The Abdus Salam International Centre for Theoretical Physics

Conference on Frontiers of Nanoscience
24 August - 1 September 2015, Trieste, Italy

Flux Noise in Superconducting Circuits: The Old Problem and the New Developments

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Abstract:

The origin of low-frequency 1/f flux noise in superconducting quantum interference devices (SQUIDs) is a long standing open question in condensed matter physics. Recent experiments indicate that there is a high density of unpaired surface spins in normal metal and superconducting thin films; it is suspected that fluctuations of these spins give rise to the 1/f flux noise. Furthermore there is experimental evidence that interactions between the surface spins are significant.

Prompted by our previous theoretical model that suggests that RKKY interactions between spins are a critical component of the flux noise, I consider a model of weakly interacting disordered spin systems and argue that in a typical random configuration, some fraction of spins form strongly coupled pairs. I explain that the generality of the low frequency flux noise is due to the appearance of these strongly coupled spin pairs that change their state rarely driven by the high frequency noise generated by the surrounding spins.

I discuss the noise in a system of classical spins and show that a similar mechanism results in a formation of quickly rotating pairs of spins similar to breathers in non linear systems.