

# Multilayer Coatings For Attosecond Experiments In The VUV Spectral Region

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Generation of ultrashort light pulses of relatively high energy photons has opened in the last years a new frontier to matter physics in a very short time scale. Ultrashort pulses can be generated in the interaction with gas jets of femtosecond laser pulses focused at high power density; the consequent tunnel ionization of the atoms in the laser field produces a spectrum of laser harmonics spanning from the near infrared up to the x-ray region. Suitably selecting a XUV portion of the HOH spectrum, pulses with sub-femtosecond time duration can be obtained.

Shortest time duration can be reached if the phase mismatch between different harmonics (second order chirp for short quantum path) is compensated and a Gaussian reshaping of the spectrum is obtained. It is worth to be noted that for attosecond experiments it is essential to study optical design able to comply with the above requirements.

Multilayer coatings are the only way to have high efficiency EUV optics working in normal incidence configuration. Typical periodic structures are characterized by energy band coverage usually restricted to few percent of the peak energy, i.e., for example, a few eV at about 100 eV. This means that in the case of ultra-short radiation pulses (< fs) the corresponding “wide” spectral features cannot be preserved.

In this work, by the use of an optimization algorithm based on “evolutive strategy”, we design optimal “wide” band a-periodic multilayers mirrors for attosecond physics experiment (see Fig. 1). The evolutive approach differs from a local optimization algorithm or genetic algorithms because is able to acquire domain knowledge based on the merit function values during the optimization process.

For attosecond pulse in the VUV spectral region SiC/Mg and B<sub>4</sub>C/Mo/Si a-periodic multilayer are designed, studied and compared, while, for attosecond pulse in the EUV region Mo/Si a-periodic multilayer are designed and studied.

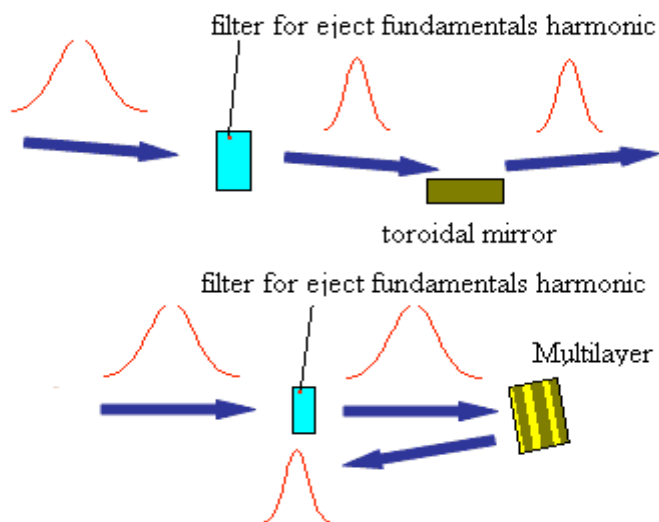


Fig. 1: multilayer optics employment opportunity in attosecond experiment.