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Recent experiments at the LDM beamline of FERMI, with EUV radiation from FEL-1: highlights and prospects

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Free-Electron-Lasers (FELs) in the EUV and XUV photon energy range have greatly expanded the feasibility range of experiments at the crossroad between tabletop lasers and synchrotrons. The FERMI facility in Trieste (Italy) is unique in the FELs landscape because it has been designed as a seeded source, resulting in superior performances in terms of control and reproducibility of its light pulses [1]. Of particular interest for spectroscopic applications are its broad tunability, wavelength purity (approaching the Fourier-transform limit, with sub-linewidth stability), short pulse duration and timing jitter. Transverse and temporal coherence are those characteristic of a true laser, and have been exploited in a series of pioneering experiments [2]. As in laboratory High Harmonic Generation, harmonics are mutually coherent, but in contrast, they are produced with much higher pulse energy.
The Low Density Matter Beamline (LDM, [3]) at FERMI, which caters to the atomic-, molecular-, and cluster-science community, has fully exploited these unique characteristics to perform precision nonlinear spectroscopy [4], explore the behavior of atoms [5] molecules [6] and clusters [7] under intense fields, and study the dynamics of photoexcited molecules [8].

The LDM beamline has also represented a versatile instrument to characterize the properties of FERMI and explore new modes of operation [9], prompting the full exploitation and control of its longitudinal coherence for breakthrough experiments [2].

I will present the research opportunities offered by LDM at FERMI in the above fields, along with some recent results, and future perspectives.

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[1] E. Allaria et al., Nat. Photon. 6 (2012) 699–704; E. Allaria et al., Nat. Photon. 7 (2013) 913–918.
[2] K. C. Prince et al., Nat. Photon. 10 176 (2016); D. Iablonskyi et al., Phys. Rev. Lett. 119 073203 (2017); M. Di Fraia et al., Phys. Rev. Lett. 123 213904 (2019); A. Wituscheck et al., Nat. Commun. 11 883 (2020); D. You et al., Phys. Rev. X 10 031070 (2020); P. K. Maroju et al., Nature 578 386 (2020); N. S. Mirian et al., Nat. Photon. 15 523 (2021).
[3] V. Lyamayev et al., J. Phys. B 46, 164007 (2013); C. Svetina et al., J Synchrotron Radiat. 22, 538 (2015).
[4] M. Žitnik et al., Phys. Rev. Lett. 113, 193201 (2014); T. Takanashi et al., Phys. Rev. Lett. 118, 033202 (2017).
[5] M. Ilchen et al., Phys. Rev. Lett. 118, 013002 (2017); M. Ilchen et al., Nat. Commun. 9, 4659 (2018); P. A. Carpeggiani et al., Nat. Phys. 15, 170 (2019); M. D. Kiselev et al., J. Phys. B 53, 244006 (2020).
[6] F Holzmeier et al., Phys. Rev. Lett. 121, 103002 (2018)
[7] Y. Ovcharenko et al., Phys. Rev. Lett. 112, 073401 (2014); B. Langbehn et al., Phys. Rev. Lett. 121, 255301 (2018); M. Mudrich et al., Nat. Commun. 11, 112 (2020); A C LaForge et al., Phys. Rev. X 11, 021011 (2021); R. Michiels et al., Phys. Rev. Lett. 127, 093201 (2021); J. D. Asmussen Phys. Chem. Chem. Phys. 23, 15138 (2021).
[8] R. . Squibb et al., Nat. Commun. 9, 63 (2018); S. Pathak et al., Nat. Chem., 12, 795 (2020).
[9] E. Allaria et al., Phys. Rev. X 4, 041040 (2014); D. Gauthier et al., Nature Communications 7, 13688 (2016).

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