

Rapid Method for DU by Alpha Spectrometry

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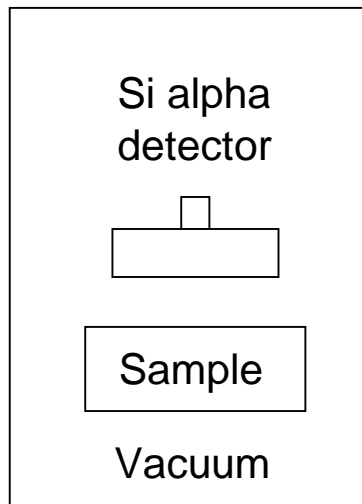
Abstract

Direct alpha spectrometry on solid samples allows for a rapid decision if depleted uranium (DU) is present or not. One uses the fact that not only U-235 but also U-234 is depleted in DU. Measurements can even be made in the field (without vacuum). A quantitative analysis is possible using alpha particle stopping power data.

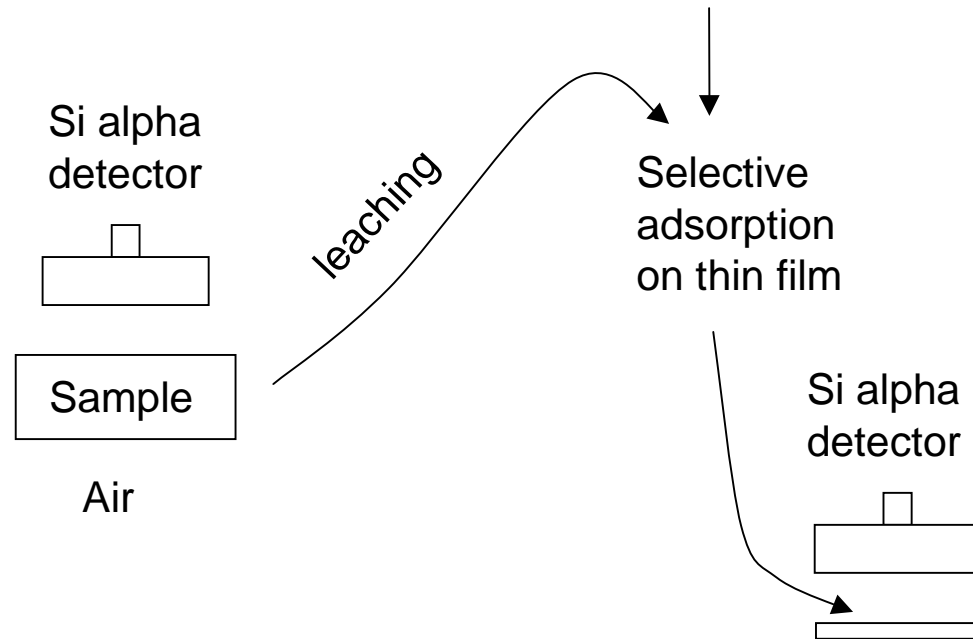
A rapid method to determine uranium in aqueous samples is to adsorb the uranium on a thin film that can be measured by alpha spectrometry. There is no need for a radiochemical separation because of the high selectivity of these films.

Rapid Methods for DU by Alpha Spectrometry

Solid samples



Aqueous samples



Fluorescent glasses containing 0.1 to 1% by weight uranium have been produced since 1800. After 1950 natural uranium has been replaced by DU. A simple direct alpha spectroscopic measurement allows for a decision if the glass has been made with natural or depleted uranium. This information helps to date a sample. The measurement can even be carried out in the field (no vacuum needed).

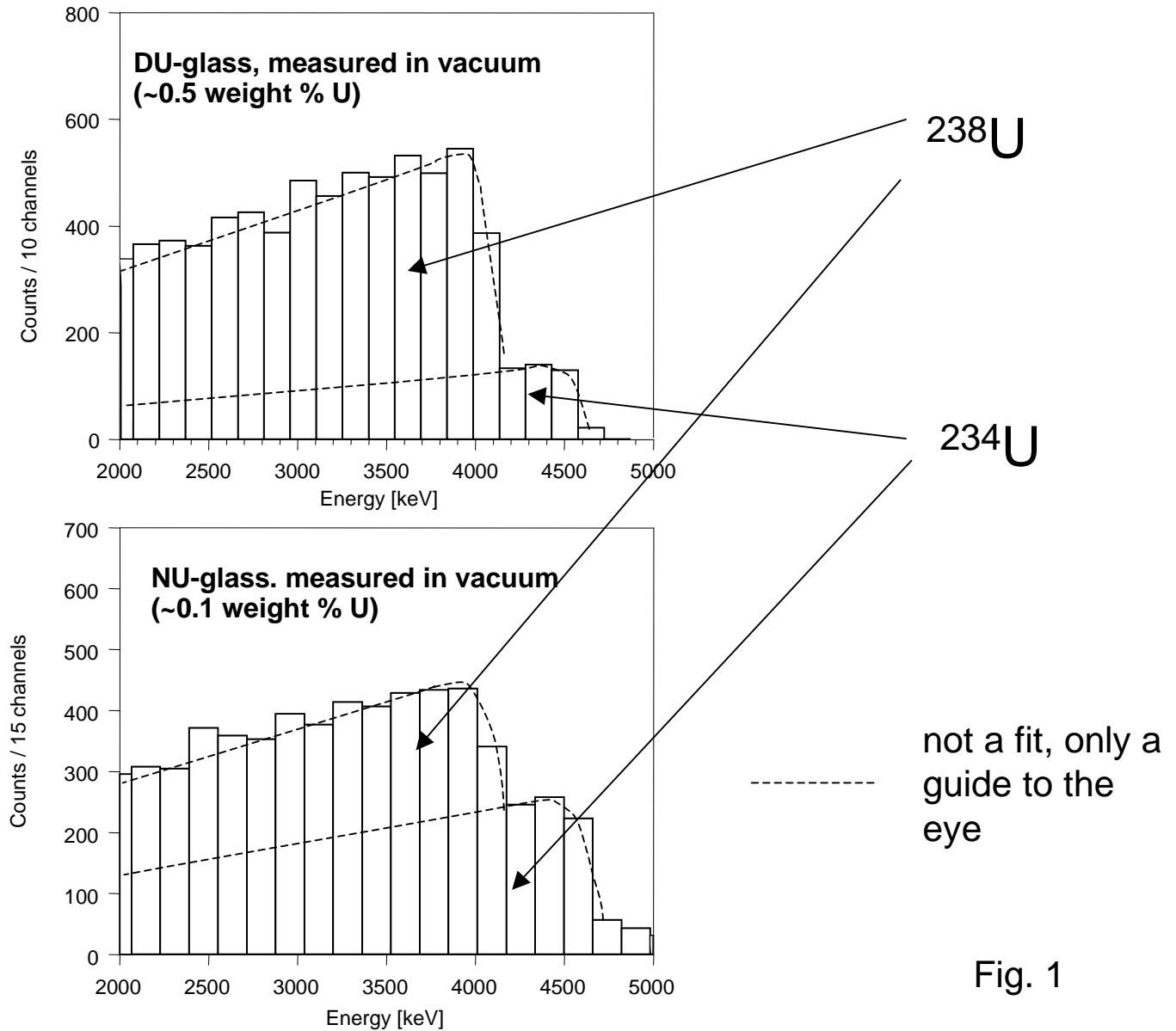
With thick samples U-235 and U-238 lines can hardly be separated but one can use the fact that in DU not only U-235 but also U-234 is depleted (Figs. 1 and 2).

For flat samples one can even make a quantitative analysis using alpha particle stopping power data (Fig.3).

For a 1 day counting time a detection limit of 100 Bq/kg can be expected.

Solid samples,
qualitative
analysis

DU or
not
DU ?



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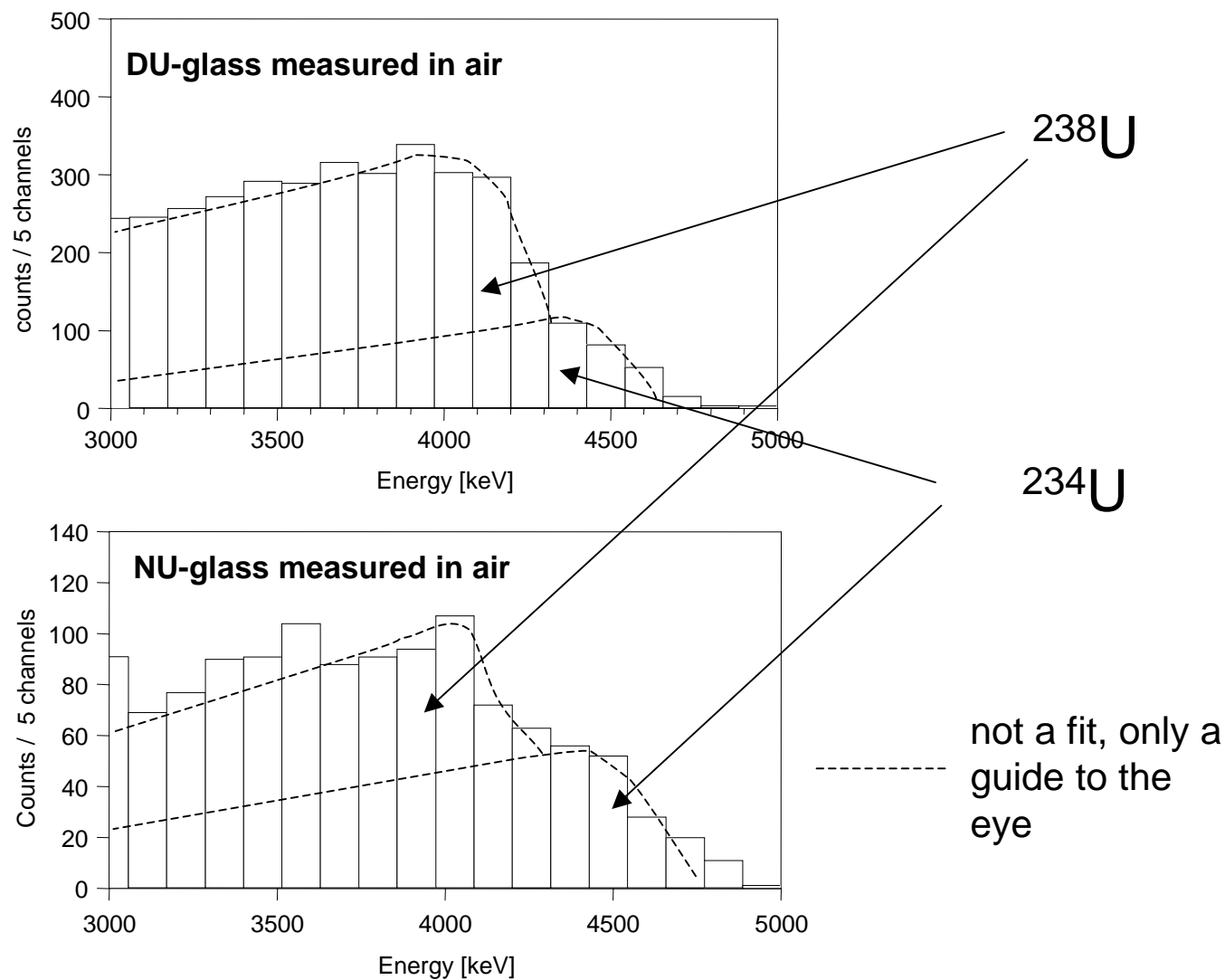
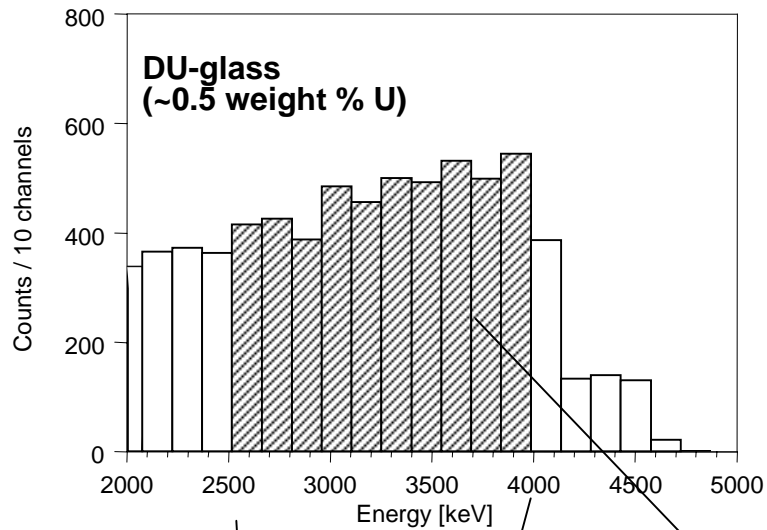


Fig. 2



Solid samples, quantitative analysis

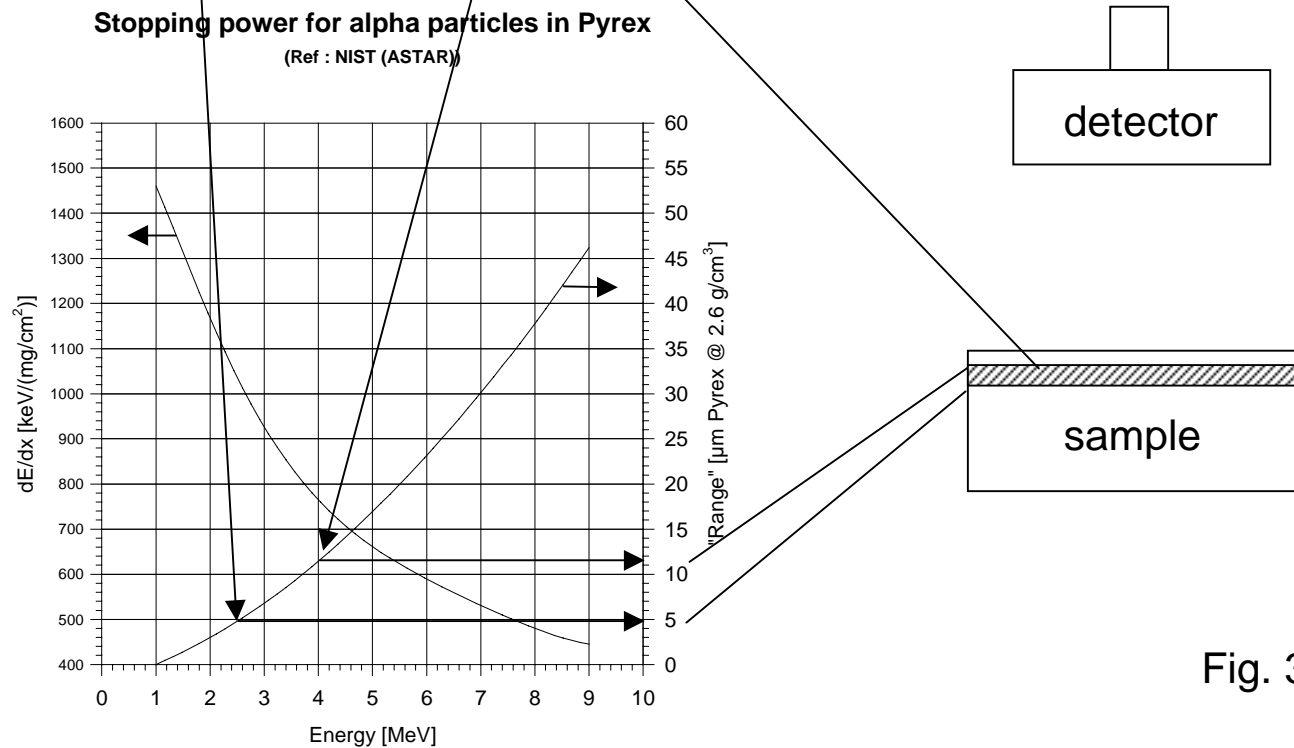


Fig. 3

With aqueous samples one has the problem that the radionuclide searched for is present at concentrations many orders of magnitude lower than other cations like Na or Ca (Fig.4). Evaporation leads to thick alpha sources with a bad energy resolution.

A common method to concentrate the radionuclide is by selective extraction and a subsequent electrochemical deposition as a thin film. This is very time consuming and produces toxic waste.

We thus have developed a simple preparation method where the radionuclides are selectively adsorbed on a thin film. After drying the film can be measured by alpha spectrometry. The method is fast and produces no toxic waste.

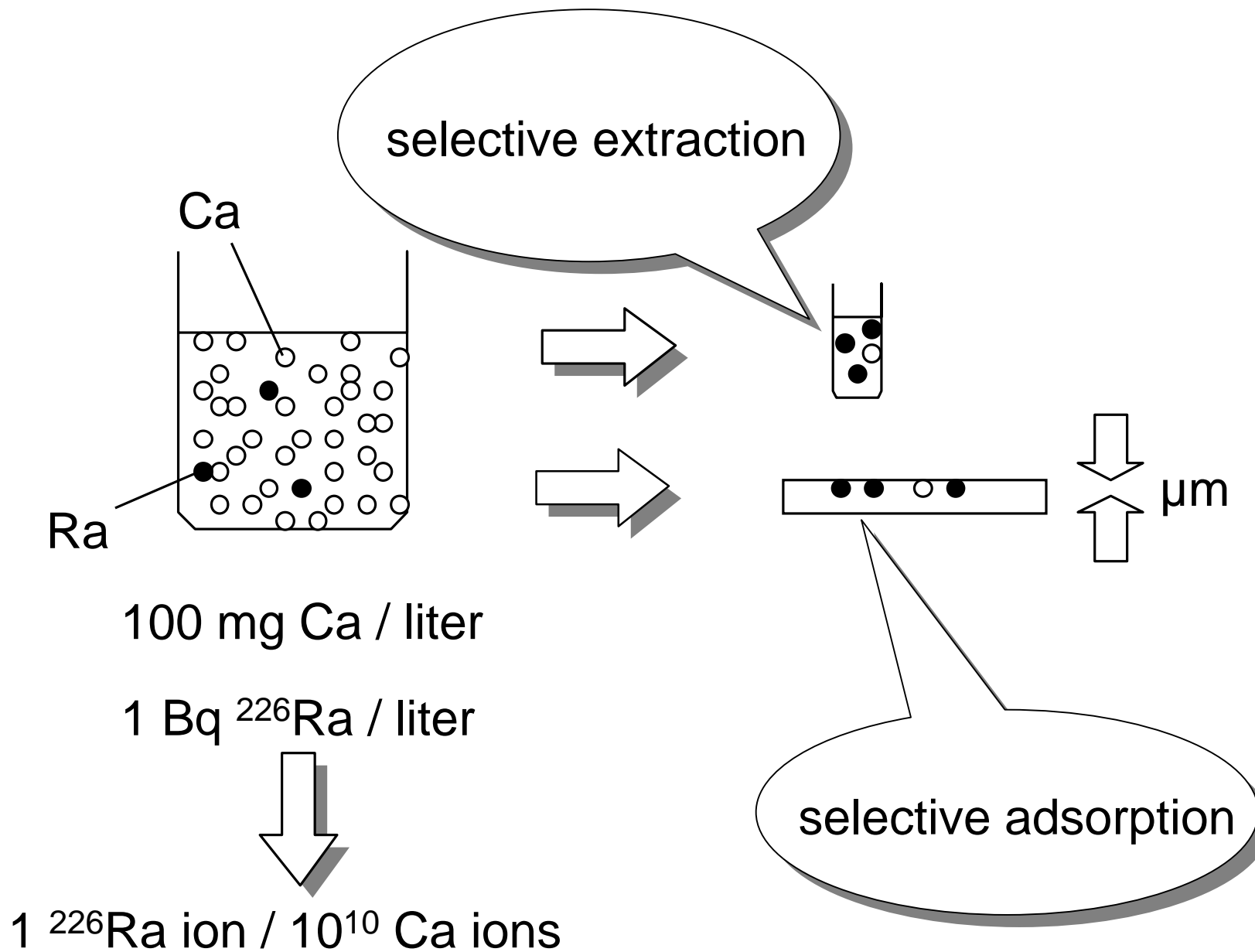


Fig. 4

The method has first been used to analyze radium in water. As selectively adsorbing material we use Mn-oxide hydroxide (Fig. 5).

The fact that the film is really thin allows for an excellent energy resolution (Fig. 6).

To adsorb uranium from aqueous samples we use thin layers of a uranium-selective ion exchanger resin, either Diphonix or Pamox (Figs. 7 and 8).

Diphonix : Eichrom Industries, Darien, IL, USA
active groups : ***diphosphonic acid + sulfonic acid***

Pamox : Tecost GmbH, Fribourg, Switzerland, active groups : ***amidoxime***

For thin layers prepared from either Diphonix or Pamox resin contact *webmaster@www.nucfilm.com*

Alpha spectrometry sample preparation by selective adsorption

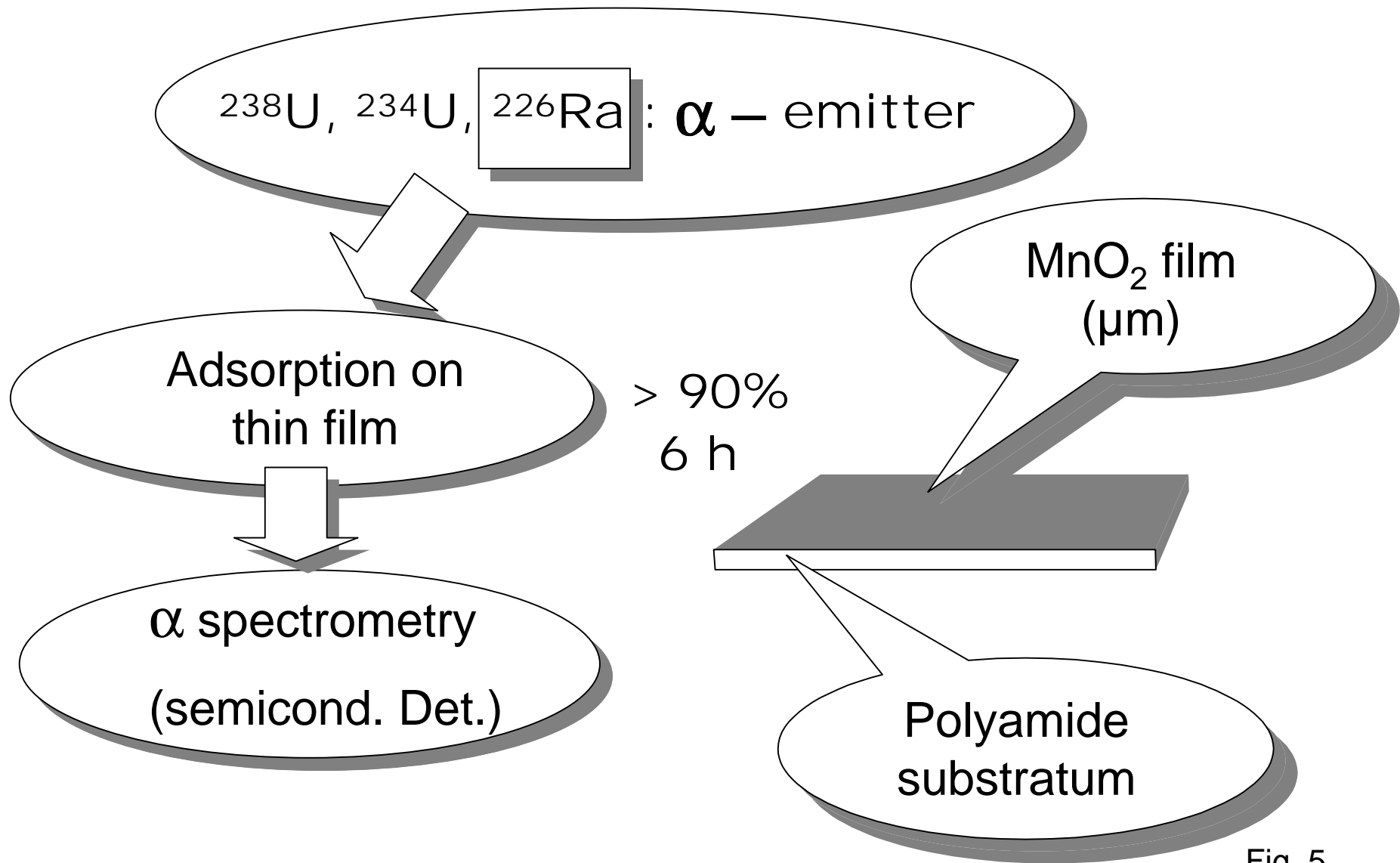
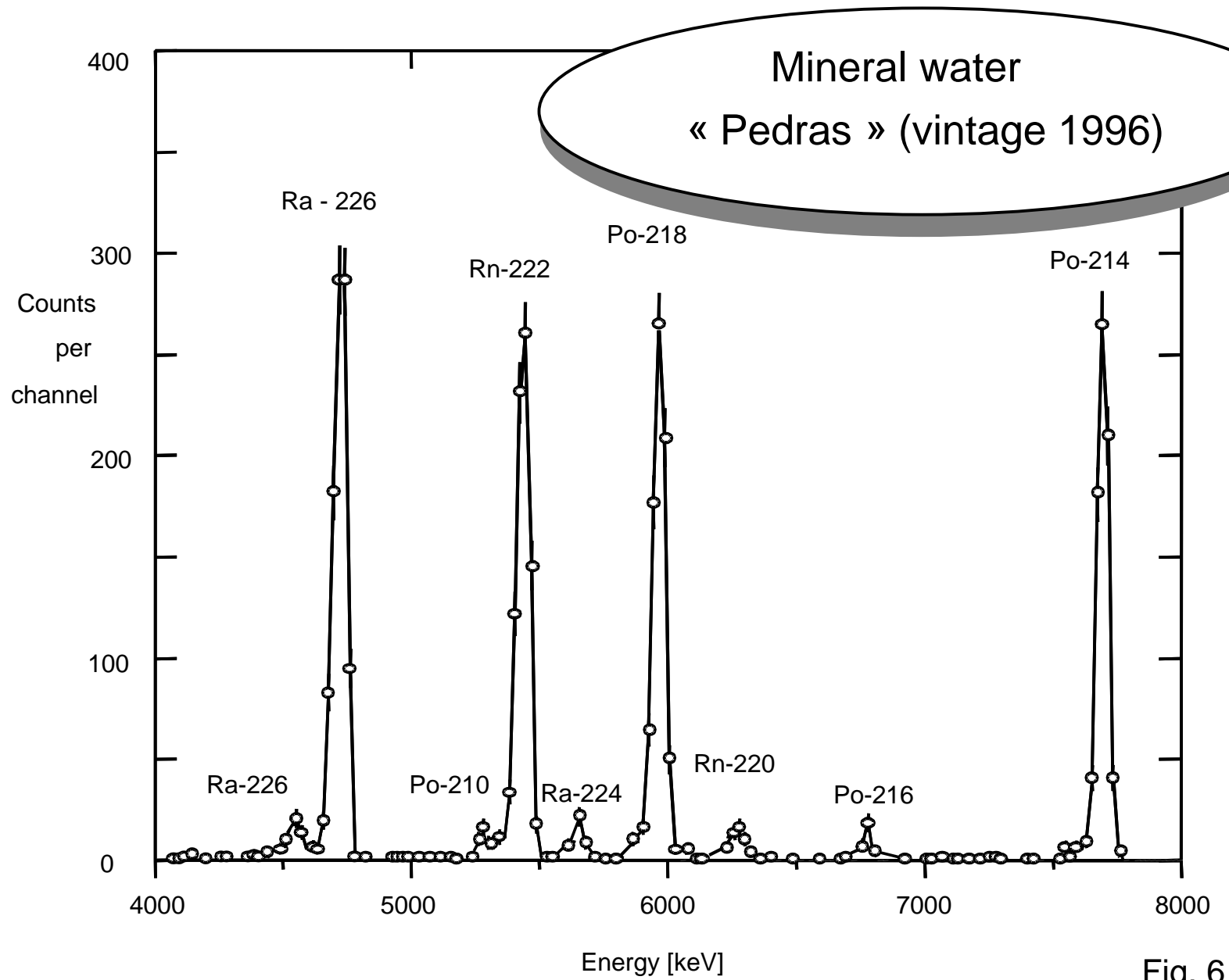


Fig. 5



Alpha spectrometry sample preparation by selective adsorption

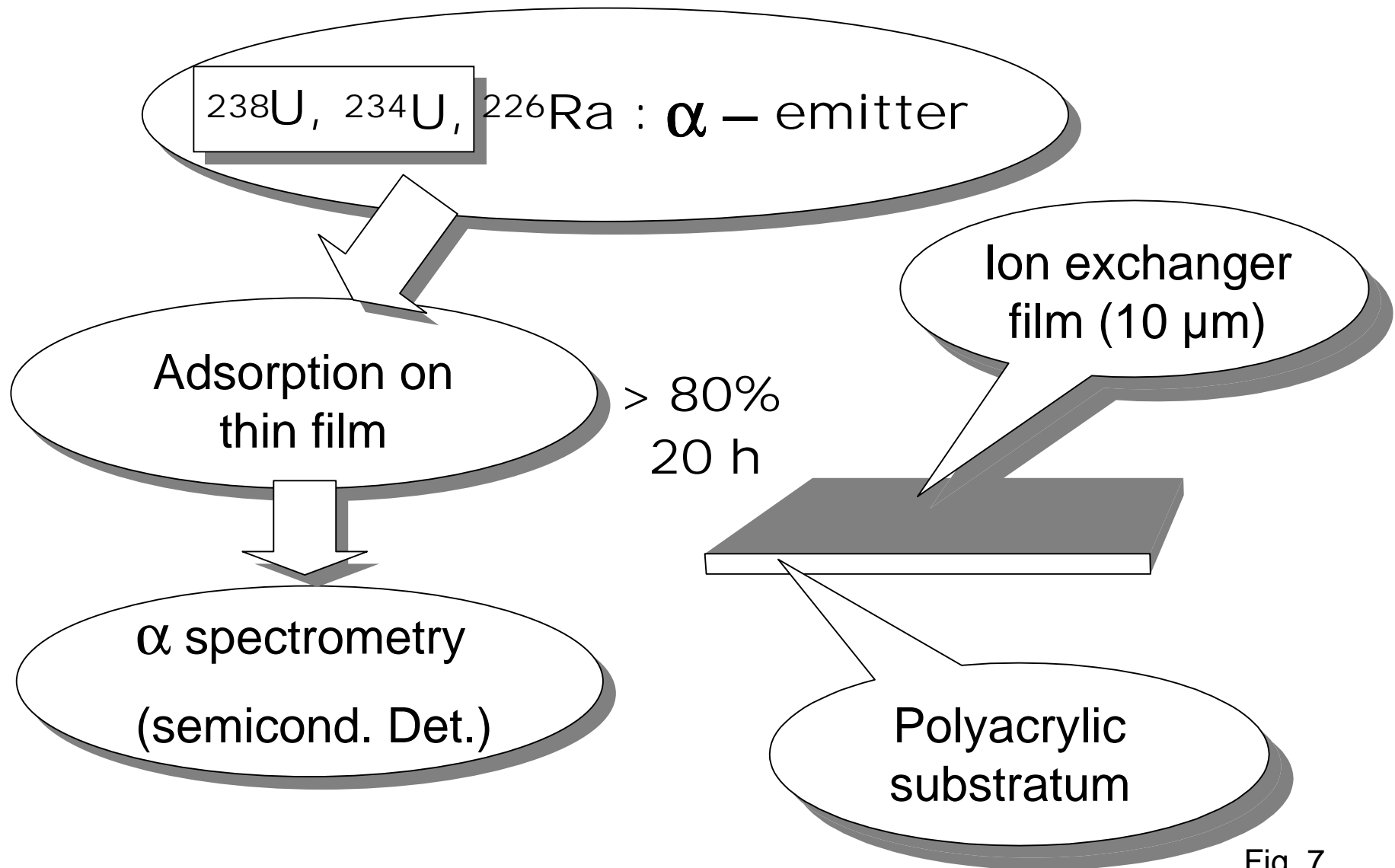


Fig. 7

Alpha spectrometry sample preparation by selective adsorption

^{234}U

^{238}U

^{235}U

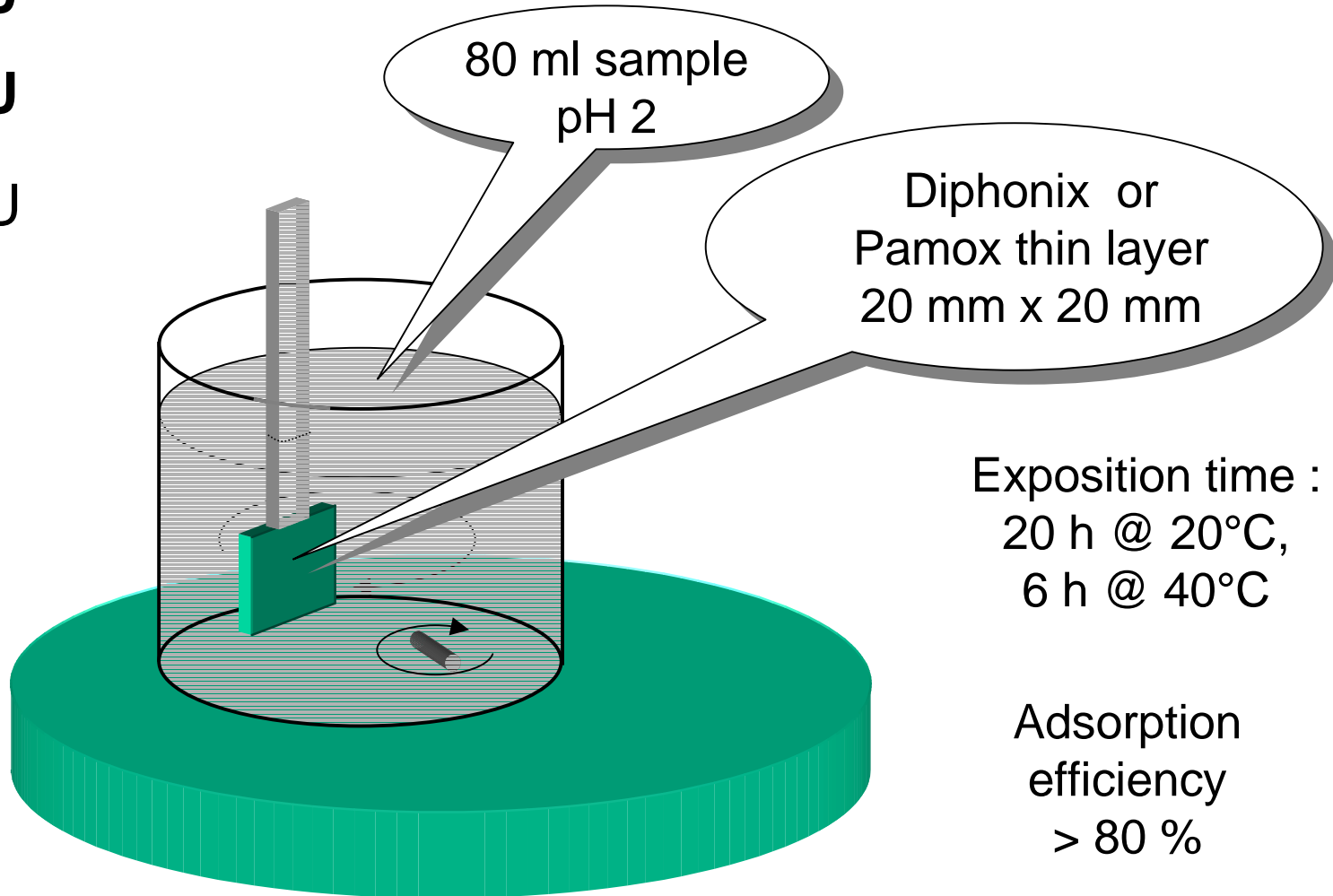


Fig. 8

The method has been developed to analyze drinking water samples. But it even works for dirty samples although precipitation on the resin layer leads to a bad energy resolution(Fig. 9). However with a good deconvolution program a quantitative analysis is still possible.

Figure 10 shows alpha spectra obtained for nitric acid solutions of doubtful chemical composition. DU and natural uranium lead to clearly different spectra.

What can be obtained for samples having drinking water quality can be seen in figure 11. Detection limit is at some mBq/l.

Reference

Surbeck, H., Alpha spectrometry sample preparation using selectively adsorbing thin films,
Applied Radiation and Isotopes 53 (2000) 97-100

Dirty aqueous sample

DU waste water from former weapons test range
(U-238 ~ 50 Bq/l, U-234 ~15 Bq/l)

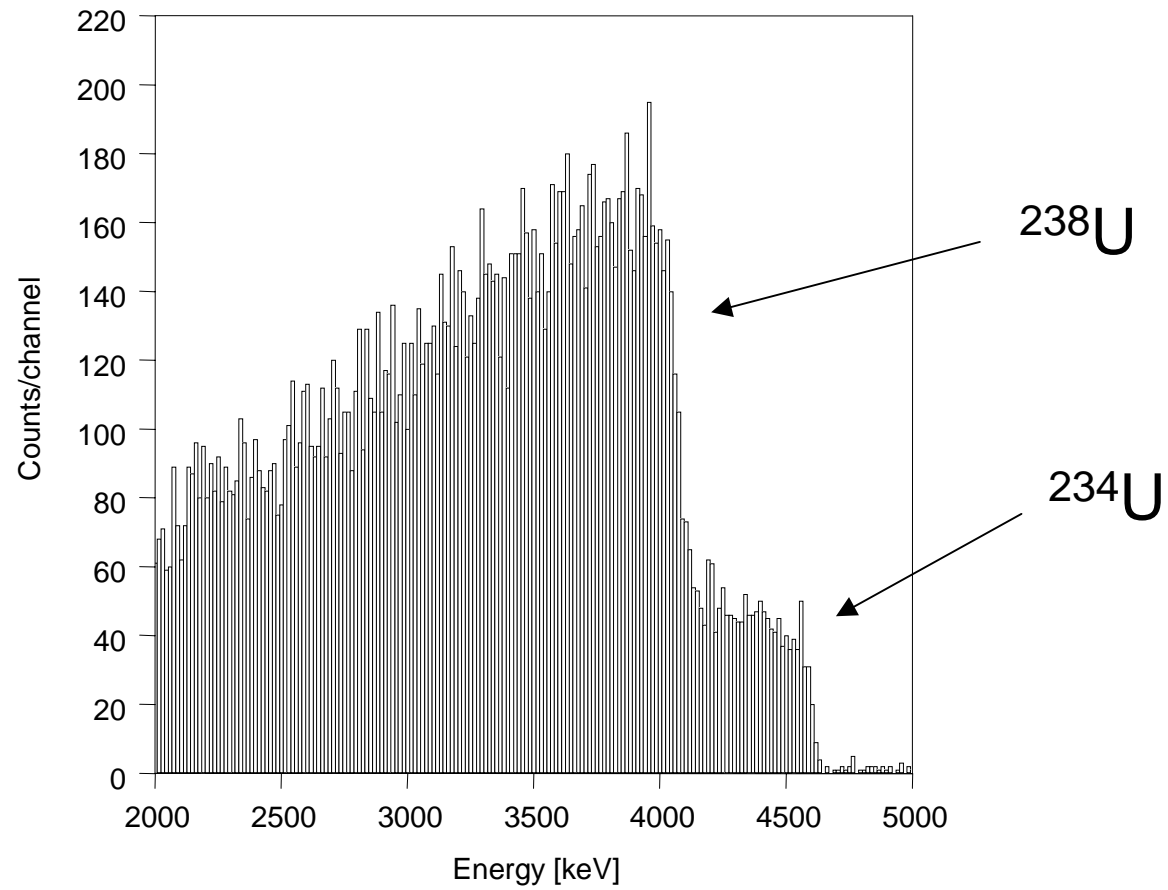


Fig. 9

Aqueous samples with less than clear chemical composition, adjusted to pH 2 with nitric acid

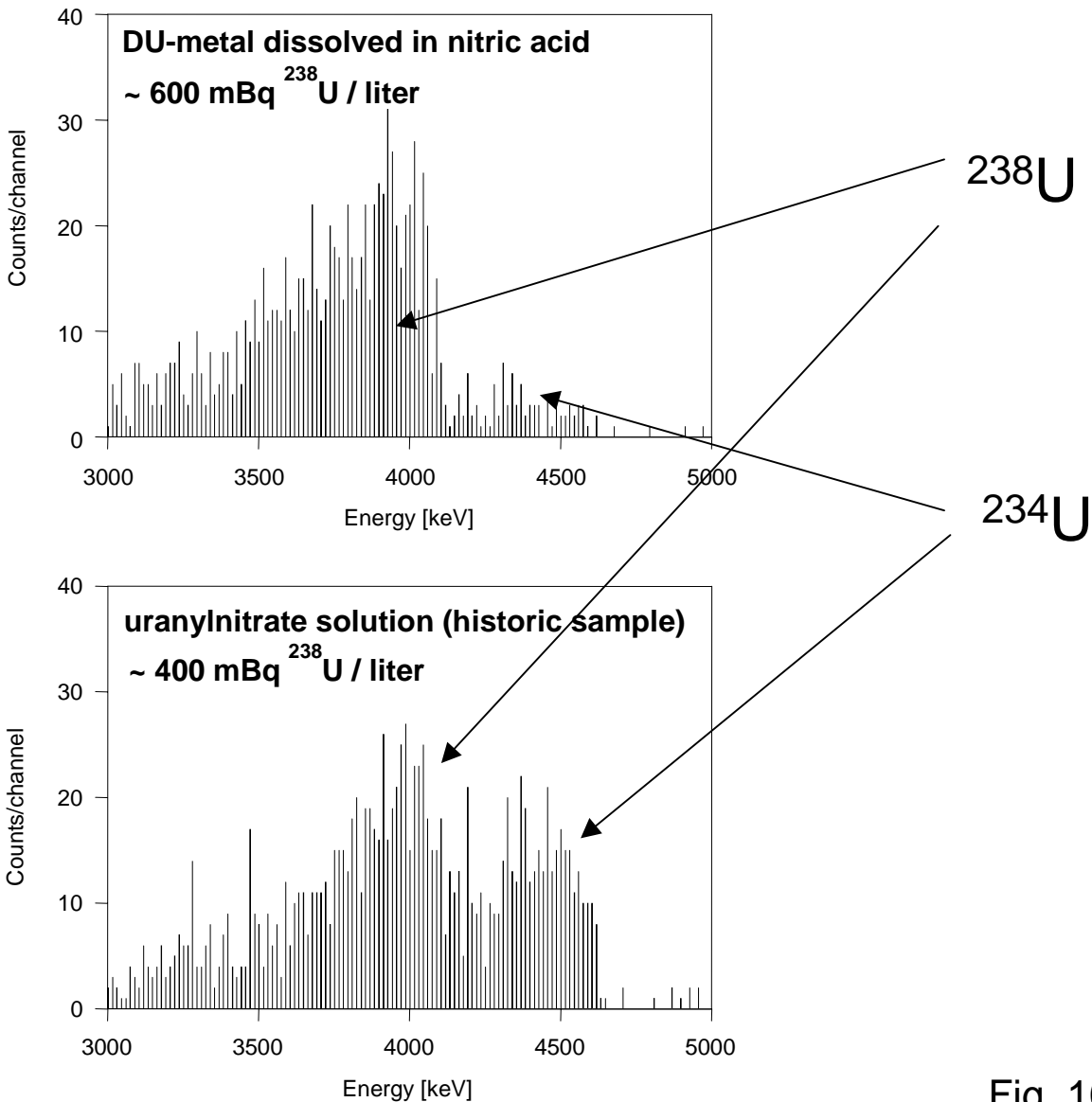


Fig. 10

Natural mineral water « Ancienne », Valais, Switzerland

Drinking water sample, acidified to pH 2 with formic acid

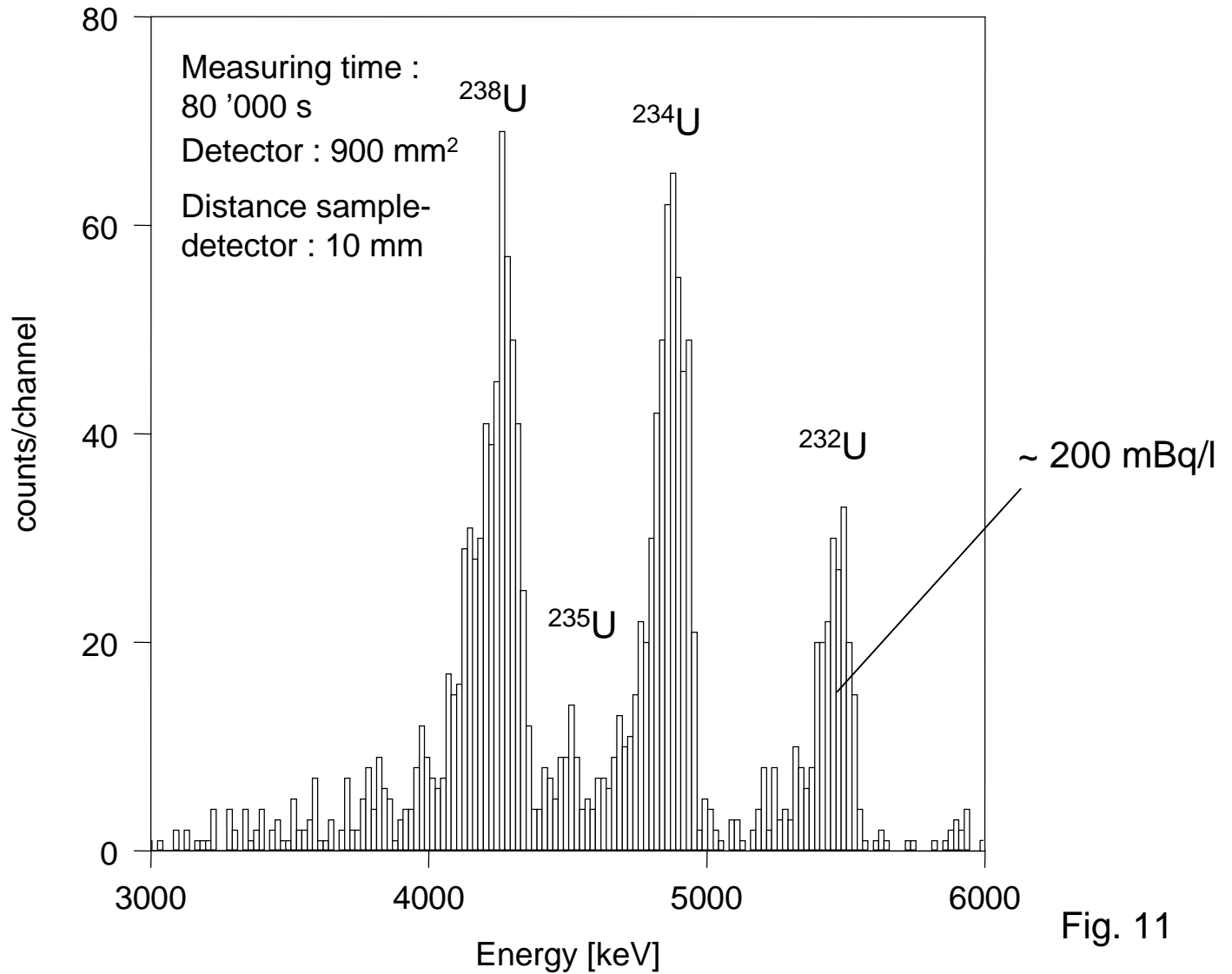


Fig. 11