

The authors are thankful to Prof. D. K. Rai for his valuable suggestions. One of the authors (G. P. M.) expresses his gratitude to U.G.C. for awarding him the teacher fellowship under the Faculty Improvement Programme.

Laser and Spectroscopy Laboratory, G. P. MISHRA,  
Department of Physics, R. TRIPATHI,  
Banaras Hindu University, S. B. RAI,  
Varanasi 221 005, K. N. UPADHYA.

1. Milliken, R. A., *Phys. Rev.*, 1925, 26, 1.
2. Ritschl, R., *Z. Physik.*, 1927, 42, 172.
3. Rao, P. R. K. and Apparao, K. V. S. R., *Proc. Indian Acad. Sci.*, 1964.
4. — and —, *Can. J. Phys.*, 1967, 45, 2805.
5. Rai, B., Pandey, R. K., Rai, S. N. and Clouthury, A. K., *Curr. Sci.*, 1971, 40, 459.
6. Herzberg, G., *Spectra of Diatomic Molecules*, D. Van Nostrand Co. Inc., New York, 1950.
7. Winans, J. G. and Youngner, P., *J. Mol. Spectroscopy*, 1960, 4, 23.
8. Manson, E. L., De Lucia, F. C. and Gord, Walter, *J. Chem. Phys.*, 1975, 62, 1040.
9. Mishra, G. P., Rai, S. B. and Upadhyya, K. N., *Curr. Sci.*, 1979, 48, 625.
10. —, — and —, *Can. J. Phys.*, 1979, 57, 824.

### SUPERCONDUCTIVITY—A CONSEQUENCE OF MAGNETIC INTERACTIONS?

It is generally agreed that the electron pair correlation of the superconducting state is a consequence of the phonon mediated interaction envisaged by the BCS theory<sup>1</sup>. In this note we report the first experimental evidence which strongly suggests that the pertinent pairing mechanism is magnetic rather than phonon mediated.

The technique of conduction electron spin resonance (CESR) offers the most effective window into the conduction band which enables to study unambiguously the magnetic behaviour of conduction electrons. For the first time we have studied the CESR in both normal and superconducting states of high  $T_c$  films of A-15 compounds such as  $Nb_3Ge$  ( $T_c = 22.65$  K),  $Nb_3Si$  ( $T_c = 15$  K) and  $Nb_3Sn$  ( $T_c = 18$  K). The results obtained for  $Nb_3Ge$  are depicted in Figs. 1 and 2.

As may be seen from Fig. 1, the spectra obtained show the CESR line along with two side resonance absorptions, observed at different temperatures. The study has been made from 400 K to 4.2 K. The orientation response of all these lines is as in Fig. 2. Our detailed analysis of these lines, communicated elsewhere<sup>2,3</sup>, has established that the first line of each spectrum (Fig. 1) is due to the CESR and the two side absorptions are due to the magnetic interactions present in the conduction band of  $Nb_3Ge$ .

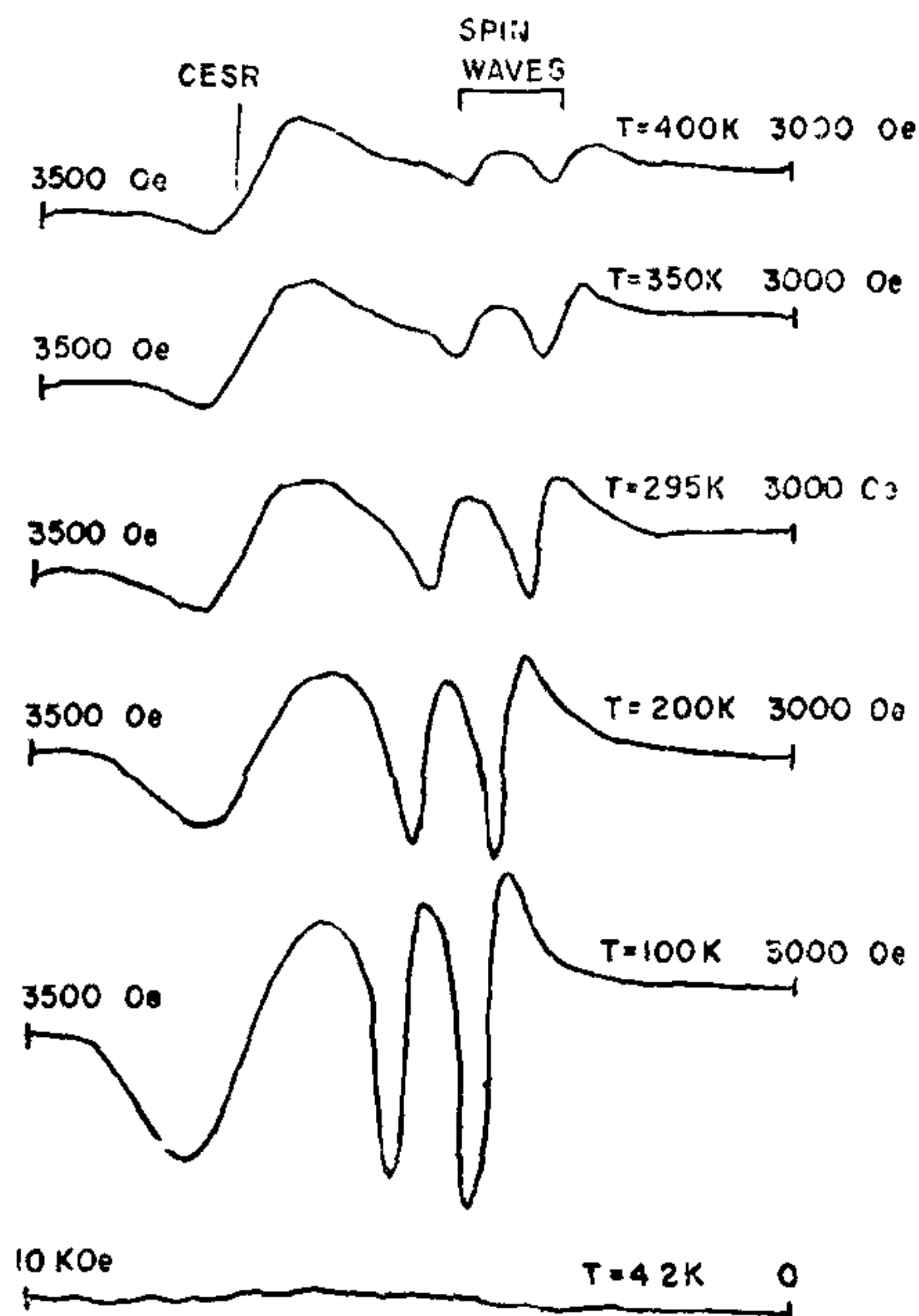


FIG. 1. CESR and spin wave resonance as a function of temperature.

The orientation study (Fig. 2) has shown that these magnetic interactions are of antiferromagnetic type, discussed by Vonsovskii and Igymov<sup>4</sup>. The striking observation is that at 4.2 K when the material is superconducting, all these lines disappeared, suggesting the formation of antiferromagnetically ordered state. We, therefore, envisage<sup>5</sup> that superconducting state is nothing but the collective electron antiferromagnetism or the SDW state of energy lower than the paramagnetic state. The disappearance of CESR in the superconducting state as observed by us is a clear indication that the conduction electrons are bound magnetically, rather than through phonon mediation. As calculated by Kaplan<sup>6</sup>, if the electrons are bound through phonons, one should have expected the CESR line in the superconducting state.

We have made similar observations on  $Nb_3Si$  and  $Nb_3Sn$ , two other A-15 superconductors.

To conclude, these observations definitely do put a question mark on the BCS phonon mediated mechanism as the cause of superconductivity. Indeed, in transition metals and alloys, which either show a complete absence of the isotope effect or a large deviation from it, the possibility of non-phonon superconductivity has been suggested.

STEREOSPECIFIC SYNTHESIS OF  
(Z)-M-1-BROMO 1-PHENYL-2-*p*-TOLYL-  
SULPHONYLETHYLENE

FOR our current investigation on the synthesis and structural studies of some E-*a*M, E-M and Z-M unsaturated sulphide-sulphones and disulphones, we were interested in preparing a *cis* (with respect to *p*-CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>SO<sub>2</sub> and Br) (Z)-M-1-bromo-1-phenyl-2-*p*-tolylsulphonylethylene as a starting material. Amiel<sup>1</sup> reported the synthesis of a compound with a similar configuration with very poor yields, the *trans* isomer forming the major product. According to our procedure the *cis* (Z) isomer in a very high yield is formed.

Recent studies<sup>2,3</sup> have confirmed that the nucleophilic addition of sodium thiolates to acetylenic hydrocarbons proceed in the *trans* fashion to yield *cis* compounds. Thus *cis*- $\omega$ -styryl *p*-tolyl sulphide (I) was prepared by the reaction of an alcoholic solution of phenylacetylene with sodium *p*-toluene thiolate.

It is well known that the addition of halogens to olefins is stereospecific, *trans*-olefin leading to the formation of a non-resolvable *meso* form (*erythro*) and *cis* isomer leading to the formation of a resolvable racemic (*d, l*) form (*threo*)<sup>4</sup>. The *cis* isomer (I), on bromination in carbon tetrachloride produced a *threo d, l*-dibromide (II) which on dehydrobromination with diethylaniline in carbon tetrachloride yielded a *cis* (with respect to *p*-tolyl-S and Br) olefine (III). This is in analogy with the compound obtained by dehydrobromination of *threo*-benzalacetophenone dibromide reported by Lutz and his co-workers<sup>5</sup>. The compound III, on oxidation, gave *cis* (with respect to *p*-CH<sub>3</sub>C<sub>6</sub>H<sub>4</sub>SO<sub>2</sub> and Br) (Z)-M-1-bromo-1-phenyl-2-*p*-tolylsulphonylethylene (IV).

Experimental

The elemental analyses were performed by Dr. R. D. MacDonald, CSIRO, Australia, The UV, IR and NMR spectra were determined with a ECIL UV-spectrophotometer, a Carl-Zeiss UR-10 Jena 242506 IR spectrophotometer and a varian A-60 NMR spectrometer respectively. The purity of the compounds was ascertained by TLC using silica gel G as the stationary phase and CHCl<sub>3</sub> : EtOAc (95 : 5 solvent layer) as mobile phase.

Phenylacetylene was prepared according to the procedure of Wittig and Witt<sup>6</sup>, b.p. 142-144° (lit<sup>6</sup>, b.p. 142-144°) and *cis*- $\omega$ -styryl *p*-tolyl sulphide was prepared as reported<sup>7</sup>, m.p. 63-64° (lit<sup>7</sup>, m.p. 64-65.5°).

(Z)-M-1-Bromo-1-phenyl-2-*p*-tolylsulphonylethylene (IV)

To a solution of 22.6 g (0.10 mole) of *cis*- $\omega$ -styryl *p*-tolyl sulphide in 100 ml of CCl<sub>4</sub>, 16 g (0.1 mole) of bromine in CCl<sub>4</sub> was added dropwise at 15-20°. To the resulting brown solution, 20 g (0.1 mole) of diethylaniline was added and refluxed for 3h. The reaction

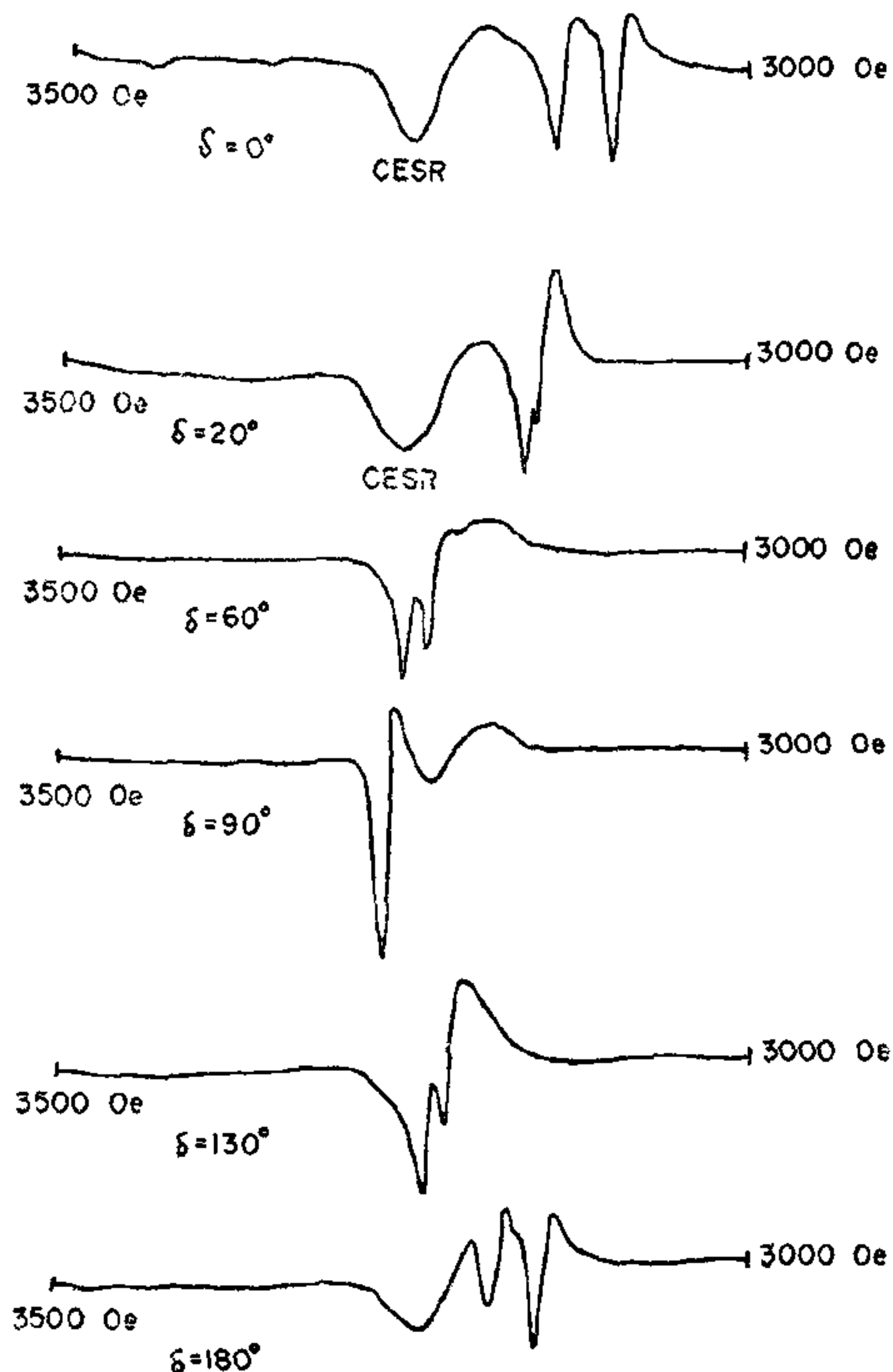


FIG. 2. CESTR and spin wave resonance as a function of the orientation of the applied field ( $\delta$ ).

Our observations, establish for the first time, the presence of antiferromagnetic interactions in conduction band as responsible for electron pairing.

National Physical Laboratory,  
Hillside Road,  
New Delhi 110 012,  
January 25, 1980.

S. N. EKBOTE.  
S. K. GUPTA.  
A. V. NARLIKAR.

1. Bardeen, J., Cooper, L. N. and Schrieffer, J. R., *Phys. Rev.*, 1957, 108, 1175.
2. Ekbote, S. N., Gupta, S. K. and Narlikar, A. V., *Ind. J. Phys.* (Accepted).
3. —, — and —, *Ibid.* (Accepted).
4. Vonsovskii, S. V. and Ingyumov, Yu, *Sov. Phys. Uspekhi*, 1963, 5, 723.
5. Narlikar, A. V. and Ekbote, S. N., Chatterjee Memorial Lecture, IV National Symposium on Cryogenics, Dec. 1979, Bombay.
6. Kaplan, J. I., *Phys. Letts.*, 1965, 19, 266.