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THE ROLE OF SPIN-ORBIT COUPLING AND HYPERFINE COUPLING IN OPTICAL PUMPING OF F-CENTRES

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Abstract. — The ground state polarization of the electronic spins achieved by optical pumping of isolated F-centres is strongly dependent on the magnetic field and the wavelength of the pumping light. Experimentally it does not show the simple relationship to the magnetic circular dichroism (MCD) that has generally been assumed. A closer theoretical analysis shows indeed that the phenomena depend critically on the kind of spin mixing that prevails in the pumping cycle.

If spin orbit coupling in the absorption band is the dominant spin mixing mechanism the sign of the pumping effect will be the same everywhere in the absorption band, if some other mechanism like spin mixing by radiation less transitions or hyperfine coupling to the surrounding nuclear spins prevails, the sign will follow the MCD. In strong magnetic fields experiments argue in favour of the first alternative, in low fields spin mixing by hyperfine coupling becomes important.

On this basis the mechanism of optical pumping of F-centres and applications to optical detection of spin resonances are discussed.

DISCUSSION

C. JACCARD. — Is the ESR signal drawn approximately to scale on the last viewgraph sheet and what is the microwave power ?

A. WINNACKER. — The viewgraph is directly copied

from the original recording of the ESR signal. We do not know the microwave power in the cavity in milliwatts, but the signal in the ESR seems approximately saturated.