Trapping Magnetic Flux in a Superconducting Ring

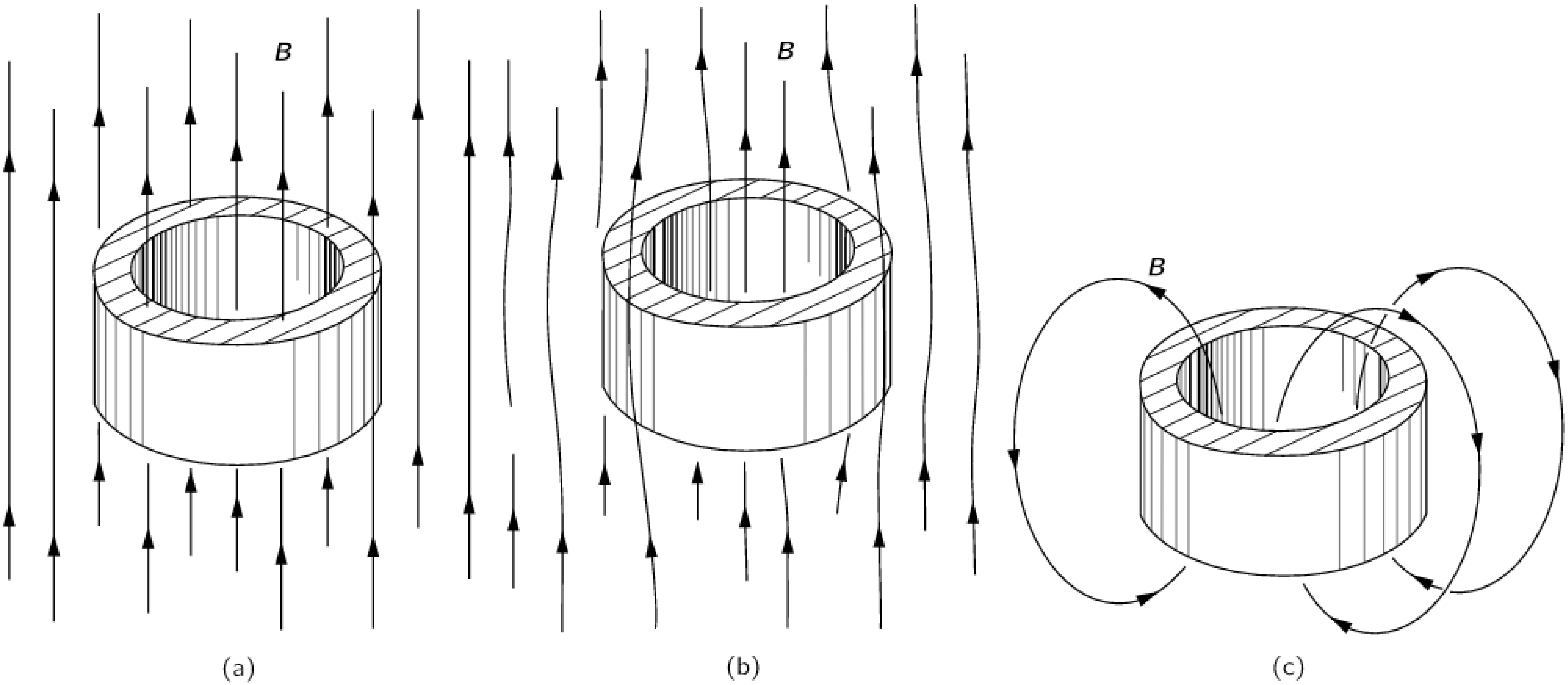


Fig. 21–4. A ring in a magnetic field: (a) in the normal state; (b) in the superconducting state; (c) after the external field is removed.

Feynman Lectures on Physics, Volume III, Chapter 21
http://www.feynmanlectures.caltech.edu/III_21.html

EXPERIMENTAL PROOF OF MAGNETIC FLUX QUANTIZATION IN A SUPERCONDUCTING RING*

R. Doll and M. Näbauer

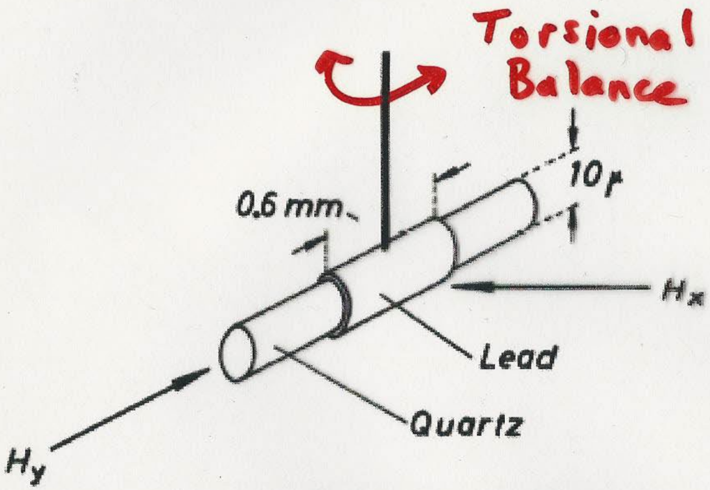


FIG. 1. Schematic diagram of the sample with the directions of the applied field H_y to be frozen in, and the measuring field H_x.

$T > T_c$ Apply H_y

Cool below T_c

Remove H_y

Apply H_x, measure torque

$$\vec{\tau} = \vec{\mu} \times \vec{B}$$

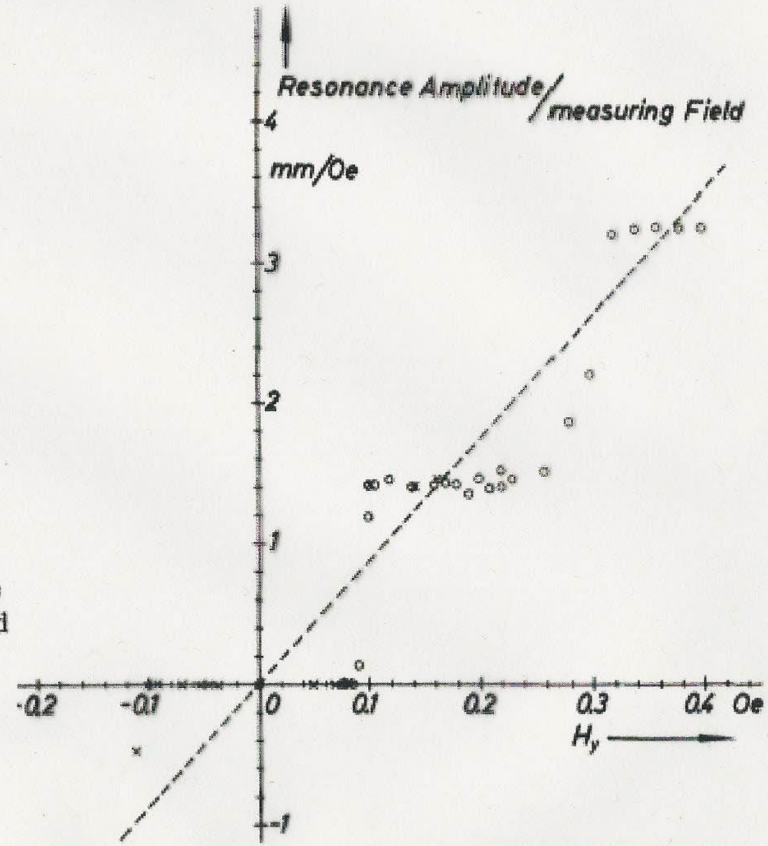


FIG. 2. Resonance amplitude divided by measuring field H_x as a function of the applied field H_y. The ordinate is proportional to the frozen-in flux. ×– First run; o– second run.

Flux Quantization in a High-T_c SC

C. E. Gough, et al. Nature **326**, 855 (1987).

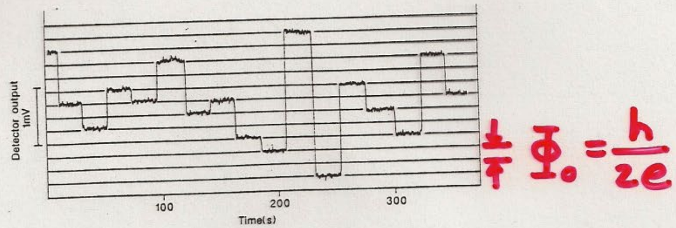
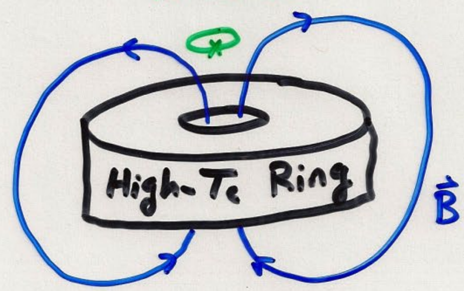


Fig. 2 Output of the r.f.-SQUID magnetometer showing small integral numbers of flux quanta jumping in and out of the ring.

$YBa_2Cu_3O_7$
ceramic
4.2 K



Experimental value for the flux quantum

$$\Phi_0 = 0.97 \pm 0.04 \; \frac{h}{2e}$$

SQUID magnetometer output stable for 1000 s

$\Rightarrow R_{ring} < 10^{-13}\,\Omega$