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MEETING XVI BEVATRON RESEARCH CONFERENCE
April 13, 1954
4 PM Auditorium, Bldg. 51

UNCLASSIFIED

E. J. Lofgren: Bevatron Operation

The occurence of a fault April 7 caused a short in the stator winding of one of the main generators. Repairs will require at least one month and the total time the generator will be down can be determined only after a further inspection of the damage.

In a week or two, after a thorough inspection of the generator and the ignitron system, Bevatron operation will be continued on one generator.

Luis Alvarez: Bevatron Targets

Since the targets of use in a Bevatron experiment will depend greatly on the nature of the experiment and the techniques to be employed, the ideas presented here relate primarily to the area of research which involves the detection with counters of heavy mesons emitted in the backward direction in the laboratory system. These mesons and their decay products have low kinetic energy over the entire range of Bevatron energies above threshold for production. For this reason discrimination by means of momentum resolution, collimating slits, ionization density and range will be possible.

Thread Target

A thread of diameter 0.01" suspended vertically in the beam for about 0.1 second is equivalent to about 12 g/cm^2 of material because the beam passes through the thread many times with small average energy loss on each traversal. The total average energy loss of about 20 Mev, spread out over many revolutions, is easily made up by the RF acceleration. The following argument indicates that the effect of multiple coulomb scattering is not important. The mean square scattering angle of a charged particle passing through matter is proportional to the matter traversed divided by the square of the product of the momentum and the velocity of the particle. The proposed thread target has about 10^3 times as many atoms as the residual gas in the path of the beam. But the factor $(p\beta)^2$ increases by a factor of about 10^5 with acceleration from 10 Mev to 6 Bev. Therefore, even for allowance for the reduction in useful aperture, the effect of the small target on the beam after acceleration should be no more serious than gas scattering near injection.

Ice Cube Target

A pure hydrogen "ice cube" about 3 mm across dropped through the beam would have about the same effect as the thread target previously described. It would have the additional advantage of providing a pure target. The solid hydrogen would evaporate quickly and could probably be pumped out without seriously affecting Bevatron operation, although the cube could be removed through a trap door if necessary.

The two targets described have several obvious advantages for the particular type of experiment considered.

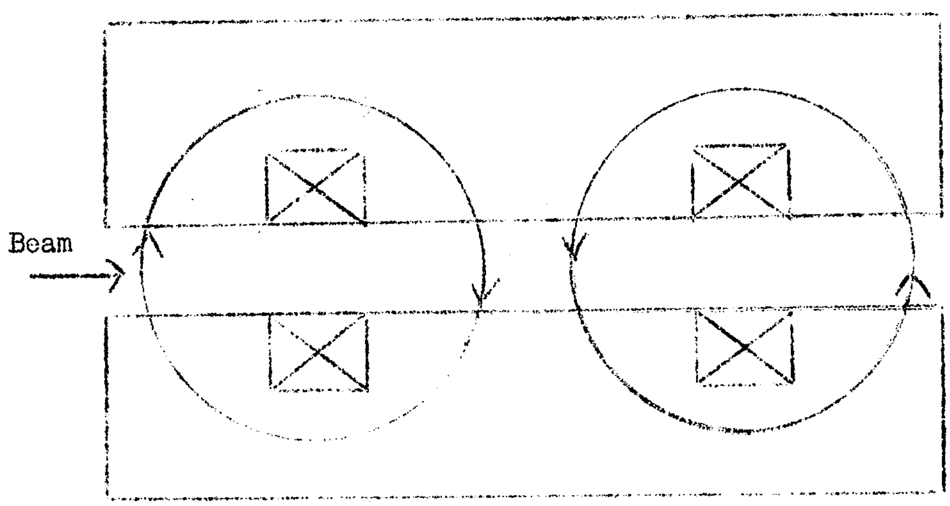
1) The large duty cycle permits higher average counting rates.

2) The small thickness permits low energy particles to escape from the target.

3) The small source size permits higher momentum resolution of reaction products.

Detection efficiencies can be improved by placing counters inside the vacuum chamber, as close as possible to the target. In order to reduce background, the counters could be turned on while the bunched beam is around on the other side of its orbit. The decay of μ-mesons coming eventually from the heavy mesons from the target could be detected during this delayed time interval of a small fraction of a microsecond.

In order to work in closer to the source of heavy mesons, a large magnet consisting of two dipole units located in a straight section could be moved in and out of the beam about once every six seconds in synchronism with the acceleration. To first order, there would be neither deflection nor displacement of the beam passing through the magnet; but a counter and target assembly moving or fixed near the magnet would permit close range observation of reaction products in a variable magnetic field.

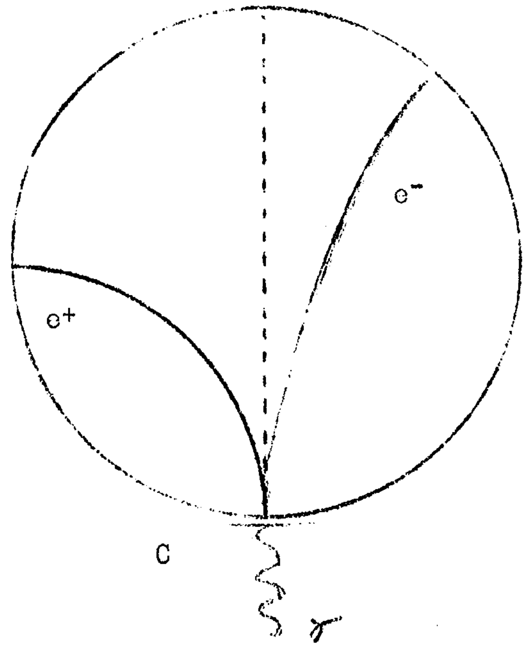


This magnet would weigh about 25 tons and would probably be driven externally with simple harmonic motion as it moved in and out on tracks.

Burton Moyer: Proposed Experiments on π^0 Mesons and other Photon Emitting Events

The efficient detection of high energy photons, preferably with good energy resolution, would be useful for study of the π^0 meson itself, for the detection of other particles which decay into the π^0, and for obtaining the energy spectrum of neutral mesons produced in high energy nuclear encounters. In the center of mass system of two interacting nucleons about 2 Bev energy is available for meson production. The expected pion distribution has an expected maximum at about 0.5 Bev in the center of mass system (or possibly at even lower energy). The determination of the important features of this distribution requires the detection of photons of energies up to 2 - 3 Bev over an angular range of 0 - 90° with respect to the direction of the accelerated beam.

The large spiral orbit magnet could be used as a pair spectrometer. It has the feature that electrons and positrons, emitted forward from a converter on the edge of the field, are bent so that they leave the field normally. Variation of energy



resolution around the circumference can be calculated or corrected by varying the geometry of the detectors. A 1.5 Bev electron is deflected 26^{o} in a field of 20 kilogauss, in the 40-inch magnet.

Another possible photon detector is a large cerenkov detector made of heavy glass with a high index of refraction. With essentially all the photon energy dissipated in an electron shower in the glass, the light pulse given out is a good measure of the primary photon energy. 5 to 10% energy resolution is not out of the question for the high energy photons with which we are here concerned.

Heavy mesons and hyperons which decay into π^{o} mesons with half lives of the order of 10^{-9} seconds can be studied with photon detectors. Possible reactions of interest are:

$$P + N \dashrightarrow V^{o} + \theta^{o} + P$$

$$V^{o} \dashrightarrow n + \pi^{o}$$

$$\theta^{o} \dashrightarrow \pi^{o} + \pi^{o}$$

$$V^{+} \dashrightarrow P + \pi^{o}$$

$$\tau \dashrightarrow \pi^{\pm} + \pi^{o} + \pi^{o}$$

A proposed experiment is as follows:

Particles from the target decaying to the right of line XY may emit photons which are detected by the counter array in coincidences BCD-A. Pairs are formed in the converter. Anti-coincidence counter A eliminates the effects of charged particles. The converter material is varied to eliminate effects due to neutrons.