Contrasting Scenarios for Organic Spin Liquids

Stephen M. Winter,[1] Kira Riedl,[2] Elena Gati,[3,4] David Zielke,[3] Steffi Hartmann,[3] Oleg M. Vyaselev,[5] Nataliya D. Kushch ,[6] Harald O. Jeschke ,[7] Michael Lang,[3] Roser Valentí,[2] Mark V. Kartsovnik[8]

[1] Department of Physics and Center for Functional Materials, Wake Forest University, Winston-Salem, North Carolina 27109, USA, e-mail: winters@wfu.edu
[2] Institut für Theoretische Physik, Goethe-Universität Frankfurt, Max-von-Laue-Strasse 1, 60438 Frankfurt am Main, Germany
[3] Physikalisches Institut, Goethe-Universität Frankfurt, Max von Laue Str 1, 60438 Frankfurt am Main, Germany
[4] Max Planck Institute for Chemical Physics of Solids, 01187 Dresden, Germany
[5] Institute of Solid State Physics, Russian Academy of Sciences, 142432 Chernogolovka, Russia
[6] Institute of Problems of Chemical Physics, Russian Academy of Sciences, 142432 Chernogolovka, Russia
[7] Research Institute for Interdisciplinary Science, Okayama University, Okayama 700-8530, Japan
[8] Walther-Meissner-Institut, Bayerische Akademie der Wissenschaften, Walther-Meissner-Strasse 8, Garching D-85748, Germany

The ultimate ground state of organic spin-liquid candidates, such as κ-$(ET)_2Cu_2(CN)_3$ has long remained elusive. While a variety of apparently conflicting experimental results have favored various scenarios over the years, a comprehensive view has yet to emerge. It has long been thought that conventional magnetic order is destabilized by strong ring-exchange, occasioned by proximity to the Mott transition. Such interactions are known to promote either chiral spin-liquid phases or unconventional spin-vortex order if sufficiently strong. On the one hand, this scenario is now supported by the recent observation of spin-vortex order in the related compound κ-$(BETS)_2Mn[N(CN)_2]_3$, which definitely confirms the importance of ring-exchange [1]. On the other hand, there is mounting evidence for an important role of disorder in the low-temperature response [2]. Here, we contrast these scenarios in view of recent experimental results.

References

[1] Kira Riedl, Elena Gati, David Zielke, Steffi Hartmann, Oleg M. Vyaselev, Nataliya D. Kushch, Harald O. Jeschke, Michael Lang, Roser Valentí, Mark V. Kartsovnik, and Stephen M. Winter. *Phys. Rev. Lett.* **127-14**, 147204 (2021).
[2] Kira Riedl, Roser Valentí, and Stephen M. Winter. *Nat. Commun*. **10**, 1-9 (2019).