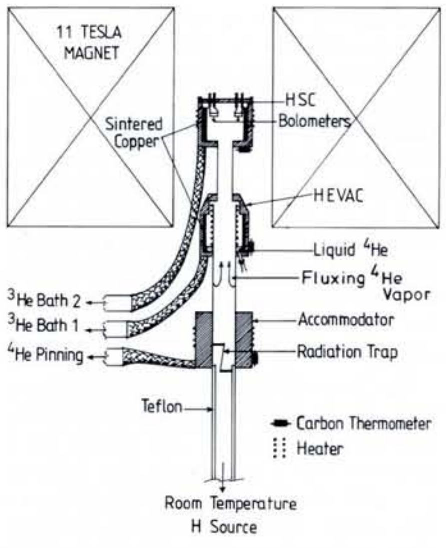

Fig. 2 — Schematic of the experiment.

that all surfaces of the confining stabilization cell must be covered with this liquid (helium is a superfluid at these low temperatures).

Experimental Set-up

The hydrogen stabilization cell (HSC) that we used is shown in Fig. 2, centred in a superconducting solenoidal magnet of maximum field, 11 T. The HSC and a device called HEVAC (HElium VApour Compressor) are cooled to below 1 K by means of (single-shot) ^{3}He evaporation refrigerators. A small amount of ^{4}He is condensed in the HEVAC reservoir and a saturated film of superfluid ^{4}He covers the walls of the HSC and HEVAC. Atomic hydrogen which is made in a conventional room temperature microwave discharge is led into the cryostat via a teflon tube. The hot H gas is cooled to ~ 4 K by contact with the accommodator [7], prior to injection into the HSC which operates at temperatures as low as 270 mK.

Spin polarization is accomplished as follows. The magnetic field gradient at the end of the magnet will draw electron spin-down atoms into the high field region and repel spin-up atoms. As the latter cannot escape the guide tube, they either recombine or relax to the spin-down state and enter the HSC. The atoms accelerated into the HSC gain kinetic energy which is relaxed to the helium covered walls of the HSC: the gas is then at the temperature of the HSC and trapped in the cell by the magnetic field gradient.

The HEVAC serves two purposes: it is an H compressor and it enables thermal isolation of the HSC. The superfluid helium film is driven by the fountain effect towards the accommodator. As the film comes into the warmer region it vaporizes; the dense vapour fluxes back and condenses out again in the HEVAC. Since the helium mass is four times that of H, He-H collisions result in an efficient transfer of momentum and the H is compressed into the HSC. The HEVAC is a miniature, self driven, vapour diffusion pump which uses superfluid helium as its pump "oil". The fluxing vapours have a detrimental aspect; they actually operate as a heat pipe. Without the HEVAC, they would exist between the accommodator and HSC, leading to serious warming of the latter and limited times of operation at low temperature. Thus the HEVAC also serves to break the thermal link between the accommodator and the HSC.

The presence of H↑ was detected by means of a bolometer. Such a device relies on a strong dependence of its electrical resistance on temperature. Normally the bolometer, which is suspended by fine wires in the HSC, is covered with helium. By passing an electrical current through the bolometer it is heated and the helium is evaporated from its surface faster than it can be replenished along the wires. When the surface is bare of helium it becomes an active area for catalyzing surface recombination, resulting in rapid conversion of H↑ to H_2. The released recombination energy causes heating and a change of resistance of the bolometer which is easily measured. The density of H is determined by measuring the temperature rise of the HSC after recombination is triggered.

Using the techniques described above, the cell has been loaded with H↑ which remained stable for periods extrapolated to hours at temperatures as low as 0.27 K. Densities greater than 10^{16} atoms/cm^3 have been achieved, although, at higher densities the lifetimes tend to become shorter. It is not yet clear if we are approaching a fundamental limitation due to recombination of if the decreasing lifetimes are related to the present geometry, magnetic field, and temperature of our system. If densities one to two orders of magnitude greater can be achieved, we may be able to study some of the fascinating aspects associated with the Bose nature of the gas.

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STELLA

On 6 March, the European Stella experiment concerned with the transmission of scientific data between high energy physics laboratories via the European satellite, OTS, was inaugurated at CERN with the additional participation of ESA, the European Space Agency, and the European Communities.

Through Stella, a large amount of experimental data can be transmitted rapidly and accurately from CERN to other high energy physics laboratories in Europe, notably: DESY FRG, Saclay France, Rutherford U.K., Pisa Italy, Dublin IRE and Graz Austria. Real data transmission speeds of up to 1 megabit/s will be possible via the geostationary satellite which was launched in May, 1978.

Stella was conceived about five years ago as a cooperation between the Commission of the European Communities, seeking ways to improve communication networks in western Europe, and ESA which is responsible for establishing satellite communication links in the region. CERN played the rôle of "guinea pig" user, in view of its requirement to transmit large amounts of data collected in high energy physics research. The experiment will provide pilot information for a network that is hoped can serve the communication needs of remote sites, facilitate remote newspaper printing, the distribution of environmental data, as well as being a real-time link between computers located in different countries.

Specific aims include the exploration of error rates (hopefully 10^{-9} or better) when using small earth receivers operating in the 11-14 GHz frequency band and employing special coding techniques, as well as an evaluation of the system for the transmission of high energy physics data as such. To determine the efficiency of transmission and methods of error detection under all weather conditions, a system of signal acknowledgement is incorporated which will permit re-transmission in the event of a failure to respond or an indication of error by the redundancy check.

Due to the very high capacity of the satellite communication channel (2 Mb/s), the real data can still be transmitted at high speed whilst introducing high redundancy in the transmission, so allowing powerful error correction techniques to be used.