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Rapporteur's report, Session (E), E. Steffens:

Cold atomic beam techniques

The discussion following the talks of this session were partly centered around the question to which extent the promises of the cold atomic beam technique which were expressed during the Ann Arbor Workshop [1] five years ago have been fulfilled in practice.

In the relevant temperature range below liquid nitrogen temperature clean surfaces like quartz or teflon do not work any more because of surface recombination. It is believed that surfaces exposed to atomic hydrogen have to be covered by frozen layers of gas or by liquid He films. At very low temperature of about 0.5K and high field of > 5T the magnetic energy $\mu_B B$ becomes large compared to the energy and magnetic trapping of certain substates occurs.

Most of the effort in the last 5 years has been concentrated on the production of cold hydrogen beams which are then state-selected in the usual way (see Session (J)), whereas only recently a Michigan-MIT-CERN-collaboration has started to study magnetic trapping for polarized jet target applications.

1. Free cold hydrogen beams ($5K < T_{acc} < 77K$):

Results from ETH, Kyushu and SIN on beam cooling indicate a gain in density at the ionizer proportional to about $1/\sqrt{T}$, that is a factor of 4 for 20K compared to room temperature beams. Frozen layers of H_2 (below $\sim$20K) or N_2 prevent recombination. At SIN, stable operation of the atomic beam for more than two weeks has been achieved with a small admixture of N_2 to the hydrogen feed gas.

Beam cooling with accommodator temperatures as low as 5K has been successfully done at BNL (as reported by A. Hershcovitch). Here the "bad" temperature range T < 70K is carefully avoided by feeding the atomic hydrogen through a heated teflon tube to the cold accommodator which is separated by a narrow slit. Intensities in excess of $2\ 10^{18}\ H^o$/sr s have been obtained.

T. Niinikoski presented calculations which showed that the density achievable in the focus after the spin selector is limited by gas dynamical phenomena. P. Schmelzbach concluded that these limits are very encouraging because they are two to three orders of magnitude above the present densities.

2. Strong cooling and magnetic trapping

R. Raymond reported on the development undertaken by a Michigan-MIT-CERN-collaboration to produce a slowly pulsed polarized jet target using microwave extraction from a 5 Tesla solenoid. The density aimed at is in excess of $10^{14}\ H^o/cm^2$. The duty cycle will be in the order of 10% (1/4 sec. every few seconds). The cryostat is being tested and most of the equipment has been obtained. D. Kleppner expressed his confidence that this development will also be useful for d.c. beam.

A very interesting approach to overcome surface recombination at extremely low temperatures has been presented by H. Hess (MIT). Instead of trapping states a+b (the two lower states) in the field <u>maximum</u> at the walls, he intends to trap in the field minimum in free space, e.g. on the axis of the system. A combination of quadrupole field and mirror coils for radial and axial trapping is required. Wall collisions are only necessary for thermalizing, but not for confining the gas. This development might lead to spin polarized H-gas stored in relatively weak trapping fields with densities of $10^{14}/cm^3$.