T H E U N I V E R S I T Y O F M I C H I G A N

COLLEGE OF LITERATURE, SCIENCE, AND THE ARTS
Department of Physics

Progress Report

THE UNIVERSITY OF MICHIGAN 83-INCH CYCLOTRON

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INTRODUCTION

This fifth quarterly report on The University of Michigan 83-inch spiral-ridge cyclotron discusses the progress which has been made in the period July 1, 1961, to October 1, 1961, on the building to house the cyclotrons and on the design and construction of the 83-inch cyclotron.

I. THE BUILDING

The Cyclotron Building is now essentially complete and is being taken over by The University on October 2, 1961. Inside, only small jobs such as adjustment of the air conditioning, heating and ventilating systems, touch-up painting, and the other usual details attendant with a new building remain to be done. On the outside, the roads and the rough grading have been completed, but the landscaping is not yet finished. A protective fence is to be installed around the two machine rooms.

This will be the last report to discuss the building.

II. THE CYCLOTRON

The coils have been mounted on the main magnet and the dust covers have been assembled. All the components necessary to make the power connections between the main magnet and the power supply and the plumbing for the water cooling have been obtained. Unfortunately, installation has been delayed until The University takes over the building because the electrical union threatened the contractor with a strike if any electrical work was done by our own (non-union) staff and students. This naturally irritated us considerably.

1. MAGNETIC FIELD MEASUREMENTS

The field-measuring equipment is complete and ready for use when the main magnet is energized. A preliminary calibration and stability test has been performed in a uniform field magnet using a proton moment flux meter as a reference. The results indicate the equipment is suitable for measurements to about one part in 10^4.

2. MODEL MAGNET STUDIES

Professor Blosser at Michigan State University is completing his studies on the proposed spiral shim configurations. A configuration has been obtained which promises to provide the necessary stability at high fields. It remains only to complete the measurements over the required range of the magnetic field.

3. VACUUM SYSTEM

The design of the main vacuum chamber has been finished and sent out for bids. Most of the components to be used in the pumping system are on order, and delivery is expected in October or November.

4. ION SOURCE

The ion source has been fabricated, including the mounting for position adjustment and filament changing without breaking the vacuum in the main vacuum chamber.

5. FOCUSING MAGNETS

Contracts have been awarded to the Bethlehem Steel Company for fabrication of the two focusing magnet frames and to the Allis-Chalmers Manufacturing Company for fabrication of the coils. These components are to be delivered to the site during February, 1962.

The necessary mechanical equipment and regulated current supply for "hot-wiring" the focusing and analyzer magnets is being constructed. To obtain some facility in the adjustment of the optics of the magnets, the equipment will be used initially to shim the field of a 90° magnet to be installed at a later date as a focusing magnet for the 50-inch cyclotron.

6. THE R.F. SYSTEM

The electrical design and the model studies for the resonator are completed and the final mechanical design is in process. With 140 kilovolts dee-to-dee, the maximum power loss in the skin is approximately 50 kw. By moving the two diaphragms, one in each "silo," the frequency is adjustable from 6.5 to above 15 Mc/sec. Fine tuning is to be done with motor-operated trimming capacitors. The alumina insulators for supporting the dees are of simple mechanical design, and are arranged so that the electric field in them is nearly homogeneous. The maximum field is approximately 10 kilovolts per inch.

The designs of the power oscillator and of the coupling loop have yet to be completed.

7. ANALYZER MAGNETS

The design of the reaction products analysis system continues. To study the focusing properties of the analyzer magnets, the equations of motion, good through second order, have been programmed for use on the Michigan IBM 709 Computer. This program tracks particles of given initial position and momentum through the three magnets, and determines the effect of aberrations in each magnet on the focusing properties of the succeeding magnets. Included in the program are provisions to vary the first- and second-order coefficients in the magnetic field expansion, the wedge angles, and the relative positions of all three magnets. Present results indicate that, by proper shimming and adjustment of the magnet fields, the ultimate resolution for the entrance angles of interest will be limited by kinematic broadening rather than by aberrations.

For the entrance angles of interest, the aberrations are only a mildly sensitive function of the second-order field-expansion coefficient. Small aberrations at the image surface of the first magnet do not appear to cause significantly larger aberrations at the image surfaces of the second and third magnets. The shape and position of the surfaces, however, do depend rather strongly on the second-order coefficients. These factors, as well as fringe effects and allowable tolerances in the field shape, are under study.