One-Dimensional Atomic Model Potentials in Attosecond Physics

K Sallai[1], Sz Majorosi[1], Sz Hack[1], and A Czirják[1]

[1] *ELI ALPS, Szeged, Hungary*
Contact Email: attila.czirjak@eli-alps.hu

In order to fully understand the processes in attosecond and strong-field physics, the quantum evolution of an involved atomic system driven by a strong laser pulse is usually needed. In the case of linearly polarized driving laser pulses, the main dynamics happen along the direction of the electric field of the laser pulse, which underlies the success of some one-dimensional (1D) approximations.

In our earlier works [1,2], we introduced the MSC potential, a 1D soft-core Coulomb potential with improved parameters, which defines a ground state density approximating the reduced density of the 3D ground state, resulting in very accurate low-frequency quantum dynamics.

In the present contribution, we highlight a new 1D atomic model potential [3], designed for the quantum simulation of a single active electron atom in a strong, linearly polarized laser field. This new GSC potential balances accuracy and efficiency, enabling TDSE simulations to produce reliable HHG spectra within minutes for peak intensities in the 100 TW/cm^2 range, in the full CEP range and in the practically important chirp parameter range.

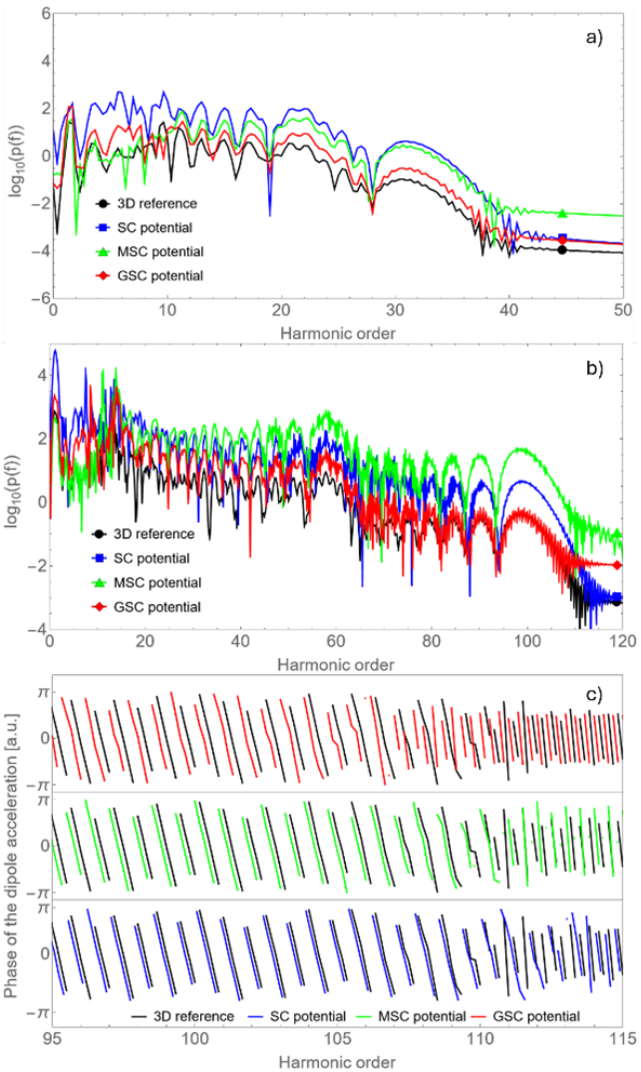

Figure 1: Assuming a laser pulse of 800 nm central wavelength and 3.1 fs pulse length, simulated (a) HHG power spectra for Ar at 1.26×10^{14}W/cm^2; (b) HHG power spectra and (c) spectral phase for Ne at 6.88×10^{14}W/cm^2 peak intensity. Results with a 3D reference simulation (black), SC (blue), MSC (green) and GSC (red) potentials

References

[1] Sz Majorosi, M G Benedict and A Czirják, Phys. Rev. A **98**, 023401 (2018)

[2] Sz Majorosi, M G Benedict, F Bogár, G Paragi and A Czirják, Phys. Rev. A **101**, 023405 (2020)

[3] K Sallai, Sz Hack, Sz Majorosi and A Czirják, Phys. Rev. A **110**, 063117 (2024)