

NOTES ON VISIT TO BROOKHAVEN ON 8TH, 9TH SEPTEMBER 1960.

Collins gave an interesting lecture for the Russian visitors about the status and research programme of the Cosmotron.

COSMOTRON.

The injected maximum charge is 3×10^{12} protons where the accelerated beam reaches 10^{11} . For 6×10^{11} injected the accelerated beam is 4×10^{10} . This lack of linearity suggests that the longitudinal space charge effects are important and no great increase in accelerated current is likely.

A new experimental area some 30 x 60 m is in use and it is policy to do most experiments with extracted beam. In fact the machine has been so well closed in with shielding that the possibility to use the circulating beam has been more or less abandoned.

The focal spot in the first extracted beam is ~ 1 cm x 1 cm. As much as 60 o/o has been extracted but 20 o/o to 30 o/o is considered satisfactory. The beam can be monitored either by measuring the C^{11} activity induced in a polythene foil or with thin walled chambers or Čerenkov counters. The thin walled chambers are very non linear and must be carefully calibrated. (The extracted beams travel some 10' in air before entering vacuum beam tubes).

Some 4000 tons of steel shielding are available together with 7000 tons of concrete.

There are 19 DC generators and 50 magnets. This is not enough and more are on order.

The shielding is good enough to permit extraction of full beam - to stop it and operate a bubble chamber in close proximity.

EXPERIMENTAL PROGRAMME.

Adair Leipuner et al. Worked in beam $1 \sim 10^{10}$ protons per pulse fall in stainless steel target, produce π^- which are focused and analysed which fall on polythene target. (Momentum $1.5 \text{ GeV}/c \rightarrow 1 \text{ GeV}/c$ with intensities of 3×10^5 10^6 per pulse). $\Delta p/p \sim 7 \text{ o/o}$.

Reaction $\pi^- + p \rightarrow \Lambda^0 + K^0$ gives source of K_2^0 which pass through last sweeping magnet. Get 3 to 5 per pulse in the bubble chamber.

Investigated various reactions of

	σ_{mb}
$K_2^0 + p \rightarrow \Lambda + \pi$	0.75
$\Lambda + 2 \pi$	2.9
$\Xi + K$	0.06 (3 found)
$K_1^0 + p$	1.3
$K_1^0 + p + N\pi$	2.6

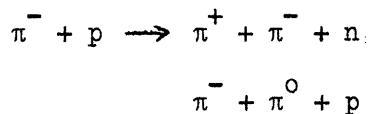
These are preliminary results. Lifetime $\Xi + K \sim 0.5 \times 10^{-10}$ sec.

Brookhaven + Jale groups have worked with $20''$ hydrogen chamber in scattered p beam $E = 2.85 \text{ GeV}$.

	$\frac{\sigma_{calc}}{\sigma_{exp}}$	} σ_{total} 130 μ barns
$p + p \rightarrow \Lambda^0 + K^+ + p$	2.2	
$\Sigma^+ + K^+ + n$	2.6	
$\Sigma^0 + K^+ + p$	1.0	
$\Sigma^+ + K^0 + p$	1.5	

The calculations were by Ferrari and the results reflect fact that $(n\pi^+)$ occurs twice as frequently as $(p\pi^0)$.

An experiment by Salant et al



Plotted frequency versus φ for proton backward in c.m.s. and found peak at 320 Mev which was not observable for forward dir. of p.

FUTURE EXPERIMENTS.

There will be more work on π , p interactions at various energies.

There will be two experiments to measure magnetic moment of Λ^0 . The observation of asymmetry in production will be used to determine initial spin orientation. Will look for change in asymmetry as result of passing through a magnetic field of 50 KG over few cm.

Experiments with π^+ beams e.g. $\pi^+ + p \longrightarrow \Sigma^+ + \dots$

About to make long run to look for cusp in $\pi^- + p \longrightarrow \Lambda^0 + K^0$ near the threshold of production Σ^0 .

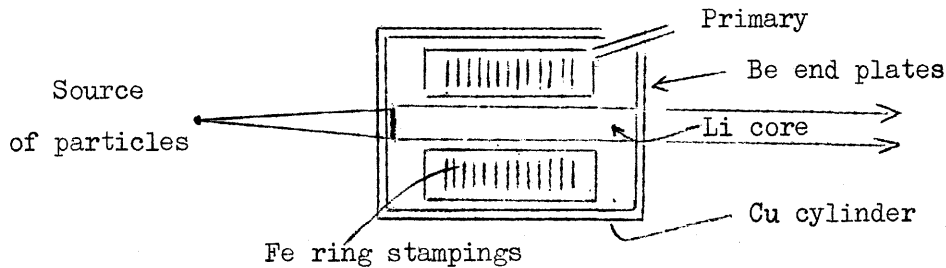
In none of cosmotron experiments has a single case of $K + \bar{K}$ production been found.

NEW INSTRUMENTS.

Yuan, Miller and Donovan are investigating use of Si semiconductors for determining energy of ionising particles stopping in material. Have been using a weak π^- beam (750 Mev). The pulse output is small ~ 5 mV, but the linearity is good.

Carrol and Collins are constructing a special magnet to use in place of quadrupoles to increase efficiency of collection of π beams. The quadrupole is efficient for parallel beams but has obvious defects in acceptance when used in pairs for divergent beams. The lens is basically a circularly symmetrical current distribution in a solid lithium core some 10 cm diameter by 40 cm long, induced by a

condenser discharge into a surround transformer core



For 1 Gev pions the multiple scattering is small and the lens can be made powerful enough to collect over a cone of opening angle 10° .

Characteristics will be $I_{pri} \sim 10^4$ Amp, $I_{sec} \sim 5 \times 10^6$ Amp (~ 1 millisecc) (because of convenient high resistivity of Li, hence large skin depth).

Thus will need pulse of ~ 1 msec to get required field distribution. Pions of 1 Gev/c will emerge parallel for total opening angle of 10° . The loss due to interactions will be about 20 o/o.

Capacitor 1400 μ f 6 KV. Water cooled primary (by conduction). Dissipation 2 KW for one pulse per 5 seconds.

This idea might be useful in beam transport problems, particularly in the neutrino experiment.

POLARISATION OF Λ^0 EXPERIMENT.

Will use fibre scintillation chamber 5 x 5 x 10 inches. Data will be read directly into computer for identifying Λ^0 decay. Scintillation chamber will be gated from counter array detecting decay of K_μ^2 . The magnet consists of a rectangular coil with smallest part of aperture (tapered) about 6 x 6 cm, and some 20 cm thick and overall about 35 x 35 cm. Held together with steel plates and pulsed by generator to give 50 KG. Leakage field ~ 400 G at 3 feet.

COLUMBIA CHAMBER.

The magnet of this chamber can take either a liquid hydrogen bubble chamber or a PBC, of about 3 feet diameter. The HBC may be finished this year. PBC has been trial assembled 13 times but does not give tracks due to boiling at coat hangers. Expansion by means of double hole plate discs insulated by brake fluid

in side walls. Membranes broke when cotton fabric used in rubber. Nylon fabric satisfactory. Trouble with rubber deterioration on the holes. Helium in expansion system. Heated by Calrod heaters. Chipped two windows. (Nylon reinforced neoprene from Reeves Bros. Inc., Division of Vulcan Rubber Products, 6th Av. N.Y.).

Uses 70 mm film clear base linagraph. Three cameras symmetrically placed. Body in Aluminium 60/61/16 slightly tapered. Volume 150 litres.

Magnet weight 40 tons max. field 15 Kg for 1.25 MW.

SPARK CHAMBERS.

Satisfactory progress. Neon at 0.5 atm, chrome plated brass plates about 40 x 40 cm² mirror finished to permit use of multiple reflection in photography. About 1 cm between plates with 10 KV. No damage from sparking.

SCANNING TABLES.

In HBC group simple tables with separate console on trolley for controls. Use yellow plastic surface for projection. Noticed 7" Aero Ektar lenses. Home made IEP. All for 35 mm.

SEPARATORS.

Have two SAMES sets. Experiments just starting on lines parallel to ours. Tank about 1 metre diameter by 1 metre high. Use evapor-ion pump but giving so much trouble that unable to work yet. 1 megohm protective resistor from SAMES. SAMES sets cost Brookhaven ~ \$ 37000 through Sorensen ! - not very pleased.

Have second 10' separator with stainless steel tank as used in cosmotron. They cost ~ \$ 10⁵. Electrodes about 45 cm wide made of stainless sheet about 4 mm thick welded to about 6 cm diam. stainless steel tube frame.

Coils on outside of tank, watercooled

Have had up to ~200 KV on feed through and supports.

Very useful fibre glass insulating tubes for supporting cables etc, cost ~ 50 ¢ per foot.

There is a thesis by Irving Michael (1958) which can be obtained from University Microfilms Inc, Ann Arbor Michigan which gives some useful data about materials for separator construction. (Thesis entitled "The Development and Performance of a New Electrostatic Separator). A curve in it suggests breakdown properties of SF₆ linear with gap. At 100 p.s.i. 600 KV at 0.7" gap, 400 p.s.i. 600 KV at 0.5" gap.

Very convenient looking plate valves from Vacuum Research Co., San Leandro, California. Maybe interesting to inquire prices.

Brookhaven is interested in high voltage supply from Radiation Dynamics Inc., Westbury, Long Island, N.Y., which goes to 600 KV and is RF powered. Unaffected by sparking. A unit giving simultaneously + 600 KV and - 600 KV may cost \$ 80000.

BUBBLE CHAMBER SITUATION.

Some four hydrogen chambers and a methyl iodide propane chamber are in use around the machine. Estimates of number of pictures taken since the cosmotron commenced to work ~~again~~ about a year ago are

20" HBC	~ 3 x 10 ⁵
12" "	~ 1 to 2 x 10 ⁵
14" "	~ 1/2 to 1 x 10 ⁵
16" PBC	~ 1/2 to 1 x 10 ⁵

It is believed somewhat more may be taken in next year due to A.G.S. The groups were well established, equipped and prepared during shut down of Cosmotron.

The Brookhaven BC group has about 18 physicists. About 3 to 6 are effectively full time on the experimental programme - the rest involved in construction of the 80". Unwritten policy is that those who want to can spend on average about half time in research. There are 7 or 8 scanners, 4 projection systems and 2 measuring machines (home made). Two of the batch of commercial machines will come into the group.

The film is clear base linagraph of 35 mm. None of the equipment can handle 70 mm film, which will be used in the 80" chamber.

There is another group which has grown out of the emulsion work which is involved in BC experiments. It is for experimental effort roughly about equal to the BC group.

Apart from the Columbia chamber, which is now being assembled almost entirely at Brookhaven there are no immediate plans for a large PBC.

For the A.G.S. the experimental programme for the HBC's is expected to concentrate at first on separated beams. The two 10' separators may give up to 3 GeV/c \bar{p} if suitably arranged and it is intended to study anti particles, particularly with regards to their similarity with their normal countertypes.

K beams are considered of lower priority and there is no specific interest for the moment in π^+ or μ beams. The HBC is not considered suitable for neutrino investigations, but the 150 litre propane chamber will be put to work.

It was thought that a well equipped and established BC group might do probably 2 and at most 3 experiments per annum.

MOSSBAUER EFFECT.

Some interesting work going on but felt now that the technique of experimentation will go over into solid state investigations. On examining the absorption spectrum of haematin possible to see that apparently micro gatherings of iron compounds exist which recoil collectively shown by the presence of absorption lines slightly displaced from normal iron absorption. Thinking of repeating experiments on the time dependence of line width.

MISCELLANEOUS.

Have seen even more convenient digital clock reading to **5 seconds**. Dimensions $\sim 10 \times 20$ cm figures $\sim 2 \times 8$ cm. "Call Ident - Tymeter" made by Pennwood Numerchron Co., Pittsburgh 8, Pennsylvania U.S.A.

Approximate floor space of solid state rectifiers

600 KW	9' x 16' x 8' high
300 KW	7' x 10' x 8' high
150 KW	6' x 8' x 7' high

Rectangular quadrupoles for 0.9 KG/inch require 370 KW limited by coil dissipation. Would require 600KW to reach 1.25 KG/in.

Useful report by J. Blewett - The Focal Properties of Certain Quadrupole Lenses - J.P.B. - 13th May 1959.

C.A. Ramm

/fv

Distribution : (closed)
PBC Group
Parameter Committee