Title
SUMMARY OF THE RESEARCH PROGRESS MEETINGS OF OCT. 2 AND OCT. 9, 1952.

Author
Shewchuck, Sergey S.

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Sergey Shewchuck

October 22, 1952

Berkeley, California

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SUMMARY OF RESEARCH PROGRESS MEETINGS OF OCTOBER 2 AND OCTOBER 9, 1952

Sergey Shewchuck

Radiation Laboratory, Department of Physics
University of California, Berkeley, California

October 22, 1952

Meeting of October 2, 1952

I. High Speed High Vacuum Ion Pump. J. S. Foster.

The details of this talk are contained in report UCRL-1930 under the same title by co-authors John S. Foster Jr., E. O. Lawrence, and E. J. Lofgren; dated August 27, 1952. In addition to the short abstract the introductory paragraph of the report is also quoted as follows for purposes of this summary:

> "A vacuum pump based on the properties of a magnetically collimated electric discharge is described. It has a speed in the range 3000 to 7000 liters a second and a base pressure in the order of 10^{-6} mm.
>
> "This report describes briefly the salient features of a new type of vacuum pump. The general concept of an ion pump has occurred to many investigators. The idea is to ionize the residual gas and to sweep it from the volume by some combination of electric and magnetic fields. It is, in fact, a fairly common observation that gas pressures in a closed system can be reduced by a discharge; however, no previous ion pump has had a base pressure or gas handling capacity comparable to large diffusion pumps. The main feature of this ion pump can be understood in terms of simple discharge phenomena."

II. High Energy He Ion Irradiation of Aqueous Solutions of Acetic Acid. H. R. Haymond.

The details of this talk are to be found in the Radiation Chemistry section of the Medical and Health Physics Quarterly Report, UCRL-1922, covering the period April, May and June, 1952. However, an abstract report, UCRL-1863, has previously been issued under the above title by W. M. Garrison, H. R. Haymond, D. C. Morrison, B. M. Weeks, Jeanne Gile-Melchert and J. G. Hamilton, dated June 26, 1952. It is quoted as follows:

"A detailed study has been made of products formed in aqueous acetic acid solutions by reactions resulting from irradiation with cyclotron-produced helium ions having an energy of 35 Mev. Reaction yields (molecules produced per 100 ev absorbed) have been determined under certain conditions of beam intensity, total energy absorption, volume and concentration of acetic acid, hydrogen peroxide and oxygen. The gaseous products, which include hydrogen, carbon dioxide, methane and carbon monoxide, were determined by mass spectrometric methods. Hydrogen peroxide production in oxygen-saturated systems is a linear function of the total energy absorbed in the solution. Organic peroxides could not be detected. The non-volatile fraction is composed principally of dibasic and tribasic acids. Succinic acid accounts for over 98 percent of the non-volatile acidity at radiation levels below about 1×10^{20} ev/cm^3. Tricarballylic, citric, malic and malonic acids, in addition to succinic acid, are produced at higher radiation levels. Identification and yield determinations were facilitated by the addition of $CH_3C^{14}OOH$ to the target solution. The non-volatile acids were separated and subsequently identified by the use of

techniques involving several different methods of partition chromatography on silica gel columns. Mixtures of the unknown product and added carrier acid were co-chromatographed and identification of the product depended on an exact correspondence between C^{14} activity and acid titre in the elution curves from two or more methods. The identification of several acid products which were isolated in milligram amounts was further confirmed by melting point determinations."

Meeting of October 9, 1952

I. A Space Charge Accelerator for Protons. J. R. Woodyard.

Attention was directed to a short article under this title which appeared in "European Scientific Notes", Vol. 6, No. 16, August 15, 1952; a publication by the Office of Naval Research, London. At this meeting the practicability for such a device of 10 meters length was discussed as well as the aspect of current economy theoretically possible. By way of a summary the first two paragraphs of this article are quoted as follows:

"Professor H. Alfvén of the Royal Institute of Technology, Stockholm, has described a new method for the acceleration of nuclear particles. A preliminary account of the idea has already appeared in the Arkiv for Fysik 5, 175 (1952). Since then a more detailed proposal has been made and apparatus is being constructed to test the ideas experimentally.

"To decrease the length of linear accelerators it is necessary to use very high electric field strengths for acceleration Alfvén has suggested the use of the strong Coulomb field in the vicinity of a dense electron cloud moving with an appropriate speed. One of the advantages of this method is that it utilizes the self-focusing force between the proton and the negative space charge."

II. Availability of the π^- Meson Beam at the Cyclotron. B. Moyer.

Several months ago Barkas and Rankin made calculations of orbits for the emergence of π^- mesons from a target placed in the circulating beam of the 184-inch cyclotron. Following their calculations a thin window was placed in the cyclotron tank wall at an approximate position for the transmission of mesons over a broad energy range originating at a target mounted on an off-set arm from the main probe.

Barkas, et al, verified the existence of the π^- flux by use of photographic emulsions located in proper positions on the cyclotron platform. The purpose of this present report is to describe features of the π^- beam which have been observed by scintillation counter telescope techniques. The present experience also indicates the feasibility of working with scintillation counters in the relatively high intensity radiation field present on the cyclotron platform inside the concrete shielding.

Stilbene crystals with photomultipliers in quadruple coincidence, using resolution time of 3×10^{-9} seconds were employed to form the telescope with which the beam was detected and measure. The telescope was located along the calculated orbit for 70 Mev pi-mesons emerging from the target at about 15 degrees inward from the direction of the incident proton beam. External to the cyclotron tank a channel was defined with lead bricks in such a way as to select this orbit. Identification of the quadruple coincidences as meson counts was made by the following typical tests:

1. The range measurement was appropriate to π^- mesons of the proper energy.

2. The last two crystals of the telescope were moved back along the orbit seven feet from the first two crystals and a time-of-flight

determination was made upon the particles giving the coincidences. The time-of-flight was appropriate to 70 Mev pi-mesons and certainly not appropriate to protons which could traverse a corresponding orbit.

3. When the last two crystals in the time-of-flight position were lifted out of the plane, the counts sharply decreased. Similarly, when they were moved from side to side out of the region of the calculated orbit the counts likewise decreased satisfactorily.

Considerations of the energy spread of the mesons detected based upon a differentiation of the range cut-off curve together with the area presented by the telescope to the meson flux indicates that the flux density used in the measurements was about 0.2 per square centimeter per second per Mev. It seems very reasonable by the use of a thicker target and by raising the beam to its maximum value to obtain a flux density of one meson per square centimeter per second per Mev in feasible working areas on the platform.

With quadruple coincidence employing resolution times such as those used here there was very little difficulty with background and it would appear that with an amount of shielding, quite reasonable to handle manually, it will be possible to do meson scattering experiments.

III. Effect of Chemical Structure on Stopping Powers for High Energy Protons. T. J. Thompson.

The details of this talk and the various experimental data presented in table form are contained in a thesis report UCRL-1910 under the same title by Theos J. Thompson, dated August 11, 1952. Therefore, for purposes of this summary two paragraphs are being quoted as follows from the abstract of this report:

"A study has been made of the stopping power of various elements and compounds for a high energy proton beam. The purpose of the measurements was twofold. First, an effort has been made to determine whether or not the relative stopping power of a compound is strictly an additive function of the elements which form the compound. Second, the stopping powers of four elements hydrogen, carbon, nitrogen, and twenty-nine compounds of these elements have been measured with a high degree of accuracy. The stopping power of a fifth element, chlorine, has been inferred from its compounds.

".....The results indicate that the stopping power of a compound as a whole is an additive function of the elements in the compound to within about 1 percent. The largest percentage deviations occur with the hydrogen and are of the order of 2 percent. The percentage deviations decrease rapidly with increasing atomic number. Thus the stopping power of chlorine in all compounds was essentially constant."