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DYNAMICS OF FLUXONS IN FIELD-COOLED HIGH- T_c SUPERCONDUCTORS

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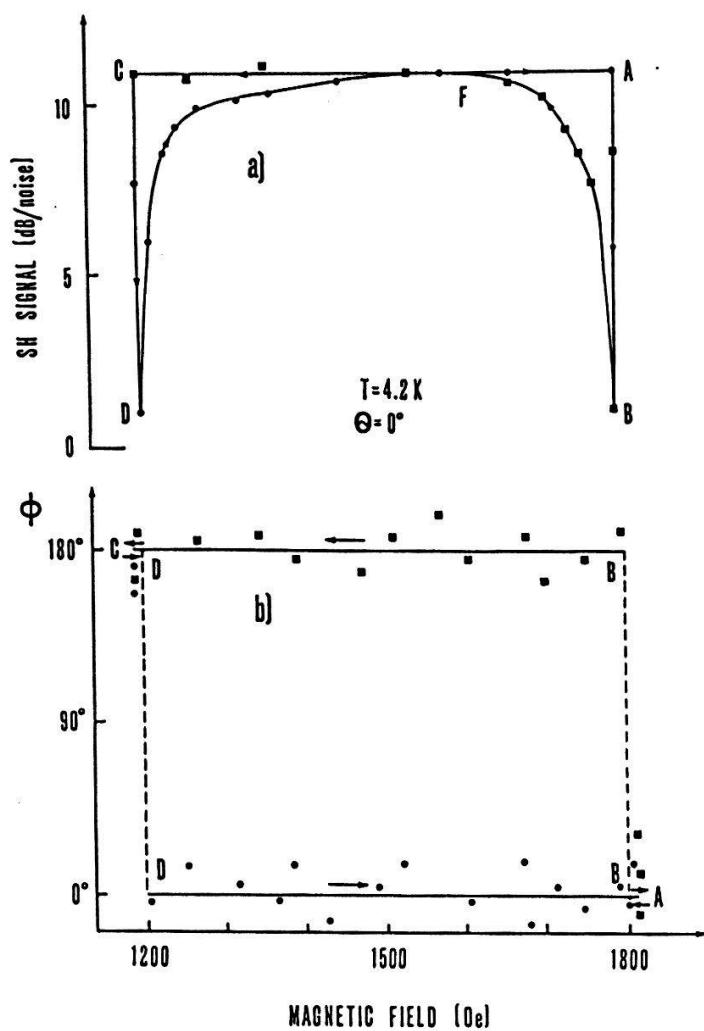
Abstract: Evidence is given that for increasing and decreasing applied fields critical states are developed in field-cooled high- T_c ceramic superconductors. In samples in the critical state a microwave magnetic field parallel to the applied field induces a magnetization with odd as well as even Fourier components.

The interaction of microwave fields with field-cooled (FC) single-phase ceramic $\text{YBa}_2\text{Cu}_3\text{O}_7$ has been studied by investigating the second-harmonic (SH) response to the driving field.

The experiments have been performed by exposing the samples to a dc field H_0 and an ac field $H(\omega)$ at an angle Θ with respect to H_0 . The SH signal radiated by the samples has been investigated. It depends on both H_0 and Θ . The signal is phase coherent. The phase as a function of H_0 and Θ has also been investigated.

Fig.1a shows the SH signal intensity as a function of H_0 in the range of fields 1200–1800 Oe. The intensity is independent of H_0 as long as H_0 is increased (or decreased) steadily. Minima are observed when the magnetic field sweep is reversed, independently of the values of H_0 in which the inversions are operated. Fig.1b shows the phase of the SH signal as a function of H_0 . The phase, at a given value of H_0 , may differ by 180° depending on the way H_0 has been attained, at increasing or decreasing fields. On increasing H_0 the phase remains constant as long as H_0 is increased, from D to A. It remains still constant at the same value when H_0 is decreased from A to B, while a 180° variation is observed on crossing B. If the field is further decreased the phase remains constant at the new value until point D is reached.

The results are consistent with the assumption that a critical state



is developed in FC Y-Ba-Cu-O by an increasing (or decreasing) applied field. Supposing valid the Bean's assumption of constant J_c in superconductors⁽¹⁾, because of the rigidity of the fluxon lattice the response of the sample, in a critical state, to a microwave field is expected to be uneven during a period of the wave: for increasing fields the induction flux is essentially influenced only during the negative semiperiod, so that a magnetization with both odd and even Fourier components results⁽²⁾.

According to this picture a theory has been developed⁽²⁾

which accounts quite well for i) SH signal intensity independent of H_0 for constant field sweep; ii) minima at the inversion points of the field sweep; iii) 180° phase variation at those values of H_0 in which the critical state is removed (e.g., points B and D of Fig.1); iiiii) angular dependence of both intensity and phase of the SH signal.

References

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