PHD POSITION ON
TIME-DEPENDENT TWO-PARTICLE REDUCED DENSITY MATRIX THEORY FOR ATTOSECOND CORRELATION DYNAMICS

Description: PhD position in theoretical physics for 3.5 years (starting date early 2024), fully funded by the Austrian funding agency FWF (benefits included)

Location: Institute for Theoretical Physics, Vienna University of Technology (TU Wien), and the Vienna Center for Quantum Science (VCQ)

Contact: Iva Brezinova iva.brezinova@tuwien.ac.at

Research program

The PhD thesis will be carried out in the newly established group of Iva Brezinova at TU Wien, which focuses on time-dependent quantum many-body systems (for more information see this webpage). We develop methods for driven and non-equilibrium quantum many-body systems, and apply them to a wide range of topics, including ultracold atoms, 2D materials, and ultrashort physics. Our theoretical work is driven by experimental advances in the generation of strong and ultrashort laser pulses. These laser pulses make it possible to resolve the time-dependent dynamics of electrons on their natural time scale in systems ranging from atoms to solids, and to create interesting non-equilibrium quantum states that can be exploited in quantum technology applications. However, the theoretical description of the dynamics lags behind the experimental progress due to the enormous complexity of the time-dependent Schrödinger equation. Therefore, one often resorts to effective single-particle models neglecting quantum many-body correlations. We have recently developed a new method (TD2RDM) that is able to accurately predict the quantum many-body dynamics of fermionic particles under strong driving. This method uses the two-particle reduced density matrix (2RDM) as the fundamental variable, thus avoiding the exponential scaling of wavefunction-based methods. In this project, we plan to apply the TD2RDM method to correlation effects in atoms under strong field driving. We will use measures from quantum information theory to assess the strength of many-body correlations and quantify their role in ultrafast dynamics.

Profile of the candidate

You should have obtained your Master thesis in Physics, preferably in Theoretical Physics. A background in quantum many-body physics, reduced density matrices, attosecond physics, strong-field physics or related topics is an advantage but not a strict prerequisite. Programming skills are appreciated. You should enjoy both analytical as well as numerical work, you must be motivated, show initiative, and be able to work both independently and with other group members.

Application

Please apply via the current PhD call of the VCQ at: https://vcq.quantum.at/phd-program/ More information about the PhD program and Vienna as a scientific environment is provided also there. Deadline is **January 8th**. (Under special circumstances, I will accept further applications post deadline directly via email: iva.brezinova@tuwien.ac.at. Please include in this case your CV and a publication list if available, a motivation letter, and contact details of at least one potential referee.)