lend support to the suggestion of Owen, Moe, and Cook that a small fraction of the 8-day iodine^{131} atoms, which decay with a 600-kev beta-ray, emit a 286-kev gamma-ray followed by a 165-kev gamma-ray.

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** Now at Mellon Institute, Pittsburgh, Pennsylvania.
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A Time-of-Flight Mass Spectrometer with Varying Field

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Of several time-of-flight mass spectrometers that have been proposed recently, only that of Goudsmit[1] gives promise of attaining very high resolution because of the favorable focusing property. The perfect focusing in this instrument can be considered a special case of that obtained in uniform crossed electric and magnetic fields[2] with $E=0$ in this case. It has been recognized that the crossed-field instrument with E having a constant value other than zero could also be used as a time-of-flight instrument in the manner proposed by Goudsmit, but this does not possess some of the advantages of the method proposed here.

In Fig. 1, there is a uniform magnetic field H in the x direction and a uniform electric field E in the z direction. The field E has the value E_0 at $t=0$ and decreases linearly with time to the value $E=-E_0$ at $t=T$. In a coordinate system moving with the proper varying velocity, the ions describe circular paths in which the time for one revolution is given as in Goudsmit's case by

$$T_1=670M/H \text{ microseconds,}$$

where M is the mass of the ion in atomic weight units and H the magnetic field in gauss. The y component of the velocity of the moving coordinate system is independent of the initial conditions and the mass of the ions. The z component of this velocity is also independent of the initial conditions, but does depend on the mass of the ions (the present discussion is concerned with singly charged positive ions). However, the distance B in the z direction to the exit slit is chosen only large enough to allow the beam to miss the electrode structure around the source and receiver and to provide sufficient space for the source and receiver.

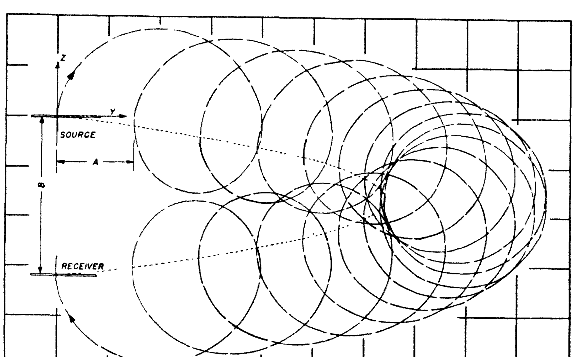

Fig. 1. Path of ions in the case of uniform magnetic field H in the x direction and uniform electric field E in the z direction.

The field E is adjusted so that a selected reference mass M_0 passes through the exit slit after an integral number of cycles n_0. Except for the small z dispersion which has an almost negligible effect in this application but which may be calculated, other ions having the proper mass to undergo an integral number of revolutions n_1 will also be perfectly focused regardless of the initial conditions. Ions having made a non-integral number of revolutions, n, when the moving coordinate system has returned to $y=0$, will be dispersed slightly in the y direction when n does become an integer. This may not be too serious as the exit slit may be made quite wide when a pulsed ion beam is used and the transit time measured in the manner of Goudsmit's instrument. However, as it may be possible to make n_0 very large by a modification of the method of varying E which will be described later, its value could be chosen so that n for the ion being measured will be fairly close to an integer when M_0 is detected. The value n_0 for the reference mass M_0 can be measured experimentally, and the nearest whole number to n may be calculated from the approximate known value of the mass M. The experiment then determines the deviation of n from this whole number by measuring the difference in the arrival times of M_0 and M.

By changing the variation of E with time, the transit time could be increased; for instance, E might be kept at zero at the turning point (maximum value of y) for a period of time while the ions revolve in the magnetic field before increasing E in the negative direction to bring the ions back to the collector. With this technique, the extent of the magnetic field in the y direction may be decreased; in fact, if the variation in E is made in a time less than that for one cycle, a ring-shaped magnet could be used. The displacement of the ion beam might be effected by a small variation in the magnetic field although this compromises somewhat the perfect focusing condition.

The chief difficulties with this scheme appear to be the long ion path and the lack of focusing in the direction of the magnetic field. However, the possibility of detecting some of the ions after a fairly long transit time looks sufficiently promising to justify some exploratory experiments. Furthermore, it appears to be possible to incorporate weak axial focusing if E is kept at zero for an appreciable portion of the time.

A very attractive variation would be to decrease E to zero, allowing the ions to spin at the maximum y displacement of the moving coordinate system and subsequently displace them in a helical path by a weak electrostatic field in the direction of the magnetic field. With this arrangement, perfect focusing is obtained for all masses except for the small z dispersion which is unimportant since this is a time-of-flight device. Using the proton moment[3] to measure the value of the magnetic field, this device could be used to determine e/M (and from it the Faraday) with good accuracy since all measurements would involve only time. Preliminary plans have been completed for the construction of the equipment to do this.

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Search for Stable Pd^{100}, W^{178}, and Pb^{202} *

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It has been pointed out[1] that the stability curve got by plotting the mass of the lightest isotope against atomic number shows marked linearity among the heavier elements of even atomic number. Since the breaks in such a stability curve must have significance in a precise theory of nuclear