3rd ICQMT 2025

3rd International Conference on Quantum Materials and Technologies

SUPERINSULATION AND BOSE (OR ANOMALOUS) METALS

Distinguished Professor Carlo Trugenberger

Carlo Trugenberger graduated in theoretical physics from the Swiss Federal Institute of Technology in Zurich, where he also obtained his PhD. After postdoctoral positions at MIT, Los Alamos National Laboratory, CERN, and Max Planck Institute in Munich he became associate professor of physics at Geneva university. He then quit academia to focus on founding two companies in the domain of artificial intelligence, one of which he stills leads today. He continues his fundamental physics research on the topics of quantum materials and quantum gravity. In 1996, in collaboration with M. C. Diamantini and P. Sodano he first predicted the existence of superinsulators and Bose (or anomalous) metals, both of which have now been confirmed.

Date and Time: From 26 April to 3 May 2025, exact day&time will be announced later.

Lecture Room: TBD

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10th ICSM 2025

10th International Conference on Superconductivity and Magnetism

Abstract

Superinsulators are dual superconductors. They form as an emergent magnetic monopole condensate in which charges are bound by electric flux tubes (strings), realizing purely electric pions, and implying infinite electric resistance up to a finite critical temperature and critical voltage.

Magnetic monopoles arise naturally in superconductors with emergent granularity and they cause the Coulomb interaction to become even much more stronger than in Mott insulators. When monopoles are suppressed above these critical values, superinsulators transition to Bose metals, frozen states caused by the mutual statistical repulsion of out-of-condensate charges and vortices and in which a metallic saturation of the resistance at low temperatures is due to charge transport on the edges, with vortices crossing them. I will review both the main aspects of the theory of superinsulation and Bose metallicity and the abundant experimental evidence supporting it, including an experiment directly measuring the linear Coulomb interaction due to electric strings.

I will also show how an infinite-dimensional symmetry forbids many-body localization for 2D gapped states so that all the phases around the superconductor-to-insulator transition in thin films are due to interactions, independently of disorder. Finally, I will mention some possible technological applications of superinsulation, both as a standalone and in conjunction with superconductors.