



Contribution ID: 137 Contribution code: O-6

Type: Oral

## Time-reversal symmetry-breaking charge order in a kagome superconductor

Monday, 29 August 2022 14:40 (20 minutes)

The kagome lattice, the most prominent structural motif in quantum physics, benefits from inherent nontrivial geometry to host diverse quantum phases, ranging from spin-liquid phases, topological matter to intertwined orders, and most rarely unconventional superconductivity. Recently, charge sensitive probes have suggested that the kagome superconductors  $AV_3Sb_5$  ( $A = K, Rb, Cs$ ) [1] exhibit unconventional chiral charge order. However, direct evidence for the time-reversal symmetry-breaking of the charge order remained elusive. We utilized muon spin relaxation to probe the kagome charge order and superconductivity in  $(K,Rb)V_3Sb_5$  [2,3]. We observe a striking enhancement of the internal field width sensed by the muon ensemble, which takes place just below the charge ordering temperature and persists into the superconducting state. Remarkably, the muon spin relaxation rate below the charge ordering temperature is substantially enhanced by applying an external magnetic field. We further show [3] that the superconducting state displays a reduced superfluid density, which can be attributed to the competition with the novel charge order. Upon applying pressure, the charge-order transitions are suppressed, the superfluid density increases, and the superconducting state progressively evolves from nodal to nodeless. Our results point to the rich interplay and accessible tunability between unconventional superconductivity and time-reversal symmetry-breaking charge orders in the correlated kagome lattice, offering new insights into the microscopic mechanisms involved in both orders.

[1] Y.-X. Jiang et. al., Nature Materials 20, 1353 (2021).

[2] C. Mielke et. al., and Z. Guguchia, Nature 602, 245-250 (2022).

[3] Z. Guguchia et. al., arXiv:2202.07713v1 (2022).

**Primary author:** Dr GUGUCHIA, Zurab (Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, Switzerland)

**Co-authors:** Mr MIELKE III, Charles (Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, Switzerland); Dr DAS, Debarchan (Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, Switzerland); Dr YIN, Jiaxin (Laboratory for Topological Quantum Matter and Advanced Spectroscopy (B7), Department of Physics, Princeton University, Princeton, New Jersey 08544, USA); Mr LIU, H. (Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China); Dr GUPTA, Ritu (Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, CH-5232 Villigen PSI, Switzerland); Mr JIANG, Y.-X. (Laboratory for Topological Quantum Matter and Advanced Spectroscopy (B7), Department of Physics, Princeton University, Princeton, New Jersey 08544, USA); Dr CHRISTENSEN, Morten (Niels Bohr Institute, University of Copenhagen, 2100 Copenhagen, Denmark); Dr MARISA, Medarde (Laboratory for Multiscale Materials Experiments, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland); Dr WU, X. (Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, D-70569 Stuttgart, Germany); Prof. LEI, H.C. (Department of Physics and Beijing Key Laboratory of Opto-electronic Functional Materials and Micro-nano Devices, Renmin University of China, Beijing 100872, China); Prof. CHANG, J.J. (Physik-Institut, Universität Zürich, Winterthurerstrasse 190, CH-8057 Zürich, Switzerland); Prof. DAI, Pengcheng (Department of Physics and Astronomy, Rice University, Houston, Texas 77005, USA); Dr MIAO, H. (Material Science and Technology Division, Oak Ridge National Laboratory, Oak

Ridge, Tennessee 37831, USA); Prof. THOMALE, Ronny (Institut für Theoretische Physik und Astrophysik, Universität Würzburg, 97074 Würzburg, Germany); Prof. FERNANDES, Rafael (School of Physics and Astronomy, University of Minnesota, Minneapolis, MN 55455, USA); Prof. NEUPERT, Titus (Physik-Institut, Universität Zürich, Winterthurerstrasse 190, CH-8057 Zürich, Switzerland); Prof. SHI, Youguo (Beijing National Laboratory for Condensed Matter Physics, Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China); Dr KHASANOV, Rustem (Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, CH-5232 Villigen PSI, Switzerland); Prof. HASAN, Zahid (Laboratory for Topological Quantum Matter and Advanced Spectroscopy (B7), Department of Physics, Princeton University, Princeton, New Jersey 08544, USA); Dr LUETKENS, Hubertus (Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, CH-5232 Villigen PSI, Switzerland)

**Presenter:** Dr GUGUCHIA, Zurab (Laboratory for Muon Spin Spectroscopy, Paul Scherrer Institute, Switzerland)

**Session Classification:** Oral contributions

**Track Classification:** Superconductivity