

Highlights from last week

Catherine Kallin

1. TRSB – μ SR, scanning probes, Kerr rotation, phase sensitive measurements
2. multicomponent order parameter
3. 3K phase
4. nodes in the gap?
5. exotic vortices

**Check out wikispace
and talks &
discussion on-line**

2. Multi-component order parameter (*Lupien*)

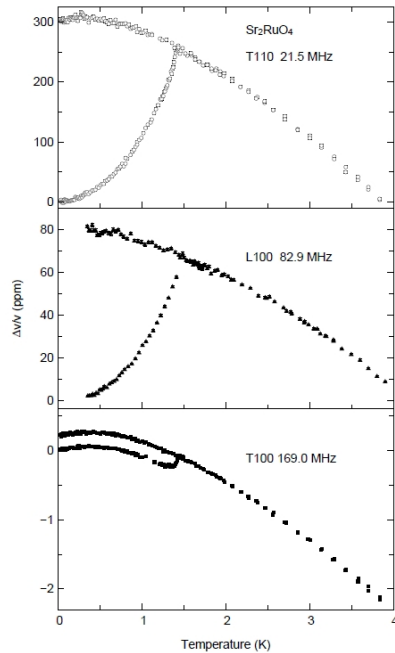


Figure 5.17: Temperature dependence of the sound velocity of the L110, T110 and T100 modes in the superconducting and normal states. The normal state is obtained by applying a field of 1.5 T approximately in the plane. See also fig. [6.18](#)

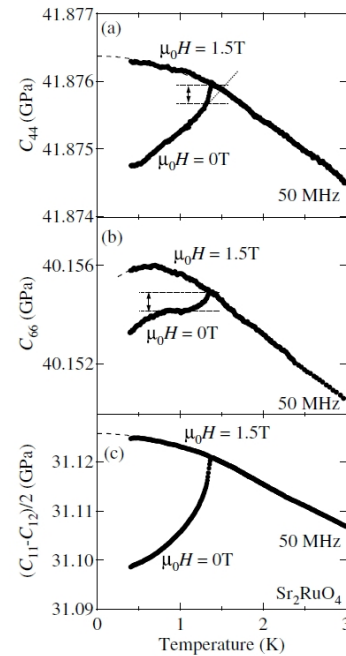


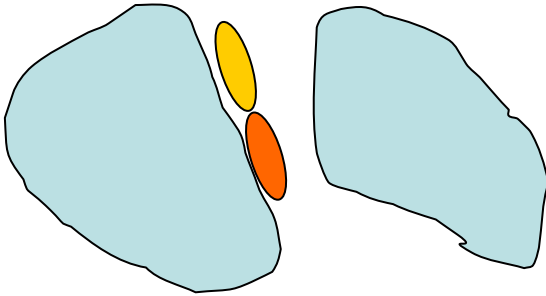
Fig. 3. The temperature dependence of the transverse elastic moduli (a) C_{44} , (b) C_{66} and (c) $(C_{11} - C_{12})/2$ below 3 K. Ultrasonic configurations are shown in Table I. We show both in the superconducting state at 0 T and in the normal state at 1.5 T along the field parallel to the c -axis. We used ultrasound with frequency 50 MHz. The broken curves represent the backgrounds. The arrows represent the roughly estimated jumps. The dotted lines are guides to the eye for the jump estimation.

Sigrist: data is strong evidence for multicomponent OP [e.g. $p_x + ip_y$, $p_x + p_y$]

Agterberg: comparison of saddle points in flux distribution with μ SR also supports multicomponent

Ultrasound data from Lupien; similar data from Suzuki

3. 3K Phase (*Sigrist, Liu*)



- Filamentary state from interface
- From observation of zero-bias conductance peak in tunneling a picture emerges that p-wave emerges below 3K (no ZBCP) and chiral p-wave (TRSB) forms at $T \sim 2.3\text{K}$ (ZBCP)

4. Nodes in gap (*Luke, Sigrist*)

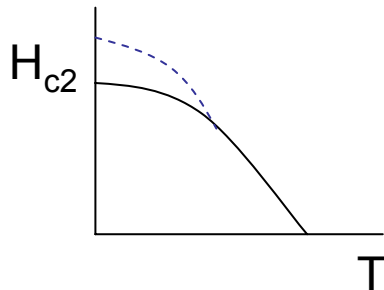
- Luke: μSR in B field \rightarrow no nodes in γ -band
- Sigrist: multiband effects mask nodal power laws except at very low T. Previous data has not ruled out horizontal nodes. Need lower T data.

5. Exotic vortices (*Kim, Chung, Bluhm*)

- Need to rotate d-vector into ab plane. $B > 200\text{G}$ along c **may** achieve this.
- Half quantum vortices – spin component does not give rise to screening current which changes the energetics and leads to attractive logarithmic interaction between vortices

Is it singlet? (*Machida*)

- Machida argued that the suppression of H_{c2} (ab direction) gives evidence for a spin singlet (d+id) -- **more on triplet? this week**



1. TRSB

Experiment	TRSB?	Domain size
muSR (Luke)	Yes	$< 2 \mu$
SQUID (Kirtley)	No	$< 2 \mu$
Scanning Hall Probe (Moler)	No	$< 1 \mu$
Tunneling (Liu)	Parity	$> 10-50 \mu$
Corner junctions	Yes	
Tunneling (van Harlingen)	Yes	$< 1 \mu$ $\sim 0.5 \mu$ dynamic
Kerr rotation (Kapitulnik)	Yes	$> 50 \mu$ with field cooling $\sim > 15-20 \mu$ in ZFC

- non-chiral surface on long length scale?
- non-perpendicular domain walls at surface
- Kerr rotation non-zero for $q=0$?