Evidence for new α-particle groups in nature

A. Chevallier, Jacques Chevallier, A. Pape, M. Debeauvais, B. Leroux

J. Physique — LETTRES **41** (1980) L-181 - L-183

15 AVRIL **1980**, PAGE L-181

Classification
Physics Abstracts
23.60

Evidence for new α-particle groups in nature

A. Chevallier, J. Chevallier, A. Pape, M. Debeauvais

Centre de Recherches Nucléaires et Université Louis-Pasteur, 67037 Strasbourg Cedex, France

and B. Leroux

Centre d'Etudes Nucléaires, 33170 Bordeaux-Gradignan, France

(*Reçu le 14 décembre 1979, accepté le 29 février 1980*)

Résumé. — Les spectres de particules obtenus à partir d'échantillons de monazite montrent la présence de groupes de particules α à 6,52 ; 7,09 ; 9,02 et 9,07 MeV, non mentionnés dans la littérature.

Abstract. — Alpha-particle spectra from a monazite are presented which show evidence for unreported groups at 6.52, 7.09, 9.02 and 9.07 MeV.

1. **Introduction.** — Previously we reported the observation of unexplained long-range α-particles in an African monazite [1, 2]. Let us recall from that work, that emphasis was placed on the search for α-particles with energies above those of most groups in the U-Th decay series, since their observation is relatively straightforward. Data taken with surface barrier detectors concurred with nuclear emulsion results on the existence of high energy counts, but since the samples examined were usually thick, accurate energy determinations could not be made electronically. The nuclear emulsion work permitted stringent criteria for data retention and allowed energy determinations from track lengths. Continued checks and accumulation of more events support the evidence for high energy α-particles already reported [2].

Early measurements on bulk minerals or roughly separated chemical fractions did not permit the search for anomalous α-particles having energies lower than 9 MeV. Now, electronic counting experiments made on better separated fractions have given evidence for several unreported α-particle groups, principally in the 6-10 MeV range. In the present Letter we report data for several such groups whose presence is unequivocal.

2. **Method.** — The measurements were made on thin samples obtained by drying ion-exchange separated portions of monazite. The technical aspects of the counting system have not changed appreciably from those already described [2], except that an isolation transformer intended to reduce the number of any spurious counts has been installed in the power line supplying the circuits.

3. **Results.** — A spectrum showing an unassigned peak at 6.52 MeV in a rare earth fraction is presented in figure 1. The naturally occurring isotopes ^{219}Em and ^{211}Po with groups at 6.55 and 6.57 MeV, respectively, cannot account for the peak because their stronger branches (for example, the 6.82 MeV group of ^{219}Em and the 7.45 MeV group of ^{211}Po) are not seen appreciably if at all; major lines from their immediate precursors and/or daughters are also absent as they are for ^{211}Bi the energy of which (6.62 MeV) is well outside the estimated 30 keV uncertainty of the present measurements.

In the same figure is seen a group at 9.02 MeV. It does not correspond to ^{214}Po, the only isotope in the natural series with a comparable energy, because the number of counts at 9.02 MeV relative to the 7.69 MeV peak is a factor of 200 too large for its branching ratio. There appears also with poor statistics other real counts above 8.78 MeV of which the origin is likewise unexplained.

In figure 2 is shown a spectrum of a uranium fraction (in spite of the presence of Th and its derivatives) having a peak at 7.09 MeV which does not fit any assignment in the naturally occurring series.

In figure 3 we show a group at 9.07 MeV observed in a Fe fraction which cannot be explained by a branch of ^{214}Po at 9.06 MeV since its observed intensity (10 % from the 7.69 MeV branch) would be

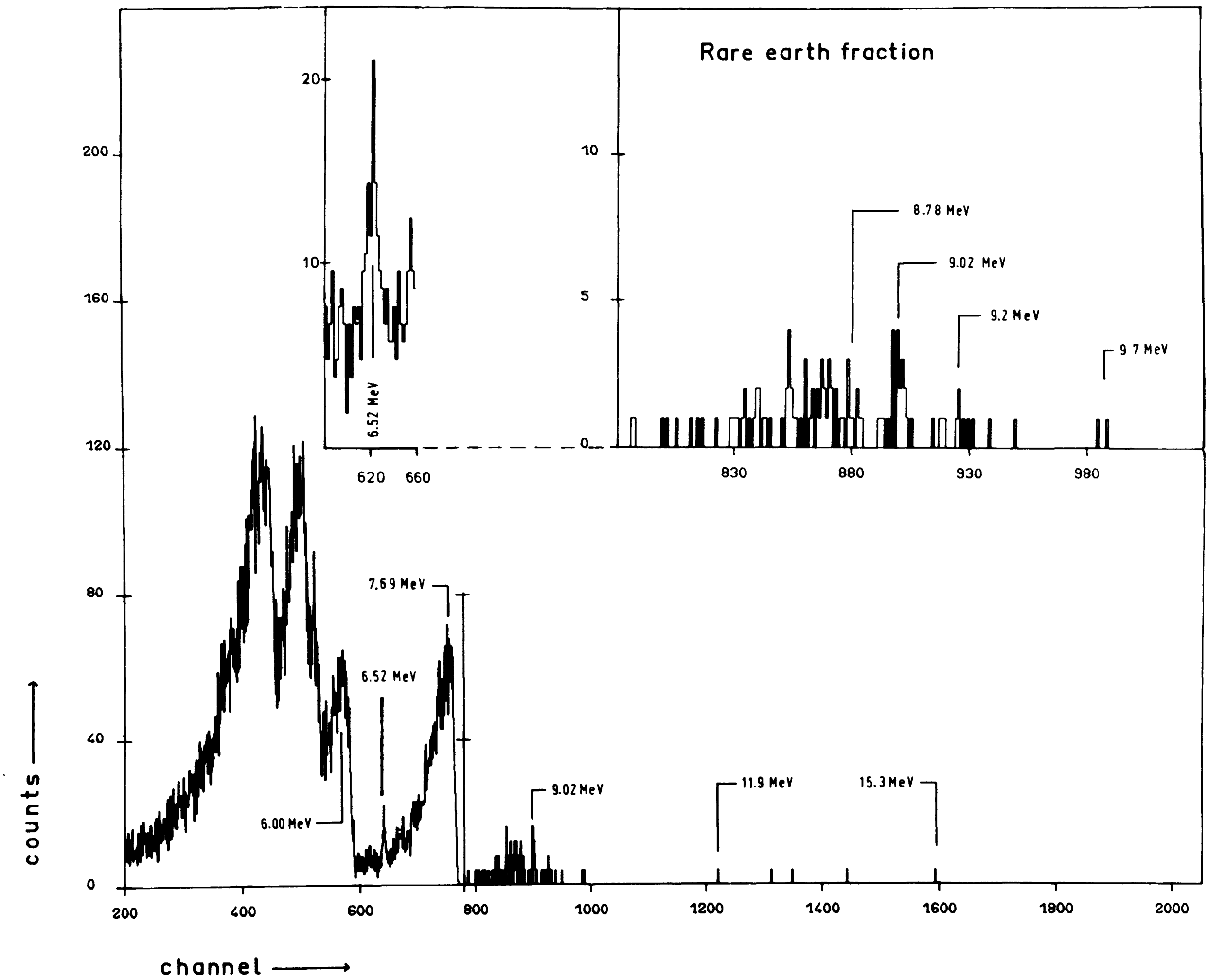

Fig. 1. — Spectrum (ΔT = 38 days) showing unidentified peaks at 6.52 and 9.02 MeV, and counts in the 8-10 and 12-15 MeV regions.

10^4 too high. Due to the poor statistics on the peak at 9.07 MeV there is a possibility that the peaks given here at 9.02 and 9.07 MeV could represent the same group, although this is thought not to be the case.

The presence of two peaks around 9 MeV can be considered as a confirmation of counting and emulsion evidence for an activity just above the 8.78 MeV group, that has already been described [2].

We call attention to the five high energy counts in the measurement of figure 1 between 11.9 and 15.3 MeV which is the energy range in which most of the long tracks were found in emulsion [2].

4. **Discussion.** — All of the groups described here with the exception of the one at 6.52 MeV have been observed several times and thus far have found no satisfactory explanation in terms of reported activities or experimental shortcomings. Reasonable explanations for any of these groups in terms of available data on transuranium elements have not been found, even if they could have been present from fallout or laboratory contamination.

From the respective measurements of figures 1, 2 and 3, having count rates of < 0.01, 0.6 and 0.1 c/s, and the preamplifier time constants used, one deduces that less than 0.001, 1 and 0.01 total counts are due to pile-up over the 38, 30 and 33 days of counting. There is thus no possibility that the new peaks or that more than a small percentage of the counts above 8.78 MeV are due to pile-up.

In the counting experiments, some of the isolated counts at $E > 11$ MeV could be due to cosmic ray events. It must be mentioned that the number of isolated high energy counts is significantly greater with some chemical fractions or the whole monazite than in any of the simultaneous *background* counts on other materials.

The various peaks were most apparent when well characterized activities of the U-Th series were strongly reduced. This fact would seem to indicate that the groups reported here may not be just unrecognized weak branches of these series, but that they could represent α-particle radioactivities not included in the present forms of the naturally occurring radioactive series.

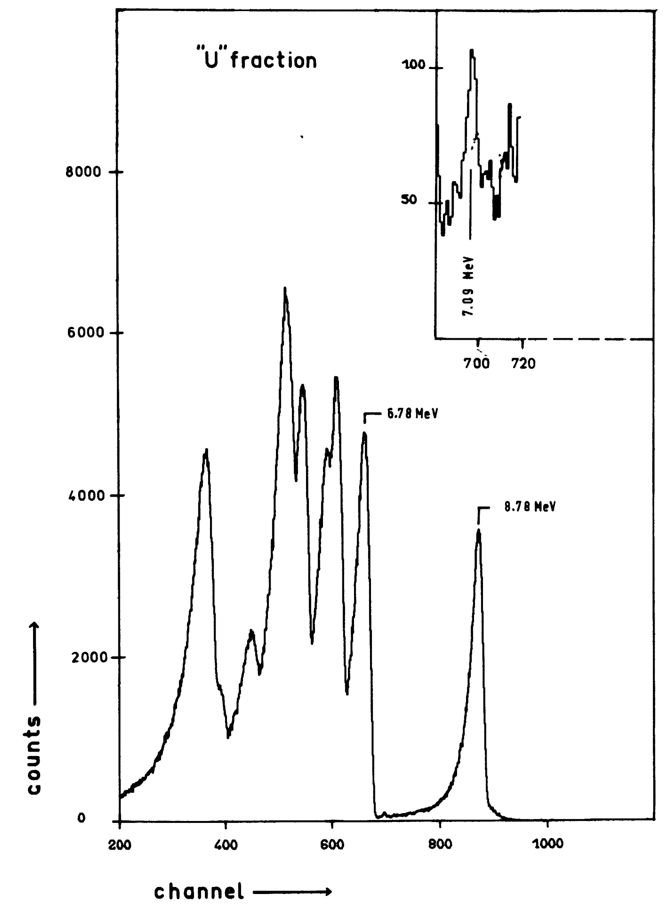

Fig. 2. — Spectrum (ΔT = 30 days) showing an unidentified peak at 7.09 MeV.

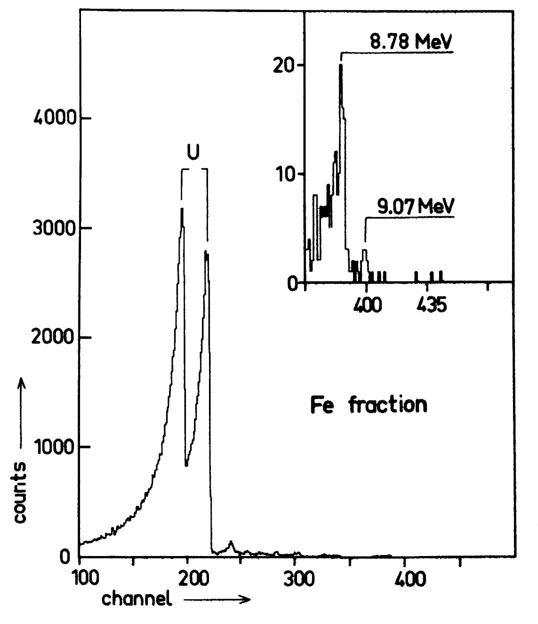

Fig. 3. — Spectrum (ΔT = 33 days) showing an unidentified peak at 9.07 MeV.

Acknowledgments. — We would like to thank H. de La Roche, Directeur of the Centre de Recherches Pétrographiques et Géochimiques of Nancy, for his interest in this work and for furnishing the samples; C. Kosztolanyi of the Centre de Recherches Radiogéologiques of Nancy, for performing the chemical separations; and J. P. Weymann for his aid with the counting.

References

[1] Chevallier, A., Chevallier, J., Pape, A. and Debeauvais, M., *J. Physique Lett.* **38** (1977) L-331.

[2] Chevallier, A., Chevallier, J., Pape, A., Debeauvais, M. and Leroux, B., *Proc. Int. Symp. on Superheavy Elements*, ed. by M. A. K. Lodhi (Pergamon Press, Inc., New York) 1978, p. 155.