



FROM THE
LAB

A WEEKLY UPDATE FROM INDIA'S FINEST RESEARCH INSTITUTES

In search of Quantum Spin Liquid

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WE ARE familiar with three common states of matter or phases: solid, liquid, and gas. Transformation between them is possible by tuning interactions between constituent particles by changing, for example, temperature or pressure. Ice becomes water if temperature is increased. Gases can be liquefied when pressurised.

Electrons in solid materials are also said to exist in different phases, depending on the way they are arranged and the way they interact with each other. Magnetic

at absolute zero temperature. This state is called 'quantum spin liquid', or QSL.

This uncertainty in spin direction can be expected in materials in which electrons are arranged in a triangular formation and their interactions are anti-ferromagnetic, that is, neighbouring electrons are aligned in anti-parallel direction. In such formation, spins on all the three corners cannot be anti-parallel to each other. This leads to a situation called 'geometrical magnetic frustration' that prevents the spins on the three corners from choosing any particular fixed orientation. The resulting state of perpetual fluctuation is the QSL state. Ferromagnetic interactions, in which all spins are aligned parallel to each other, do not frustrate because spins at all the corners can point in the same direction. For