Synthesis of intense, multicolor extreme ultraviolet fields at FERMI: a route towards attosecond coherent control of nonlinear processes

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The generation of intense, multicolor fields in the extreme ultraviolet spectral range at Free Electron Lasers (FELs) opens new perspectives for the characterization and control of nonlinear processes in atoms and molecules. In this talk, we will present results on the two-photon double ionization of neon obtained at the seeded FEL FERMI, showing the possibility to completely characterize the sequential ionization process. The role of autoionizing resonances embedded in the continuum will be also discussed.

FERMI offers also the possibility to synthetize multicolor fields, whose amplitudes and relative phases can be independently controlled. Recently the first experiment demonstrating the coherent control of the photoionization process in neon atoms was demonstrated [1]. In the temporal domain, the coherent superposition of two or more coherent harmonics leads to a complex temporal structure, whose characteristics depend on the relative phases between the harmonics. If the harmonics are in phase, a train of short attosecond pulses is realized. We will analyze the future perspectives for the generation and, in particular, for the characterization of train of attosecond pulses at FERMI. The possibility to control independently the phase of each harmonics paves the way for a complete temporal shaping of the attosecond waveform, with potential applications in attosecond coherent control schemes. We acknowledge the contributions of the Low Density Matter (LDM) collaboration, of Dr. Denys Iablonskyi and Prof. Kiyoshi Ueda (experiments), and of Prof. Alexei Grum-Grzhimailo, Prof. Klaus Bartschat, Dr. Nicolas Douguet, and Dr. Elena Gryzlova (theory).

References

[1] K. Prince et al., *Nat. Photon.* **10,** 176 (2016).