MO 31: Poster – Collisions, Scattering and Correlation Phenomena (joint session A/MO)

Time: Thursday 17:00–19:00 Location: Philo 1. OG

MO 31.1 Thu 17:00 Philo 1. OG

Relativistic S-Matrix Calculations of Compton Scattering from Bound Electrons — •Nick Marius Mayer[1,2], Jonas Sommerfeldt[3], and Andrey Surzhykov[1,2] — [1]Technische Universität, Braunschweig, Germany — [2]Physikalisch-Technische Bundesanstalt. Braunschweig, Germany — [3]Laboratoire Kastler Brossel, Paris, France

Compton scattering is a fundamental process in which an incoming photon is inelastically scattered by an electron bound to an atomic nucleus. It finds important applications across many areas of modern science, ranging from medical radiotherapy to X-ray polarimetry. With regard to the latter, we present theoretical analyses of Compton scattering by bound electrons, with special focus on polarization effects. In particular, we discuss calculations based on S-matrix theory. To carry out these calculations, we developed a program that numerically solves the radial Dirac equation accurately for a bound electron in the central nuclear potential, approximated here by a Coulomb potential. Based on this approach, detailed calculations of the doubly differential cross section (DDCS) and the polarization properties of photons scattered by K-shell electrons can be carried out across a broad range of energies and for arbitrary polarization states of the incident photon beam.

MO 31.2 Thu 17:00 Philo 1. OG

Observing ergodicity breaking via violations of random matrix theoretic predictions — •Venelin Pavlov[1], Peter Ivanov[1], Diego Porras[2], and Charlie Nation[3] — [1]Center for Quantum Technologies, Department of Physics, St. Kliment Ohridski University of Sofia, James Bourchier 5 blvd, 1164 Sofia, Bulgaria — [2]Institute of Fundamental Physics IFF-CSIC, Calle Serrano 113b, 28006 Madrid, Spain — [3]Department of Physics and Astronomy, University of Exeter, Stocker Road, Exeter EX4 4QL, United Kingdom

Quantum many-body systems can exhibit distinct regimes where dynamics is either ergodic in the sense that it explores an extensive region of available state-space, or non-ergodic, where the dynamics may be restricted or localized. In this work we explore the ability to probe the ergodicity of dynamics via local observables, and use expected results from random matrix theory (RMT) as a benchmark for the ergodic regime. We explore the time evolution of the quantum Fisher (QFI) information in the presence of three different ergodicity breaking mechanisms in a non-integrable spin system, namely, as a consequence of transition to integrability, Many-Body Localization (MBL) and Quantum Many-Body Scars (QMBS). We show that it can be used as a potential witness for transition to non-ergodic behavior. In ergodic quantum systems the QFI exhibits an additional intermediate linear time scaling together with it's typical short-time and long-time quadratic scaling. We show that in all of the three ergodicity breaking scenarios the violation of the random matrix theory predictions leads to the vanishing of the intermediate linear time regime.

MO 31.3 Thu 17:00 Philo 1. OG

Analytical determination of multi-time correlation functions in quantum chaotic systems — •Yoana Chorbadzhiyska[1], Peter Ivanov[1], and Charlie Nation[2] — [1]Faculty of Physics, Sofia University "St. Kliment Ohridski", 5 James Bourchier Blvd, Sofia 1164, Bulgaria — [2]Department of Physics and Astronomy, University of Exeter, Stocker Road, Exeter EX4 4QL, United Kingdom

The time-dependence of multi-point observable correlation functions are essential quantities in analysis and simulation of quantum dynamics. Open quantum systems approaches utilize two-point correlations to describe the influence of an environment on a system of interest, and in studies of chaotic quantum system, the out-of-time-ordered correlator (OTOC) is used to probe chaoticity of dynamics. In this work we analytically derive the time dependence of multi-point observable correlation functions in quantum systems from a random matrix theoretic approach, with the highest order function of interest being the OTOC. We find in each case that dynamical contributions are related to a simple function, related to the Fourier transform of coarse-grained wave-functions. We compare the predicted dynamics to exact numerical experiments in a spin chain for various physical observables. We comment on implications towards the emergence of Markovianity and quantum regression in closed quantum systems, as well as relate our results to known bounds on chaotic dynamics.