The Fast Ionization Chamber in the Study of α-Radioactivity in Air.

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In a recent paper [1] we studied the behaviour of argon nitrogen mixtures as filling gas of fast ionization chambers and we showed that the electron collection in these mixtures is not practically influenced by small quantities of oxygen.

With such mixtures it is possible to operate a fast ionization chamber easily and quickly thus avoiding the necessity of the good vacuum and the careful purification of gases required when using unmixed pure gases, such as argon or nitrogen. The linearity of the chamber α-particle spectra measurements is as good as in the case of pure gases.

The chamber used in these experiments is the same described in [1]. The chamber is filled and operate in the same way.

The air, which is under examination is sucked through an electrical discharge between a few scores of sharp points and an aluminum plate; in this way most of the radioactive contaminations contained in the air are deposited on the plate in a thin layer. This method of collecting radioactive products of the air has been described and extensively studied by G. Aliverti [2].

The plate is quickly put in the ionization chamber and the energy spectrum of α-particles is measured at different times.

The results obtained with ordinary air are shown in fig. 1 (*a*, *b*, *c*) the quantity of air under examination being 1 cubic metre and the time of flow about 20 min. The air was taken in the basement of our laboratory.

The spectrum taken between the 22-nd and 30-th minute after the beginning of the flow is shown in fig. 1*a* where the line of RaA (5.99 MeV) and of RaC′ (7.68 MeV) can be noted. The spectrum in fig. 1*b* was taken between the 40-th min and 50-th. It can be seen that the RaA line has disappeared and the small peak at 6.05 MeV is due to the ThC; the ThC′ line at 8.77 MeV is clearly visible.

In fig. 1*c*, corresponding to a time between the 200-th min and the 460 min, it is noted that the RaC′ line has decayed while the ThC′ lines have maintained a stationary intensity.

The figures are in agreement with the

(1) U. Facchini, A. Malvicini: *Nucleonics*, **13**, no. 4, 36 (1955); *Nuovo Cimento*, **1**, 1255 (1955).

(2) G. Aliverti: *Nuovo Cimento* (1931-32); *Zeits. f. Geophys.*, **9**, 16 (1933).

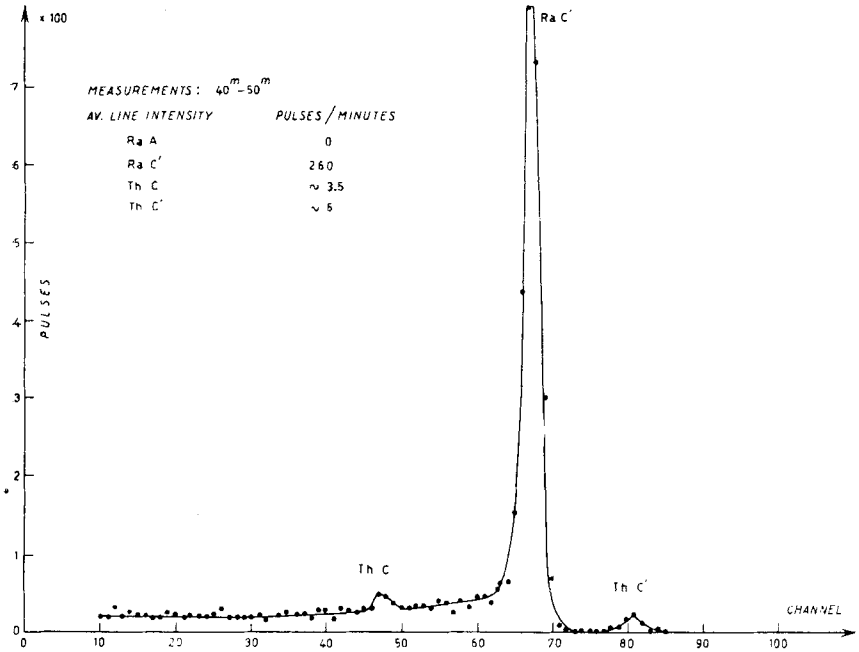

Fig. 1*a*. – α spectrum from ordinary air: air volume: 1.06 m³; time of flow 20 min; measurement: 22÷30 min.

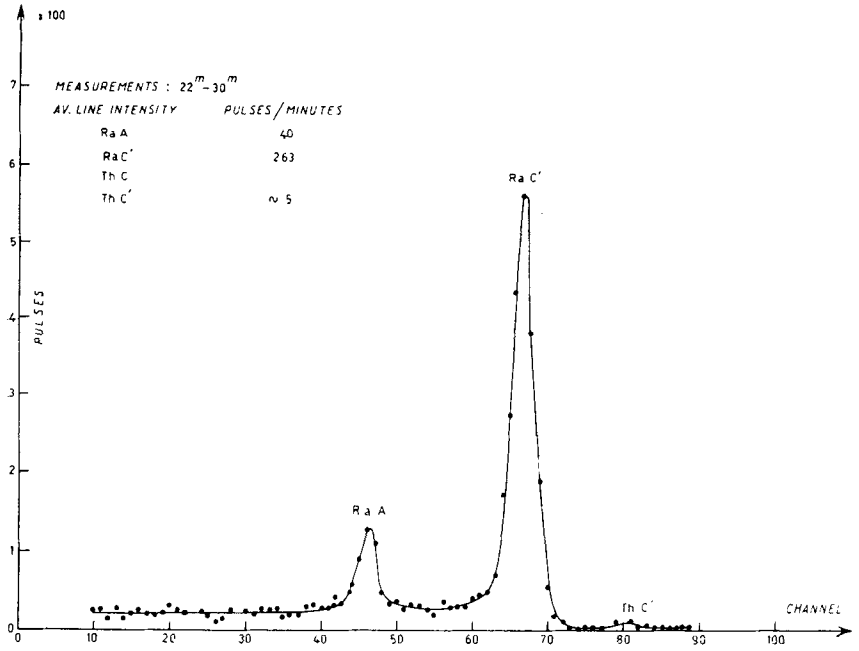

Fig. 1*b*. – α spectrum from ordinary air: air volume: 1.06 m³; time of flow 20 min; measurement: 40÷50 min.

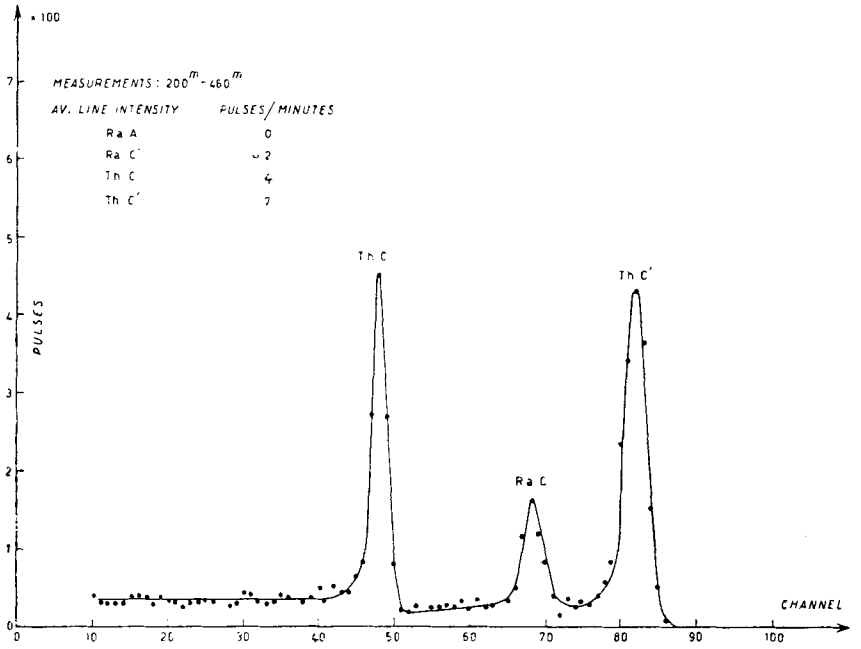

Fig. 1c. – γ spectrum from ordinary air: air volume: 1.06 m³; time of flow 20 min; measurement: 200÷460 min.

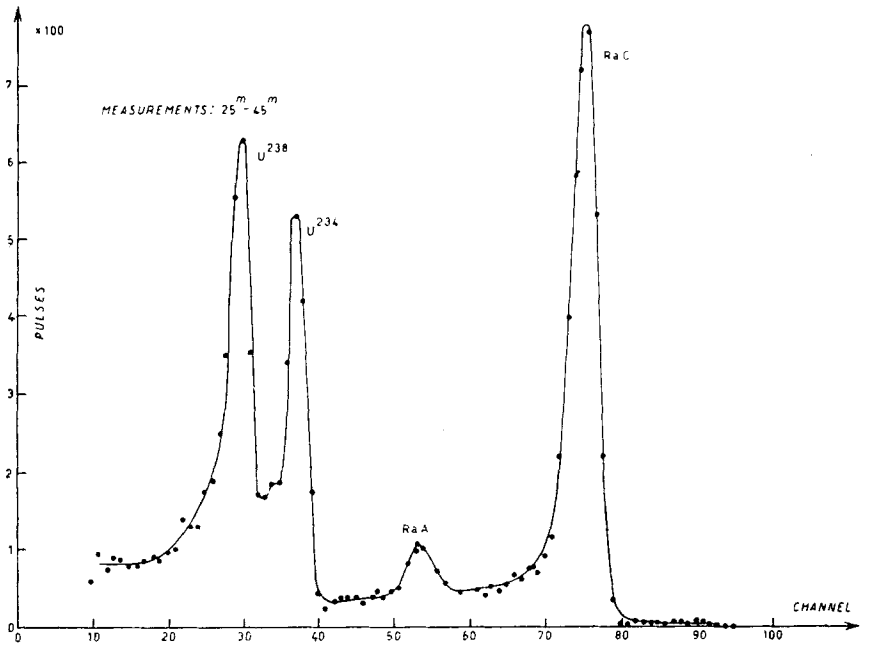

Fig. 2. – α spectrum from air contaminated with uranium: air volume: 1 m³: time of flow 20 min; measurement: 25÷45 min.

well known decay schemes of these radionuclides. Taking into account the decay time of the different nuclides it is possible to obtain their relative concentration in air. When the method is calibrated, the absolute concentrations are obtained easily.

The method described is very sensitive: ordinary air can be analyzed without any difficulty. The yield of collection of radioactive deposits is greater than 50%. The background of the ionization chamber is often less than 1 pulse per minute and depends on the cleanness of the electrodes, this background is made of pulses of different amplitude.

When an α-particle line is measured by means of a pulse analizer the pulses are collected by a certain number of channels (5-6).

The background pulses in these channels form only a small percentage of the total background; i.e. 2 to 3 pulses/hour. It is therefore possible to reveal a line of α particles when the total number of pulses on the corresponding channels is of the order of 20 pulses/hour.

When, for instance, the analyzed volume of air is 1 m^3, a radionuclide can be revealed when its concentration in the air is of the order of $5 \cdot 10^{-13}$ Curie/m^3 a very low one.

The method described above can be used for studying air contaminated with α-active elements such as Pu, U, Po, etc. This will be of interest to uranium or plutonium plants and hot laboratories where the air is contaminated. Fig. 2 shows the α-spectrum obtained from 1 m^3 of air taken in a uranium workshop.

The uranium activity can be easily and quickly measured and distinguished from the usual α-lines (RaA, RaC', etc.) of ordinary air, without having to wait for the decay of these lines. This is also true in the case of plutonium where the method described can be even useful.

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