CHAMBERLAIN : I think there is one mechanism for producing these deuterons which could be fairly important and which I believe would be independent of the deuteron wave function; namely, close collisions between two nucleons which could even be *p-p* collisions. In the close collisions sometimes the relative energy of the two final nucleons is small, I mean small compared to 25 GeV. I believe if you consider all of the highly inelastic collisions, including some where the relative energy is really very small you can compute the deuteron formation independently of the deuteron wave function.

TAFT : I would like to report on a measurement of one thousand inelastic collisions (two pronged events) of protons on protons at 3 BeV. Only two such events out of a thousand could be of the fundamental process $p+p \to \pi^+ + d$.

HAGEDORN : As to the proposal of Chamberlain I would like to say : it can be proven more or less rigorously that the condition that the final relative momentum of the two nucleons is small turns out to be the same as if you consider an interaction volume which is different from the interaction volume for production of pions by a factor which is roughly the deuteron wave function, squared, at the origin. So the two pictures are more or less the Fourier transform of each other.

LIST OF REFERENCES AND NOTES

1. Blokhintsev. JETP **33**, p. 1299, (1959).

PARTICLES PRODUCED BY 24 BeV PROTONS

L. Gilly, B. Leontic, A. Lundby, R. Meunier, J. P. Stroot and M. Szeptycka

CERN, Geneva, Switzerland

(presented by A. Lundby)

We have partly completed an experimental program to search for unusual particles produced by the CERN Proton Synchrotron (CPS). The first stage consisted in measuring the mass spectrum of long-lived ($\gtrsim 10^{-8}$ sec) charged particles produced in the forward direction by 24 BeV protons striking an internal target (usually 10-50 microns Al). In order to avoid an appreciable displacement of the apparent target position at different momenta due to the fringing magnetic field of the machine, we chose a direction 8.5° with respect to the protons striking the target located at the beginning of a 3 m long straight section. The beam layout is shown in Fig. 1.

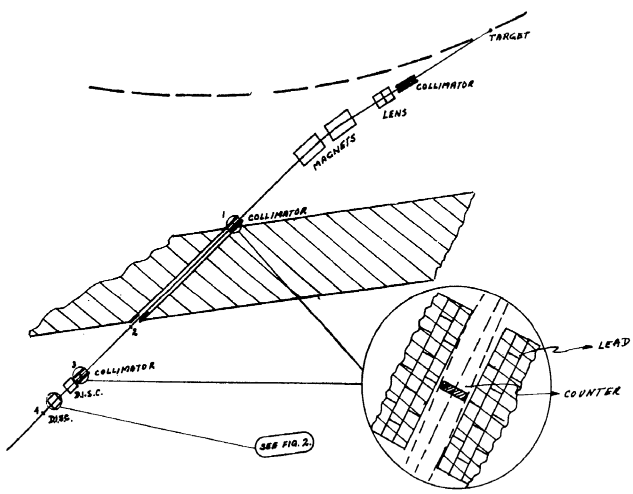

Fig. 1 Experimental layout.

We identify the mass of the particle by measuring its momentum (magnetic rigidity) and velocity (Čerenkov angle). The basic element in the detection system is a differential, isochronous, self-collimating Čerenkov counter, (DISC). The principle of the DISC in which we use a liquid as radiator is shown in Fig. 2. We have so far worked with $0.85 \lesssim \beta \lesssim 0.96$, which corresponds to the maximum yield of particles with masses from a few hundred to a few thousand MeV produced in the forward direction.

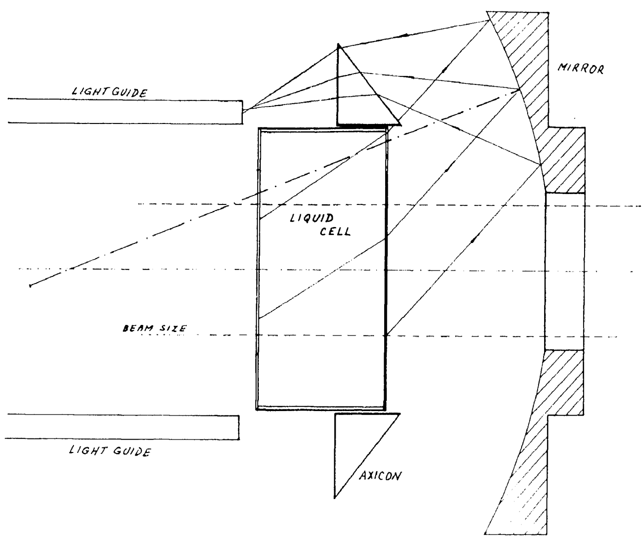

Fig. 2 Basic design of a DISC.

We usually prefer to fix β and vary momentum. In this way the measurements can be done fast with a minimum of systematic errors. The DISC only radiates when the magnetic rigidity $\beta\gamma m/z$ of the selected particles of charge ze corresponds to a chosen value of $\beta\gamma$. Fig. 3 shows typical spectra at $\beta = 0.95$. The fractional number of particles which radiates in two DISCs in series at different momenta is shown. The relative yields of the particles at the different momenta are of the order of 10 times larger than indicated due to the auto-collimation ($\pm 0.5°$) and the smaller momentum acceptance of the DISCs as compared to the monitor. Absorption and multiple scattering in the counters are also not taken into account. The total beam intensity was of the order of 10^5 per burst with about 2×10^{11} circulating protons in the machine.

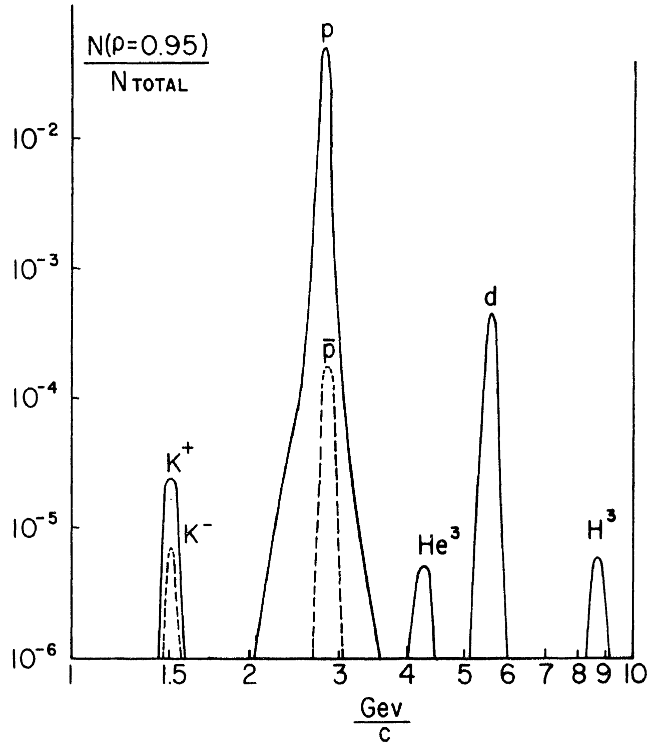

Fig. 3 Particle spectrum from 24 BeV protons striking a 50μ Al target in CPS.

We find the following absolute ratios:

$$N_{K^+}/N_{K^-} \simeq 3 \text{ at } 1.5 \text{ BeV/c}$$

$$N_p/N_{\bar{p}} \simeq 100 \text{ at } 3 \text{ BeV/c}$$

$$N_d/N_{\bar{d}} > 10^3 \text{ at } 6 \text{ BeV/c.}$$

At 1.5 BeV/c there is about 10% K^+ in the beam when corrected for decay, at 3 BeV/c about 0.2% $\bar{p}$, at 6 BeV/c about 0.5% d and at 9 BeV/c about 10^{-4} H^3 and He^3. At $\beta = 0.95$ the ratio of the intensities is $N_p/N_d \simeq 170$, $N_p/N_{H^3} \simeq N_p/N_{He^3} \simeq 10^4$.

The masses of the particles agree to within 1% of the accepted values. The relative charges of the particles were verified by analyzing the pulse height of the output from one of the DISCs. At the He^3 peak the pulses were about four times larger than elsewhere. In this way we also ascertained that there was less than 1% He^4 at the deuteron peak.

We saw no mass 500 m_e or D particle (719 MeV) in the beam ($<10^{-6}$).