working in the subject. It is possible that this part of the paper will have some interest for the pure mathematician, for it is rather unusual that graphics should be able to give, not simply an approximate, but an exact and rigorous answer to a question which analysis is, as yet, unable to solve.

MAGNETIC AND ELECTRIC DEFLECTION OF THE α RAYS FROM RADIUM.¹

BY E. RUTHERFORD.

THIS paper contains a preliminary account of experiments made to determine with accuracy the ratio e/m of the α particles projected from radium. The α rays from radium are complex and consist of particles projected with very different velocities. Such a source of rays is not suitable for accurate measurement, as the rays are unequally deflected in electric and magnetic fields.

This difficulty was overcome by using an active wire exposed for some hours to the radium emanation as a source of rays. Fifteen minutes after removal, radium *A* has been almost completely transformed, and the activity is then due almost entirely to radium *C*. Previous experiments by the author (*Phil. Mag.*, July, 1905) have shown that such an active wire serves as a homogeneous source of α rays. The layer of active matter on the wire is extremely thin, and the α particles are all projected from the wire at the same speed.

The magnetic deflection of the α rays was measured by a method similar to that described in a previous paper (*loc. cit.*). The electric deflection was determined by the photographic method. The rays passed between two parallel plates 3.75 cm. long and .21 mm. apart. A photographic plate was placed about 4 cm. above the plates. The apparatus was then exhausted by a mercury pump, and a known voltage applied between the plates. The active wire was placed outside the apparatus, the rays entering the vessel through a thin mica screen of known thickness. The electric field was reversed at intervals. For weak fields, the narrow trace of the rays on the plates was first broadened; with stronger fields, the single band broke into two, each narrower than the normal width of the band without an electric field. The outside edges of the bands were clearly defined, and the distance between the outer edges could be readily measured.

In this arrangement, the parallel plates served to determine the width of the pencil of rays, as well as to apply the electric field. Since the plates were close together, a field corresponding to 20,000 volts per cm.

¹ Communicated to the American Physical Society, December 29, 1905.

could be obtained with 400 volts between the plates, without any danger of a discharge, even if the vacuum were not very good.

From the distance between the outside edges of the two bands, the value of mv^2/e could be calculated. The value of mv/e was determined in the magnetic experiment by measuring the curvature of the path of the rays after passing through the same thickness of mica as in the electric experiment.

The determinations of e/m and v for different strengths of electric and magnetic fields were very concordant. The values of e/m in the different experiments lay between 5.0×10^8 and 5.2×10^8 . A separate experiment showed that the value of e/m was unaltered by passing the rays through the mica screen.

The initial velocity of projection of the rays from radium *C* is very nearly 2×10^9 cm. per second.

The writer originally obtained by the electric method a value of e/m for radium rays of 6.5×10^8 ; Des Coudres by the photographic method found a value 6.3×10^8 , while Mackenzie recently obtained a value of 4.7×10^8 . These experimenters all used radium in radioactive equilibrium as a source of α rays. The rays were non-homogeneous, and it was consequently not easy to obtain an accurate value of e/m .

Since the value of e/m for the hydrogen atom in the electrolysis of water is about 10^4 , the present results show that, within the limit of experimental error, the apparent mass of the α particle from radium *c* is twice that of the hydrogen atom.

The question whether the α particle is a molecule of hydrogen, an atom of helium, or a helium molecule carrying twice the ionic charge, was discussed. It is not at present possible to decide definitely between these possibilities. Further experiments are in progress to determine the value of e/m for the α particles from the other radium products and from thorium and actinium.

SOME PROPERTIES OF THE α RAYS FROM RADIUM. II.¹

BY E. RUTHERFORD.

IN the Philosophical Magazine (July, 1905), the author showed that the α particles emitted from a thin film of radium *C*, obtained on a wire by exposure to the radium emanation, decreased in velocity in their passage through matter. When the α particles from radium *C* had been reduced to a velocity of about 60 per cent. of their initial velocity, the photographic effect produced by them was relatively very small.

The velocity was deduced from measurements of the deflection of a

¹ Communicated to the American Physical Society, December 29, 1905.