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ADDENDUM TO
PROJECT SC65:

LOCAL MAGNETIC FIELDS IN FERROMAGNETICS STUDIED BY POSITIVE MUON PRECESSION

O. Hartmann, E. Karlsson, L.-O. Norlin and K. Pernestål, University of
Uppsala and

J. Chappert, J.F. Dufresne and A. Yaouanc, CENG, Grenoble

I. Present status of SC65

In the beginning of the μ SR activities at CERN all research done by the Uppsala-CERN (and later Uppsala-CERN-Geneva) groups was carried out under the project SC65. It included the setting up and optimizing of the μ^+ beam and the μ SR apparatus and the first studies of muon stopping in simple, non-magnetic metals. Later, the problems of muon localization and diffusion in non-magnetic metals were broken out and treated under the heading "SC76: Impurity trapping of positive muons in metals."

The studies of muon behaviour in magnetic systems have in the mean-time been concentrated on two different problems:

1. The studies of local magnetic fields in semi-metals, where a large paramagnetic shift was found (in Sb-metal), indicating the presence of polarized electrons close to the muon (1).
2. The setting up of detector telescopes and crystal arrangements for observation of μ SR-spectra in unpolarized ferromagnetic samples. These are now in good working conditions and have been applied mainly to studies of pure Fe and impurity-doped Fe crystals (1), but some time has also been devoted to ordered ferromagnetic alloys. Target materials of controlled purity have been obtained from CENG, Grenoble.

II. Proposal for further studies of magnetic systems

Having now, partly from the diffusion studies, an improved background for interpretation of the μ SR-spectra, we plan to take up a few specific problems in magnetism for studies by μ SR. It is proposed that the continuation of this project is done in collaboration with CENG, Grenoble, where studies of connected problems are carried out with other techniques.

We will divide the problems into two categories, (1) magnetically ordered systems and (2) local magnetic polarization around muons in "non-magnetic" metals.

1. Magnetically ordered systems

Among the pure magnetic metals, the μ SR-spectra are by now reasonably well understood for the cases of Ni, Co and Gd, whereas the question of Fe is still open, since the μ SR spectra disappear at low temperatures.

Since we have found, in diffusion studies on other b.c.c. metals, that the muon mobility is extremely sensitive to impurities (2,3), we plan to investigate more closely the effect of doping with 10-100 ppm concentrations of certain light elements (going into interstitial sites) and a few selected heavier elements (substituting iron). The muon depolarization rate will then contain information on the diffusion mechanisms and (possibly) about so-called strain induced localization, if it occurs at very low temperatures.

In magnetic intermetallic compounds there are also problems concerning the fast depolarization in the magnetically ordered state. Further studies are needed to find out the metallurgical conditions for observations of the signal. At the same time, we plan to study the depolarization rate in the paramagnetic region slightly above T_c in order to study the critical behaviour of the spin systems.

Similar investigations are also of great interest for the amorphous ferromagnets, where the μ SR-method can give unique information of the correlations of the spins around T_c (4). These kinds of materials have been studied intensively at Grenoble and a few samples like YFe_2 may be produced in sufficient quantities to be studied with the present muon beam. Others can only be investigated when we have access to a low-momentum beam.

2. Local magnetic polarization

The studies of muons in semi-metals will continue, in order to understand the local electron structure around the muonic charge in these materials and the conditions for muon-electron bound state formation. A natural continuation of this project is to study muons in the alloy system $Sb_{1-x}Bi_x$ where the electronic band gap varies continuously from metallic to semi-conductor conditions.

III. Request for beam time

For the continuation of project SC65 we need 15 shifts at the SC up to the end of 1978 and 30 shifts for the period January-August 1979.

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