Contribution ID: **56** Type: **Poster**

Modular multiscale approach to modelling high-harmonic generation in gases

The quantitative description of high-harmonic generation is a challenging task because it spans various physical scales: (a) the nonlinear propagation of the driving laser pulse, (b) the quantum-mechanical single-atom response that produces the harmonic field, (c) and the collective contribution of all microscopic emitters to the macroscopic high-harmonic signal. We present a modular computational model to describe the whole process. The implementation of the solvers is modular using an HDF5 data interface. (a) uses a cylindrically symmetric unidirectional pulse propagation, (b) one-dimensional Schrödinger equation, (c) a diffraction-integral based approach. The implementation is done in Fortran, C, and Python. The model is accompanied by jupyter-notebook data processing and other techniques to make the code user-friendly. The whole code was already applied for real physical problems in, e.g., *O. Finke et al, SciRep 12 7715 (2022).*

This computational model is not yet related to SMILEI. We would be curious to investigate possibilities to benchmark the unidirectional propagation against SMILEI or to use SMILEI electric fields as inputs for the TDSE to see detailed microscopic response of weakly ionised plasma.

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Session Classification: Poster session