All transitions $\Delta F=\pm 1$, $\Delta m_F=\pm 1, 0$ accompanied by a change in high-field magnetic moment were observed and individually resolved, permitting the unambiguous assignment of the zero field lines as follows:

$F = 7/2$ to $F = 5/2$, 1034.48 ± 0.10 Mc/sec;
$F = 5/2$ to $F = 3/2$, 599.44 ± 0.10 Mc/sec;
$F = 3/2$ to $F = 1/2$, 303.93 ± 0.10 Mc/sec.

Assuming the hyperfine structure to be inverted, because the nuclear magnetic moment[2] is negative, the interaction constants a and b which fit the data to within the experimental error are then

$$a = -267.68 \pm 0.03 \text{ Mc/sec},$$
$$b = -111.55 \pm 0.10 \text{ Mc/sec}.$$

The total zero-field hyperfine splitting of the $^3P_2$ state optically measured by Rasmussen[3] to be 0.06 cm^{-1} (1800 Mc/sec) agrees well with our value of 1938 Mc/sec.

The total magnetic dipole interaction arises from the interaction of the $3s$ electron plus the interaction of the $(2p)^5, {}^2P_{3/2}$ "hole" with nucleus,

$$a = (1/4)a_s + (3/4)a_p. \qquad (1)$$

The quadrupole interaction arises only from the interaction of the $^2P_{3/2}$ "hole" with the nucleus,

$$b = b(2p^5, {}^2P_{3/2}). \qquad (2)$$

The value of $\langle 1/r^3 \rangle_p$ used in estimating the quadrupole moment was obtained by substituting in Eq. (1) the observed a and the value for a_s calculated from the Fermi-Segrè formula.

The quadrupole moment is $(+0.093 \pm 0.010) \times 10^{-24}\text{cm}^2$, where the major source of error is taken to be in the value for $\langle 1/r^3 \rangle_p$. The Sternheimer correction, as well as the relativistic correction factors have been ignored.

The original motivation for this experiment was the comparison of the quadrupole moment of the "almost" mirror nuclei Ne^{21} and Na^{23}. The quadrupole moment of Na^{23} was found[4] to be $(+0.100 \pm 0.011) \times 10^{-24}\text{cm}^2$. It is interesting that, within the experimental error, the quadrupole moments of Ne^{21} and Na^{23} are identical.

The authors wish to thank K. Clusius of the Physikalisch-chemisches Institut of Zürich for the gift of the original Ne^{21}-enriched gas sample. We are also grateful to J. T. Latourette of Harvard University for sharing his enriched gas sample with us. We thank Professor P. Kusch, Professor H. Foley, Professor V. Hughes, and Professor C. Schwartz for helpful discussions.

Full details of the experiment will be published in the Physical Review.

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DISCOVERY OF A NEW MENDELEVIUM ISOTOPE

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Helium ion bombardments of E^{253} have resulted in the identification of a new isotope of mendelevium (element 101) with mass number 255. The isotope decays by orbital electron capture to Fm^{255}, with a half-life of approximately 1/2 hour. The daughter isotope was identified by its alpha energy (7.08 Mev) and half-life (21.5 hours).[1] Mendelevium-255 may also decay by alpha branching with an energy of 7.34 Mev, but the evidence for this is not conclusive.

Bombardments were carried out at the 60-inch cyclotron at Crocker Laboratory using a modified version of the target probe previously described.[2] Helium ion energies of 24, 29, 36, and 42 Mev were obtained with intensities of the order of 5 microamperes on a target area of 0.07 cm^2. Approximately 2×10^{12} atoms of E^{253} were electroplated on the target area of a 1.0-mil gold foil. During the course of the experiments, the amount of einsteinium decayed to a value of 3×10^{11} atoms. The transmuted nuclei were caught on a catcher foil adjacent to the target area using standard recoil techniques.[3] To determine the recoil and chemical yield, a known amount of Cm^{244} was included in the target so that the Cf^{246} and Cf^{245} produced by the helium ion beam would serve as a monitor.[4]

The earliest experiments were confined to a search for short-lived alpha-emitting isotopes of mendelevium. Two methods were used to obtain the actinide fraction. In the first method, a gold catcher foil (0.2 mg/cm^2) was dissolved in aqua regia, and the gold was removed by passing the solution (in 2*M* HCl) through a Dowex-1 anion resin column. In the second method, the recoil nuclei were caught on a thin Mylar film (0.5 mg/cm^2) which subsequently was placed on a platinum plate and ignited to destroy the organic matter. The sample was transferred to a 50-channel alpha pulse-height analyzer for observation of the alpha groups.

In the investigation for longer lived isotopes, the gold catcher foil was dissolved and the gold removed as described above. The actinide fraction was evaporated to dryness, redissolved in 0.05*M* HCl and sorbed on a Dowex-50 (12% cross-linked) cation resin column. The actinides were then eluted in sequence with 0.25*M* ammonium alpha-hydroxyisobutyrate solution (*p*H =4.68). The mendelevium and fermium elution positions were internally calibrated by adding thulium and yttrium tracers. A 7.08-Mev alpha group, decaying with a half-life of 21 hours, was observed in the mendelevium and fermium fractions. In order to establish that the 7.08-Mev alpha group in the mendelevium fraction was due to electron capture decay from mendelevium, the mendelevium fraction was transferred to a second cation column and again separated into mendelevium and fermium fractions. The 7.08-Mev alpha group was observed in both new fractions. It was concluded that in the time interval between cation columns, Fm^{255} grew in as a result of the electron-capture decay of Mv^{255}. A half-life of the order of 1/2 hour was estimated for the electron capture decay of Mv^{255}. In a parallel determination, the observations of spontaneous fission events from Fm^{256} in the mendelevium and fermium fractions confirmed the decay of Mv^{256} by electron capture. Approximately 100 times as many fission events were seen in one experiment as compared to the number previously reported.[5] A revised half-life of 1.5 hours was measured for the electron capture decay of Mv^{256}.

A 7.34-Mev alpha group, decaying with a half-life of approximately $\frac{3}{4}$ hours, was observed in only the mendelevium fraction. This alpha group appeared in low intensities at all bombardment energies and was therefore interpreted as possibly being due to alpha-decay branching of Mv^{255} (Table I).

The cross sections for the formation of Mv^{256} and Mv^{255} at the various helium ion energies are given in Table I. Included also are the overall formation cross sections of Fm^{256}, Fm^{255}, and Fm^{254}, uncorrected for possible contribution for the electron capture decay of the mendelevium isotopes. A revised spontaneous fission half-life of 160± 10 minutes is reported for Fm^{256} (Fig. 1).

Eighteen separate experiments were done in this series of bombardments. The observable half-life range for an alpha-emitting isotope of medelevium, formed with 1 millibarn cross section, was approximately 5 minutes to 1.5 months.

We would like to give our thanks to the Chemistry Division Instrumentation Group for their aid with the electronic counting equipment. We should also like to thank the crew of the Crocker Laboratory 60-inch cyclotron for the dependable service encountered during our bombardments.

Table I. Summary of helium ion bombardments of E^{253}.

Isotope	Mode of decay	Half-life	Cross section 24 Mev	29 Mev	36 Mev	42 Mev
Mv^{256}	Electron capture	~1.5 hr	~0.1 mb	~1 mb	~1 mb	~1 mb
Mv^{255}	Electron capture	~1/2 hr	*b*	~1 mb	~1 mb	~1 mb
	7.34-Mev α	~3/4 hr	*b*	~0.2 mb	~0.2 mb	~0.2 mb
Fm^{256}	Spontaneous fission	160 ± 10 min	~0.1 mb[c]	~1 mb[c]	~1 mb[c]	~1 mb[c]
Fm^{255}	7.08-Mev α[a]	21.5 hr[a]	~0.4 mb[c]	~4 mb[c]	~6 mb[c]	~6 mb[c]
Fm^{254}	7.20-Mev α[a]	3.24 hr[a]	*b*	~0.5 mb[c]	~10 mb[c]	~10 mb[c]

[a]Reference 1.
[b]Activity insufficient for calculation of cross section.
[c]These are over-all cross sections.

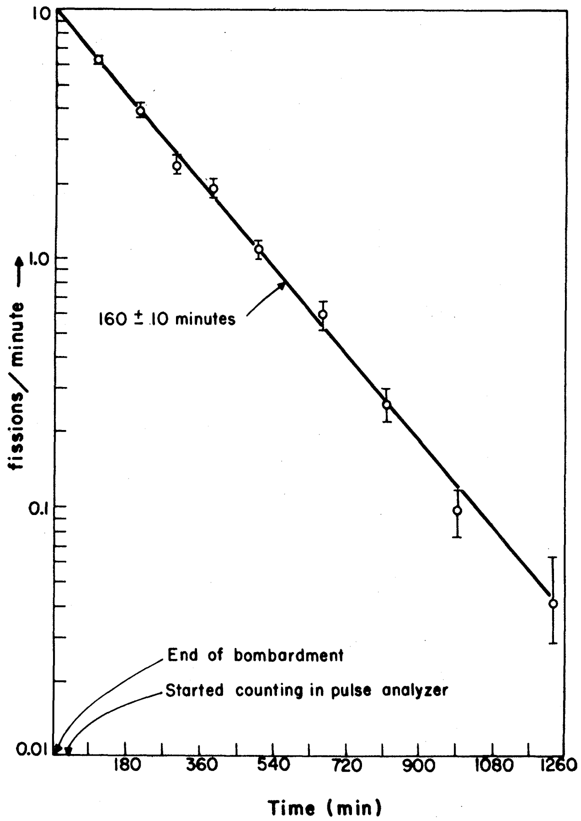

FIG. 1. Spontaneous fission half-life of Fm^{256}.

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DECAY OF A NEGATIVE τ' MESON*

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In a systematic study of negative K-meson decays and interactions in flight, an example of the τ' mode of decay has been observed. A photomicrograph of this decay, event 1320, is shown in Fig. 1. From the known momenta of the incident particles and the position of the decay point in the stack the energy of the K^- meson at decay was determined to be 105 ± 10 Mev. Ionization measurements on the K^- meson track at the decay point are in agreement with this value. Track A is a π^- or μ^- meson as determined from ionization versus range and from its characteristic scattering along the track. However, the three-prong star at its end strongly favors identification as a π^- meson. The energy of this meson, if a π, as determined from its range, is 19.5 Mev. The laboratory angle between the incident K^--meson direction and the out-going light meson is 42 deg. If this event were a $K^-_{\pi 2}$ decay, the π^- meson emitted at 42 deg would have an energy of 190 Mev. Thus the $K^-_{\pi 2}$ decay mode is ruled out.

Prongs B and C have ionizations of 0.97 ± 0.10 and 0.93 ± 0.10 times plateau, respectively. Multiple scattering versus ionization identifies these as electrons with $p\beta$ equal to 102 ± 20 and 52 ± 13 Mev/c, respectively. The opening angle of the electron pair is 17 deg. The total momentum vector of the electron pair makes an angle of 65 deg with the K^--meson direction.

In order to establish this event as an example of the τ' decay mode of the K^- meson,

$$K_{\pi 3}^-\ (\tau') \to \pi^- + \pi^0 + \pi^0$$
$$\hookrightarrow e^+ + e^- + \gamma,$$

it is necessary to rule out other decay modes as well as a K^- capture in flight. The kinematics and the presence of the charged π (μ) meson and the π^0 meson, as evidenced by the high-energy electron pair, immediately rule out all decays except the τ' and $K_{\mu 3}^-$.

The permitted processes and the ratios of their expected frequencies are listed in column 1 of Table I. The expected numbers of events having a single π^- (μ^-) meson with no accompanying blobs, slow electrons or recoils are given in column 2. For the decay processes these numbers are the branching ratios of K^+ mesons[1] times the number of K^- decays in flight which we have observed. For the K^- captures in flight the number has been obtained in the following way. We have seen 2 nondecay-like π^- meson events (π meson plus blob, slow electron, or recoil but no other prongs) in 250 K^- interactions in flight. About 75% of the single-π events from K^- captures at rest are nondecay-like. Taking the same ratio of decay-like to nondecay-like single-π events among the inter-