Pressure-tuned magnetic interactions in a triangular-lattice quantum antiferromagnet

Sergei Zvyagin

Dresden High Magnetic Field Laboratory (HLD)
Helmholtz-Zentrum Dresden Rossendorf (HZDR)
01328 Dresden, Germany

Quantum triangular-lattice antiferromagnets are important prototype systems to investigate numerous phenomena of the geometrical frustration in condensed matter. Apart from highly unusual magnetic properties, they possess a rich phase diagram (ranging from an unfrustrated square lattice to a quantum spin liquid), yet to be confirmed experimentally. One major obstacle in this area of research is the lack of materials with appropriate (ideally tuned) magnetic parameters. Using Cs_2CuCl_4 as a model system, we demonstrate an alternative approach, where, instead of the chemical composition, the spin Hamiltonian is altered by hydrostatic pressure. The approach combines high-pressure electron spin resonance and r.f. susceptibility measurements, allowing us not only to quasi-continuously tune the exchange parameters, but also to accurately monitor them. Our experiments indicate a substantial increase of the exchange coupling ratio from 0.3 to 0.42 at a pressure of 1.8 GPa, revealing a number of emergent field-induced phases.

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