Development of the ANKE pellet target*

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The preparation of the ANKE pellet target has been continued in 2002 and several test runs were performed during which the vacuum, cryogenic and hydrogen-supply systems have been modified and optimized.
During the test runs in the first half of 2002, stable working parameters for hydrogen condesation in the hydrogen condenser (see Fig. 1) and for hydrogen jet generation inside the triple point chamber (TPC) have been established. A hydrogen gas flow of about 2 l/min is needed to obtain permanent liquid hydrogen-jet generation through a nozzle with a diameter of 40μm. The temperature of the condesor channel and the TPC must be close to the triple point value ($T_{\rm tp} = 14$ K, $p_{\rm tp} \sim 100$ mbar) with an accuracy of not less than 0.1 K. During cryogenic tests a flow of the cooling helium gas (with a temperature of 5–7 K) of 10 l/min was needed. The vacuum in the isolating volume around the cryostat must not be worse than 10^{-5} mbar to support stable temperature condidions for operation of the hydrogen heat exchangers. This pressure can be achieved with a turbo pump *TMH260*.

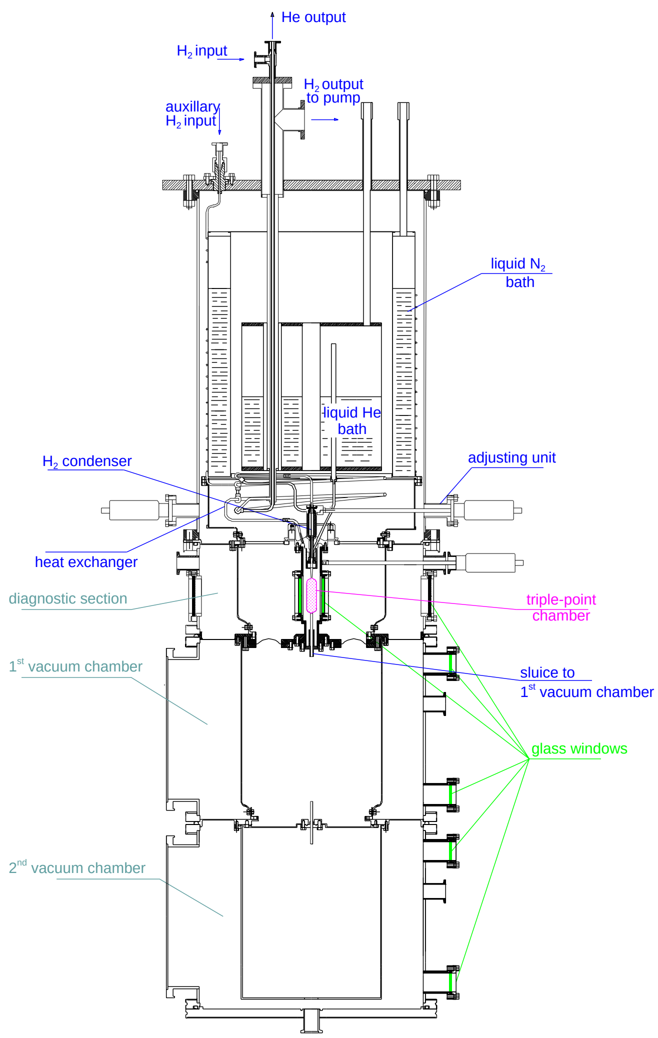

Fig. 1: Layout of the target cryostat (Dec. 2002).

Long-term jet transfer into the TPC and longitudinal instabilities are the most important problems for stable droplet generation. To decrease the influence of surface evaporation the jet speed was increased approximately by a factor two and, simultaneously, the nozzle diameter was decreased from 60μm to 40μm. Figure 2 shows the flow of the hydrogen jet through the 40μm nozzle into the TPC breaking up into droplets in the lower part of the chamber.

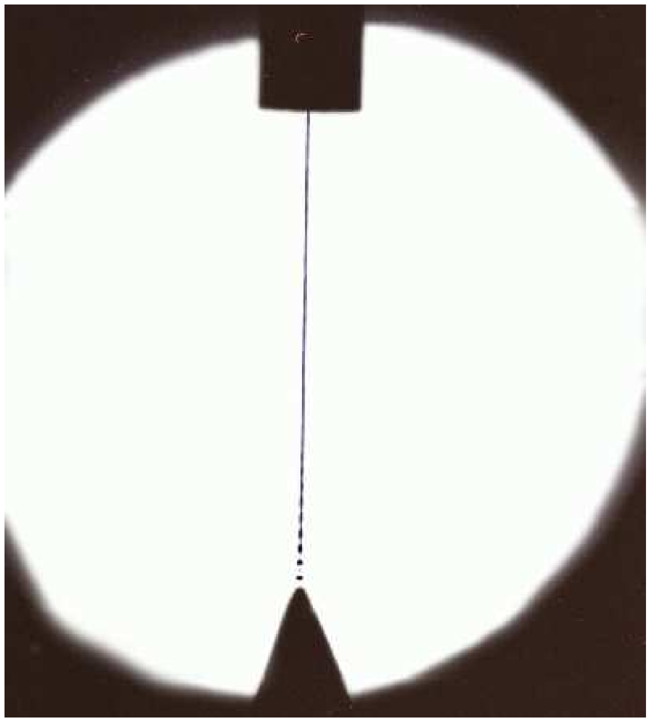

Fig. 2: Stable flow of mono-sized hydrogen droplets in the triple point chamber of the ANKE pellet target. The picture has been taken during a test run in May 2002.

The diagnostic system of the pellet target consists of three main components: a slow and a fast part and a laser system. The slow part comprises two digital video cameras *PCO pixelfly* mounted under an angle of 90°. It is used for the definition of the working parameters needed for disintegration of the hydrogen jet in the TPC with minimal disorder of the droplet sizes and speeds. The fast system will make use of a fast digital video camera and will serve for the definition of the pellet speeds and vertical displacements in the first and second vacuum chambers. The laser system consist of a the laser, optical elements and a photomultiplier. This system can be used to study the spatial distribution of pellets and for initial adjustment of the droplet generator.
As a result of test runs during three years (2000–2002) final modifications for improving the characteristics of the cryostat and target-supply systems were implemented in fall 2002. To improve the resolution of the droplet observation and to stabilize the temperature in the TPC, a new chamber made from copper with high heat conductivity and with larger observation windows has been produced at ITEP and assembled inside the new diagnostic section of the target cryostat. To increase the pumping capacity, four *TMH2000* turbo pumps have been mounted to the 1st and 2nd vacuum sections, which have been increased in height from 210 mm

to 330 mm. Special quartz-glass windows for observation of the pellet trajectories and velocities have been placed in perpendicular directions at five height levels of the cryostat. First tests with the modified setup have been performed in December 2002. The requested parameters for stable target operation could again be established. A pressure of 10^{-7} mbar has been achieved in both vacuum chambers and a flow of liquid hydrogen droplets has been observed with an open sluice from the TPC to the first vacuum chamber. The scheme of the modified ANKE pellet target cryostat, which is now ready for first production of frozen hydrogen pellets in spring 2003, is shown in Fig. 1.

References:

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