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A JET OF ULTRACOLD POLARIZED HYDROGEN ATOMS

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ABSTRACT

The principles of a proposed jet of ultracold polarized hydrogen atoms are outlined. Status of the project led by the University of Michigan to test these ideas is described.

At high magnetic fields (5 T) and very low temperatures (0.5 K), for hydrogen atoms the magnetic energy is much larger than the thermal energy, so that if such cold atoms approach such a high field, atoms with electron spin parallel to the field are repulsed and atoms with electron spin anti-parallel to the field are attracted into the field, thermalize by hitting the walls, and are trapped. As Niinikoski (1) pointed out, if microwaves of the appropriate frequency (140 GHz for 5 T) are applied, electron spins of some of the atoms will be flipped, and these atoms will be accelerated out of the high field, forming a beam. It is hoped that this beam will be of high optic quality and high density (perhaps approaching $10^{14}/cm^3$), but there are many factors which will affect beam quality and density which are not well understood.

It is to explore the characteristics of such a beam and its possible uses for high-energy physics that our group is building the apparatus shown in Fig. 1. Atoms from a cold discharge are further cooled by the upper parts of a dilution refrigerator, until they reach the horizontal mixing chamber and superconducting solenoid. Microwaves will shine in from the left and atoms with flipped spins will be extracted to the right in the figure.

Status of the Project

-The vacuum housing has been built and tested.

-The vertical sections of the dilution refrigerator have been designed and are being assembled. Preliminary refrigerator and film burner tests are expected to begin in the spring of 1986.

-The superconducting solenoid has been tested and mounted, but a leak into the insulating vacuum has to be fixed.

-A 140 GHz microwave system is being acquired.

-A pumping system for the dilution refrigerator has been borrowed from Rice University.

It should be emphasized that the present apparatus is meant to be a learning tool rather than equipment which will itself be used for high-energy physics.

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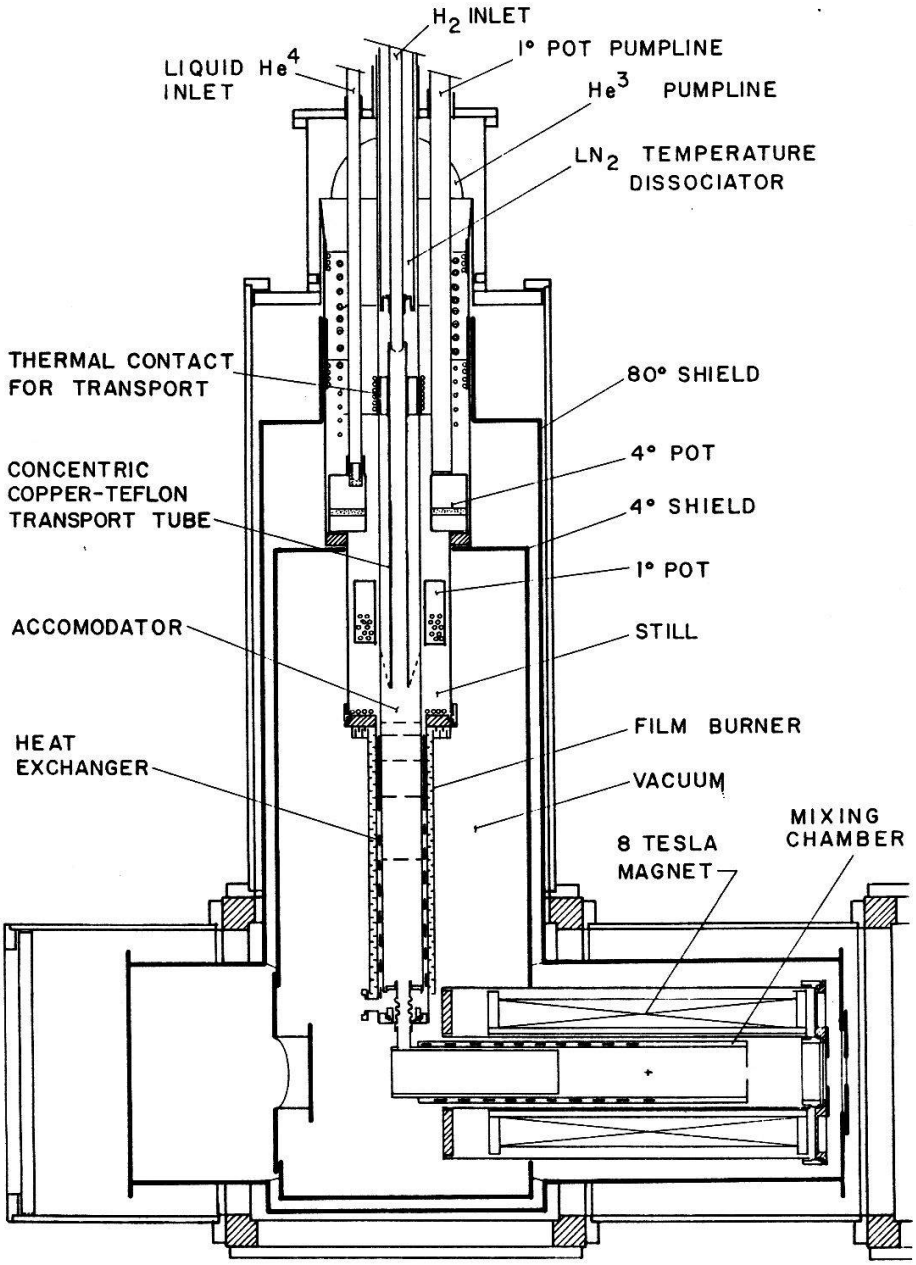

Fig. 1 The Michigan - MIT - CERN polarized proton jet

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Reference

(1) T.O. Niinikoski, Proc. 1980 Int. Symp. on High-Energy Physics with Polarized Beams and Polarized Targets, Lausanne (Birkhauser EXS-38, Basel, 1981) p. 191

See also rapporteur's report, Session (E), E. Steffens.