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of May 25, 1950

Henry P. Kramer

September 18, 1950

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Bevatron Progress Report. W. Brobeck.

The building is scheduled to be finished by August 1, 1950 at which time erection of the magnet will commence. In order to decrease power losses from eddy currents in the reinforcing bars of the magnet foundation which is in the process of being poured, bars are insulated from each other at the joints by means of fiber windings. The steel assembly of the magnet is 50 percent completed. The design of the magnet coils has been frozen.

The design of the pole pieces has been placed on a firm foundation by model tests that have been conducted for the past six months. A final check of the shape will be made by the Theoretical Group. The pole pieces are designed so that if it becomes feasible to decrease the gap width in order to increase the present design energy of 3.5 Bev possibly to 6 Bev the pole tips can be added without rebuilding the evacuated annulus.

The residual magnetism has been investigated by means of a pulsed 1/2 scale model. To remove residual fields, which have been found to vary considerably, either a reverse pulse through the magnet coils or else compensating coils will be used.

The problem of evacuating the beam space is being studied by means of a full scale 10° section of the tank. To prevent outgassing it is contemplated to cover the exposed steel surfaces with vitreous enamel painted with a thin coat of metallic paint to preserve the conducting properties of the surface.

Preacceleration and injection will be performed in several stages. An ion gun including a Cockroft-Walton power supply will provide a 1/2 μ amp. beam at

0.5 Mev, which is pre-accelerated to 10 Mev by a linear accelerator.

The accelerating system whose circuit is sketched in Fig. 1, has been developed through tests on the 1/4 scale model. The frequency will vary from 400 to 2300 kilocycles as the magnetic field increases from 300 to 9800 gauss.

Search for Compton Scattered Protons. A. Silverman.

Compton radiation is produced by an unbound charged particle that oscillates in an electromagnetic field which is provided by an incident photon. Although, in the past Compton scattering has been observed only in cases where the oscillator was a free electron, there is no restriction inherent in the theory which limits the observation of this process to electrons alone. However, since the intensity of the scattered radiation is according to Klein and Nishina proportional to the inverse of the square of the mass of the oscillator and directly proportional to the incident intensity, the likelihood of observing Compton scattering by protons is extremely small, that is, of the order of 10^{-6} of the probability of observing electron Compton scattering. $\left(\left(\frac{d\sigma}{d\Omega}\right)_{90^o} = 4 \times 10^{-32}\ cm^2 \right)$. The high intensity of the x-rays from the synchrotron, and the availability of refined detecting apparatus encouraged the search for Compton scattering by protons.

For the detection of the scattered photons, the three crystal telescope introduced at the Radiation Laboratory by Steinberger was used with its axis at 90^o to the incident beam and a 1/4 inch lead converter between the first and second crystals. Protons were detected by means of a pair of proportional counters. Only those protons were counted that arrived in coincidence with quanta of electromagnetic radiation. The target consisted of polyethylene. The scheme of the experiment is shown in Fig. 2. The aperture of the lead collimator was such as to admit protons recoiling at angles θ between 37^o and

43°. A lower limit to proton energies admitted is set at 10 Mev by a certain thickness of absorber. An upper limit of 70 Mev is imposed by the counters. This corresponds to an energy range from 100 to 300 Mev for the scattered γ-rays.

The experimental results are summarized as follows:

Target	Counting Rate	Accidental Rate	Experimental Conditions
Polyethylene	91 + 9	5.8	
Carbon	13 + 5	6.2	
Polyethylene	14 + 5	6.3	no converter in crystal telescope
Polyethylene	36 + 6	5.4	crystal telescope 30° out of plane of beam and proton detector
Polyethylene	124 + 25	3.2	angle θ between beam and proton detector increased to 60°

The accidental rate was measured by putting a delay on the coincidence between proton and photon. The accidental rate thus measured agreed with calculations. Two circumstances indicate that the proton-photon coincidences observed are not due to Compton scattering. The number of counts is larger than one would expect from Compton scattering and with Compton scattering one would have expected the intensity to decrease with the angle θ.

However, the observed data may be interpreted as evidence for the creation of neutral mesons, the protons being the recoils in the process, and the observed γ-rays coming from the decay of the neutral mesons. This explanation is in accord with the observed increase in intensity with increase in angle θ. For, the neutral mesons are impelled in an opposite direction from that of the protons and upon decay give a two maxima of γ-rays at about 15° with their direction of motion, which, in the present experimental set-up, ought to yield a maximum of protons for $\Theta = 75^{\circ}$. On the basis of this interpretation an approximate cross section for the production of neutral mesons by the interaction of 270-320 Mev γ-rays with protons is 3×10^{-29} cm^2.

Rare Earth α-emitters. J. Rasmussen.

Emission of α-particles is energetically possible for all isotopes of mass greater than about 150. Until relatively recently, however, it had not been observed with regularity for any except the very heavy isotopes of elements with Z greater than 84(Po) with the one exception of the α-emitting samarium isotope. α-activity was then observed in isotopes of Hg and Au. Here α-activity is reported in artificially produced rare-earth isotopes. The information obtained is summarized in the table below. By means of α-decay theory an accurate knowledge of half-lives and mass numbers will permit a more precise calculation of nuclear radii. For the prupose of determining mass numbers an attempt will be made to produce sufficient quantities of the listed materials to permit analysis by the mass spectrometer.

Element	Z	E_α(Mev)	$T_{1/2}$	N
Sm	62	2.14	10^{11}y	85
Gd	64	3.2	>4y	<87
Gd or Tb	64 or 65	4.2	~ 7 min.	<87
Tb	65	3.7	19 hr.	<87
Tb	65	4.0	4.0 hr.	83, 84, or 85
Dy	66	3.55	2.3	<90
Dy	66	4.1	~ 22 min.	<90
Dy or Ho	66 or 67	4.3	~ 5 min.	<90

The atomic weights of the isotopes seem to point to the existence of a 'magic number' of 82 neutrons for α-stability.

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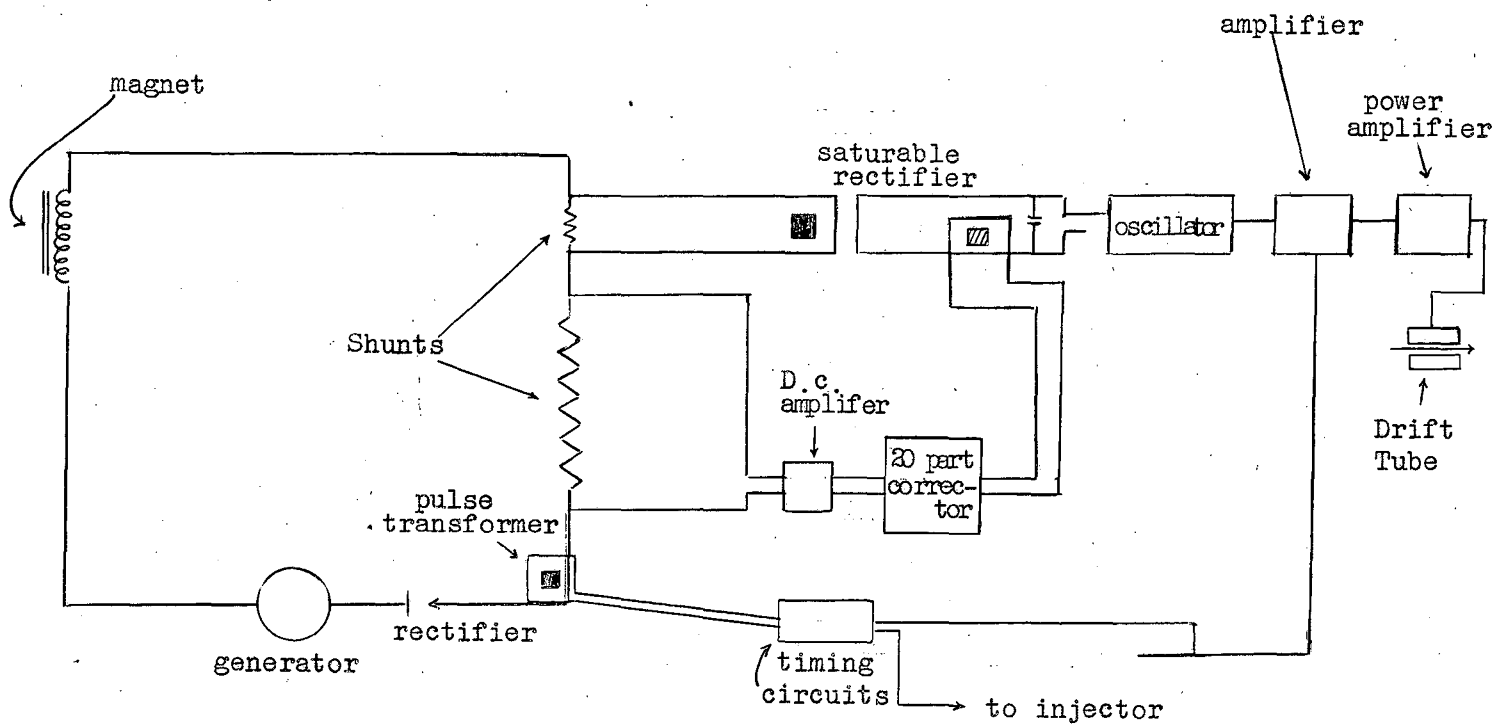

Fig. 1

Circuit scheme for the bevatron.

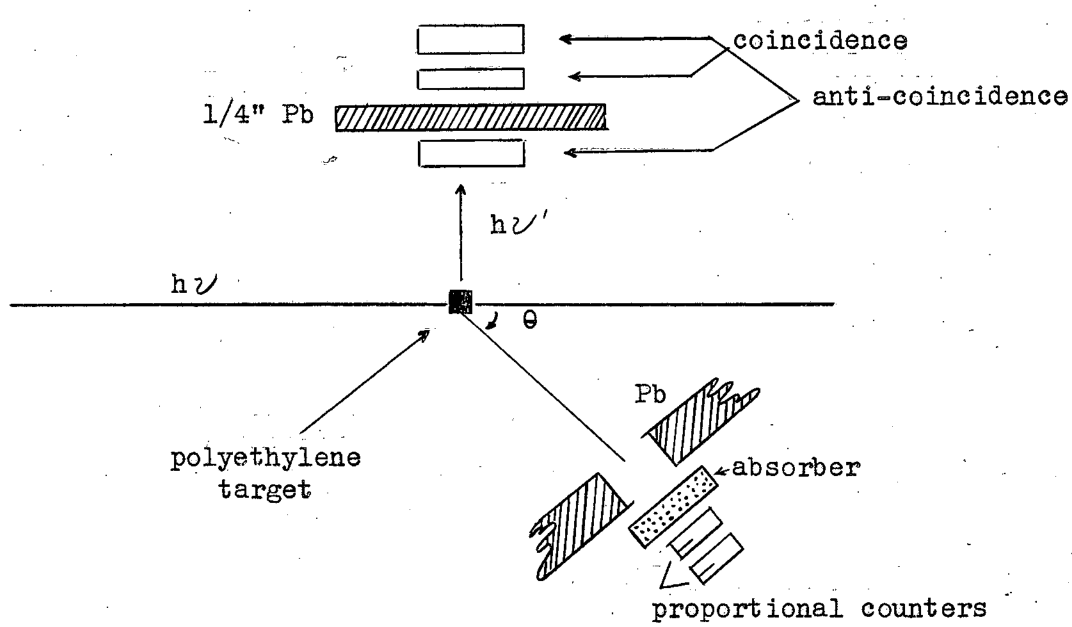

Fig. 2

Apparatus for the detection of Compton scattered protons.

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