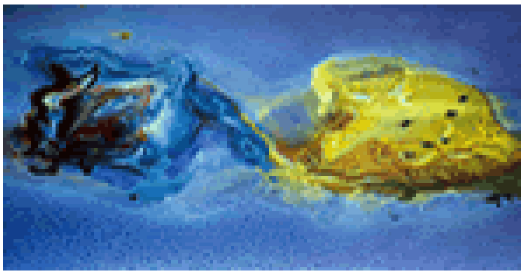

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Type: **Invited talk**

Confinement and asymptotic freedom with Cooper pairs

Friday 3 August 2018 16:00 (20 minutes)

We have studied the superconductor-insulator transition (SIT) in strongly disordered superconducting films and Josephson junction arrays (JJA) as a paradigm example example in which quantum synchronization gives rise to new phases of matter in d=2 and d=3 spatial dimensions.
In fact recent experimental results have shown that at absolute zero electrons can form quantum coherent states different from a superconductor. These states are superinsulators, dual superconductors with infinite resistance even at finite temperature, a new topological state of matter that we predicted in 1996, and a metallic state often referred to as Bose metal. We propose a long-distance topological gauge theory description SIT that enabled us to identify the underlying mechanism of superinsulation as Polyakov's linear confinement of Cooper pairs via instantons, blocking their motion on large scales and in asymptotic freedom at small distances. This implies that systems of a size smaller than the string scale appear in a quantum metallic state. Accordingly, the SIT realizes the field-theoretical S-duality.
Our findings generalize the concept of a super-insulator to 3D systems and open the route to desktop experiments revealing and elucidating observable implications of confinement and topological phenomena in QED.

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