Critical properties of the Anderson transition through the looking-glass of the CBS and CFS peaks

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Date: 11 September 2020, Friday
Time: 4:00 PM
Venue: Remote via Zoom Join (Meeting ID: 836 5837 3469, Password: 969212)
https://us02web.zoom.us/j/83658373469?pwd=ZkpnOVNpcm85VENiQU1NcFFQRXQyUT09
Host: Associate Professor David Wilkowski

Abstract
In disordered media, the absence of diffusion arising from the spatial localization of single-particle states is known as Anderson localization (AL). In three dimensions, AL manifests itself as a phase transition which occurs at a critical energy or at a critical disorder strength (the mobility edge) separating a metallic phase where states are spatially extended, from an insulating one where states are localized. Theoretically, much efforts have been devoted to the study of the critical properties of the Anderson transition (AT), such as wave-function multifractality or critical exponents. In practice however, only a handful of experiments have found evidence for the 3D Anderson transition, among them cold atoms, and even fewer have investigated its critical features (mostly in the context of quantum-chaotic dynamical localization). In addition to the intrinsic difficulty of achieving wave localization in three dimensions, one reason for the rareress of experimental characterizations of the Anderson transition is the lack of easily measurable observables displaying criticality. In this talk, I will show that the critical properties of the AT are encoded into two emblematic interference effects observed in momentum space: the coherent backscattering (CBS) and the coherent forward scattering (CFS) peaks, the latter being a critical quantity of the transition. By a finite-time scaling analysis of the CBS width and of the CFS contrast temporal dynamics, one can extract accurate values of the mobility edge and critical exponents of the transition in agreement with their best known values to this date. Furthermore, exactly at the mobility edge, the CFS peak contrast is directly related to the so-called information dimension and reflects multi-fractal properties of the wave functions. Perspectives in the field will be mentioned.

Short Biography
Dr Miniatura is a Research Director (DR1) at the Centre National de la Recherche Scientifique (CNRS, France) and Visiting Research Professor at NUS and NTU (Singapore). He is the Director of the Singapore-based CNRS-UCA-SU-NUS-NTU International Joint Research Unit UMI 3654 MajuLab.
Dr Miniatura is an alumni of ENS Cachan (1986). He defended his PhD at University Paris 13 in 1990 and his Habilitation in Physics at the University of Nice Sophia in 2001. Hired by CNRS in 1989, he developed an atomic interferometer at University Paris 13 from 1990 to 1996, and received the CNRS Young Researcher Medal in 1994 for his work on topological phases. In 1996, he moved to Institut Non Linéaire de Nice - now Institut de Physique de Nice - where he co-developed and co-led a cold atom group working on coherent transport in disordered media (weak and strong localisation of light and matter waves). With his colleagues, he first demonstrated the coherent backscattering effect for light propagating in cold atomic samples (1999). In 2008, he joined the Centre for Quantum Technologies (Singapore) as a Visiting Research Professor where he developed a theory group working on quantum gases (quantum transport and localization, strongly correlated systems, artifical gauge fields, atomtronics, etc). In 2012, he co-discovered the coherent forward scattering effect, the signature of Anderson localization in momentum space.

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