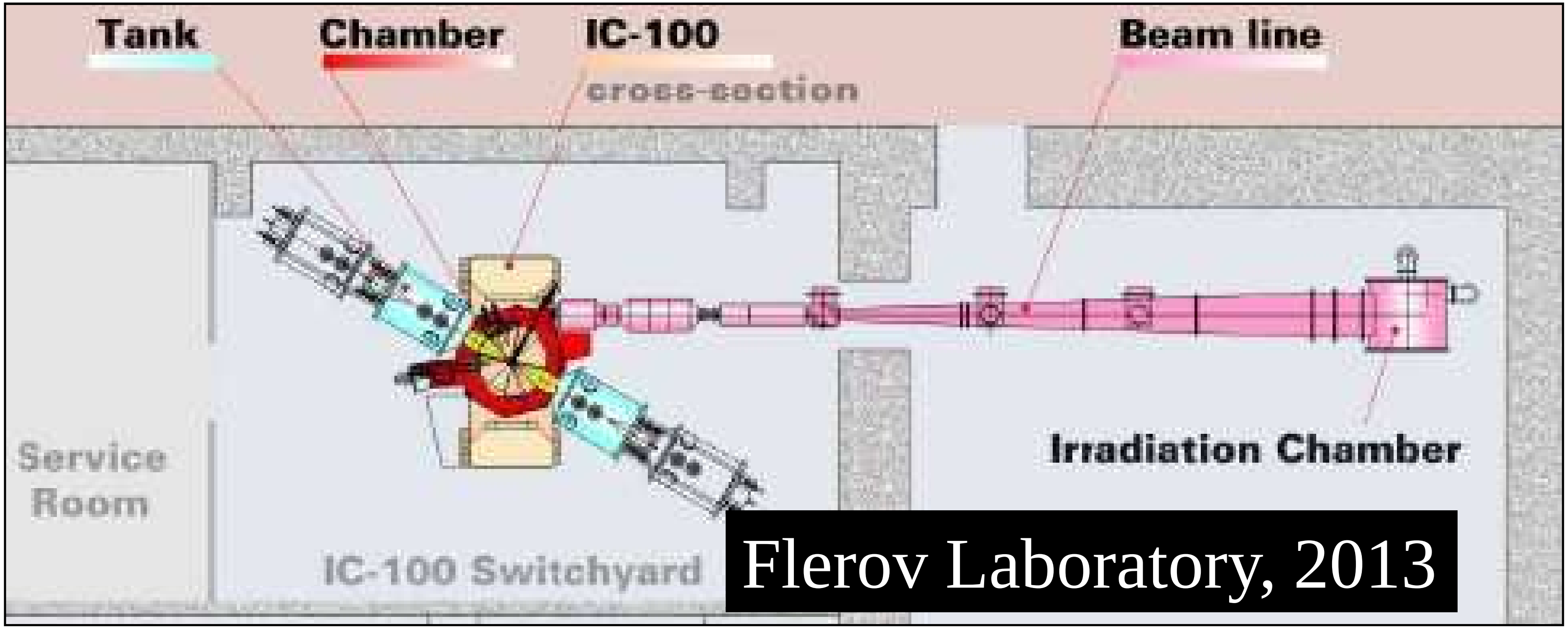
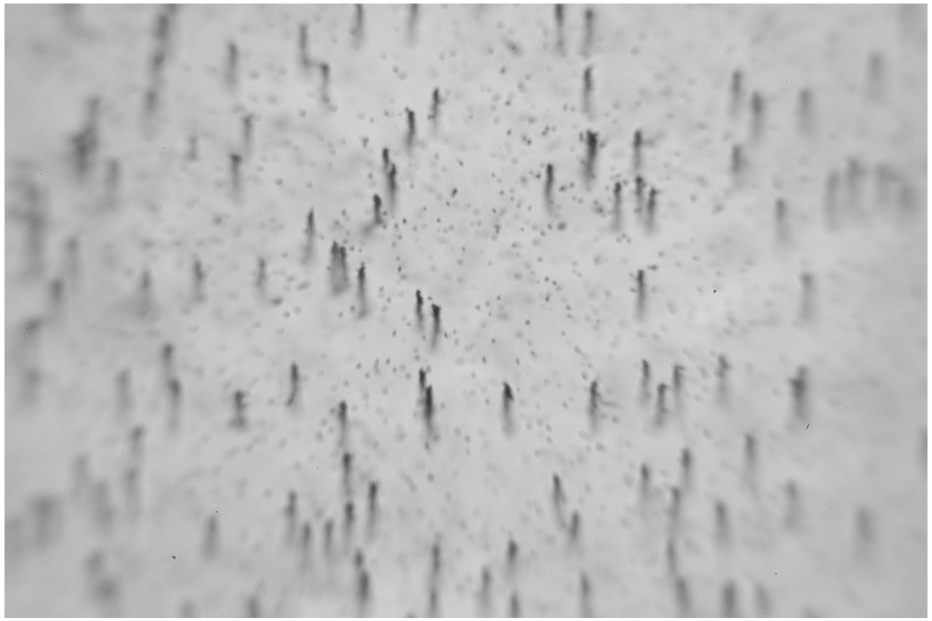
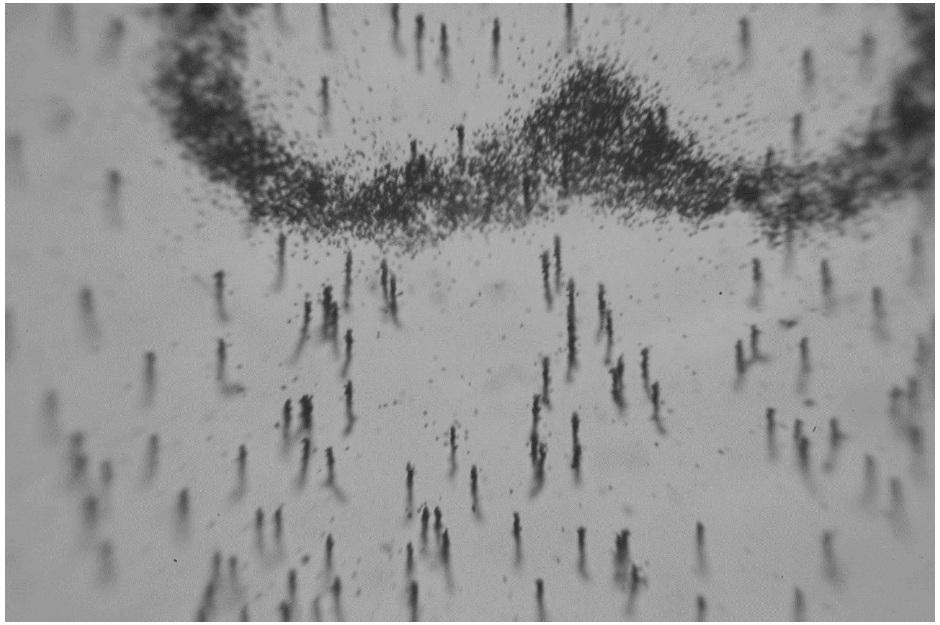
New suggestions of studies on physics of nuclear fission with NTE

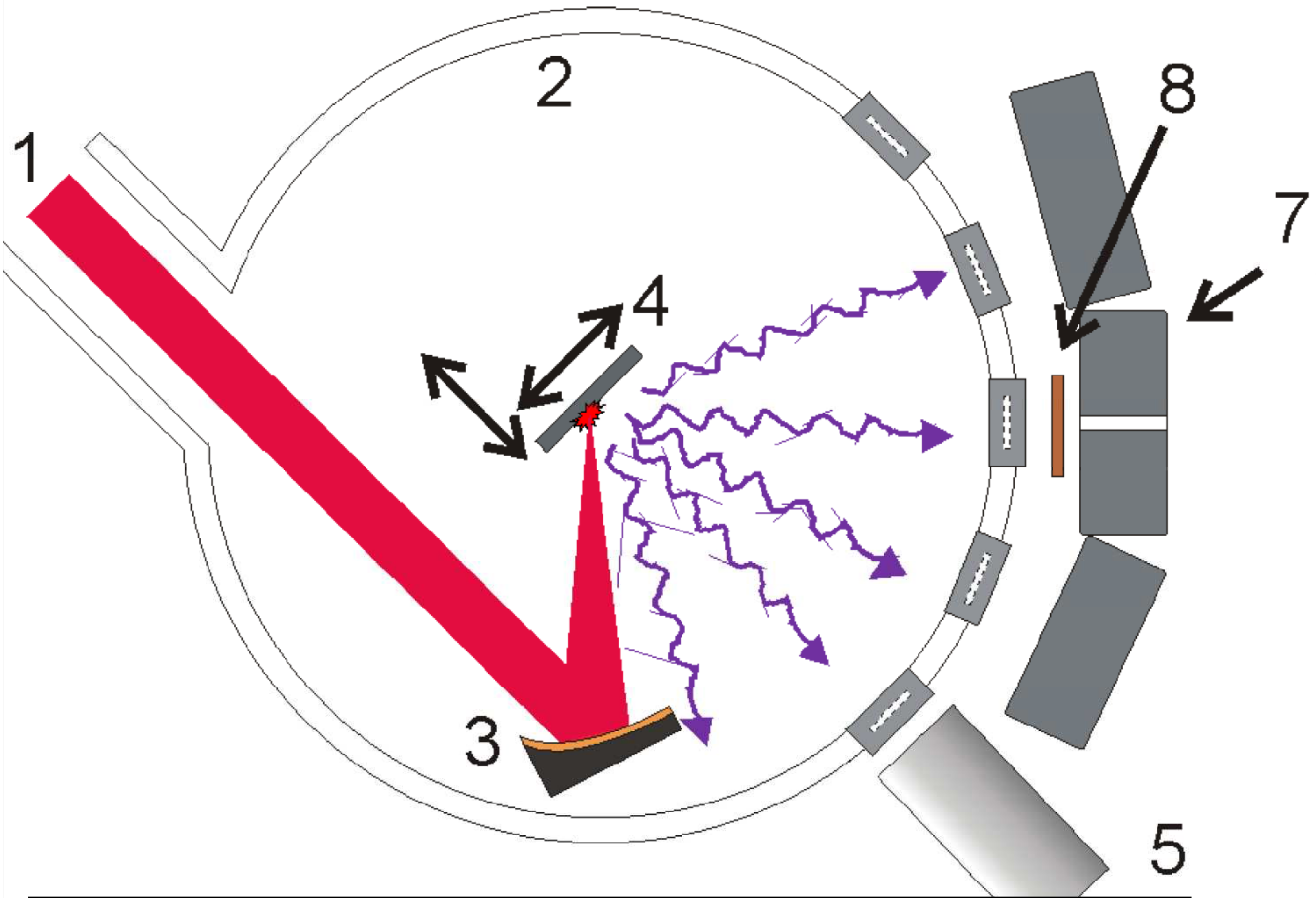
P. I. Zarubin

The BECQUEREL Collaboration
Veksler and Baldin Laboratory of High Energy Physics
Joint Institute for Nuclear Research
Dubna, Russia

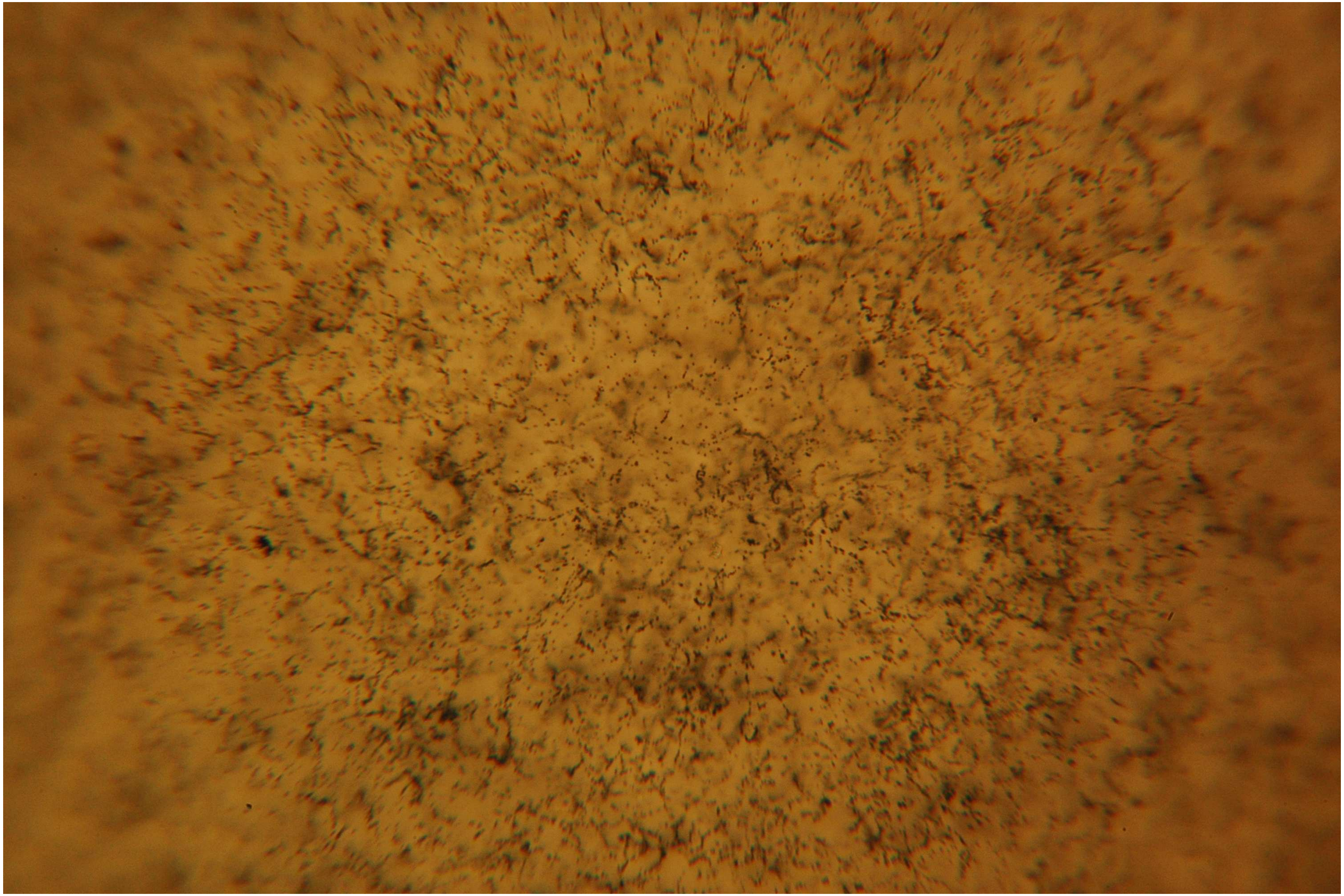

Tank
Chamber
IC-100
cross-section
Beam line
Service Room
IC-100 Switchyard
Irradiation Chamber
Flerov Laboratory, 2013

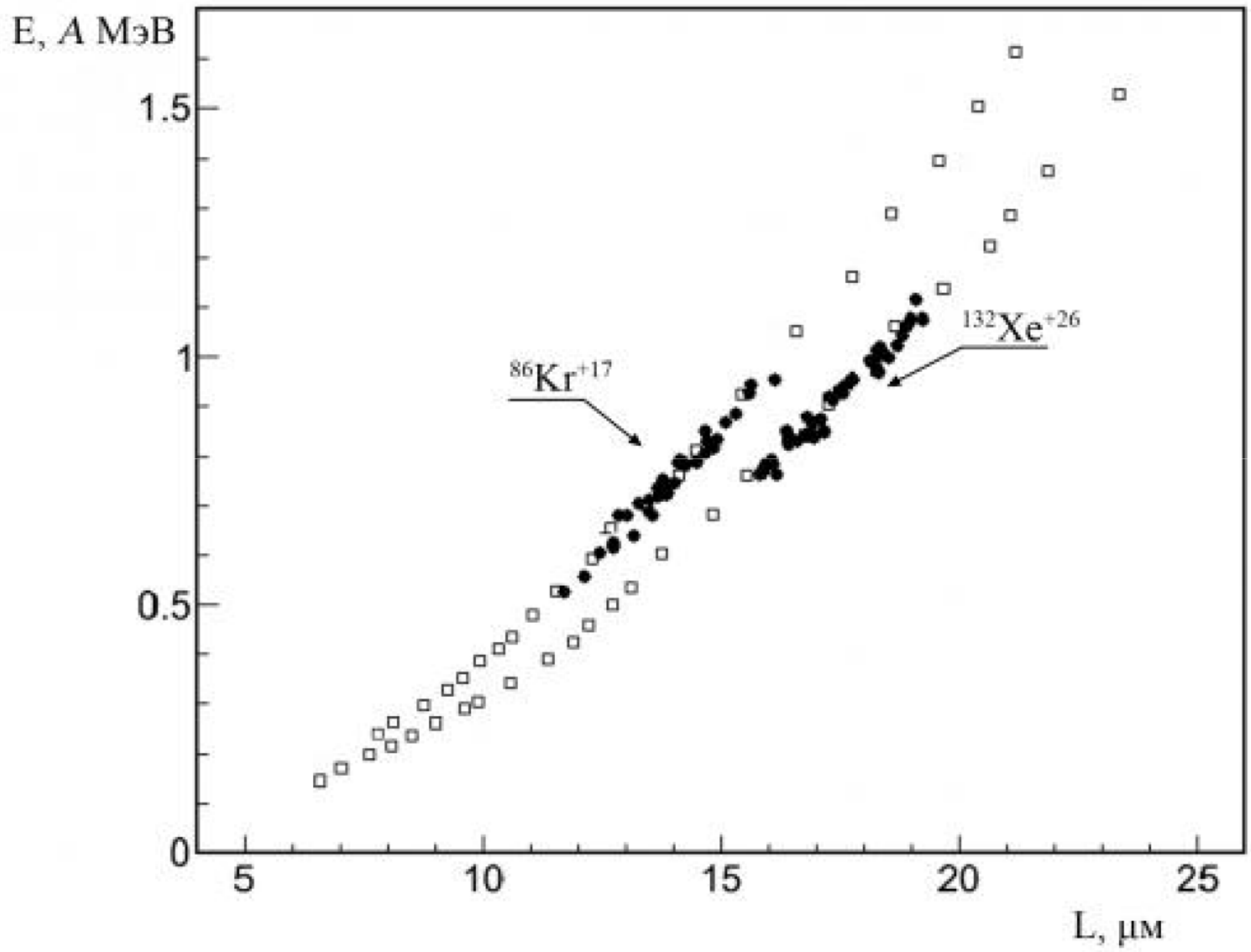


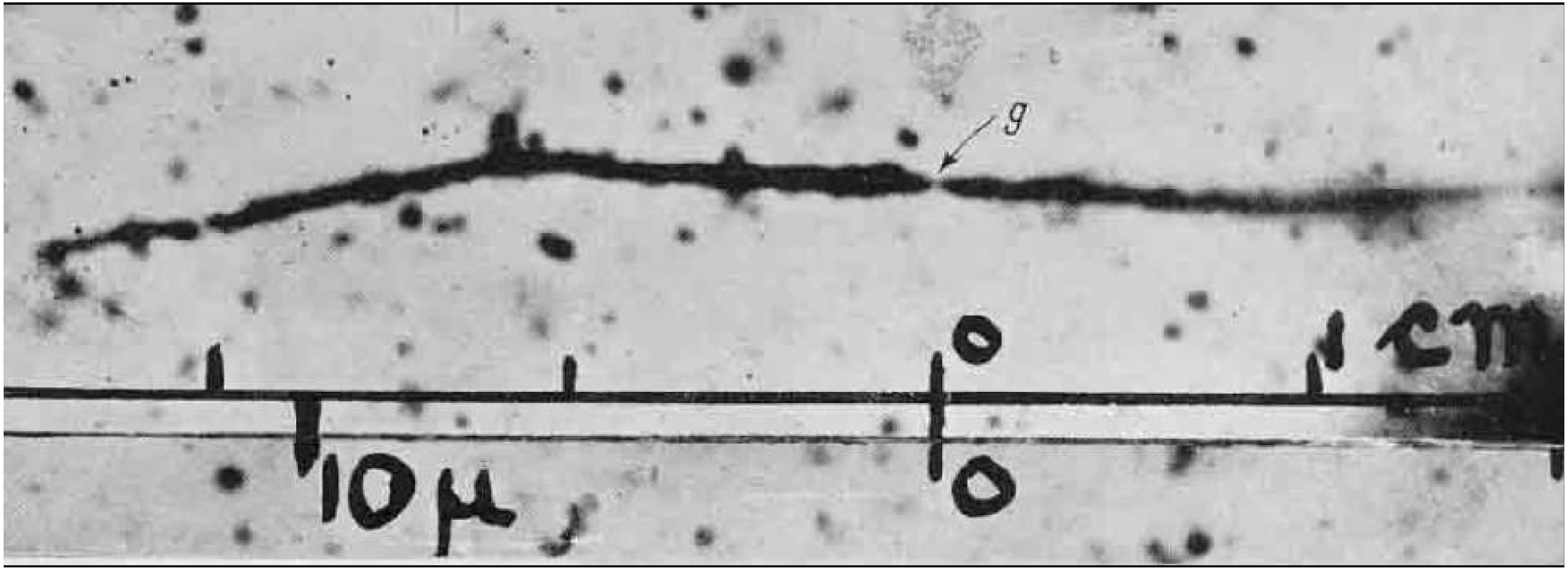




Femtosecond Laser , Laser Center Moscow State University




E, A МэВ
1.5
1
0.5
0
5
10
15
20
25
L, μм
86Kr+17
132Xe+26



Tracks due to the fission of uranium. A thin layer of a uranium salt was 'sandwiched' between two layers of emulsion so that the origin of the two fission fragments can be determined by the gap in the track (g), and the two ranges thus separately determined. The fragment on the left has collided with a nucleus in the emulsion to produce a forked track. The refinement of detail given by the very fine-grain emulsions produced by DEMERS is immediately apparent. The upper scale is divided to correspond approximately to the equivalent range in centimetres of air at N.T.P.

ФОТОГРАФИЧЕСКАЯ РЕГИСТРАЦИЯ ИОНИЗИРУЮЩИХ ИЗЛУЧЕНИЙ

СБОРНИК СТАТЕЙ

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СБОРНИК СТАТЕЙ

Перевод с английского, итальянского, немецкого и французского

И * Л

ИЗДАТЕЛЬСТВО
ИНОСТРАННОЙ ЛИТЕРАТУРЫ

Москва—1953

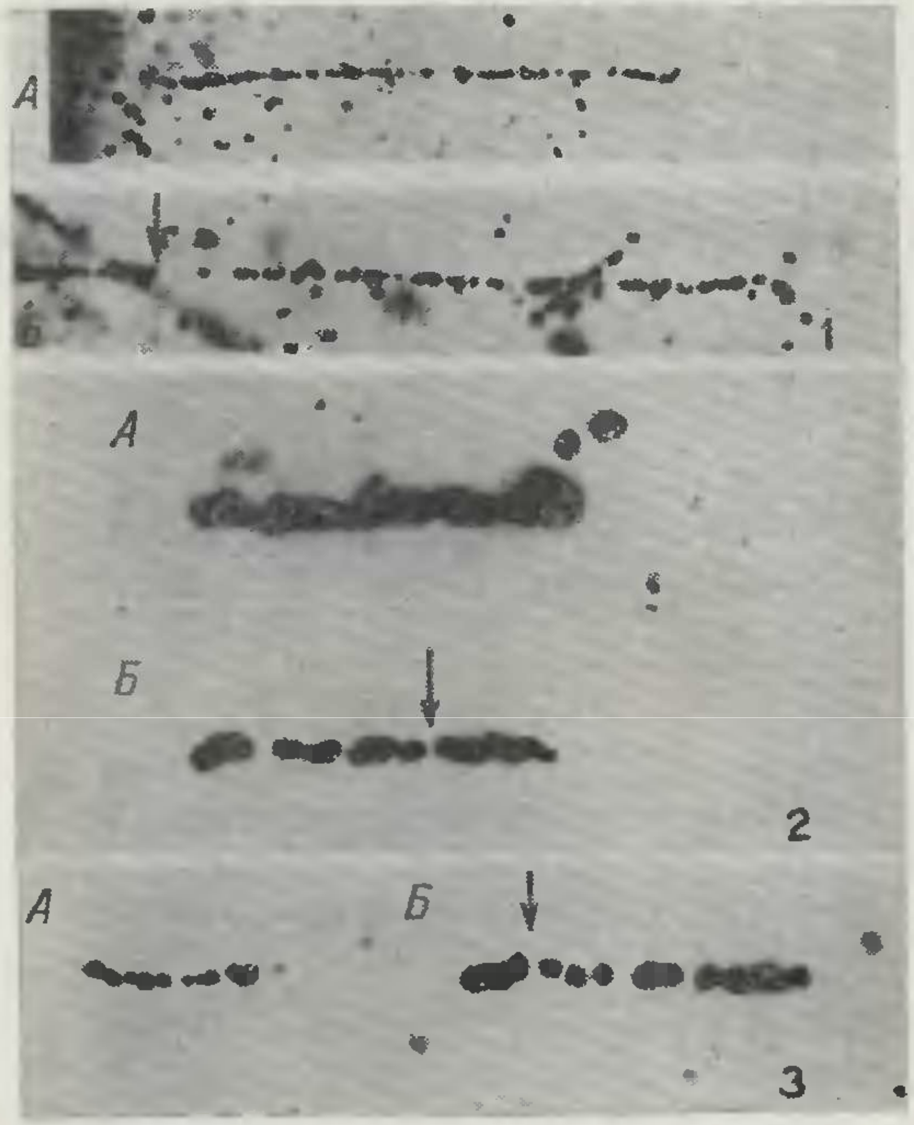
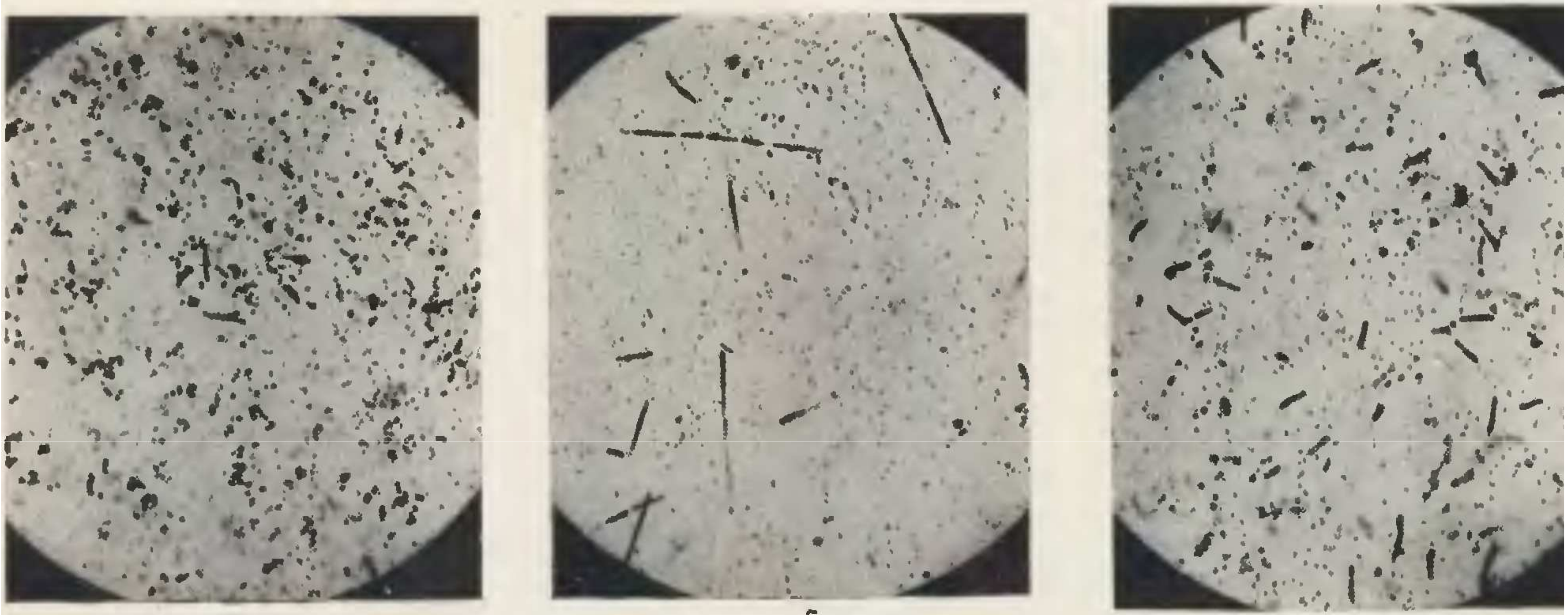


Рис. 13. Расщепление тепловыми нейтронами:
1 — лития, 2 — бора, 3 — азота.

А — проявление без ослабления; *Б* — проявление после частичного ослабления. Стрелка указывает точку расщепления.



а *б* *в*

Рис. 1. Следы частиц из реакций:

а — N^{14} (*n*, *p*) C^{14}; *б* — Li^{6} (*n*, α) H^{3}; *в* — B^{10} (*n*, α) Li^{7}.

Все микрофотографии получены при одинаковом увеличении. Ввиду ограниченной глубины фокуса микроскопа отдельные следы, идущие в глубь эмульсии, выходят из фокальной плоскости.

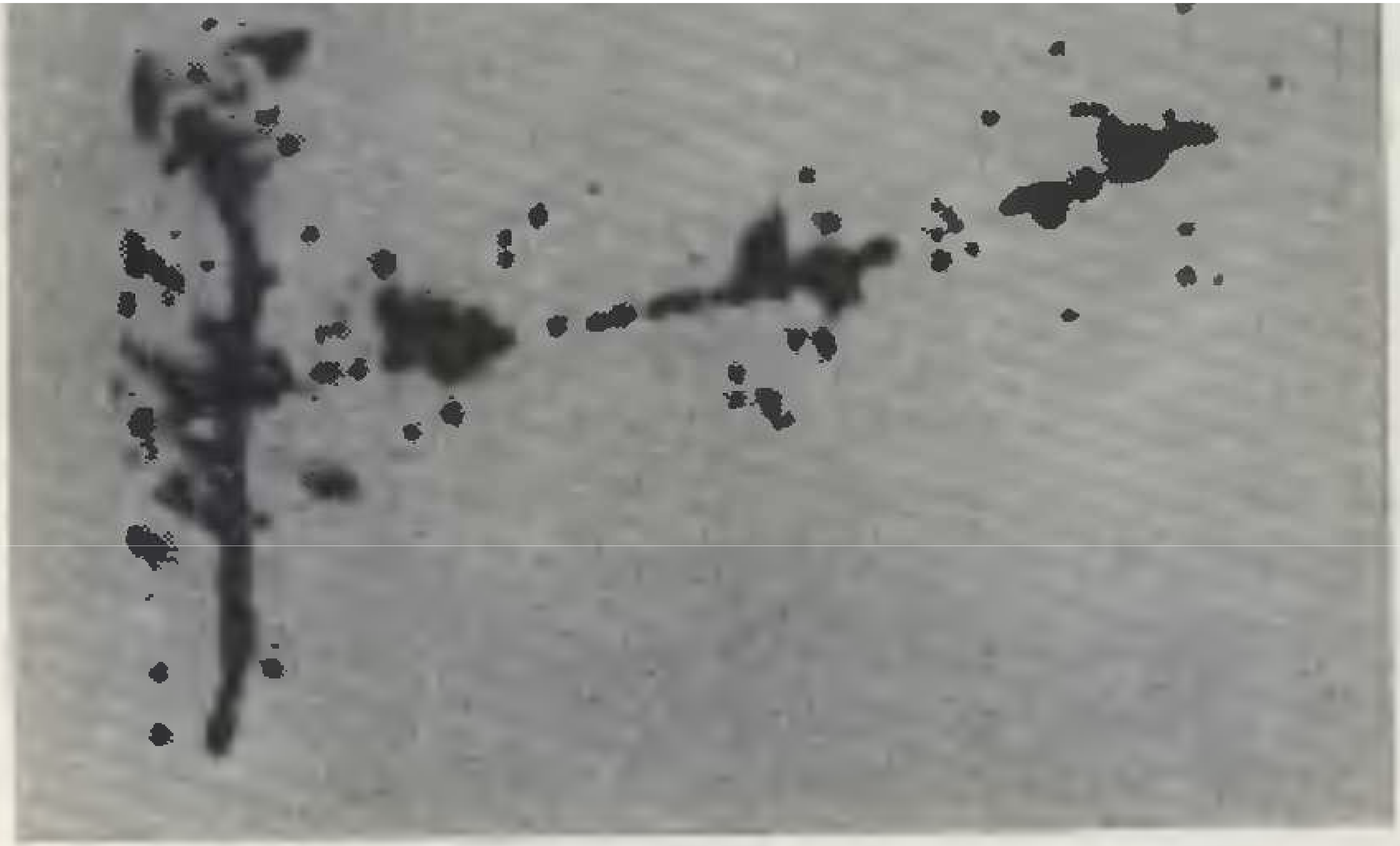
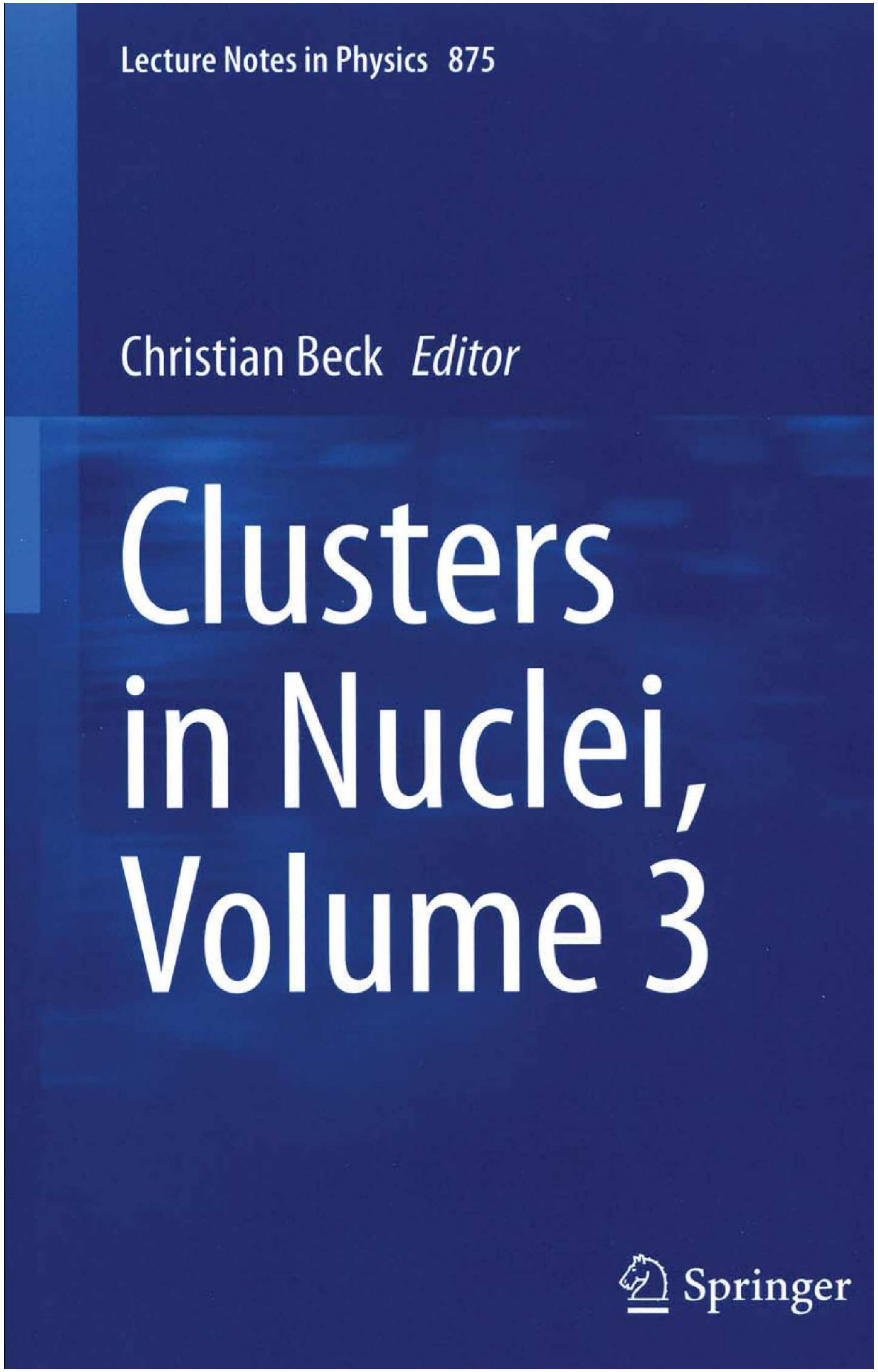


Рис. 11. Деление тория, сопровождаемое испусканием легкой частицы.



Chapter 6
Clusterization in Ternary Fission

D.V. Kamanin and Y.V. Pyatkov

6.1 Searching for New Ternary Decays—Background and Motivation

The present paper is devoted to the observation of a new kind of ternary decay of low-excited heavy nuclei. This decay mode has been called by us "collinear cluster tri-partition" (CCT) in view of the observed features of the effect, that the decay partners fly apart almost collinearly and at least one of them has magic nucleon composition. CCT is observed together with conventional binary and ternary fission. It could be one of the rare fission modes, but at the moment this assumption is not an established fact. For instance, many years have passed between the experimental discovery of the heavy ion radioactivity and working out of a recognized theory of the process.

Nuclear fission, a process where a heavy nucleus decays into two fragments of intermediate mass (e.g. Ba + Kr) has been identified by Hahn and Strassmann in 1938. It was discovered by chemical analysis while irradiating natural Uranium with thermal neutrons [1]. Shortly afterwards Petrzhak and Flerov [2] observed spontaneous fission of the ^{238}U isotope. The energy release in the fission process was immediately calculated by all leading physicists at that time to be very large, typically 200–205 MeV (e.g. Meitner and Frisch [3]). The large value is due to the larger binding energy per nucleon (E_B/N) in the mass range around mass $A = 54$ (iron, $E_B/N = 8.2$ MeV), as compared to the value at the end of the periodic table, ($E_B/N = 7.2$ MeV). This fact could have been noticed four years before

D.V. Kamanin (✉) · Y.V. Pyatkov
Flerov Laboratory of Nuclear Reactions, Joint Institute for Nuclear Research, Joliot-Curie 6, Dubna 141980, Moscow Region, Russia
e-mail: kamanin@jinr.ru

Y.V. Pyatkov
National Nuclear Research University "MEPHI", Kashirskoe shosse 31, Moscow 115409, Russia
e-mail: yvp_nov@mail.ru

C. Beck (ed.), *Clusters in Nuclei, Volume 3*, Lecture Notes in Physics 875,
DOI 10.1007/978-3-319-01077-9_6,

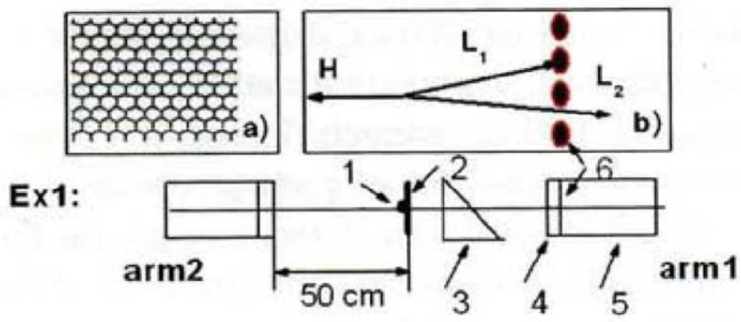


Fig. 6.1 Scheme of (Ex1) for coincidence measurements of two fragments of the fission decay of ^{252}Cf. This experiment has been performed at the FOBOS setup [35]. Here: *1*—Cf source, *2*—source backing, *3*—micro-channel plate (MCP) based timing "start" detector, *4*—position sensitive avalanche counter (PSAC) as "stop" detector, *5*—ionization chamber (BIC) with the supporting mesh, *6*—mesh of the entrance window. The front view of the mesh is shown in the insert (**a**), an enlarged mesh section is presented in the insert (**b**). After passage of the two fragments through the source backing, two light fragments L_1 and L_2, are obtained with a small angle divergence due to multiple scattering. In (**b**) we show that one of the fragments (L_1) can be lost hitting the metal structure of the mesh, while the fragment L_2 reaches the detectors of the arm 1. The source backing (2) exists only on one side and causes the mentioned angular dispersion in the direction towards the right arm 1

Fig. 6.2 Scheme (Ex2) of the mini-FOBOS spectrometer which includes a "start" avalanche counter with an internal target (*1*), Bragg ionization chambers (BIC) (*2*) and "stop" position-sensitive avalanche counters (PSAC) (*3*). The target is irradiated by a collimated beam of thermal neutrons (*4*)

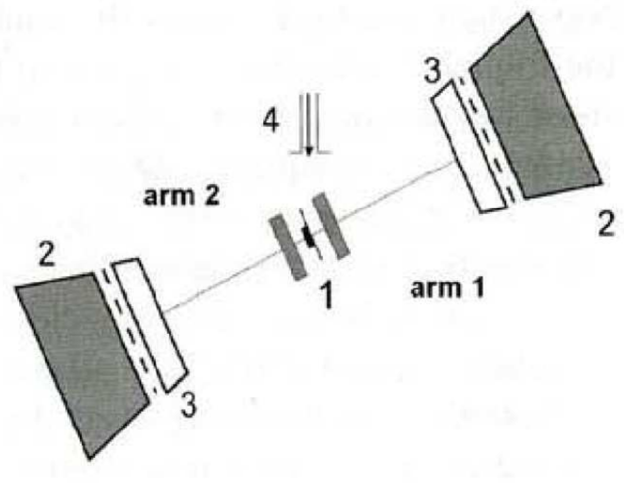


Fig. 6.19 Illustration of the scenario of collinear cluster tripartition

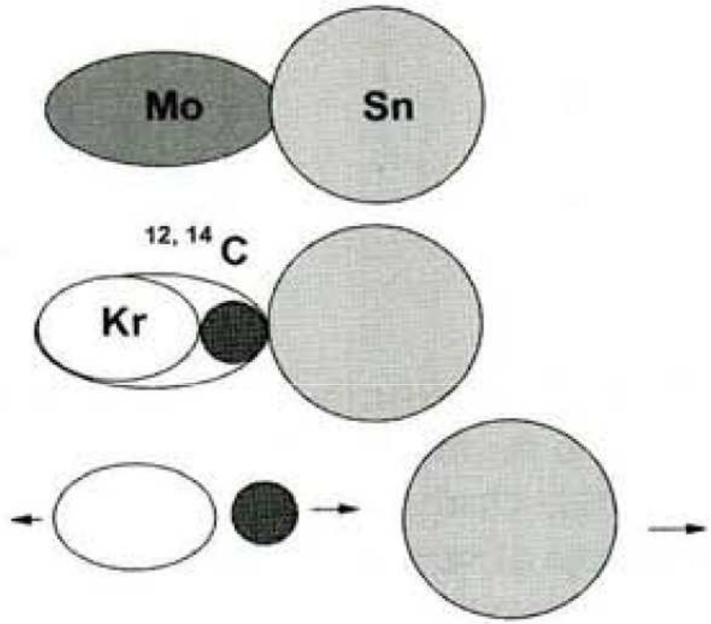
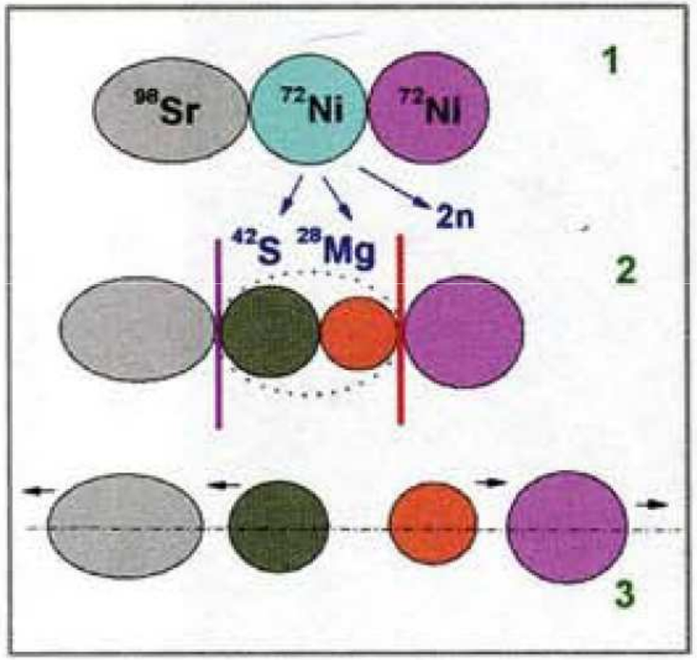


Fig. 6.33 Presumable scenario of one mode of collinear multi-body decay



Before scission: chain of three magic clusters

Clustering of the middle nucleus, double rupture (sequential fission) which sets free the constituents (^{42}S, ^{28}Mg) of the middle molecule (^{72}Ni)

All the partners of the decay fly apart almost collinearly

Fig. 6.10 Cluster scheme for the comparison of the lead radioactivity with collinear cluster tri-partition