

L.4 : A new design of single tiled grating laser pulse compressor

A laser pulse compressor is a crucial part of any chirped pulse amplification based ultra-short pulse laser system, and is used to recompress the amplified stretched pulse back to the minimum achievable pulse duration. Recompression of high energy laser pulses requires a large aperture compressor to avoid damage of the compressor gratings. Since the size and the damage threshold of a compression grating are limited, the high energy pulse compression is also achieved using segmented or tiled array of smaller size gratings. In such a compressor, gratings with smaller dimensions are coherently tiled together with sub-wavelength accuracies, to mimic a large size single grating. However, there remains a practical challenge to align the tiled optical surfaces and keep them aligned to sub-wavelength accuracies. This is due to the large number of degrees of freedom of motion, (translational and rotational) in the system and the corresponding phase errors result in poor temporal pulse compression and focused beam quality.

A pulse compressor design that use only one tiled grating has been proposed and demonstrated to reduce cost, size, and easier maintenance of the compressor. Since present design is a folded one, with several mirrors to allow multiple hits of the laser beam on single tiled grating, it is expected to have limited parametric space for pulse compression. However, the single grating pulse compressor geometry can provide an alternative solution in situation where one requires a very large compression factor. Figures L.4.a, b and c respectively depict three geometries of pulse compressor using a single grating. Compression of positively chirped laser pulses of ~250 ps duration to 350 fs has been experimentally demonstrated. [For details, please see D. Daiya et al, Opt. Commun. 309, 15 (2013)].

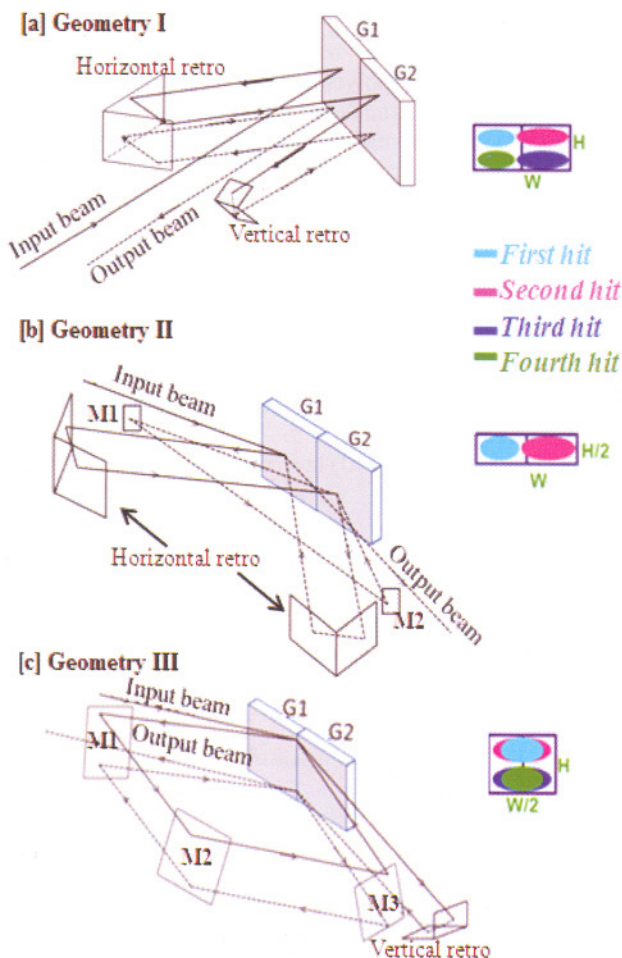


Fig.L.4.1: a-c) Typical geometries of single tiled grating pulse compressor

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