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CURRENT STATUS OF THE DESIGN OF A TRITIUM TARGET FOR THE SACLAY 700 MeV LINAC

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I would like to report here briefly on a liquid tritium target that we are designing at Saclay. Our primary aim is to determine the magnetic form factor of ^3H up to $q^2 = 30\ fm^{-2}$. This single-arm electron scattering experiment is the natural complement of our recent measurement of $Fm(q^2)$ for ^3He, its mirror nucleus. The old and obvious idea of comparing the electromagnetic properties of the two trinucleon systems has not yet been fully realized experimentally. This is due to the infortunate natural radioactivity of tritium, which demands high level safety precautions. For our target, we have chosen to limit the amount of tritium in the system to one gram, i.e. an activity of 10 kCi.

Our tritium target is being designed exclusively for single-arm electron scattering experiments, with reasonable beam intensities (10 to 30 µA) and scattering angles between 25 and 155 degrees. This should allow to measure the elastic, inelastic and deep inelastic scattering of electrons, including the 2 and 3-body break-up if a sufficient energy resolution can be achieved. The limited amount of tritium available forces us to work with a well collimated beam : the target cylinder has a diameter of 10 mm. We want to reduce as much as possible the background originating from the windows of the target, in order to benefit from the very low background level available in the ALS electron hall. In order to improve the signal to noise ratio obtained with previous tritium targets, we have abandoned the former solution of high pressure gas targets with rather thick windows ($P = 200$ atm, $e = 0.75$ mm), for a liquid tritium target with increased density, lower pressure and thinner windows ($T = 25$ K, $P < 20$ atm, $e = 0.05$ mm). The tritium vessel is sealed, with exclusion of any handling or pumping of radioactive fluid during the target operation. This is obtained in the following way :

- the sealed volume is composed of two distinct bodies, connected by a small tube. The first part is a 4 cm^3 cigar-shaped target cell. The larger body acts as an expansion vessel. Each vessel can be brought separately to a different temperature, and this is what allows the changes on the thermodynamical state of the tritium fluid. The target has two states :

- The "out of beam" state, where both vessels are at room temperature. The whole volume (200 cm^3) is filled with gaseous tritium at 20 atmospheres.

- The "in beam" state, where the target cell only is brought to a cryogenic temperature (T = 25 K), while the expansion vessel is kept at T = 300 K. The thermodynamic study shows that most of the tritium liquefies into the target cell, the residual gas in the hot expansion vessel acting as a piston towards the small cell. The final pressure is of 3 atm. The cooling is made by solid conduction through the wall of the target cell ; this allows the liquefaction without handling of the fluid. The Fig. 1a and 1b show the two states of the target. The Fig. 2 sketches the whole set of successive containment vessels that will surround the target, and allow for safe road transportation and handling. The operational safety procedure includes the filling of the target in a laboratory dedicated to tritium handling, transportation to the ALS electron hall and immediate return of the target after the experiment for emptying. The experiment is tentatively scheduled for the spring of 1983.

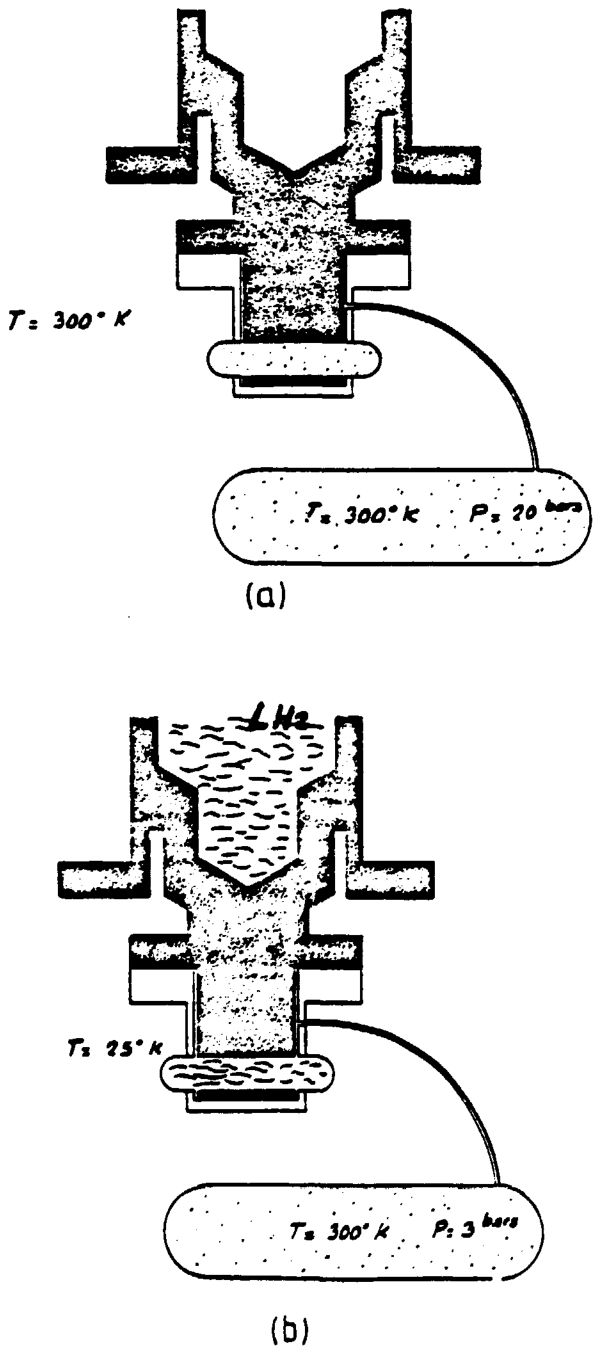

Fig. 1 - The two states of the sealed target : a) out of operation ; b) in operation.

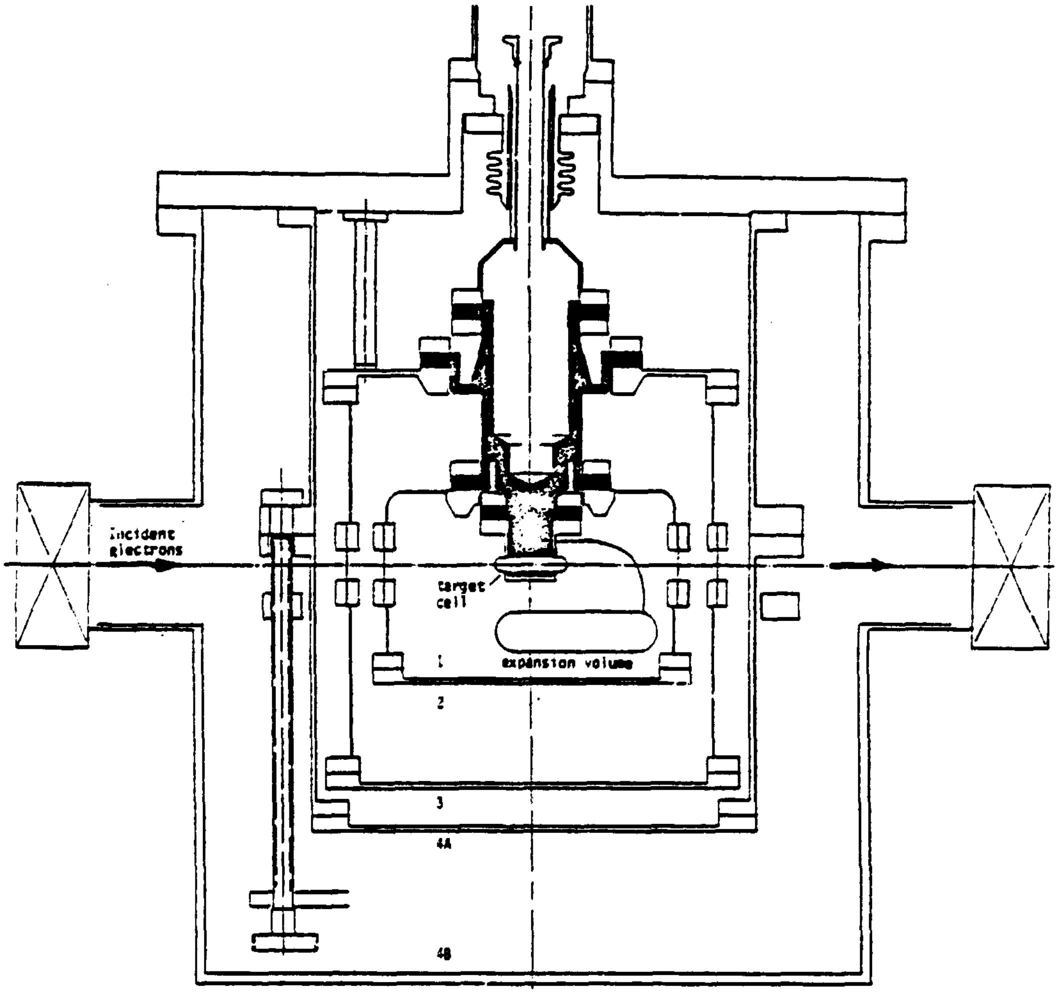

Fig. 2 - The tritium target with its safety envelopes : there are always four concentric envelopes, during transportation and during normal operation. The outer rigid transport vessel can be separated in two parts by remote control, in order to let the beam go through the thin membranes of the inner envelopes.