group delay of individual mirrors (green/blue solid) in comparison to compensation target (2.0 mm fused silica glass, black dashed).

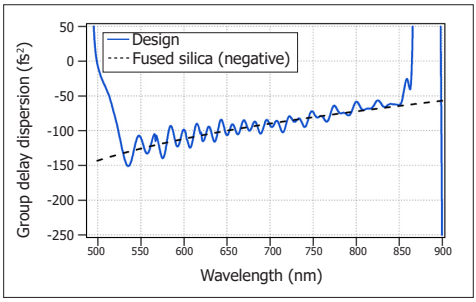


Fig. 7 DCM10 group delay dispersion design of mirror pair (blue solid) in comparison to the compensation target (2.0 mm fused silica glass, black dashed).

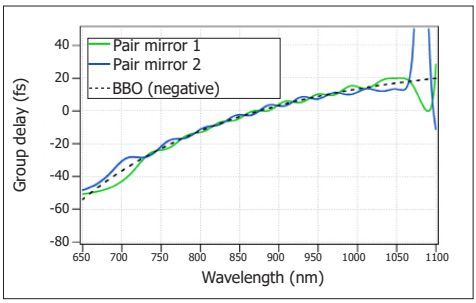


Fig. 8 DCM11 pair group delay of individual mirrors (green/blue solid) in comparison to compensation target (1.8 mm BBO, black dashed).

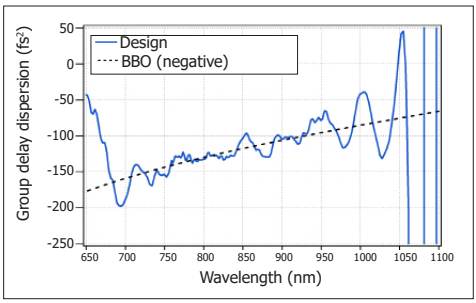


Fig. 9 DCM11 group delay dispersion design of mirror pair (blue solid) in comparison to the compensation target (1.8 mm BBO, black dashed).

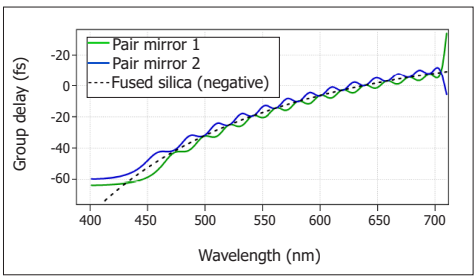


Fig. 10 DCM12 pair group delay of individual mirrors (green/blue solid) in comparison to compensation target (1.3 mm fused silica glass, black dashed).

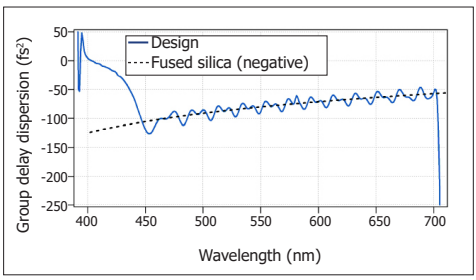


Fig. 11 DCM12 group delay dispersion design of mirror pair (blue solid) in comparison to the compensation target (1.3 mm fused silica glass, black dashed).

Enhanced silver mirrors

This protected silver mirror is enhanced for femtosecond applications and tested for sub-5 fs pulses. It features an average reflectivity of more than 99% between 600 nm and 1200 nm (0-45°) (Fig. 12) and a tailored flat dispersion characteristic in this range. The enhanced silver mirror "blue" is optimized for shorter wavelengths and offers a reflectivity of more than 97% between 450 nm and 950 nm. Both mirror types will give you more freedom in designing your experimental setup.

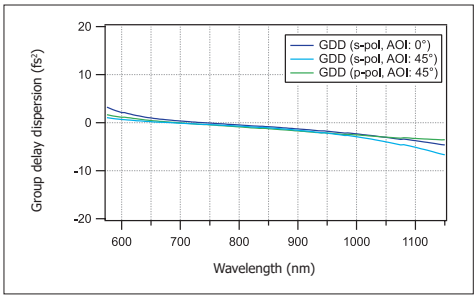


Fig. 12 Flat tailored GDD of the enhanced silver mirrors which is designed for femtosecond applications in a wavelength range between 600 nm and 1200 nm.

Specification of DCM and silver mirrors

	DCM7 GVD-mirror pair	DCM9 GVD-mirror pair	DCM10 GVD-mirror pair	DCM11 GVD-mirror pair	DCM12 GVD-mirror pair	CM-2 GVD-mirror (set of 2)	Enhanced silver mirror (single)	Enhanced silver mirror "blue"
Wavelength range (nm)	600-1200	450-950	500-850	650-1050	400-700	740-940	585-1500	450-1300
Reflectivity (%) HR	>99.6 @600-1200 nm	>99.6 @700 nm	>99.6 @480-870 nm	>99.8 @650-1050 nm	>99.7 @400-700 nm	>99.8 @800 nm	>99 @600-1200 nm	>97 @450-950 nm
Reflectivity (Side 2) AR	515-532 nm	n/a	n/a	n/a	n/a	n/a	n/a	n/a
GDD/pair	-120 fs^2 @800 nm	-60 fs^2 @700 nm	-100 fs^2 @650 nm	-130 fs^2 @800 nm	-80 fs^2 @550 nm	-220 fs^2 @800 nm	< ±10 fs^2	< ±10 fs^2
Target design	4.4 mm CaF_2	1.2 mm FS	2.0 mm FS	1.8 mm BBO	1.3 mm FS	3 mm FS	n/a	n/a
Dimensions	35 x 20 mm : 10 mm thickness						25 mm diameter 6.35 mm thick	25 mm diameter 6.35 mm thick
ROC	Flat							
AOI	0-10°						0-45°	

Glass wedges for dispersion fine tuning

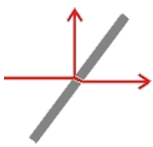
The glass wedge pairs allow for dispersion fine tuning and optimal pulse compression in combination with dispersion compensating mirrors. The dispersion characteristics of the DCM mirrors are especially designed to work together with specific glass materials and thus such a wedge pair can be used to fine-tune the dispersion and compress pulses for the desired application.

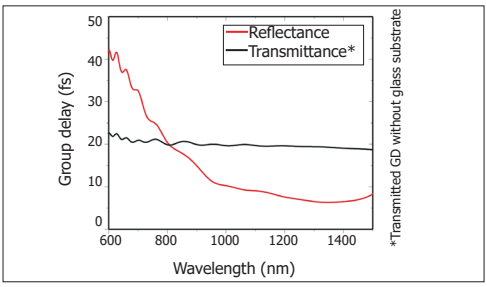
Specification of glass wedges

	Calcium fluoride	Fused silica	
Centre thickness	1.4 mm	1.4 mm	2.0 mm
Dimensions	35 x 20 mm	35 x 20 mm	50 x 25 mm
Wedge angle	4°	4°	
Surface Quality	<lambda/6, S/D<60-40	<lambda/10	<lambda/4
For use with	DCM7	DCM9, DCM10, DCM12	
Bandwidth	300 - 1500 nm, uncoated for use under Brewster angle		

Beam splitter with balanced dispersion

The Laser Quantum all-dielectric beam splitters feature a constant splitting ratio for an ultra-broadband wavelength range and a balanced dispersion in transmission and reflection. Therefore these components are ideally suited for femtosecond applications where a precise control of reflectivity and dispersion is required over a wide spectral range. Transmission and reflection properties of this beam splitter are designed to be identical and thus perfect for dispersion-balanced interferometers or autocorrelators (Fig. 13 & Fig. 14).





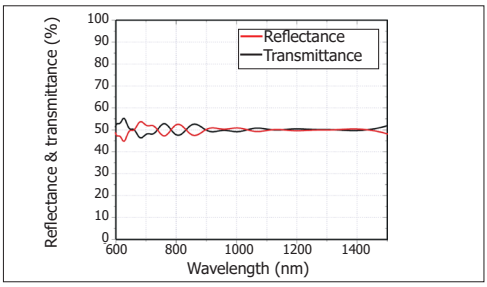


Fig. 13 & Fig. 14 The reflectance, transmission and group delay of the broadband beam splitter with 50% splitting ratio and identical group delay after transmission and reflection. The dispersion in reflection upon the dielectric coating is designed to be identical to 0.7 mm of fused silica thus the dispersion in transmission is the same as in reflection.

Specification of beam splitter

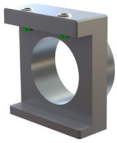
Wavelength range:	600 - 1500 nm	Substrate:	Fused silica substrate
Split ratio:	50%±5%	Dimensions:	Diameter 1"; 0.7 mm thickness

venteon optics

Laser Quantum
A Novanta Company

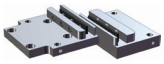
Specialised mirror/optics mounts

Rectangular optics mount



This special optics mount accept rectangular optics/mirrors with a height of either 20 mm or 25 mm (depending on the chosen version) and can be directly mounted into standard 1" round mirror mounts. The slim design without sideframe is ideally suited to build up compressor beam lines using rectangular mirrors with multi-bounces.

Wedge mounting adapter pair

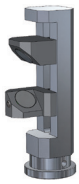


This pair of wedge mounting adapters is designed to accept up to 4 mm thick glass wedges, as provided by Laser Quantum, to allow dispersion fine tuning in a pulse compression setup. One of the adapters can be directly screwed onto M4 threaded pedestal posts whereas the other features a 20 mm grid for M2 screws to allow for a direct mounting onto standard compact translation stages that can be ordered optionally. The design of these adapters allows for a minimal gap between the wedges to minimise dispersive effects.

Specification of specialised mirror/optics mounts

Rectangular optics mount	Wedge mounting adapter pair
Accepts rectangular optics with a height of 20 mm or 25 mm	Accepts glass wedges and optics up to 4 mm thickness
No width limitation of the optics	No width limitations (open frame design)
Directly compatible to standard 1" mirror mounts	Optimised design for mounting two wedges with minimal gap between each other and gentle glass clamping due to rubber sheets
Aperture in backplane for leakage or transmitted radiation	M4 thread for direct pedestal mounting (one adapter). Mounting holes (M2-grid) for direct translation stage mounting (one adapter)
High quality aluminium alloy, anodised or with vibration-grounded finish	Translation stage with 6.5 mm travel can be ordered optional with an additional adapter for pedestal mounting below the translation stage

Monolithic periscope



The monolithic periscope is designed to realise a broadband polarisation rotation or beam offset within a minimal space and highest stability due to the use of non-adjustable mirror mounts. It is ideally suited to rotate from p-polarisation to s-polarisation, e.g. for use with **venteon SPIDER** or for parametric phase matching. The design allows for easy height adjustments of the mirror mounts/sliders for quick adaptation to the optical beam path.

Specification of monolithic periscope

Monolithic periscope
Three different mirror mounts (sliders) included to realise different periscope and beam steering options
Polarisation rotating (90°) or non-rotating (0°) beam offset possible
Mirror mounts accept 0.5" optics
Adapters for 1" optics available (optional)
M4 threaded for direct pedestal post mounting
Minimal beam height: 1.5" (using 0.5" pedestal post mounting)
Minimal beam offset (input - output): 15 mm
Maximal beam offset (input - output: 55 mm
Monolithic stainless steel body
Choice of mirrors (sold separately) available

LASER QUANTUM LTD
tel: +44 (0) 161 975 5300
email: info@laserquantum.com
web: www.laserquantum.com

LASER QUANTUM INC
tel: +1 510 210 3034
email: info@laserquantum.com
web: www.laserquantum.com

LASER QUANTUM GmbH
tel: +49 7531 368371
email: info@laserquantum.com
web: www.laserquantum.com