TITLE: Introduction to the computational analysis of the static properties and dynamics of one-dimensional spin-1/2 systems.

Quantum spin-1/2 models are the prototypes of realistic quantum systems with interactions. They are employed in the description of various complex physical phenomena and have been experimentally simulated in optical lattices. In this tutorial, you will learn how to write computer codes to exactly diagonalize these models. You will then use the eigenvalues and eigenstates to:
(i) Analyze signatures of quantum phase transition, localization, and quantum chaos.
(ii) Investigate the dynamics of the system by studying the evolution of fidelity, Loschmidt echo, Shannon entropy, and various few-body observables.
(iii) Compare the infinite time averages of observables with thermal averages and then identify the conditions that can lead to the thermalization of isolated quantum systems.
Computer assignments will be provided, so it is important to have a computer with a programming language of your preference already installed.

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1) A. Gubin and L. F. Santos, "Quantum chaos: an introduction via chains of spins-1/2", American Journal of Physics **80**, 246 (2012);
[http://arxiv.org/abs/1106.5557].
2) K. Joel, D. Kollmar, and L. F. Santos, "An introduction to the spectrum, symmetries, and dynamics of spin-1/2 Heisenberg chains", American Journal of Physics **81**, 450 (2013); [http://arxiv.org/abs/1209.0115].
3) P. R. Zangara, A. D. Dente, E. J. Torres-Herrera, H. M. Pastawski, A. Iucci, L. F. Santos, "Time Fluctuations in Isolated Quantum Systems of Interacting Particles", Physical Review E **88**, 032913 (2013); [http://arxiv.org/abs/1305.4640].
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7) E. J. Torres-Herrera and Lea F. Santos, "Local quenches with global effects in interacting quantum systems", [http://arxiv.org/abs/1402.7084].
8) E. J. Torres-Herrera, Davida Kollmar, Lea F. Santos, "Relaxation and Thermalization of Isolated Many-Body Quantum Systems", [http://arxiv.org/abs/1403.6481].