

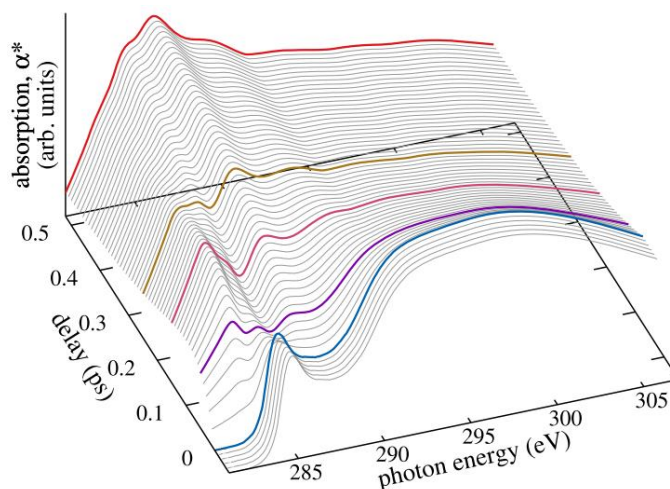
# Ultrafast phenomena in condensed matter explored through extreme ultraviolet sub-picosecond pulses

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The beamline EIS-TIMEX of the FERMI free electron laser (Trieste, Italy) investigates unexplored ultrafast phenomena in condensed matter triggered by the interaction between light and condensed matter. An overview on diverse classes of experiments carried out at TIMEX is provided, discussing both the used experimental approach and scientific impact. Presented experiments include high energy density matter [1,2], nonlinear phenomena (spectral effects [3], second harmonic generation [4,5], saturable- and two-photon-absorption [6]) and photo-catalysis [7]. Unpublished experimental achievements, such as the ultrafast electron diffraction scheme operated at TIMEX, are also shown.



**Figure:** Sub-picosecond time resolved XAS spectrum of carbon (K-edge) under laser-driven extreme conditions of pressure and temperature. The ultrafast melting dynamics occurs in less than 0.5 ps. The resulting liquid carbon temperature exceeds 14000 K at a pressure of about 0.5 Mbar.

## References:

- [1] Principi E., Krylow S et al. *Physical Review Letters* 125, 155703 (2020)
- [2] Principi E., Giangrisostomi E. et al. *Physical Review B* 97, 174107 (2018)
- [3] Ferrante C., Principi E. et al. *Light: Science and Applications* 10, 92 (2021)
- [4] Lam R., Ray S. et al. *Physical Review Letters* 120, 023901 (2018)
- [5] Schwartz C. P., Ray S. et al. *Physical Review Letters* 127, 096801 (2021)
- [6] Hoffmann L., Jamnuch S. et al. *J. of Physical Chemistry Letters* 13, 8963 (2022)
- [7] Cresi J.S.P., Principi E. et al. *Nano Letters* 21, 1729 (2021)