PHYSIKALISCHES KOLLOQUIUM

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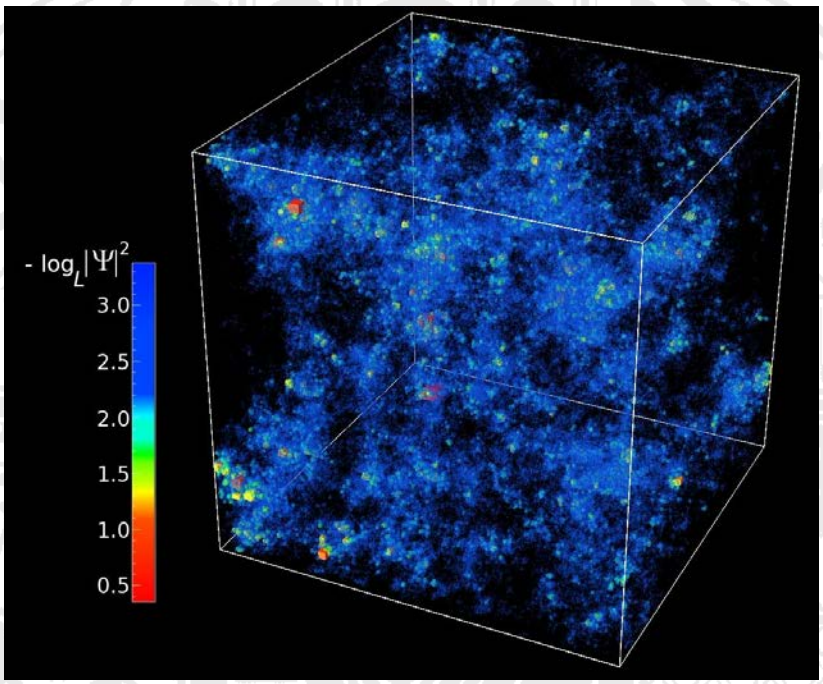

DISORDER- AND INTERACTION-INDUCED LOCALISATION PHENOMENA: FROM CONDENSED MATTER TO COLD ATOMS

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Microscopic structural changes of material properties may induce quantum interference phenomena which have drastic effects on the macroscopic behaviour of a system. For instance, a quantum particle in a sufficiently disordered medium will refuse to flow, and remain confined to a finite spatial domain, potentially inducing an insulating behaviour. This effect is known as Anderson localisation, a phenomenon whose importance touches upon a plethora of fields in physics, with fascinating properties, such as the existence of multifractal fluctuations of the particle's quantum state. Localisation can also emerge as a consequence of the inter-particle interaction, giving rise to the so-called Mott insulating phases. The competition between Mott and Anderson, i.e. between interactions and disorder, is a subject of intense current research which finds an ideal playground in experiments with cold-atoms in optical potentials.

We will discuss different probing techniques for these localisation phenomena, from the analysis of multifractal fluctuations of wave functions at the Anderson transition, to monitoring the signature of many-body interactions between cold atoms trapped in optical lattices using matter-wave scattering. We will treat briefly the importance of localisation and interactions in driven atomic systems, and the possibility to 'tame' disorder when seeking novel solutions for engineering transport properties in complex materials.