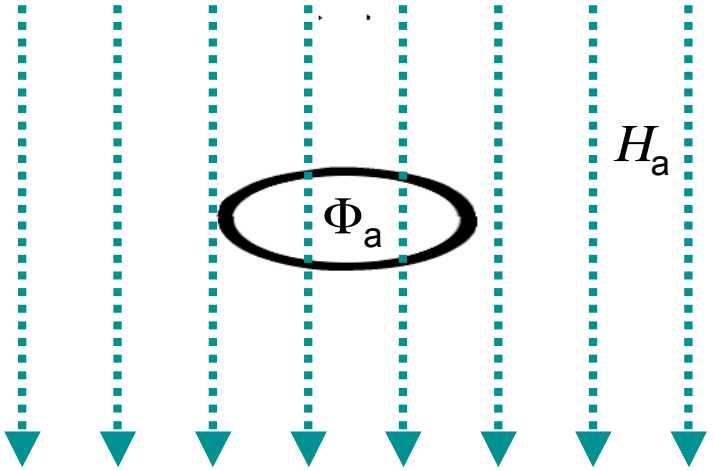
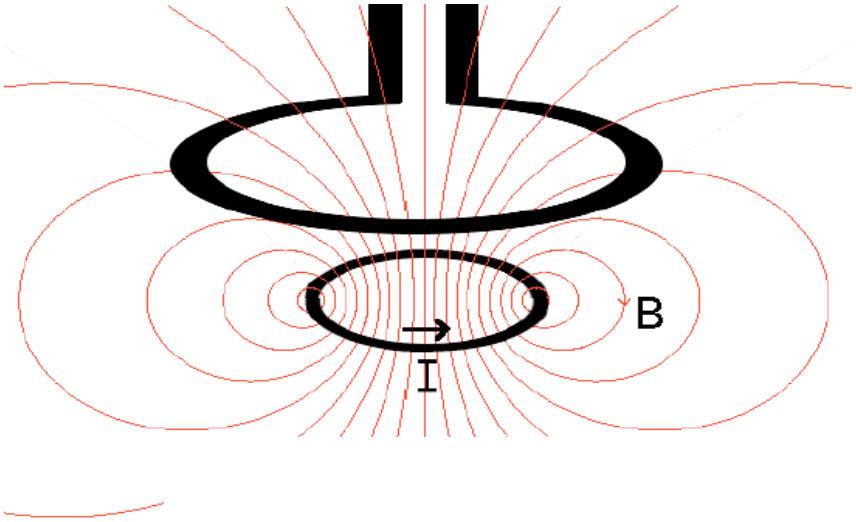
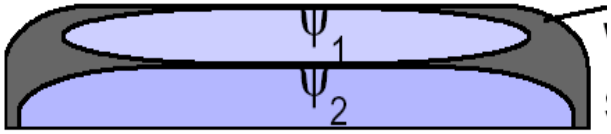
Observation of “fractional fluxoids” in bilayer rings



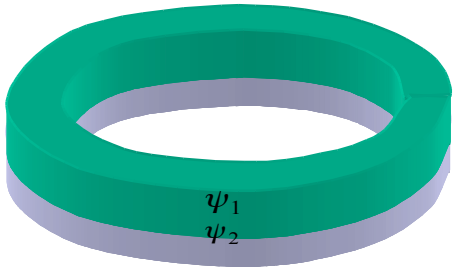


- Apply field
- Measure field generated by induced current in sample ring

Sample structure:
Josephson coupled bilayers



Data: $I_{\text{ring}}(\Phi_a)$



Experiments from Moler Lab, PRL **97**, 237002 (2006)

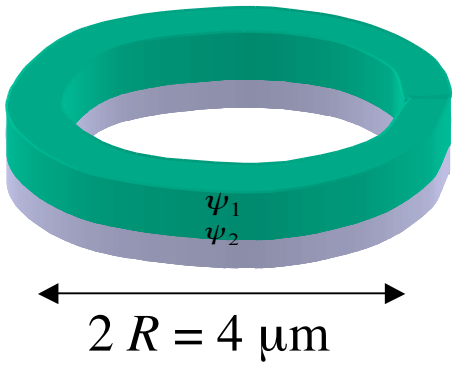
Transition sequence

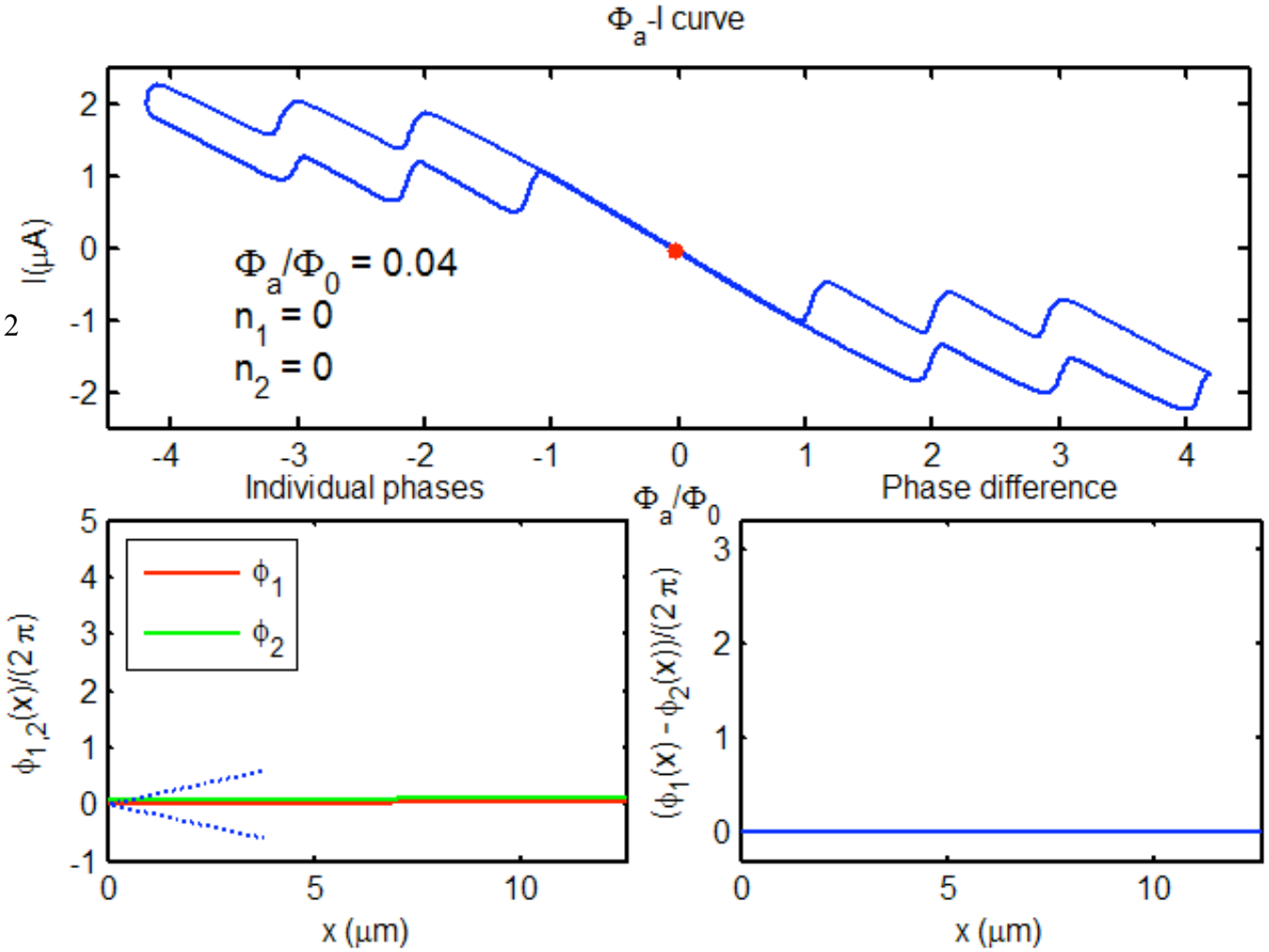
Boundary condition: $\psi(L) = e^{i2\pi\Phi_a/\Phi_0}\psi(0)$

$\psi(x) = |\psi|e^{i\phi(x)}$ $\quad\quad$ $\phi(x) = (\Phi_a/\Phi_0 - n)x/R$ for single OP.

$I \propto \nabla\phi$

$$F_{coup} \propto \int_0^L dx\,|\psi_1 - \psi_2|^2$$





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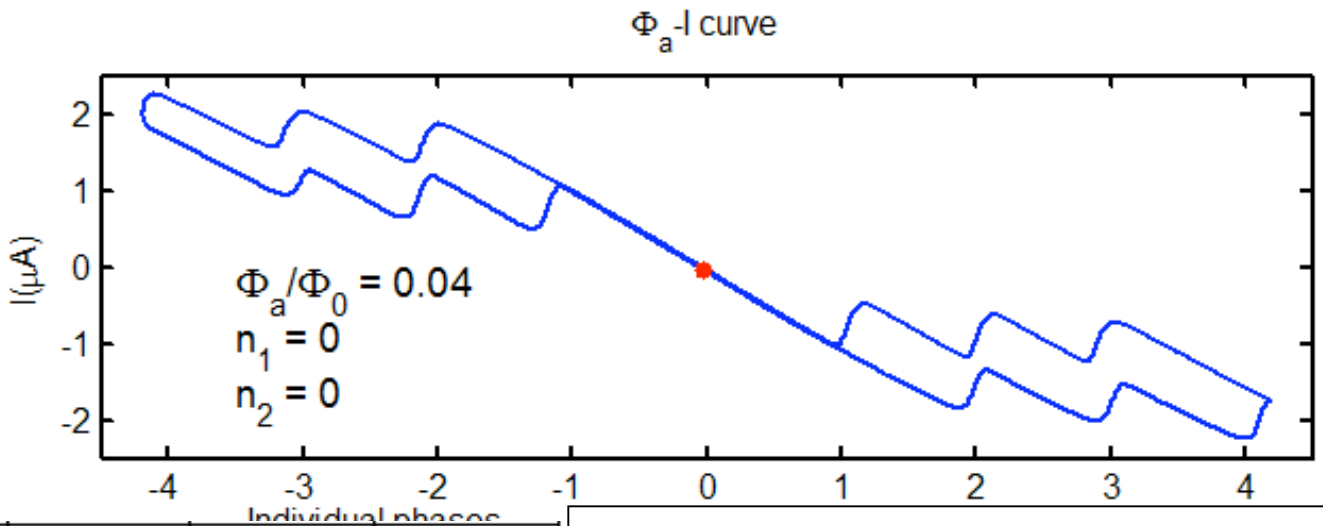
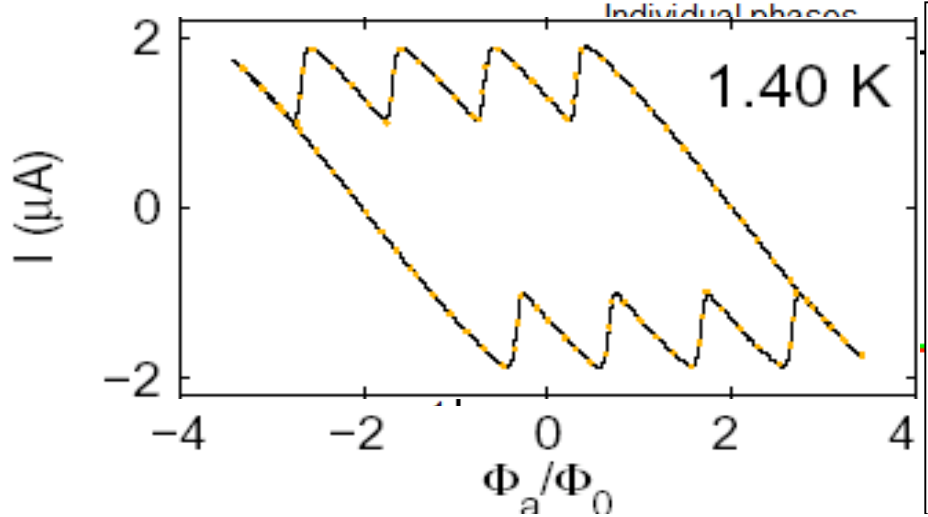
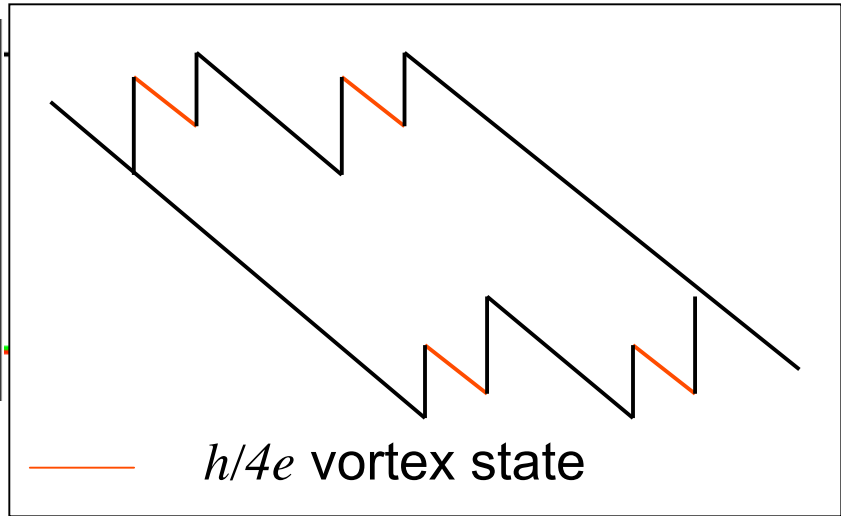
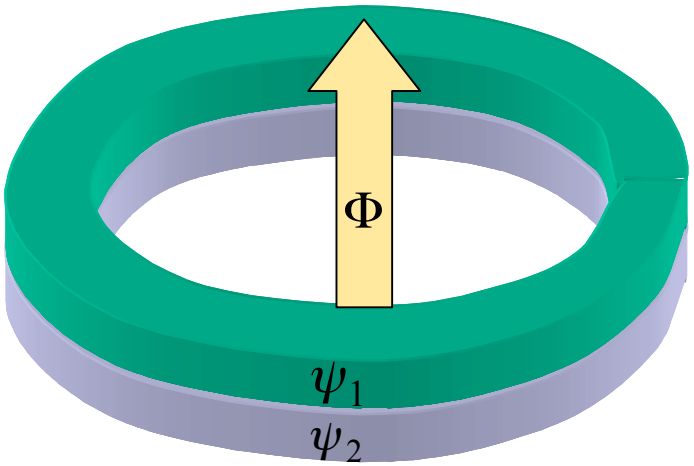






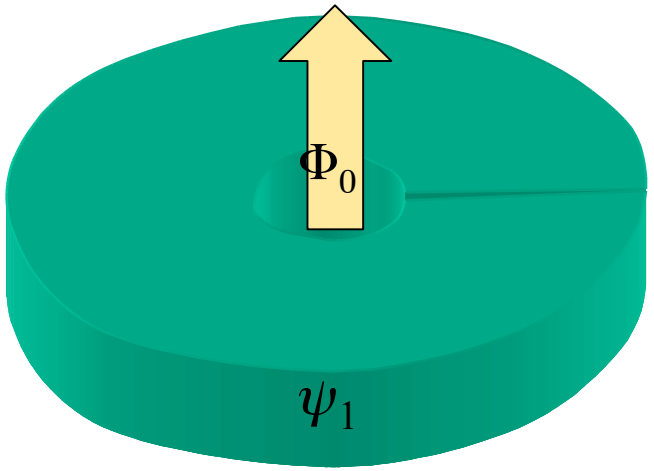
Fractional fluxoids vs. vortices

$wd << \lambda^2 \Rightarrow \Phi \approx \Phi_a$



$I = I_1 + I_2$

$wd >> \lambda^2 \Rightarrow \Phi = n\,\Phi_0$



$n_1 = 1$

- Weak screening =>
  only Josephson coupling relevant
- Different ξ, T_c facilitates entry of fluxoid in only one OP

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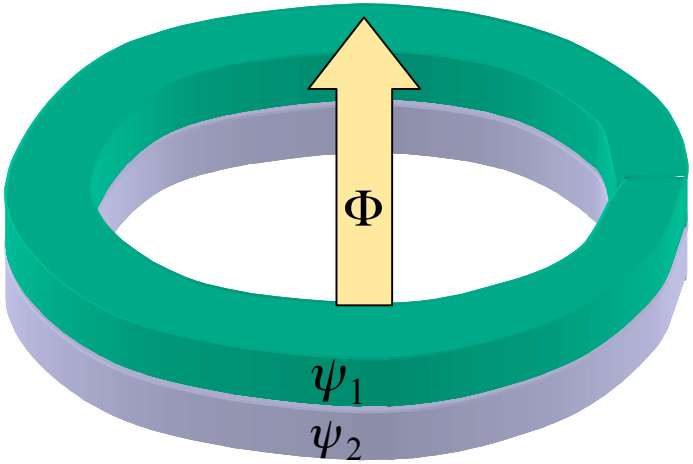

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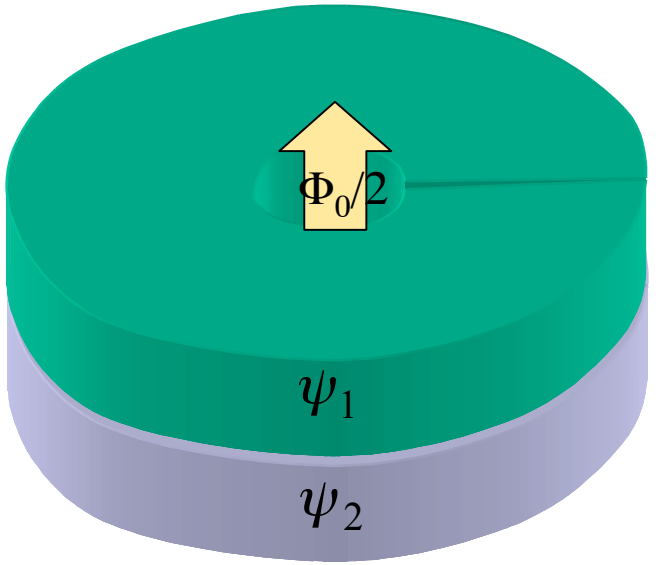


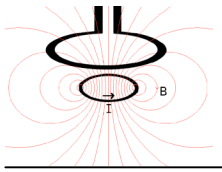
$n_1 = 1$

$n_2 = 0$

ψ_2 partially screens vortex in ψ_1

$\Rightarrow \Phi = \Phi_0/2$

- Energy divergent in sample size due to **magnetic coupling**
- could be overcome in mesoscopic samples.
- 2 OP components identical



Likely obstacles

- Fabrication of mesoscopic Sr_2RuO_4 samples very difficult
- Problems due to surface scattering
- Can *d*-vector be flipped?
- Pinning of *d*-vector to crystal axis?

But: Might make other interesting observations.

Φ_a-I curve decomposition