Simulating polaron biophysics with Rydberg atoms

Marcin Płodzień[1], Tomasz Sowiński[2], Servaas Kokkelmans[1]

[1] Department of Applied Physics, Eindhoven University of Technology, PO Box 513, 5600 MB Eindhoven, The Netherlands
[2] Institute of Physics, Polish Academy of Sciences, Aleja Lotników 32/46, PL-02668 Warsaw, Poland

Transport of excitations along proteins can be formulated in a quantum physics context, based on the periodicity and vibrational modes of the structures. Exact solutions are very challenging to obtain on classical computers, however, approximate solutions based on the Davydov ansatz have demonstrated the possibility of stabilized solitonic excitations along the protein. We propose an alternative study based on a chain of ultracold atoms. We investigate the experimental parameters to control such a quantum simulator based on dressed Rydberg atoms [1]. We show that there is a feasible range of parameters where a quantum simulator can directly mimic the Davydov equations and their solutions. Such a quantum simulator opens up new directions for the study of transport phenomena in a biophysical context.

[1] M. Płodzień, Tomasz Sowiński, and Servaas Kokkelmans, arXiv:1707.04120.