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UNIVERSITÄT BERN

Seminar über Laser Physics and Ultrafast Photonics

Referent/speaker: Prof. Dr. Andrea Caviglia, Department of Quantum Matter Physics, University of Geneva

Titel/title: Building quantum matter, one atom at a time

The quantum vacuum is not empty. Unlike its classical counterpart, the ground state of quantum fields carries zero-point fluctuations with measurable physical consequences, from the Casimir force between neutral conductors to the Lamb shift in atomic spectra and the Purcell modification of spontaneous emission. A central theme of this talk is that boundaries and materials are not passive: they reshape the electromagnetic mode spectrum, making the quantum vacuum itself a tunable object.

Against this backdrop, I discuss how atomically precise epitaxy of complex transition-metal oxides with perovskite structure (ABO_3) enables the bottom-up construction of quantum materials with tailored properties. Heterointerfaces act simultaneously as boundary conditions for electrons, phonons, and photons, opening a space of emergent phenomena inaccessible in bulk compounds. I will present two illustrative examples from our group.

First, I will discuss the engineering of quantum geometry through interfacial symmetry breaking, leading to a quantum-metric-driven nonlinear magnetoresistance recently observed at the (111) surface of $SrTiO_3$. Second, I will close by discussing the emerging framework of materials quantum electrodynamics, where placing a quantum material inside an electromagnetic cavity allows vacuum fluctuations themselves to be harnessed as a resource for modifying ground-state order.

Zeit/time: Thursday, May 21, 2026, 11.15 Uhr
Ort/place: Room B116, ExWi, Sidlerstrasse 5, Bern, Schweiz