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AN EXPERIMENTAL SYSTEM FOR THE STUDY OF THERMAL PROPERTIES OF SPIN POLARIZED PARTICLES

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Résumé.- On décrit le dispositif expérimental destiné à la mesure de la conductivité thermique de l'hydrogène atomique polarisé et de la capacité calorifique de $^3$He adsorbé partiellement polarisé. On donne une estimation de certains des paramètres de l'expérience.

Abstract.—The experimental system being prepared to measure the thermal conductivity of spin polarized atomic hydrogen and the heat capacity of adsorbed, partially spin polarized $^3$He is described. Estimates for some of the experimental parameters are given.

We have constructed an apparatus for the study of thermal properties of spin polarized particles. The installation consists of a cryostat with a 7.7 T solenoid and a simple dilution refrigerator (although all testing so far has been done with a $^3$He refrigerator). The apparatus has a room temperature rf discharge atomic hydrogen source and the capability for adsorbing a variety of gases at low temperature into separate experimental regions.

We are currently working on two experiments, one to measure the thermal conductivity of gaseous spin polarized hydrogen, and another one to measure the heat capacity of partially spin polarized $^3$He adsorbed on Grafoil. A schematic of the experimental setup is shown in Fig. 1.

The thermal conductivity experiment is at present a simplified version of the experiments performed by Fokkens et al. /1/ to measure the thermal conductivity of gaseous $^3$He, $^4$He and their mixtures. Relatively small thermal conductivities can be measured, but even more important, densities of only $10^{14}$ to $10^{16}$ atoms/cm$^3$ are needed to obtain meaningful data. The magnetic needle shown in Fig. 1 is a special feature that can be introduced to produce a local enhancement of about 1 T in the magnetic field between the plates and thus increase the density of H+ in a very small region /2/.

For the second experiment, a small adsorption heat capacity cell is attached to the refrigerator mixing chamber. The heat capacity of unpolarized...
3He adsorbed on Grafoil has been measured in the past /3/. For $T > 0.2K$ and low densities the adsorbed $^3$He behaves like an interacting two dimensional Fermi gas. Deviations from ideal quantum behavior have been largely accounted for by including the effect of two body interactions into a second virial correction to the heat capacity /4/. The effect of total nuclear spin polarization on the three dimensional second virial coefficient has been calculated by Lhuillier and Laloe /5/. Above 0.2K and for the maximum magnetic field available to us, the nuclear polarization is small, but its effect on the heat capacity should be measurable. We have calculated that at 0.2K and $B = 7$ T the change in the virial correction is 1%.

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1. Fokkens, K., Vermeer, W., Taconis, K.W., de Bruyn Ouboter, R. Physica 30 (1964) 2153.