GR 1: Quantum (Field) Theory and Gravity

Zeit: Montag 9:00–10:30 Raum: VMP6 HS A

Hauptvortrag GR 1.1 Mo 9:00 VMP6 HS A

Time Dilation in Quantum Systems and Decoherence — •Caslav Brukner — Fakultät für Physik, Universität Wien, Austria — Institut für Quantenoptik und Quanteninformation, Österreichische Akademie der Wissenschaften, Austria

Phenomena where both quantum theory and general relativity become relevant are typically assumed to be present at extreme physical conditions: at high energies and in strong gravitational fields. In this talk I will consider low-energy quantum mechanics in the presence of weak gravitational time dilation and show that the latter leads to novel phenomena that could be accessible in quantum optical experiments. I will present a quantum version of the "twin paradox" in which a quantum system is brought in superposition of being at two different gravitational potentials, and show that time dilation induces entanglement between internal degrees of freedom and the center-of-mass of a composite particle. In particular, I will derive that time dilation can cause decoherence of composite quantum systems and thus contribute to the transition to classicality. Finally, using relational point of view, I will analyze what these results could imply for the situations where the quantum system is localized but the (space-time) background is in a quantum superposition.

Hauptvortrag GR 1.2 Mo 9:45 VMP6 HS A

Semiclassical Einstein equation — •Rainer Verch — Institut für Theoretische Physik, Universität Leipzig

The semiclassical Einstein equation is formulated in the setting of quantum field theory in curved spacetimes, and features the Einstein tensor of a classical spacetime geometry on the left hand side, and the expectation value of the stress-energy tensor of a quantum field on that classical spacetime geometry, in a suitable state, on the right hand side. In the talk, several results pertaining to this equation, which have emerged over the past several years, will be reviewed. This includes, in particular, ruling out certain "designer spacetime" scenarios, solutions and stability for cosmological spacetimes, the possibility or not of having Chaplygin-gas type solutions, quantization of fluctuations in cosmology, and the non-relativistic limit.