Merrill's value and if no other reason can be given for choosing Drinkwater, Richardson, and Williams over Houston and Chu, then the value of the Rydberg, which would then have to be calculated from consideration of all of these data, would be increased significantly since Houston's and Chu's data in combination with the spectroscopic mass determinations yield $R_\infty = 109737.387$ cm^{-1}. In fact, a least squares solution of the present observational data, excluding Eq. (g) and putting in its place, $x=y$, gives 109737.346 ± 0.019 cm^{-1}. The larger error in this case is a reflection of the larger spread in the data because of the inconsistency between the cadmium and helium wavelength standards.

We shall conclude by listing the Rydberg constant for the four lightest stable nuclei. In addition to the previously quoted mass we use the value 3.015899 ± 0.000011 for the mass of the He^3 nucleus (the probable errors quoted for the nuclear masses have negligible effect on the error of the results)

$$R_\infty = 109737.311 \pm 0.012 \text{ cm}^{-1},$$
$$R_H = 109677.575 \pm 0.012,$$
$$R_D = 109707.420 \pm 0.012,$$
$$R_{He^3} = 109717.346 \pm 0.012,$$
$$R_{He^4} = 109722.268 \pm 0.012.$$

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Proposed Method for Producing Short Intense Monoenergetic Ion Pulses*

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A method is outlined whereby suitable periodic deflection over the range of possible path lengths between foci of an appropriate focusing magnet is utilized to convert a continuous monoenergetic ion beam at one focus into very short duration high intensity monoenergetic ion pulses at the other focus. Time-of-flight analysis of reaction particle pulses resulting from the interaction of the ion pulses with stationary target nuclei is discussed, and the application of this method to the elastic and inelastic scattering of neutrons is considered briefly.

In principle the interaction of a beam of high intensity short duration monoenergetic ion pulses with stationary target nuclei and time-of-flight analysis of the resultant reaction particle pulses is a form of spectroscopy applicable to all types of nuclear particles. Spacially separated, by differing times of flight from target or scatterer to an appropriately placed detector, the energy and angular distribution of any particular group of particles could then be determined without interference from other groups or in the case of scattering without interference from the source particles except for elastic scattering in the forward direction.

The problem of an appropriate method of producing a beam of high intensity, short duration, monoenergetic ion pulses appears, however, to have hindered application of this technique. One approach to this problem, which it is felt may be of sufficient general interest to warrant publication in its present design stage, is outlined in the accompanying diagram (Fig. 1).

It consists in principle of deflecting successive portions of a continuous monoenergetic ionbeam, such as that from an electrostatic generator, over progressively shorter paths between foci a and g of magnet M in a manner such that all portions of the beam so deflected arrive at g essentially simultaneously in a high intensity, short duration current pulse. These ion pulses incident in turn on an appropriate target at g produce similar short duration, high intensity, reaction particle pulses. In more detail, magnet M is a focusing magnet with an ion deflector at focus a, a target at focus g, and the property that path lengths from a to g become progressively shorter for paths entering the magnetic field at successive points from k to e. When swept at an appropriate rate from c to e by the deflector at a, all ions successively crossing line $c\,e$ in one edge of the monoenergetic ion beam can be made to emerge from the magnetic field on a cylindrical surface which collapses to a focus on its axis through g. Under these circumstances a sharply focused, relatively low intensity, long duration ion pulse entering the field of magnet M emerges greatly foreshortened along its direction of motion and arrives at g as a very short duration, high intensity pulse.

As a consequence of the quite arbitrary choice of geometry shown, the path length from c to d, due to the selection of 45° for angles $c\,b\,j$ and $d\,b\,j$, is approximately $2S$ longer than the path length from e to f. The rate at which the ion beam must be swept along line $c\,e$ on entering the field of magnet M to fulfill the above requirement is then approximately one-half the velocity of the incident beam. Swept at this rate, a segment of the deflected and chopped incident ion beam x thick and approximately $2S$ long becomes a pulse ap-

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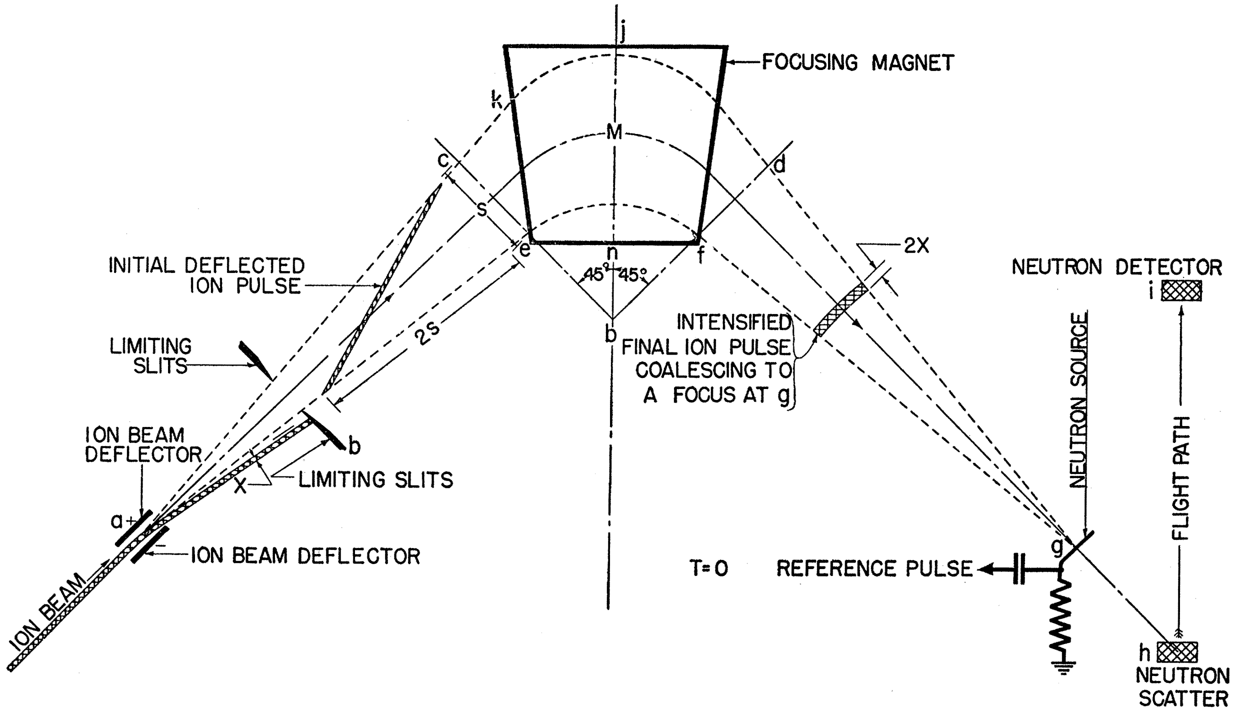

FIG. 1. A suggested experimental apparatus for the production of high intensity short duration ion pulses and its application to the measurements of energy and angular distribution of elastically and inelastically scattered neutrons.

proximately $2x$ long which coalesces to a focus on the target at g. The time duration of the ion pulses at g would then be $2x/v$, where v is the ion velocity, and the pulse current at g would be intensified by a factor of S/x over that of the beam entering the deflector at a.

The selection of a mean total deflection greater or smaller than 90° for focusing magnets of the type shown leads to pulse lengths smaller or greater, respectively, than $2x/v$. In general, the pulse length is given by approximately x/v', where v' is the sweep velocity from c to e, and the pulse current by I_0S/x, where I_0 is the steady-state ion current at a. In the case where the magnet dimension $n\,j$ is fixed it should be noted that although increasing the total deflection leads to greater pulse length and lower peak current it also results in a greater total charge per pulse.

For a single ion pulse incident on target g let the time sequence of reaction particle groups at the detector be termed an R.P.G. pattern. The maximum pulse repetition rate for nonoverlapping successive R.P.G. patterns is then determined by the length of time it takes the lowest energy particle group being observed to traverse the flight path. Since the average current at g is proportional to the pulse repetition rate and is a measure of the rapidity with which data can be gathered, it should be noted that under some circumstances higher repetition rates with attendant R.P.G. pattern overlap may be usable. With a judicious choice of repetition rate, a particle group of interest could probably still be singled out in the presence of considerable pattern overlap, although identification of such an isolated monoenergetic group might require a particle detector capable of a certain degree of energy discrimination or a knowledge of the relative positions of different particle groups as a function of detector position or repetition rate.

If the reaction particles are scattered neutrons, then for 1-Mev $Li^7(p, n)Be^7$ neutrons incident on the scatterer at h, 2.7-Mev protons with a corresponding velocity of 2.3×10^9 cm/sec would be incident on the Li target at g. For $S=20$ cm and $x=0.2$ cm the time duration of the proton pulses at g would be 1.8×10^{-10} sec, the length of time for the proton beam to sweep from c to e on entering the magnet M would be 1.8×10^{-8} sec, and the proton pulse current would be intensified by a factor of 100 over the steady proton beam current entering the deflector at a. For a flight path of 100 cm and a 100-kev lower limit on neutron energy to be observed, the flight time is 2.3×10^{-7} sec corresponding to a nonoverlapping R.P.G. pattern repetition rate of 4.4×10^6 cycles/sec. The average current at g for a steady beam of 50 μa at a would be 3.8 μa and the peak current would be 5 ma.

It should perhaps be noted that experiments of the type possible with a steady neutron flux are equally possible with the "pulsed-neutron delayed-detection" scheme outlined above, with the additional advantage of a much higher neutron flux during the appropriate brief detection period. This would in many cases result in an improved ratio of useful to background counts.