Tribute to Anton Oed

Anton's Pre-MicroStripGasCounter-History

at the Institut Laue Langevin

Peter Geltenbort
Institut Laue Langevin (ILL), Grenoble, France

with special thanks to

Friedrich Gönnenwein and late Anton Oed
without their long lasting support, advice and friendship I wouldn't be here

Anton Oed was born 1933 in Ulm

He studied Physics in Tübingen

For his diploma thesis on
“The double resonance spectrum of ^{23}Na”
he received the prize of the Mathematic-Natural Scientific Faculty of the University in Tübingen

In his doctoral thesis, *again in atomic physics*, he studied
“The double quanta decay of the 2s level of hydrogen”

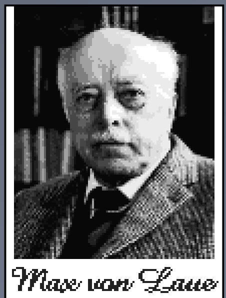
....

In September 1979 detached from the Physical Institute of the University of Tübingen, Germany, to the Institut Laue-Langevin (ILL) in Grenoble, France, **to develop the detectors for the fission fragment spectrometer “Cosi fan tutte”**

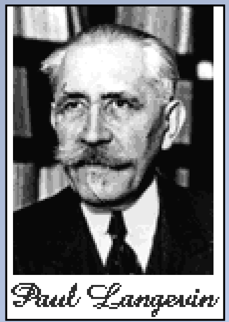
Anton OED

NEUTRONS FOR SOCIETY

Institut Laue-Langevin (ILL)



H. Maier-Leibnitz



L. Neel

"A neutron factory and an user facility"

founded 17 January 1967
International Convention (renewal every 10 years)
signed until end 2023

first neutrons in 1971

cold and hot neutrons sources started operation in 1972

general refit from 1991 - 94

"earthquake" refit from 2003 - 07

several Modernisation Programmes

Associates : France, Germany, United Kingdom
Scientific Member Countries : E, CH, I, A, CZ, SK, B, S, DK, PL

covers about 93% of European neutron users

Fields of research

solid-state physics, material science, chemistry, bio- and earth sciences, engineering,
nuclear and particle (fundamental) physics

Experimental Programme in 2018
- 821 experiments (allocated by subcommittees) on 28 ILL-funded and 10 CRG instruments
- 1600 visitors coming from 41 countries
- 570 publications by ILL staff and users

~515 staff; ~103 M€ annual budget

Very Hot (Fission) Neutrons → **Ultra-Cold Neutrons**

10^7 eV → **10^{-7} eV**

European Photon and Neutron (EPN) Science Campus

Institut Laue-Langevin (ILL) operates the most intense (reactor) neutron source in the world, feeding a suite of 40 high-performance instruments

European Synchrotron Radiation Facility (ESRF) is a world-leading synchrotron radiation source hosting 41 cutting-edge experimental stations

The Institut de Biologie Structurale (IBS) is a research centre in structural biology. The IBS possesses cutting edge facilities and is a partnership between CEA, CNRS and UJF

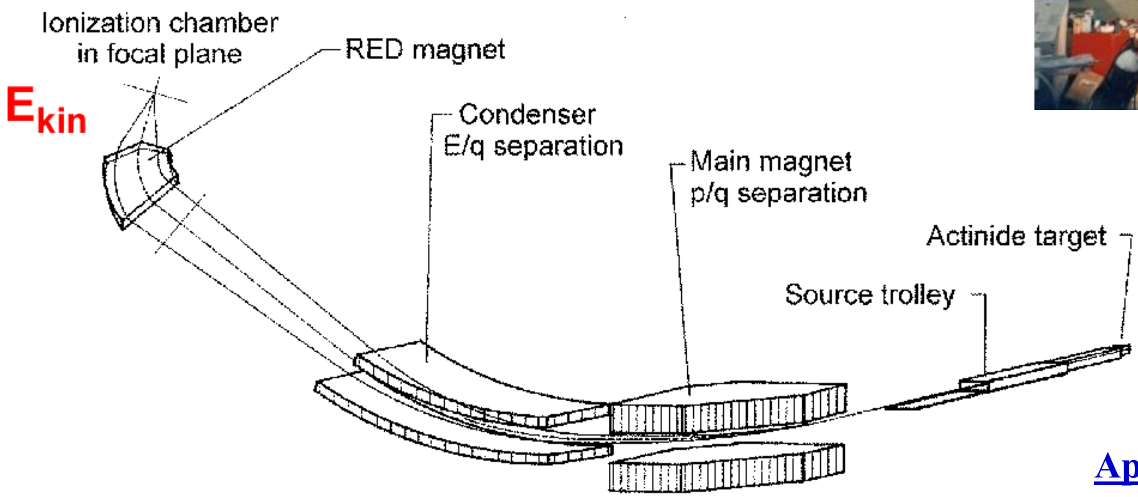
European Molecular Biology Laboratory (EMBL) Grenoble is an outstation of the EMBL organisation (HQ in Heidelberg), specialising in research in structural biology (in very close proximity to the ILL and the ESRF)

PN1: The fission fragment separator "Lohengrin"

U. Koester, Y.-H. Kim, N. Laurens

mass-separated fission fragments,

up to 10^5 per second, $T_{1/2} \geq \mu s$



- **n-flux 5.5×10^{14} cm^{-2}/s**
- **few mg fission target (various materials)**
- **several 10^{12} fissions/s**

$$m v^2 / r_{el} = q E \qquad m v^2 / r_{magn} = q v B$$

$$E_{kin} / q = E / 2 r_{el} \qquad m v / q = B r_{magn}$$

P. Armbruster et al., Nucl. Instr. Meth. 139 (1976) 213.

Applications:

- exotic, neutron-rich nuclides (production, decays, magnetic moments, r-process)
- fission yields

Typical duration of experiments: one to three weeks

Cosi fan tutte

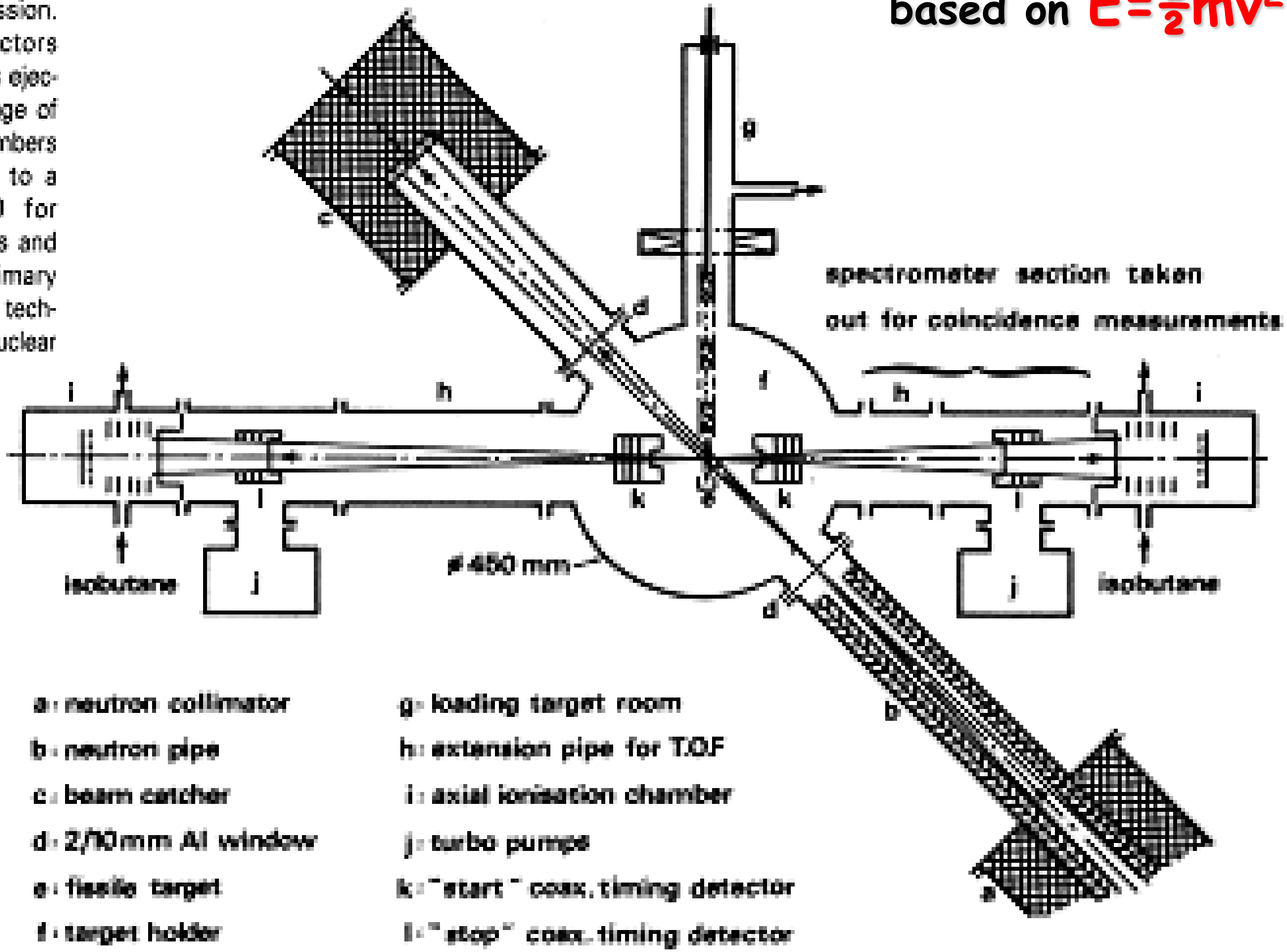
Coincidence
spectroscopy
in
fission
alphas and
neutrons
taking
up
to
three
events

G. Siegert, ILL Internal Scientific Report 78SI321S (December 1978)

Cosi fan tutte (PN8) set-up

"Cosi fan tutte" is a fission fragment spectrometer measuring simultaneously the velocity v and the kinetic energy E of both fragments from a fissile target under thermal neutron bombardment and enables the individual fragment mass to be determined after prompt neutron emission. The use of coaxial timing detectors (based on the detection of electrons ejected from a thin foil after the passage of fragments) and axial ionisation chambers of high resolving power leads to a mass resolution m/δm = 170 for m ≅ 95 amu. Upon applying mass and momentum conservation the primary masses can be calculated. A special technique allows the identification of nuclear charges.

based on $E=\frac{1}{2}mv^2$



Nuclear Instruments and Methods 179 (1981) 265–270

Time Pickoff [1]

A FAST BEAM COAXIAL TIME PICKOFF SYSTEM

A. OED, G. BARREAU, F. GÖNNENWEIN, P. PERRIN, C. RISTORI *
Institut Laue–Langevin, 38042 Grenoble Cédex, France

and

P. GELTENBORT
Physik. Institut der Universität Tübingen, Morgenstelle, D-7400 Tübingen, FRG

Received 1 August 1980

A new time pickoff system for particle beams with an area of 78 mm^2 and a transmission of 99.8% is described. In a time-of-flight spectrometer using two of these pickoff systems an instrumental time resolution of 95 ps for fission fragments with 100% detection probability and a time resolution of 150 ps for α-particles with 35% detection probability have been measured.

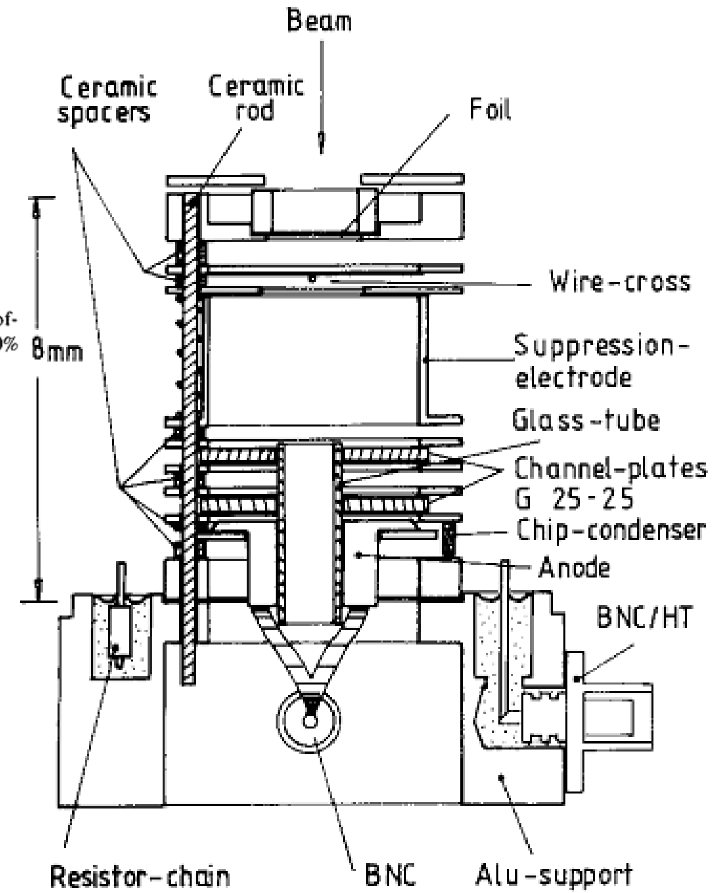


Fig. 1. Sectional view of the beam coaxial time pickoff system.

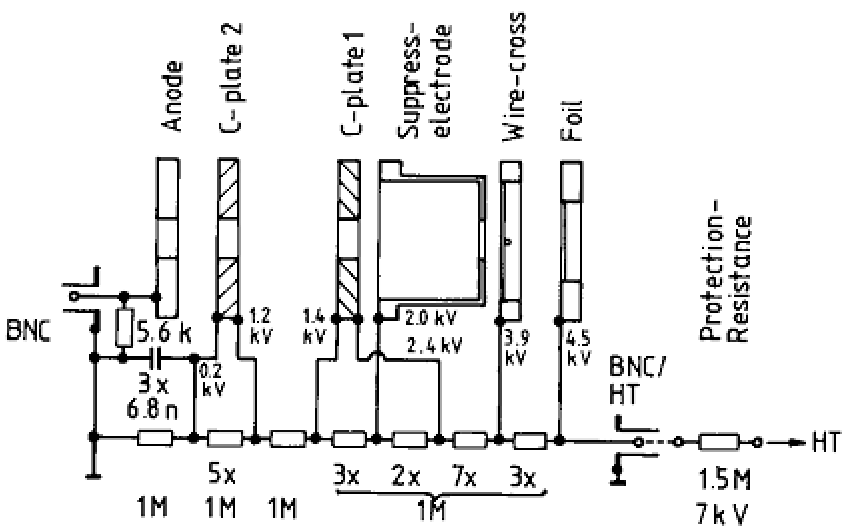


Fig. 2. A schematic of the electrical arrangement. With the indicated voltages the best time resolution for fission fragments has been achieved.

Time Pickoff [2]

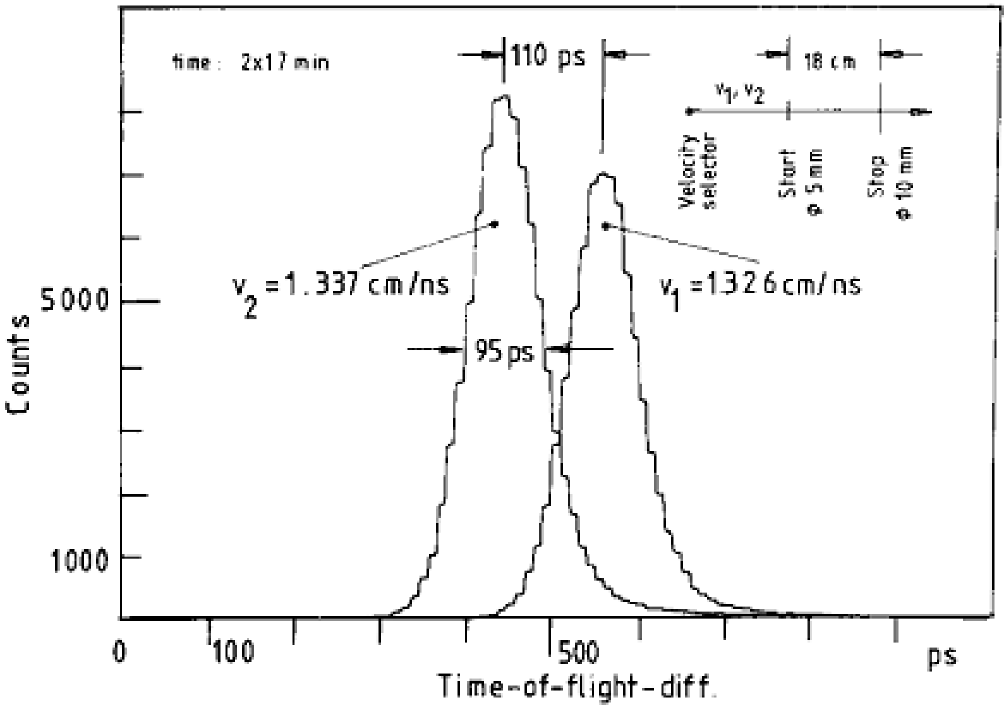


Fig. 5. TOF spectrum measured with a flight path of 18 cm for fission fragments with two velocities of 0.82% difference; this corresponds to an energy difference of less than 1.5 MeV for the selected mean mass 95. The instrumental time resolution is 95 ps.

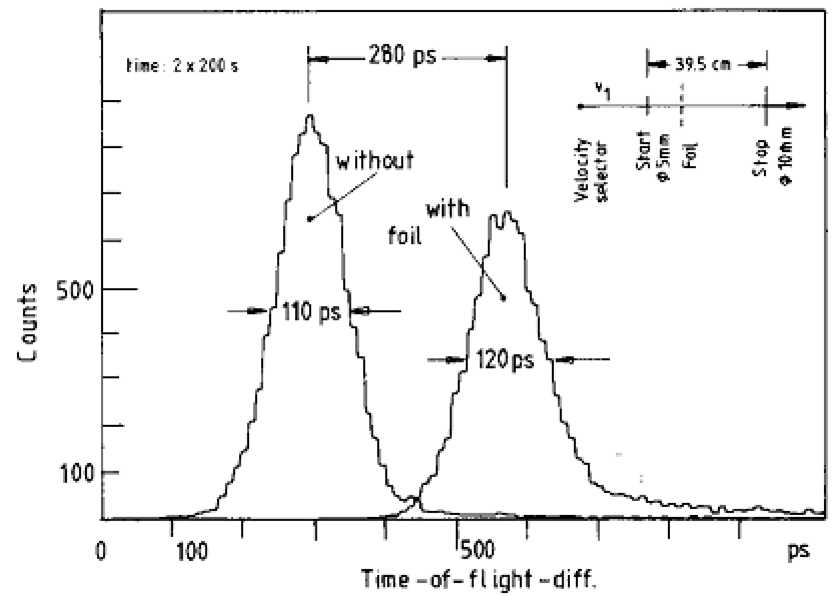


Fig. 6. TOF spectra for fission fragments with a flight path of 39.5 cm and a velocity of 1.326 cm/ns without (left) and with (right) an additional foil. The energy loss of 1.6 MeV and the energy straggling cause the shift and the widening of the time resolution line.

Axial Ionization Chamber [1]

Nuclear Instruments and Methods 205 (1983) 455–459
North-Holland Publishing Company

HIGH RESOLUTION AXIAL IONIZATION CHAMBER FOR FISSION PRODUCTS

A. OED [1], P. GELTENBORT [2], F. GÖNNENWEIN [1], T. MANNING [1] and D. SOUQUE [3]

[1] *Institut Laue-Langevin, 156 X, 38042 Grenoble Cedex, France*

[2] *Physikalisches Institut der Universität Tübingen, Auf der Morgenstelle D, D-7400 Tübingen, Germany*

[3] *Ecole National Supérieure d'Ingénieurs Electriciens, Grenoble, Domaine Universitaire, F-38400 Saint-Martin d'Hères, France*

Received 12 July 1982

The construction of an ionization chamber with the electrical field parallel to the particle beam (axial chamber) is described. The energy resolution achieved for typical light and heavy mass fragments from the thermal neutron induced fission of ^{235}U is 385 keV and 510 keV, respectively.

Axial Ionization Chamber [2]

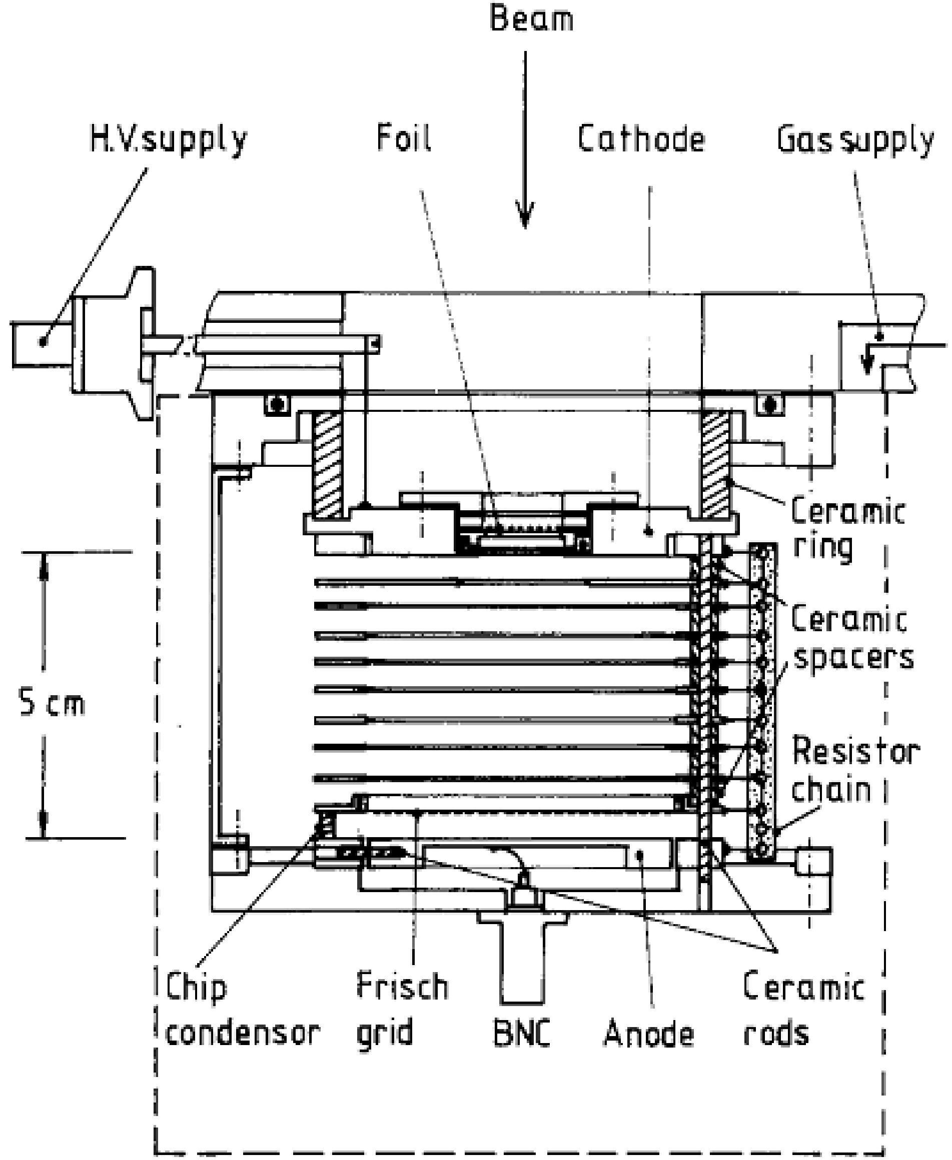


Fig. 1. Cross section of the axial ionization chamber.

Axial Ionization Chamber [3]

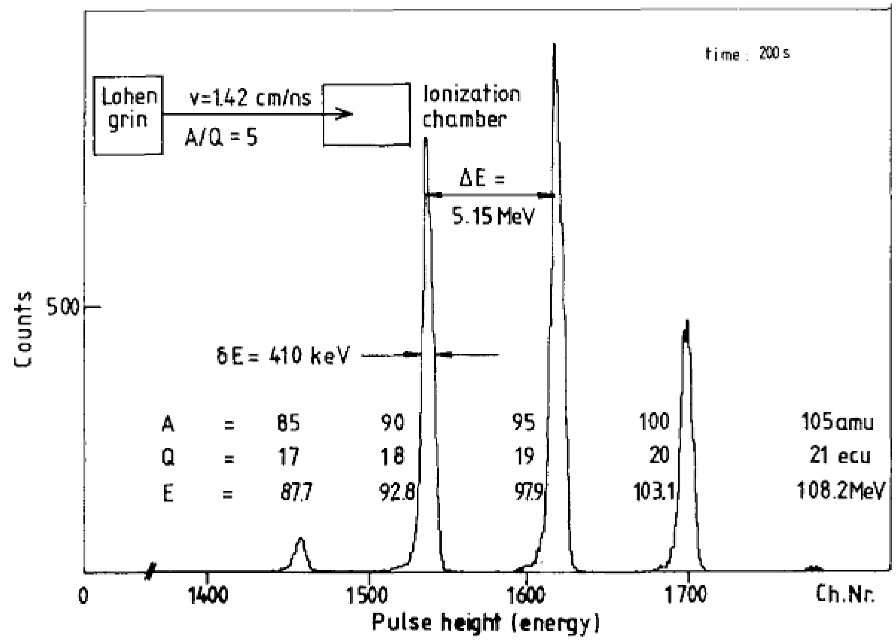


Fig. 3. Spectrum of a fragment beam from the neutron induced ^{235}U fission selected by the separator Lohengrin with the mass over ionic charge ratio $A/Q = 5$ and the velocity $v = 1.42$ cm/ns. The chamber was operated with isobutane (99.5%) at a pressure of 120 Torr and a specific field strength of 5.9 V/cm·Torr. The entrance window is made from a Parylene-C-foil of 30 $\mu g/cm^2$ in thickness.

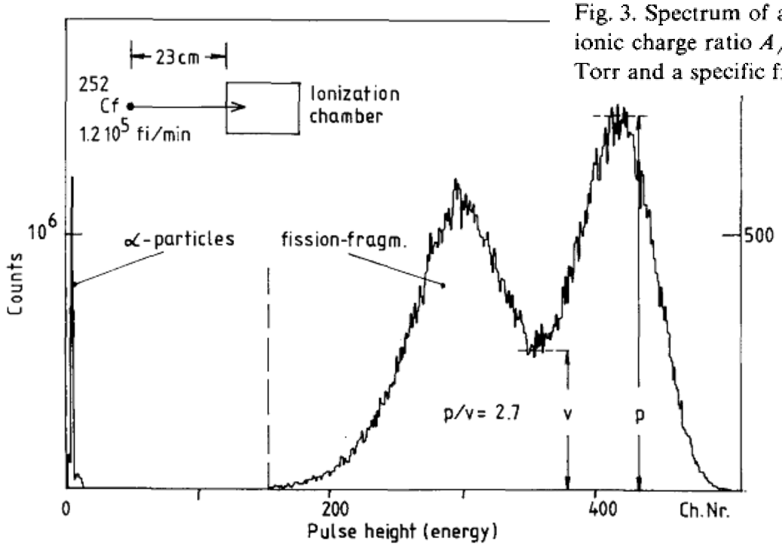


Fig. 2. Spectrum from a ^{252}Cf source measured with the axial ionization chamber. Ionization gas: isobutane (99.5%) at 120 Torr. The specific field strength is 5.9 V/cm·Torr. The alpha-particles are not stopped in the chamber. The entrance window is made from stretched polypropylene foil with 50 $\mu g/cm^2$ in thickness.

Bragg Curve Spectroscopy [1]

Nuclear Instruments and Methods 205 (1983) 451–453 451
North-Holland Publishing Company

A NEW METHOD TO IDENTIFY NUCLEAR CHARGES OF FISSION FRAGMENTS

A. OED [1], P. GELTENBORT [2] and F. GÖNNENWEIN [1]

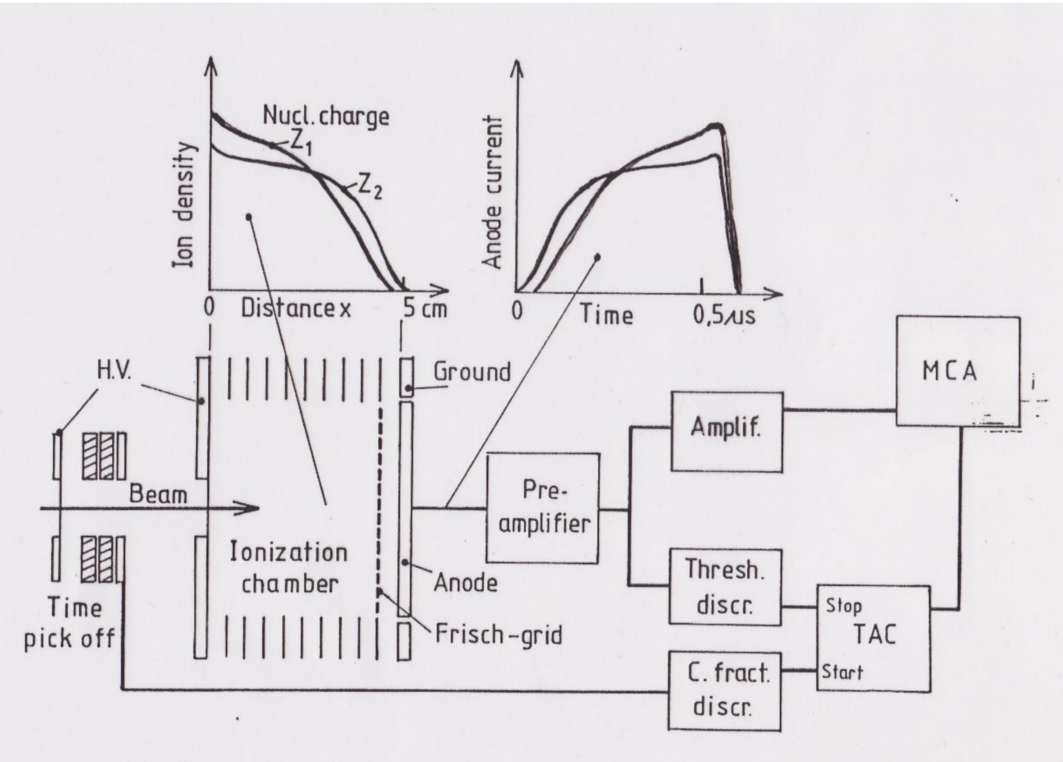
[1] *Institut Laue-Langevin, 156 X, 38042 Grenoble Cedex, France*

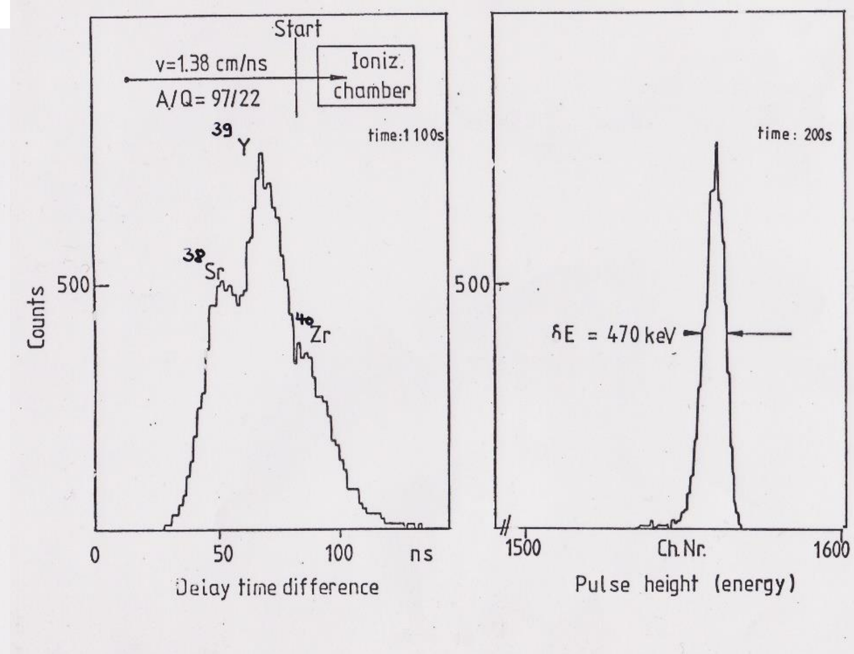
[2] *Physikalisches Institut der Universität Tübingen, Auf der Morgenstelle D, 7400 Tübingen, West Germany*

Received 1 June 1982

For a mass and velocity selected beam of fission fragments, the elemental components of the beam have been determined by measuring the difference between the time the fragments enter an axial ionization chamber (with the electrical field lines parallel to the particle trajectory) and the time the anode pulse crosses a given level. The nuclear charge resolution achieved for typical fission fragments out of the light mass group in thermal neutron induced fission of ^{235}U is $Z/\Delta Z = 43$ for a nuclear charge $Z = 39$.

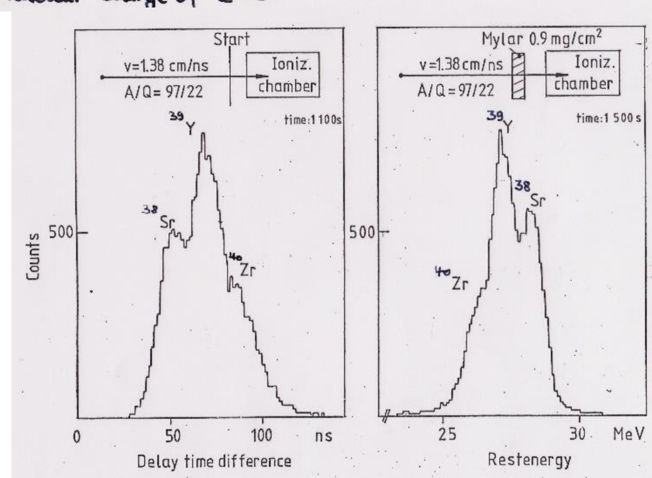
Bragg Curve Spectroscopy [2]





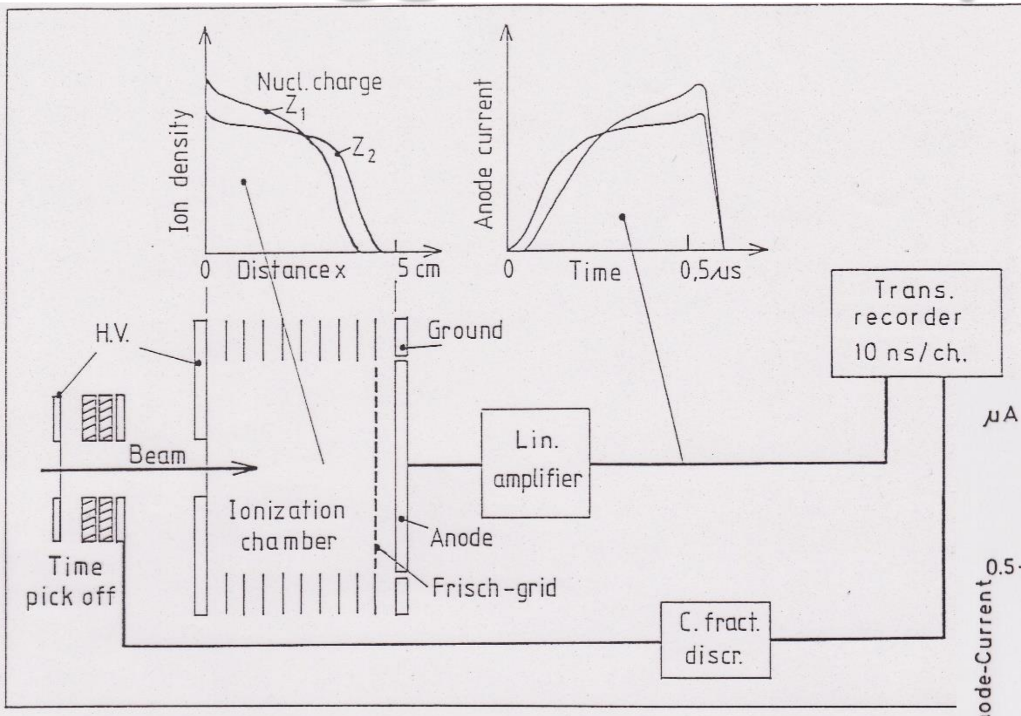
$Z/\Delta Z = 43$

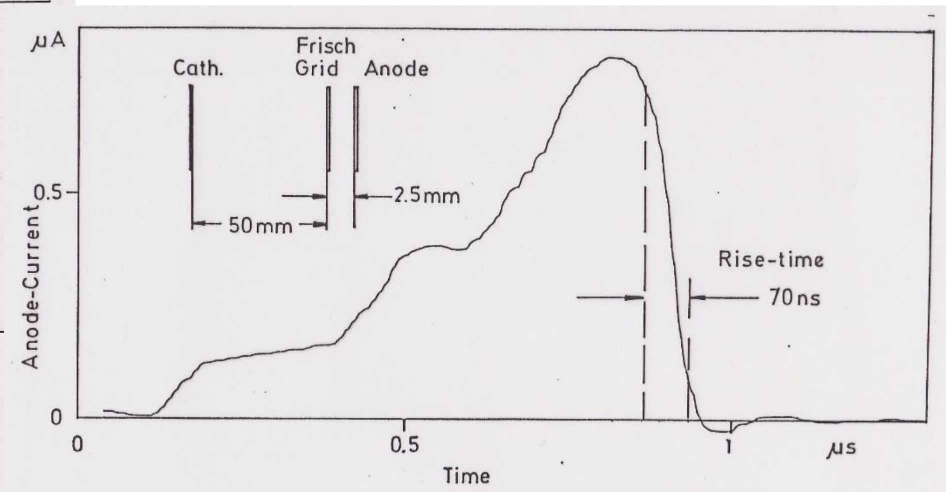
at a nuclear charge of $Z = 39$



$Z/\Delta Z = 43$ at $Z = 39$

Bragg Curve Spectroscopy [3]





Experimental set-up

Velocity selected fission fragments of the spectrograph "Lohengrin" at the I.L.L. are stopped in an axial ionization chamber.The anode signal which corresponds to the Bragg curve is digitally stored.A trigger signal is delivered by an external time pick-off.

Cosi fan tutte (PN8)

Nuclear Instruments and Methods in Physics Research 219 (1984) 569–574 569
North-Holland, Amsterdam

A MASS SPECTROMETER FOR FISSION FRAGMENTS BASED ON TIME-OF-FLIGHT AND ENERGY MEASUREMENTS

A. OED and P. GELTENBORT

Physikalisches Institut der Universität Tübingen, Auf der Morgenstelle D, D-7400 Tübingen, Fed. Rep. Germany

R. BRISSOT, F. GÖNNENWEIN and P. PERRIN

Institut Max von Laue – Paul Langevin, 156 X, 38041 Grenoble Cedex, France

E. AKER and D. ENGELHARDT

Institut für Experimentelle Kernphysik, Universität Karlsruhe, Kaiserstrasse 12, D-7500 Karlsruhe, Fed. Rep. Germany

Received 24 February and in revised form 14 June 1983

With the aim of determining masses of fission fragments by measuring velocities and kinetic energies, specially adapted time-of-flight detectors and ionization chambers were developed. The start and stop detectors for the time-of-flight sense the electrons emitted from a thin foil upon passage of fragments. The time resolution achieved is $\simeq 100$ ps. The ionization chambers have the electric field arranged parallel to the particle trajectory, and with isobutane as the counting gas, the intrinsic energy resolution for fragments with $m \simeq 100$ amu is typically 400 keV. The combination of both the time-of-flight and ionization chamber, to produce an energy–time-of-flight spectrometer, was tested with fragments from the $^{235}U(n, f)$ reaction on an external thermal neutron beam at the ILL/Grenoble. In the light group of fission fragments, all masses are resolved individually with a mass resolving power $m/\delta m = 170$ for $m = 95$.

Cosi fan tutte (PN8)
detector performances

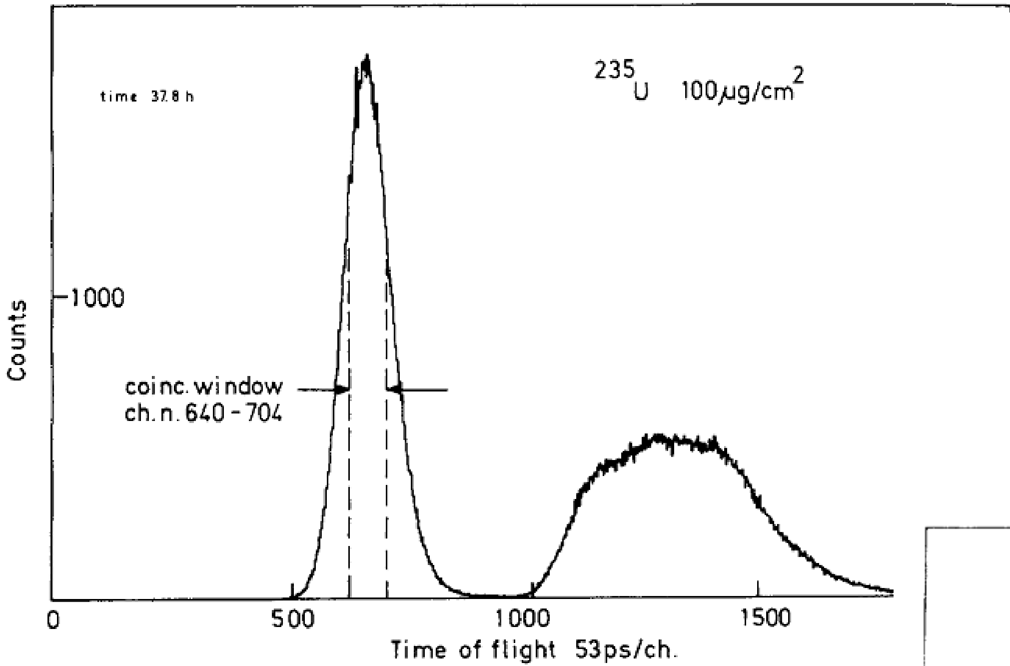


Fig. 1. Time-of-flight spectrum of fission fragments from $^{235}U(n, f)$ for thermal neutr

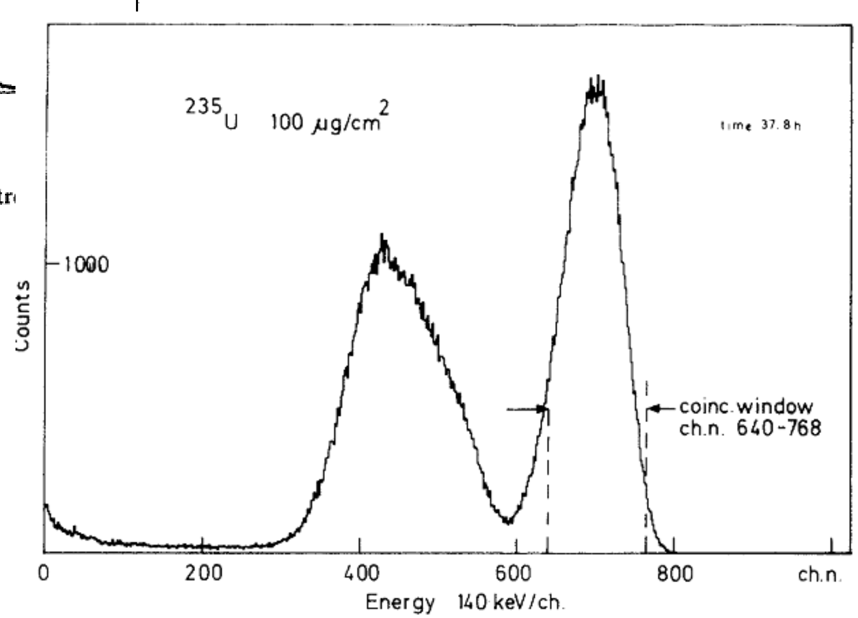


Fig. 2. Energy spectrum of fission fragments from $^{235}U(n, f)$ for thermal neutrons. Target thickness 100 $\mu g/cm^2$

Cosi fan tutte (PN8)
mass resolution

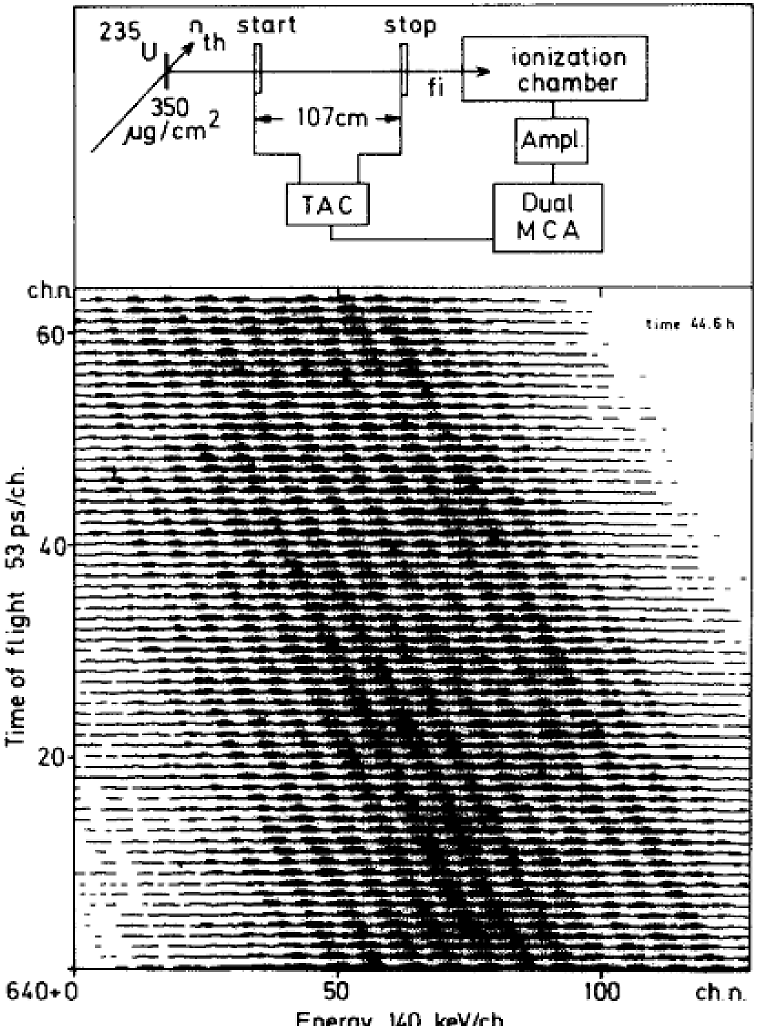


Fig. 3. Contour plot of correlated time-of-flight and energy data from ^{235}U(n, f) for thermal neutrons. Target thickness 350 μg/cm^2. The plot is for window settings on the time-of-flight and the energy as indicated by hatched lines in figs. 1 and 2. The data correspond to the light mass group. The insert shows schematically the setup.

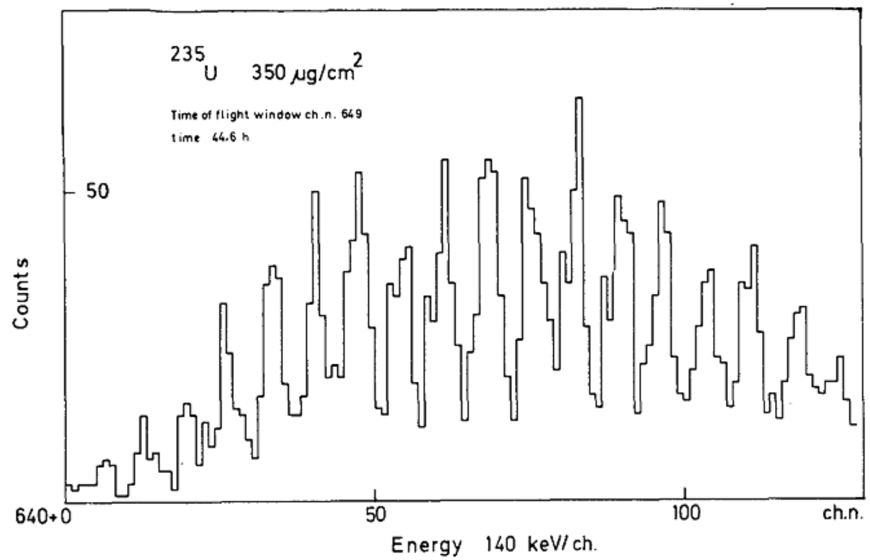


Fig. 4. Energy spectrum of fission fragments from ^{235}U(n, f) for thermal neutrons with a time window of 53 ps set on the time-of-flight. The peaks in the spectrum correspond to individual masses in the light mass wing of fragments.

Results [1]

ELSEVIER

Nuclear Physics A580 (1994) 15–32

NUCLEAR
PHYSICS A

Investigation of mass, charge and energy of $^{241}Pu(n_{th}, f)$ fragments with the Cosi-Fan-Tutte spectrometer

P. Schillebeeckx [a,1], C. Wagemans [b,c], P. Geltenbort [d], F. Gönnenwein [e], A. Oed [d]

[a] *CEC-JRC, Institute for Safety and Technology, I-21020 Ispra, Italy*
[b] *National Fund for Scientific Research, Brussels, Belgium*
[c] *Nuclear Physics Laboratory of the University, B-9000 Gent, Belgium*
[d] *Institut Laue – Langevin, F-38042 Grenoble, France*
[e] *Physikalisches Institut der Universität, W-72076 Tübingen, Germany*

Received 15 June 1993; revised 18 May 1994

Abstract

The mass, charge and energy distributions and their correlations have been studied for the fragments from thermal neutron-induced fission of ^{241}Pu, using the fission-fragment spectrometer Cosi-Fan-Tutte. The mass and charge distributions obtained agree with the corresponding radiochemical data. A proton even–odd effect of $(10 \pm 1.5)\%$ on the nuclear-charge yield and 0.4 ± 0.2 MeV on the total kinetic energy has been determined. A fission-mode analysis on the nuclear-charge distribution has been performed.

Results [2]

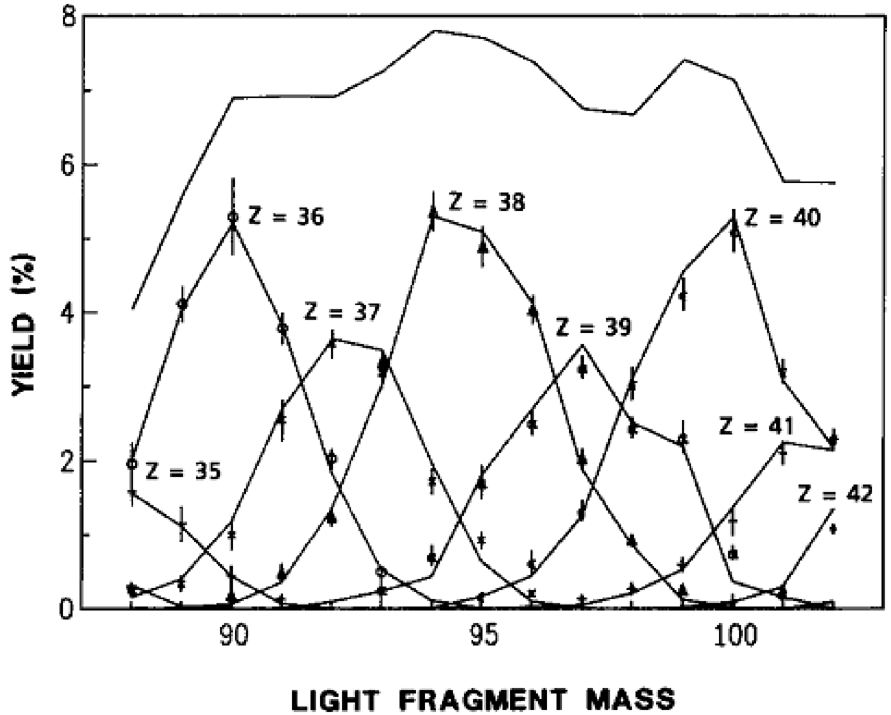


Fig. 4. Comparison of the nuclide distribution for $^{235}U(n_{th}, f)$ obtained in this work (points) with the results of Lang et al. [16] (full line).

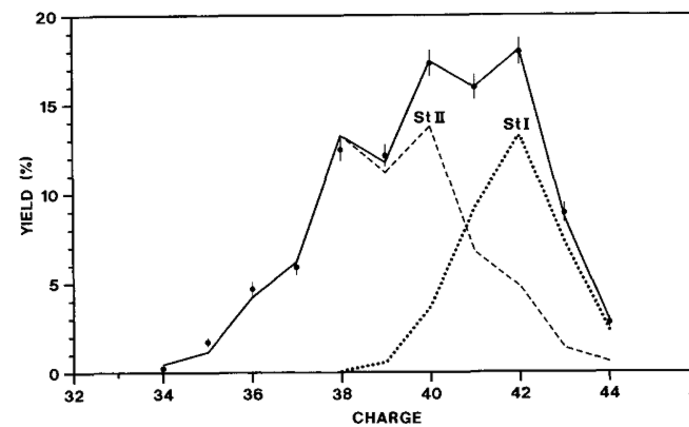


Fig. 10. The elemental distribution summed over kinetic energy for $^{241}Pu(n_{th}, f)$ obtained in this work (points) with the results of the fission-mode analysis (full line).

Anton Oed was born 1933 in Ulm

He studied Physics in Tübingen

For his diploma thesis on
"The double resonance spectrum of ^{23}Na"
he received the prize of the Mathematic-Natural Scientific Faculty of the University in Tübingen

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"The double quanta decay of the 2s level of hydrogen"

....

In September 1979 detached from the Physical Institute of the University of Tübingen, Germany, to the Institut Laue-Langevin (ILL) in Grenoble, France, to develop the detectors for the fission fragment spectrometer "Cosi fan tutte"

Returned to his "beloved atomic physics" in Tübingen

But "bought back" by the ILL to develop the next generation neutron detectors (5 October 1983 – 30 April 1998)

1988 proposed "Position-Sensitive Detector with Microstrip Anode for Electron Multiplication in Gases", NIMA263, 351 - 359

More in the following talks by V. Peskov and B. Guerard

Anton OED

1988 proposed "Position-Sensitive Detector with Microstrip Anode for Electron Multiplication in Gases", NIMA263, 351 - 359

PSD stands for **P**osition **S**ensitive **D**etector

which means in German

Orts**E**mpfindlicher **D**etektor or **OED**

Anton OED

Workshop

Progress in Gaseous MicroStrip Proportional Chambers

21 – 23 June 1993

ILL, Grenoble (France)