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William A. Wenzel: General Purpose Bending Magnet

GENERAL

It will be desirable to have a general purpose bending magnet available for use with the Bevatron. The design discussed below, while tentative, is believed to incorporate most of the desired properties for use with the external beam. Suggestions for improvements, modifications, etc. should be addressed to Dr. W.A. Wenzel, Extension 424.

POWER SUPPLY

The primary power supply for use with the magnet is capable of delivering 360KW continuous or 540KW pulsed at about 15 percent duty. It should be possible to operate two magnets with the design discussed below on pulsed operation. The rise time of the pulse magnet, as limited by the generator field rise rate, will be of the order of 2 sec.

Five-Foot Magnet Specification

Magnetic Volume (gap x width x length)	4" x 14" x 60"	
Maximum Field	18,000 gauss	
Power Required	200 - 300 KW	
Proton Momentum	6.5 Bev/c	0.6 Bev/c
Enclose Angle	7°	87°
Proton Radius of Curvature	40'	4'
Deviation of protons from a straight line thru the end points of the path	0.94"	12"

UTILIZATION

The magnet described above, when used in the re-entrant section on the inner radius of the West Tangent tank, will permit measurements up to 4.5 Bev/c before the positive particles will strike the main Bevatron magnet yoke. Higher energy particles will have to be observed at shorter monitoring distances.

Melvin Ruderman: Experiments Relating to Gyromagnetic Ratios of Heavy Mesons

An experiment is discussed which may give an estimate of the gyromagnetic ratio of hyperons. Even a qualitative knowledge may be useful. If Λ^0 is some state of $\pi^- + p$, it will almost certainly have $\mu/J < 0$. A neutral "fundamental" particle (described by the "bare" Dirac equation, like an electron) has $\mu/J = 0$.

A summary of relevant data on $\pi^- + p \rightarrow \Lambda^0 + K$ is given in table I. These data seem to imply:

(1) Λ^0 is produced backwards in c.m. and therefore comes out rather slowly in the laboratory. (A strong backward peaking indicates large

orbital angular momenta involved in the production.)

(2) There is a strong tendency toward coplanarity between production and decay planes of Λ^o.

(2), if confirmed, shows that Λ^o remembers its production plane. Now if $J \leq 1/2$, the Λ^o has to decay spherically symmetrically in its own rest system. Classically the plane of decay is perpendicular to $\vec{J}$ because $\vec{J} = \vec{p} \times \vec{r}$. Quantum mechanically, if θ is the angle between $\vec{J}$ and decay plane, the angular distribution is $(1 - \cos^2 \theta)^{J/\hbar}$. Therefore the data imply that Λ^o is produced with high spin perpendicular to the reaction plane. (Even if data were more extensive they could give only a lower limit on J since the Λ^o is not made with 100 percent polarization.)

It seems feasible to change orientation of Λ^o spin between production and decay by a strong magnetic field appropriately directed in the production plane.

If Λ^o has a gyromagnetic ratio about that of a proton, then in 3×10^{-10} sec (lifetime of Λ^o) a field of 50,000 gauss can change the decay plane by half a radian. If data like that in table I continues, this change and its sign is easily detected. Magnetic fields of order 75,000 gauss will be available for plate work. Because Λ^o's are relatively slow in the laboratory, there is no time dilitation; it may be possible to select only longer lived ($> 3 \times 10^{-10}$ sec) Λ^o to increase the effect.

For this effect to be measured, one should have much greater numbers of Λ^o's than made at Brookhaven. Solid targets will certainly increase number. Will production and passage through matter spoil coplanarity? This is also important if plates are used to detect the decay.

1) Passage through matter:

Calculation shows negligible depolarization in passing through matter for any reasonable gyromagnetic ratio. Also, even an unreasonably large Λ^o quadrapole moment will not depolarize. Positively charged polarized particles (except positrons) will come to rest in matter without losing their polarization. Negatives may be depolarized when they come to rest and are captured into atomic levels, especially if they have quadrapole moments.

2) Production of Λ^o in C by π^-:

The π^- can scatter on a nucleon of carbon before Λ^o production. Experiments at 1.5 Bev give a π^- - p cross section of 30 mb. About 15 mb is diffraction and therefore small angle ($< 6^o$). Carbon has too few nucleons for more than one scatter to be probable with this cross section. Therefore the direction of a π^- is most probably almost not altered in a C nucleus. If Λ^o does <u>not</u> interact with a nucleon of C much more strongly than n or p (this would seem to be the case if current interpretation of delayed π's from nuclear fragments is correct) then the polarization of Λ^o from π^- + p and π^- + C should be similar.

Since the cross section for Λ^o production in H at 1.5 Bev is $\sim$ 1 mb, higher energy mesons incident on C should produce enough Λ^o mesons to make the above experiment feasible. Similar experiments could be suggested for other mesons if they have a spin $> 1/2$ and are produced polarized.

TABLE I

Angles Between Plane of Production and Plane of Decay of Λ°

Events / Particles	A	B	C	D	E
$(V_1^{\circ})\ \Lambda^{\circ}$	$5^{\circ} \pm 5^{\circ}$	30 ± 20	18 ± 7	27 ± 10	
$(V_1^{-})\ \Lambda^{-}$					$7^{\circ} \pm 5^{\circ}$
$(V_2^{\circ}, V_4^{\circ})\ \Theta^{\circ}$			60 ± 6	$70^{\circ} \pm 5^{\circ}$	

TABLE II

Production Angle of Λ With Respect to Incoming π^- in Center of Mass System

Λ°	141°	125°	177°	174°	
Λ^{-}					30°