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SUMMARY OF THE RESEARCH PROGRESS MEETING OF MARCH 22, 1951

Bonnie E. Cushman

September 10, 1951

Berkeley, California

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I. Dr. Willis Lamb spoke briefly about the work on the ground state and fine structure of hydrogen which is being done currently at Columbia University.

II. Spallation Products of Copper - Roger Batzel.

The products from the bombardment of 340 Mev protons on $Cu^{63 \text{ and } 65}$ have been examined. A difference of as many as 40 nucleons between the target material and the products has been observed (see Fig. 1 for the yields of the products relative to Cu^{61}). The experimental yields were then used as a basis for extrapolating for probable yields in adjacent regions (Fig. 2). It is evident that the region of maximum yield follows the line of the stable isotopes. See UCRL-1077 for a complete report.

III. Scattering of Mesons at 90° from Carbon - M. Skinner.

Preliminary results using the meson beam from the 184-inch cyclotron were presented. The experimental arrangement is shown in Fig. 3. The peak of the meson beam energy spectrum is at 53.5 Mev and its half-width 5 Mev (see UCRL-922 for production method). Since the background in the cave was too high to permit detection of the mesons by counters or plates, the geometry was changed to make the collimator narrower and a factor of 5 was picked up in the solid angle, enabling the detectors to be placed closed to the scatterer. The plates were left protruding somewhat from the absorber in order to read low energy mesons.

The total scattering cross section at 90° was determined to be $d\sigma/d\Omega = (2.2 \pm 1.0) \times 10^{-26}$ cm^2/ster. It is expected that the error will be lessened when corrections are made for glass and copper absorption, goemetrical factors, etc. A background run without the carbon showed no mesons where previously ten were found. The energy loss of the mesons can be determined by tracing back their path through the absorber, to their origin, assuming that ionization accounts for all the loss. This leads to a meson energy spectrum with a peak at 42 Mev and a 9 Mev half-width. Thus the energy loss in the scattering process occurs in a finite interval and can be explained by a theory of elastic scattering by individual nucleons rather than the carbon nucleus as a whole. However, this idea would be incompatible with the results obtained by Steinberger at Columbia (see Table I for comparison of results).

Table I

	σ Total Columbia	σ Elastic Cornell		4π σ 90° Berkeley
C	300 mb	~ 300 mb		270 mb (would expect 12 x 4 mb for meson-nucleon scattering)
H	< 4 mb		≅ Nuclear Area πr_0^2 for C ≅ 320 mb	
Al		~ 600 mb		

IV. <u>Pulse Height Method for Counting Particles in Flight - Le Roy Kerth.</u>

A method for counting either + or - mesons has been developed by Wilcox, Heinz, Leonard, Peterson and Kerth. The particles are identified by pulse height and either $H\rho$ or range and may therefore be counted without being stopped.

In constructing the apparatus, gas proportional counters were abandoned because of the high singles rate in favor of crystal scintillators. It was then necessary to prove that the pulse height was proportional to the energy and to determine where fluctuations would arise, i.e., (1) in the electronics,

(2) in the light gathering efficiency for various parts of the counter, (3) in the photomultiplier tube gain, and (4) in the statistics.

Fluctuations in the electronic set-up can be held to a minimum by using as good equipment as possible. Fig. 4 shows the arrangement used. The circuit may be used with coincidence or anti-coincidence and the whole pulse height spectrum may be seen at one time. Resolving time was 10^{-8} sec. at the cyclotron and checked to 4×10^{-9} sec. with artificial pulses.

Fig. 5 shows the gain of the photomultiplier tube plotted against the voltage. The power supply is regulated by the Fairchild method and the tube is run at 1500 V. Maximum voltage is 1700 V.

It is thought that statistical fluctuations are caused by variations in the light received, and the only way to avoid them is to get more light in the photo tubes. With liquid scintillators the fluctuations are very much larger than with crystals, probably because of the small energy of the pulses from the liquid.

It is maintained that mesons can be uniquely counted by this method if high energy protons are eliminated.

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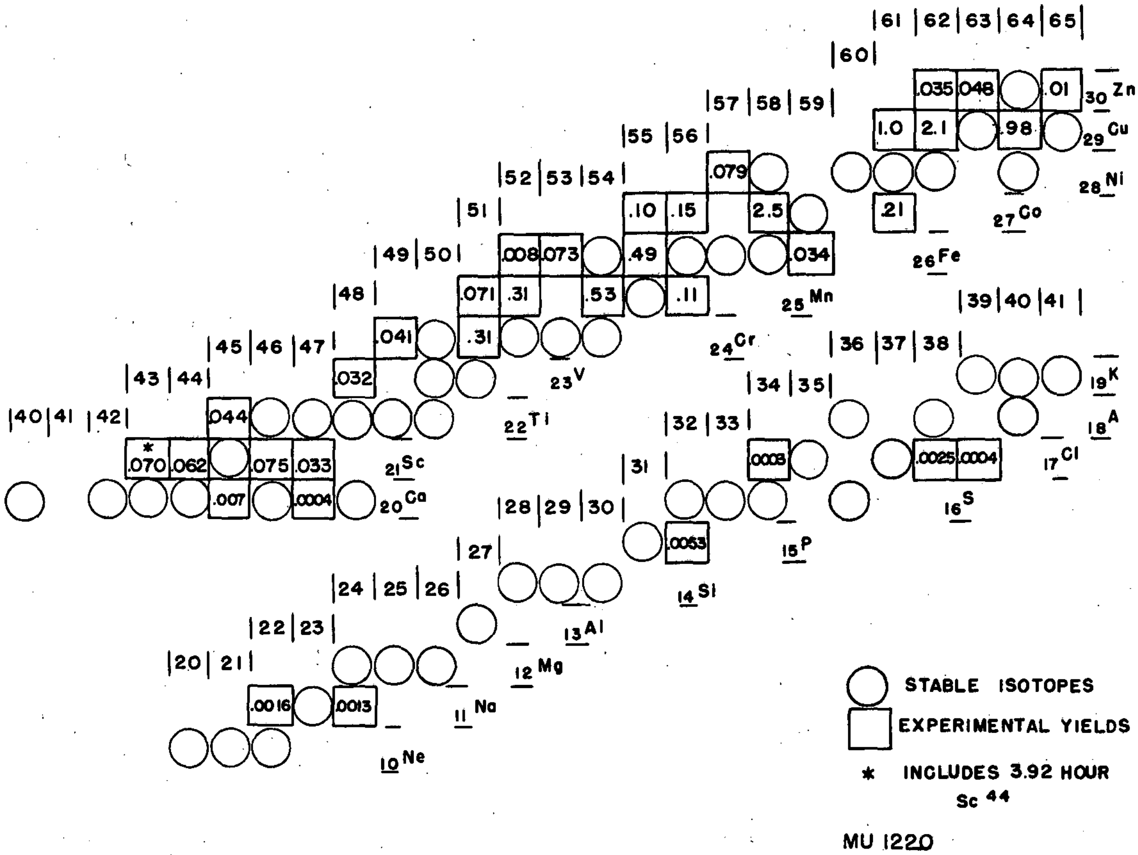
STABLE ISOTOPES
EXPERIMENTAL YIELDS
* INCLUDES 3.92 HOUR Sc 44
MU 1220

Fig. 1

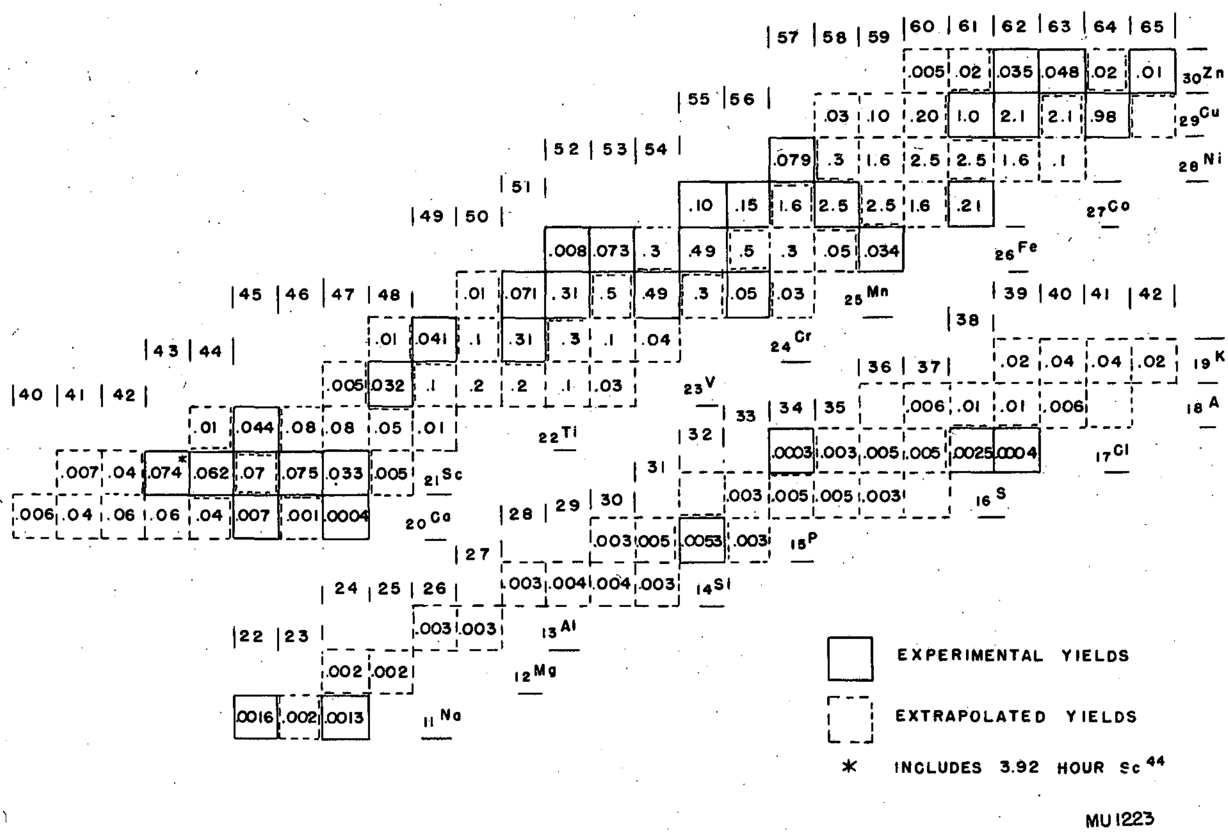
30Zn
29Cu
28Ni
27Co
26Fe
25Mn
24Cr
23V
22Ti
21Sc
20Ca
19K
18A
17Cl
16S
15P
14Si
13Al
12Mg
11Na
EXPERIMENTAL YIELDS
EXTRAPOLATED YIELDS
* INCLUDES 3.92 HOUR Sc 44
MU1223

Fig. 2

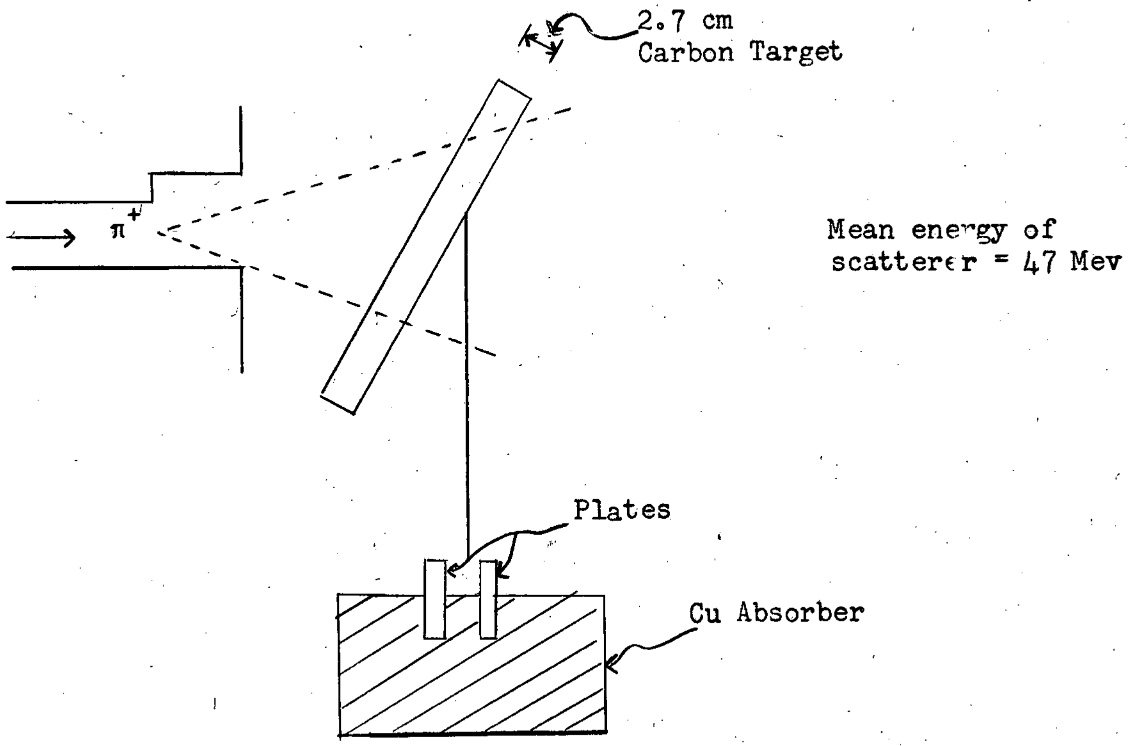
2.7 cm
Carbon Target
π+
Mean energy of
scatterer = 47 Mev
Plates
Cu Absorber

Fig. 3

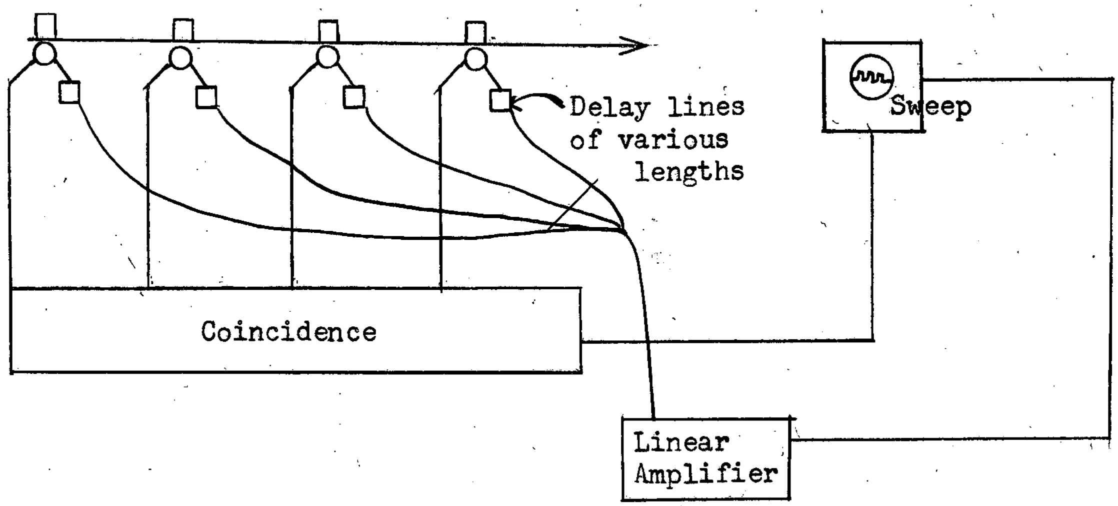
Delay lines
of various
lengths
Sweep
Coincidence
Linear
Amplifier

Fig. 4

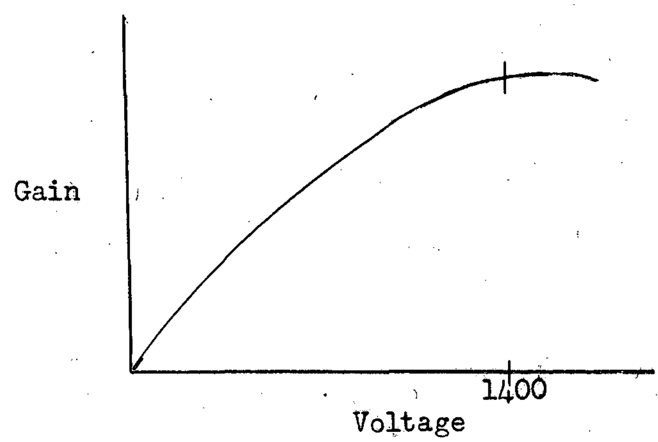

Fig. 5