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INTERNAL HYDROGEN TARGET FOR THE CPS.

The following are some of the main points which might decide whether an internal hydrogen target for the CPS is a useful and practicable project. These items are dealt with more fully in the accompanying report.

Regarding usefulness, one important restriction is the position of the target in the PS ring. As such a target cannot directly replace in position a standard target, and as l.s.s. 1 is planned to be occupied by the slow ejection system, it would appear that new beams would have to be set up for the internal hydrogen target. This may be a serious disadvantage.

The experimental requirement of a beam burst length of 20 to 100 ms for counter experiments is difficult to comply with in the case of the internal hydrogen target. The target operation technique of bringing the beam slowly on to a target cannot apply to the liquid target in a container as it is necessary to move the beam quite fast ($\sim$10μs) across the edge of the container to the main mass of hydrogen. It appears that the longest beam obtainable would be a few milliseconds.

The experiments outlined here are those which are most obvious at present to the various experimental groups. It is likely that some interest may be lost in these ideas during the constructional period of the proposed target; but it is also probable that new suggestions will arise in that time too.

In general, the opinion amongst the experimental groups is that an internal hydrogen target would be a very useful facility (from the point of view of time a contained target is preferred) and that if it was available many interesting experiments could be planned.

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Summary.

1. Is this project practicable ?

Yes, either a contained target (W) or a liquid jet (target J).
[Design should include the following features and /or overcome the following problems :

a) proton interaction ratio $\frac{H_2}{\text{walls}} \geqslant 10$ (W)

b) heating effect of beam (W + J)

c) removal of H_2 from PS vacuum chamber (J)

d) radiation damage to container (W)

e) device to move target near beam (W)]

2. Is an internal target experimentally useful ?
(assuming an extracted proton beam is available)

Yes, in general for p-p and p-n scattering, and processes in which the cross sections are low ($< 10^{-30}$ cm^2/ster) requiring high proton intensities.

3. a) What experiments are likely to be planned with an internal H_2 target ?

(i) wide angle p-p scattering.
(ii) elastic p-n charge exchange scattering.
(iii) rare processes by $p+p \rightarrow \pi^+ + d$.
(iv) production of slow $\bar{p}$.
(v) search for ω_o particle.

b) What experiments (which could be done with an extracted beam or subtraction technique) would be done with an internal H_2 target if it was available ?

(i) p-p elastic and inelastic scattering (all angles, all energies)
(ii) p-n elastic, inelastic scattering) deuterium target
(iii) p-d elastic, inelastic scattering (
(iv) surveys of $\pi^{\pm}$, $K^{\pm}$, $\bar{p}$ yields from protons (all angles, all energies)

4. Can the experiments in 3(a) be carried out in any other way ?

Possibly, either by subtraction technique with the internal beam or using the extracted beam, both at the expense of machine time (a factor of about 3 to 10 could be involved).

5. Are the possible <u>target positions in the PS ring</u> compatible with the suggested experiments ?

<u>Target W</u> :

ss 100 (angle 0°, S. Hall) 3 (a) (ii) for zero angle scattering

ss 3 (angles $> 3^{\circ}$, S. Hall) 3 (b) (i), (ii), (iii), (iiii).

ss 5 (angles $\geq 22^{\circ}$, N. Hall) 3 (a) (iii)
angles $> 14^{\circ}$, S. Hall) 3 (b) (i) , (ii), (iii), (iiii).

ss 6 (all angles, N. Hall (3 (a) (i), (ii), (iii).
angles $> 22^{\circ}$, S. Hall)) 3 (b) (i), (ii), (iii), (iiii).

<u>Target J</u> :

ss 6 as for target W

ss 11

6) Is a contained type of target operative in 12 months preferable to a liquid H_2 jet obtainable in 18 months ?

Yes.

7) Expenditure : see attached page. (p.6)

N.B. There is also the possibility that it might be decided that the class of experiment in 3 (a) should not be carried out at all. In which case, there is no real cause for an internal hydrogen target.

EXPENDITURE.

	TARGET W	TARGET J
a) personnel	1 project director (physicist or engineer) 1 physicist or engineer 1 vacuum technician 1 technician with cryogenic experience 1 W/S mechanic 1 draughtsman	
b) capital expenditure	Helium refrigerator (200,000 SwFr)	(i) Helium refrigerator (200,000 SwFr) or 1 large rotary pump for H_2 gas (ii) 4 Roots pumps) 6 Diffusion pumps((100,000 SwFr) 10 Rotary pumps)
c) materials	(i) H_2 cryostat (ii) Device to move target near beam (iii) 2 fast acting vacuum valves	(i) H_2 Dewars (ii) Device to move apertures (iii) 2 fast acting vacuum valves
d) running cost	(i) Liquid H_2 50 Litres/week (500 SwFr/week) (ii) Liquid N_2 200 Litres/week (100 SwFr/week)	(i) Liquid H_2 1250 Litres/week (12500 SwFr/week) (ii) Liquid N_2 negligible or nil.
e) project time	12 months	minimum 18 months