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SUMMARY OF THE RESEARCH PROGRESS MEETING

June 30, 1949

Henry P. Kramer

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SUMMARY OF THE RESEARCH PROGRESS MEETING

June 30, 1949

Henry P. Kramer

Proton-proton Scattering at 340 Mev. C. Weigand.

At the Research Progress Meeting on April 21, 1949, O. Chamberlain reported on the difficulties encountered with a proton-proton scattering experiment in the electrostatically deflected proton beam of the 184-inch cyclotron. At that time no clearly defined results were reported since the large background made proper resolution of data impossible. A number of changes and refinements in the apparatus have resulted in a considerable improvement of the measurements.

The present experimental arrangement is shown in Fig. 1. The proton beam is well defined by a lead collimator. A photograph taken at the position of the radiator shows an exposed area 1 x 1.5 cm^2 in extent. Two guard counters flank the beam and serve to indicate any angular fluctuation that might occur due to a small change of voltage on the electrostatic deflector. An air filled ionization chamber measures the beam current. A little way beyond, a scatterer is interposed in the beam. The proton cross section is obtained by taking measurements with CH_2 and graphite and subtracting. After the beam passes through the scatterer it is monitored by an argon filled ionization chamber that announces to the cyclotron control room aberrations in proton current and indicates adjustments in phasing that have to be made in order to maintain the beam at a steady intensity. The portion of the proton beam that is scattered at the target is counted by a telescope of three counters in coincidence. Between the second and the last counter a tungsten foil of variable thickness is placed to permit energy discrimination.

If the only effect of the tungsten foil were to slow down the protons that pass through it, one would expect the number of coincidences to be a constant function of absorber thickness with a sharp cut off at the thickness corresponding to a complete stoppage of the particles. However, account must be made of proton losses in the absorber due to nuclear collisions. As a first approximation, one expects the number of protons lost in collisions to increase linearly with the number of nuclei, that is, with thickness of absorber. In more refined analyses one must take into consideration the variation of nuclear cross sections with the energy of the protons. Because the effect of the tungsten absorber is not completely known, there is some uncertainty regarding the proper interpretation of the data.

In particular, the scattering of the experimental points near zero tungsten absorber thickness does not unambiguously point to the proper extrapolation curve. It is thought that perhaps the measured differential cross sections near zero thickness may be somewhat high. In order to test the possibility of scattering from the walls of the counters, the copper lining was replaced by aluminum with a lower scattering cross section but no difference was observed.

Two telescopes were set up at a right angle to each other and coincidences were counted. Relativity theory predicts that a maximum of coincidences between both particles that take part in the scattering process should occur at 86° in the laboratory system. A maximum was actually found at 85°.

In order to check the coplanarity of the direction of the telescope and the beam, the telescope was moved in a vertical direction and it was affirmed that the original position is that in which a maximum of coincidences is counted.

Some Excitation Functions of Thorium. W. Meinke.

The interest in excitation functions is based both on theoretical and practical considerations. From the practical point of view one would like to know at what energy to bombard in order to obtain the maximum yield of the isotope in which one is interested.

About six months ago, experiments were begun to study the yield of the reaction $Th^{232}(\overset{p}{d},6n)Pa^{227}$ as a function of beam energy. Thorium foils were sandwiched between 1 inch x 1 inch sheets of copper. It was found that the maximum yield rose only by a factor of ten above the background at what was thought to be zero beam energy. However, examination showed that the beam was not completely blocked by the copper absorber since it was able to strike the stack from the side and thus penetrate to the Th foil through less than the supposed thickness of copper. This experimental arrangement was therefore discarded.

Copper absorbers 3 inches x 2-1/2 inches were then carefully milled and thorium foils 3/4 inch in diameter were placed in holders with tongues protruding on the beam side to eliminate portions of the beam striking the stack from the side. The results of yield measurements were much better defined. A large number of protoactinium isotopes ranging in mass number from 233 to 227 were produced both with protons and deuterons from the 184 inch cyclotron. However, at present, results are available only on the Pa^{227} yield, which is the strongest activity in the Pa fraction for 4-5 hours after bombardment ceases. The reaction $Th^{232}(p,6n)Pa^{227}$ gives 1.5×10^6 α disintegrations/min. and the reaction $Th^{232}(d,7n)Pa^{227}$ gives an α count of 6×10^6 disintegrations/min.

The Pa fraction was removed from the target material by dissolving in HNO_3 TTA solution and then evaporating on a hot plate. The only impurities that are carried along are Zn, Hf, and Co, which do not interfere with the measurements.

A threshold for the reaction $Th^{232}(p,6n)Pa^{227}$ was found at 52 Mev and a peak at 78.5 Mev. An indication of a sharp maximum was first seen with 12 foils on which the chemistry was performed simultaneously. Then the peak was isolated with 16 foils spaced around the expected energy. Fig. 2 shows the progressive determination of the peaks.

Work is going on in the examination of the reaction with deuterons $Th^{232}(d,7n)Pa^{227}$ which is also thought to have a peak. Preliminary results indicate that this supposition is founded in fact.

The high energy portion of the excitation function seems to point to nuclear transparency effects.

An account of the work is presented in UCRL 382, Chemistry Division Quarterly Report April, May, June, 1949.

LMB/Information Division
July 11, 1949

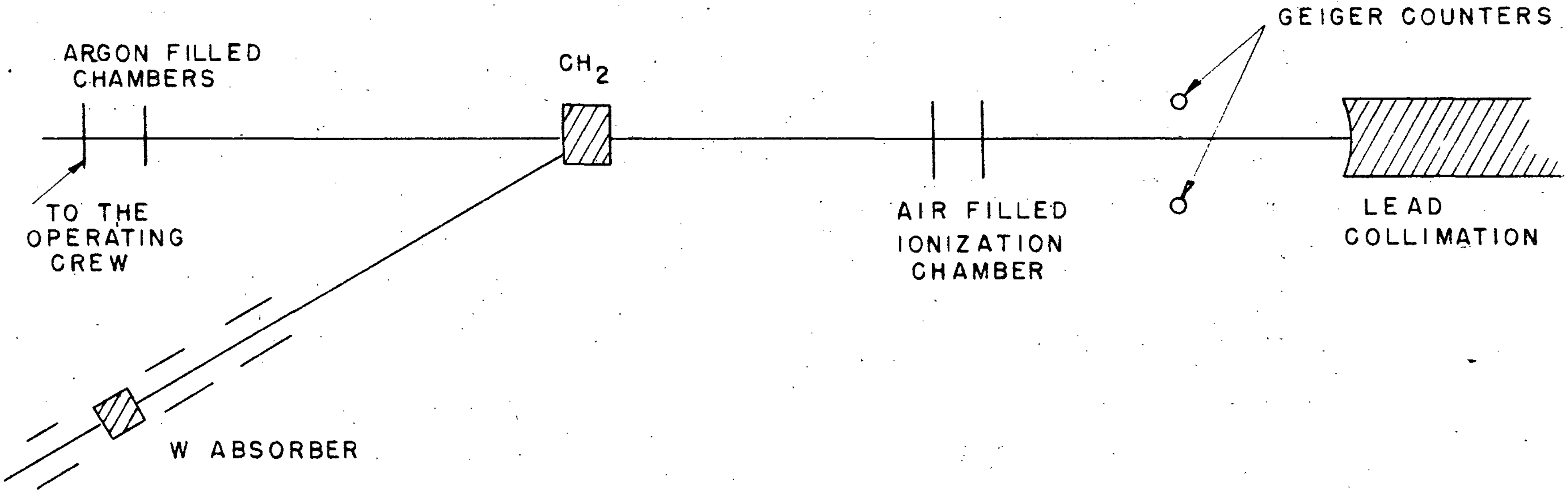

FIG. 1

APPARATUS FOR P-P SCATTERING AT 340 MEV

EXCITATION FUNCTIONS

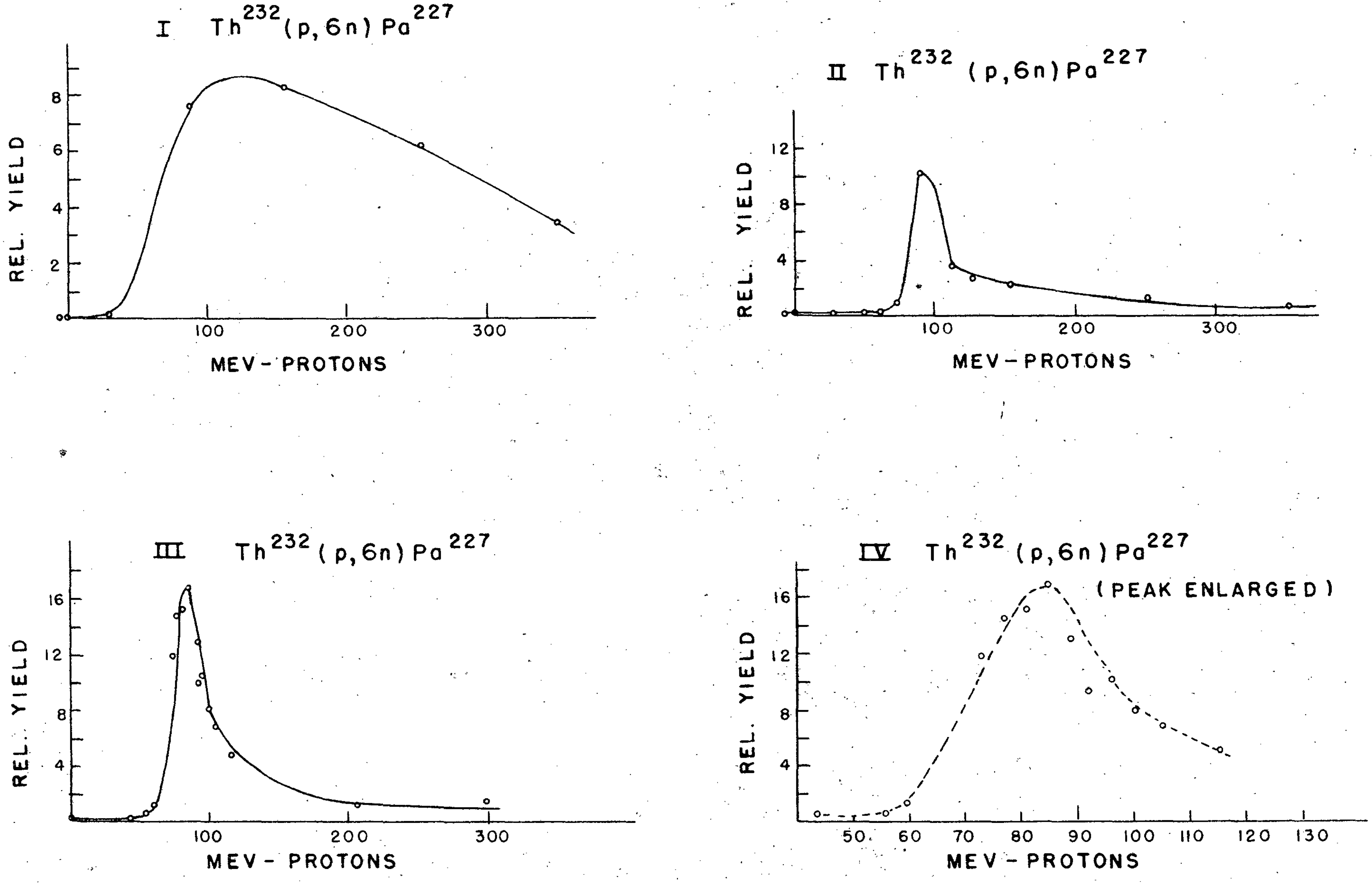

FIG 2

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