Two-components order parameter in Sr_2RuO_4

S. Benhabib[1], C.Lupien[2], L.Bergés[1], M.Dion[2], D.Vignolles[1], F. Lalibeté[2], M.Nardone[1], A.Zitouni[1], Y.Maeno[3], L.Taillefer[2,4] and C. Proust[1]

[1] *Laboratoire National des Champs Magnétiques Intenses (LNCMI-EMFL), (CNRS-INSA-UGA-UPS), Toulouse / Grenoble,31400/38042, France.*
[2] Institut Quantique, Département de physique & RQMP, Université de Sherbrooke, Sherbrooke, Québec, Canada J1K 2.
[3] *Department of Physics, Graduate School of Science, Kyoto University, Kyoto 606-8502, Japan.*
[4] Canadian Institute for Advanced Research, Toronto, Ontario, Canada M5G 1.

Despite the extensive effort, the pairing mechanism in the unconventional superconductor Sr_2RuO_4 is still unknown. The spin susceptibility is not affected by the superconducting transition suggesting odd-parity pairing [1,2]. In addition, muon-spin relaxation and polar Kerr rotation measurements have demonstrated the presence of broken time-reversal symmetry [3,4]. These experiments suggest a chiral *p*-wave order parameter in Sr_2RuO_4 [5].

Subsequent, specific heat, thermal conductivity and ultrasound attenuation measurements demonstrated the presence of low energy excitations related to nodal quasiparticles [6,7,8]. Furthermore, the interpretation of the thermal conductivity data suggests the presence of a vertical lines rather than horizontal lines nodes [7]. However, the presence of vertical nodes is incompatible with the chiral *p*-wave order parameter, implied by the muon-spin relaxation and polar Kerr rotation measurements [3,4].

Due to the coupling of the superconducting order parameter to the lattice strain, it is possible to get useful information about the symmetry of the order parameter using the ultrasound spectroscopy [9,10]. I will present systematic ultrasound study performed on single crystal of Sr_2RuO_4 in different acoustic modes. We observed a negative jump in transverse mode at T_c. From group theory and symmetry considerations, this result allows us to put strong constraints on the symmetry of the superconducting order parameter of Sr_2RuO_4 [11].

[1] K.Ishida et al. Nature,396, 658 (1998)

[2] J.A.Duffy et al. PRL,85, 5412 (2000)

[3] G.M.Luke et al. Nature,394, 558(1998)

[4] J.Xia et al. PRL,97, 167002 (2006)

[5] A.P.Mackenzie et al. Rev.mod.Phys,75, 657 (2000)

[6] S.Nishizaki et al.J.Phys.Soc.Japan 69, 572 (2000)

[7] E.Hassinger et al. PRX, 7, 011032 (2017)

[8] C.Lupien et al. PRL, 86, 5986 (2001)

[9] M.Dion et al .PRB, 80, 220511(R) (2009)

[10] M.B.Walker et al. PRB, 66, 214508 (2002)

[11] S.Benhabib et al. to be published