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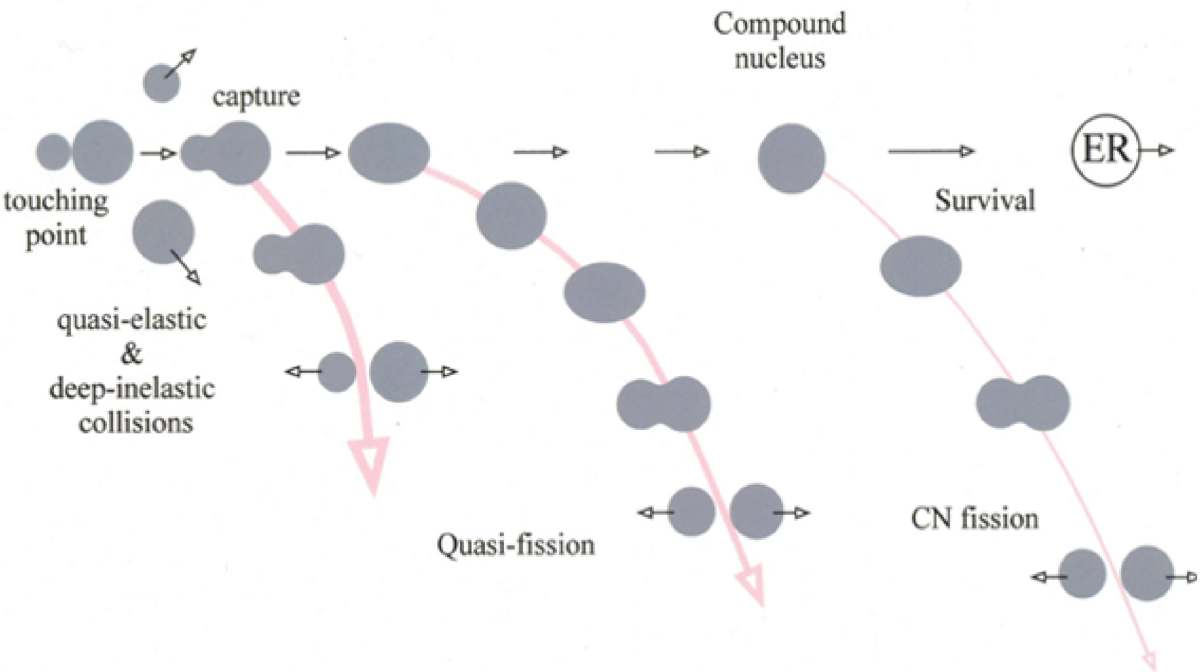
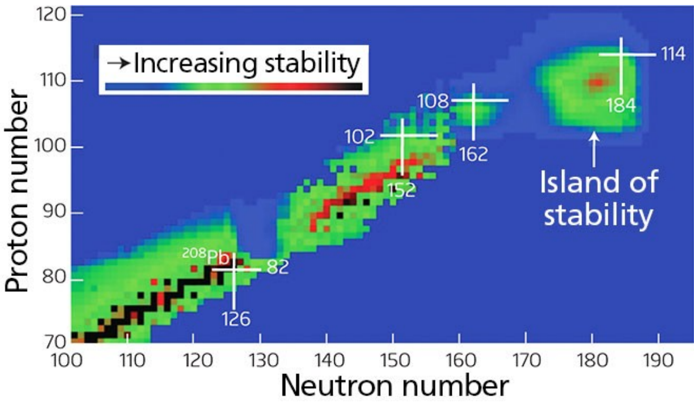
JINR Summer Practice - **Stage 2**

Measurement of mass-energy distributions of fission fragments using time-of-flight method

Supervisors: **Dr. Edurd Kozulin**, Kirill Novikov, Ivan Pchelintsev, Ivan Dyatlov, Iulia Harca

Introduction





- What are our limits?
- What are the signatures of the Fusion-Fission/Quasi-Fission processes?
- Why is the quasi-fission important?

The CORSET Time of Flight Spectrometer

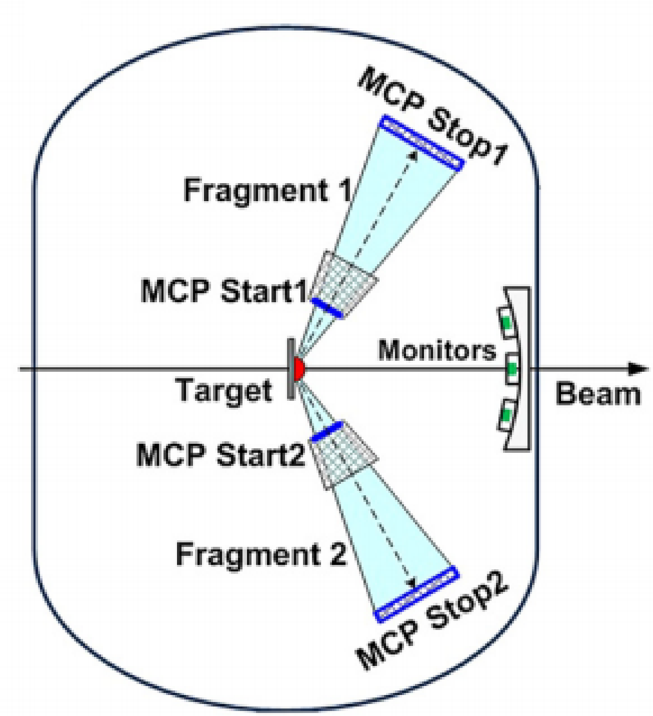
Measurable parameters:

- ToF, X, Y

Extractable parameters:

- Velocity
- Energy
- Angles
- Mass

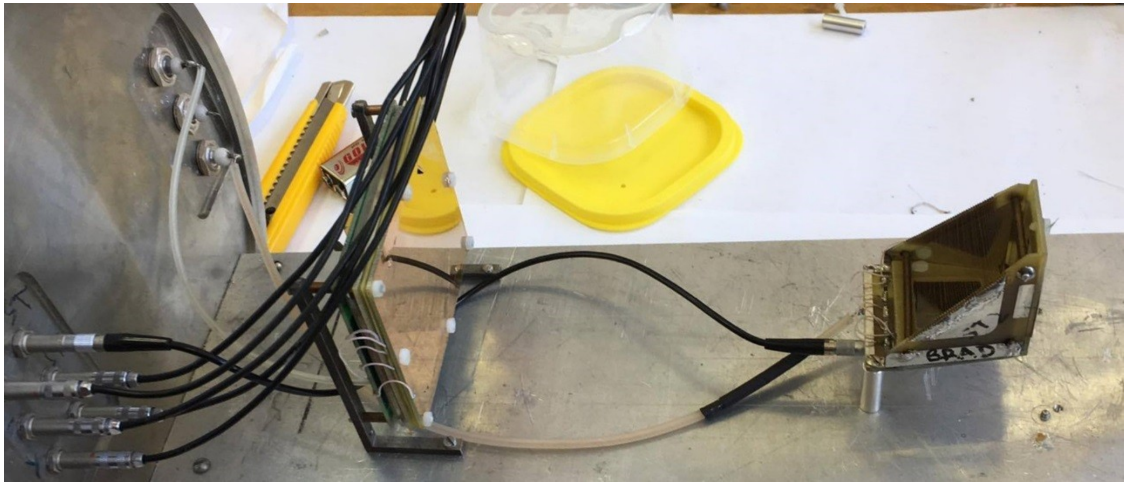
of reaction products

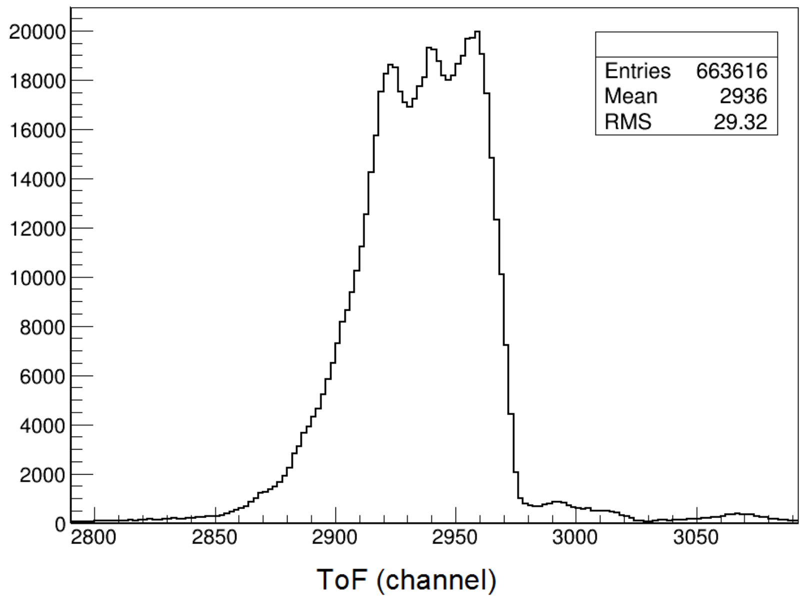


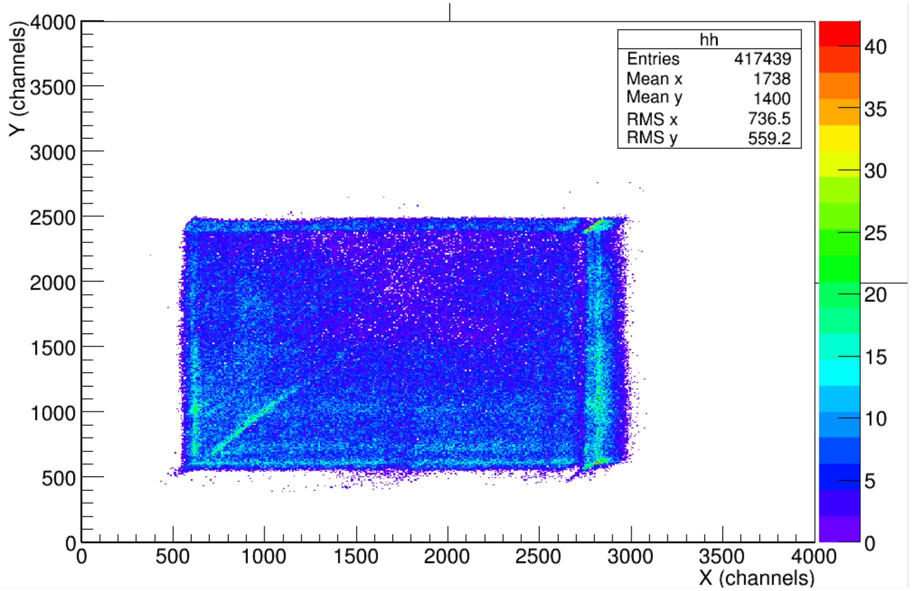
Time Resolution 150ps
Mass resolution ~2amu

The importance of calibration

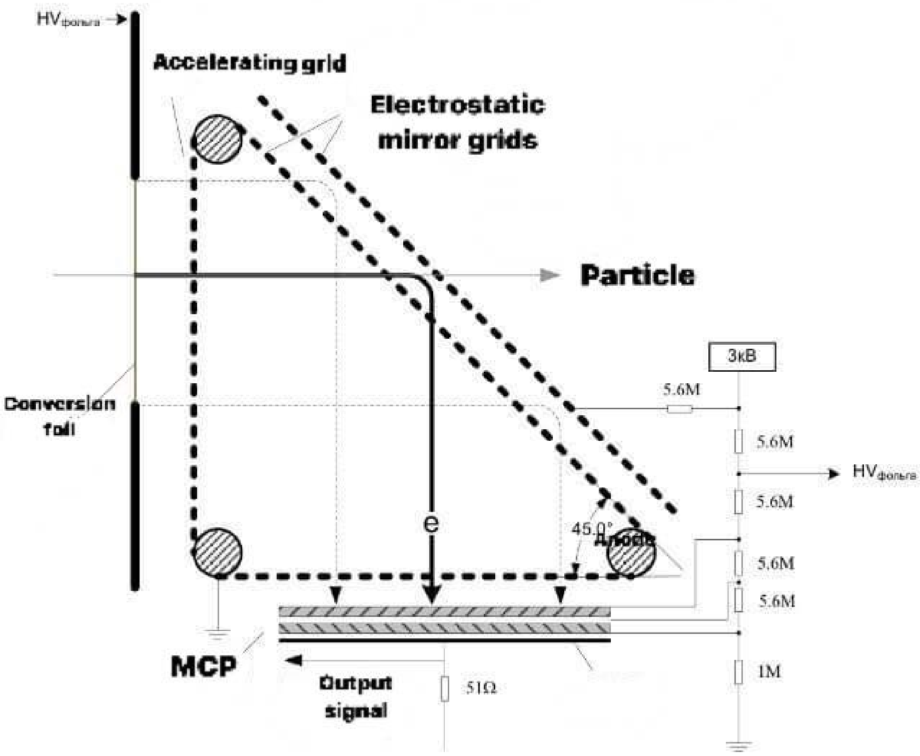
Source	Energy [KeV]	ToF [ns]
^{226}U	4824.4	14.41
^{238}Pu	5499.1	13.49
^{239}Pu	5155.8	13.94

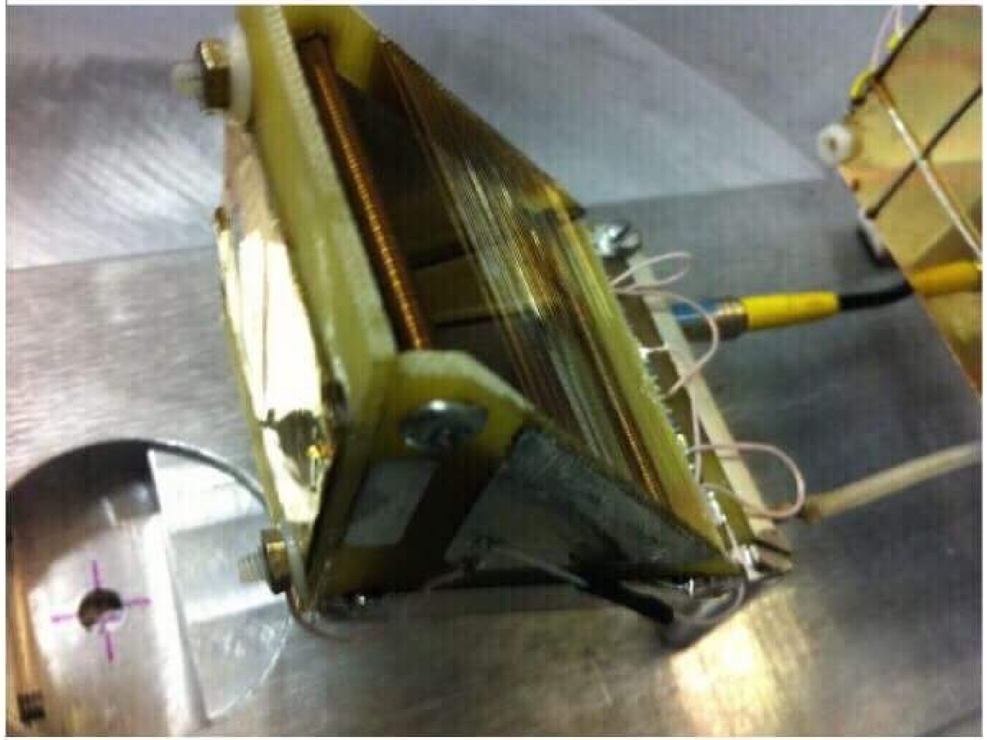




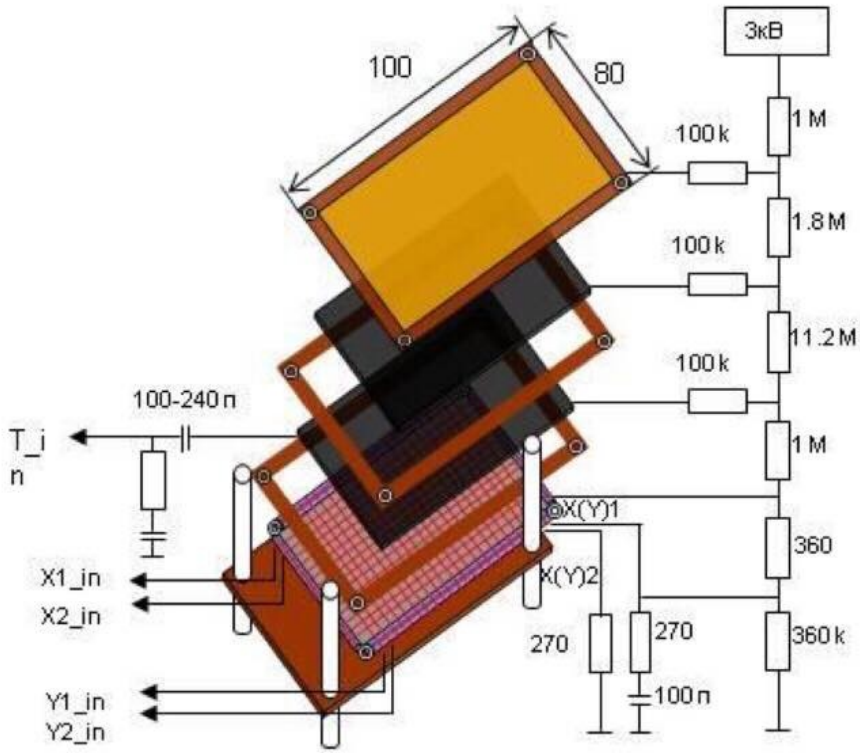


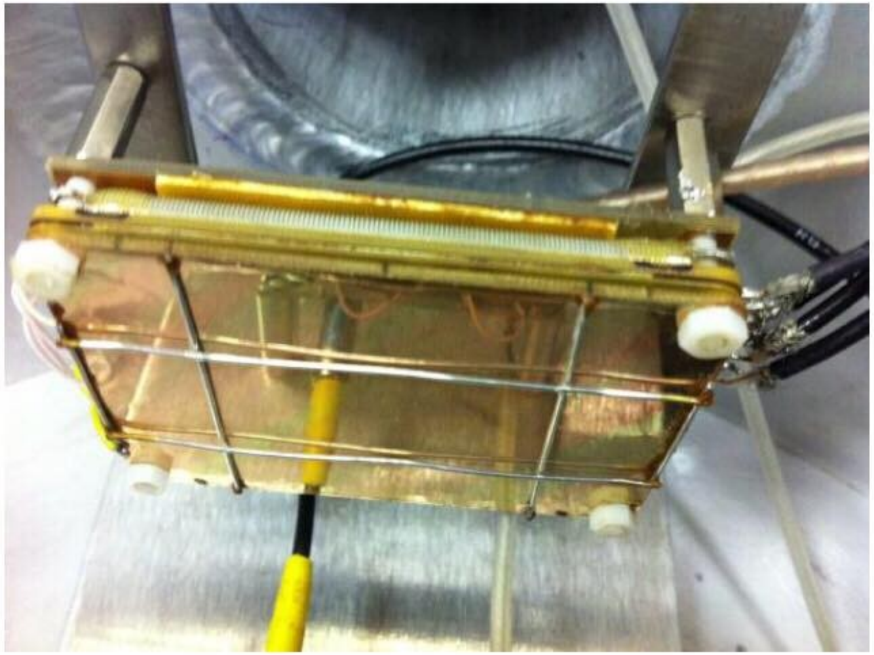
The START detector



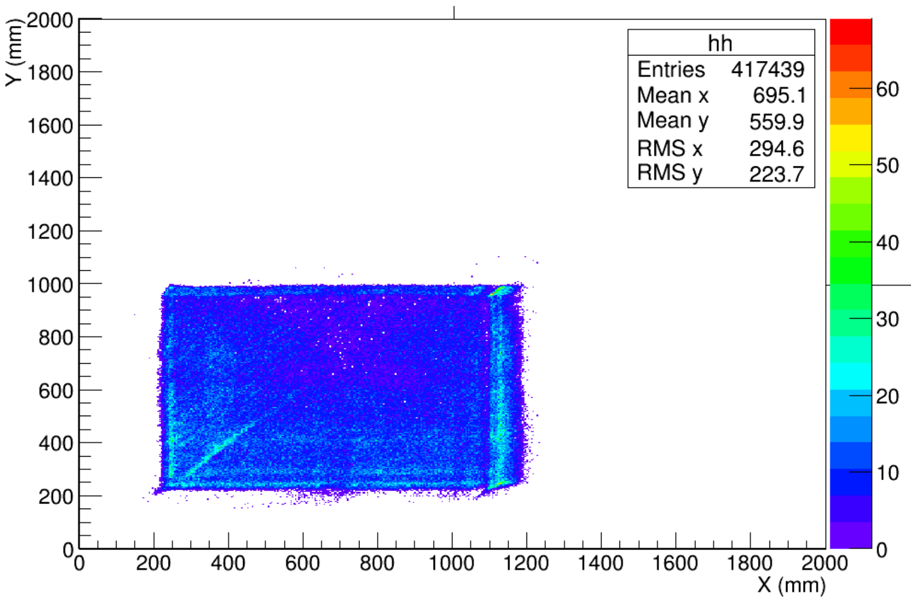


The STOP detector



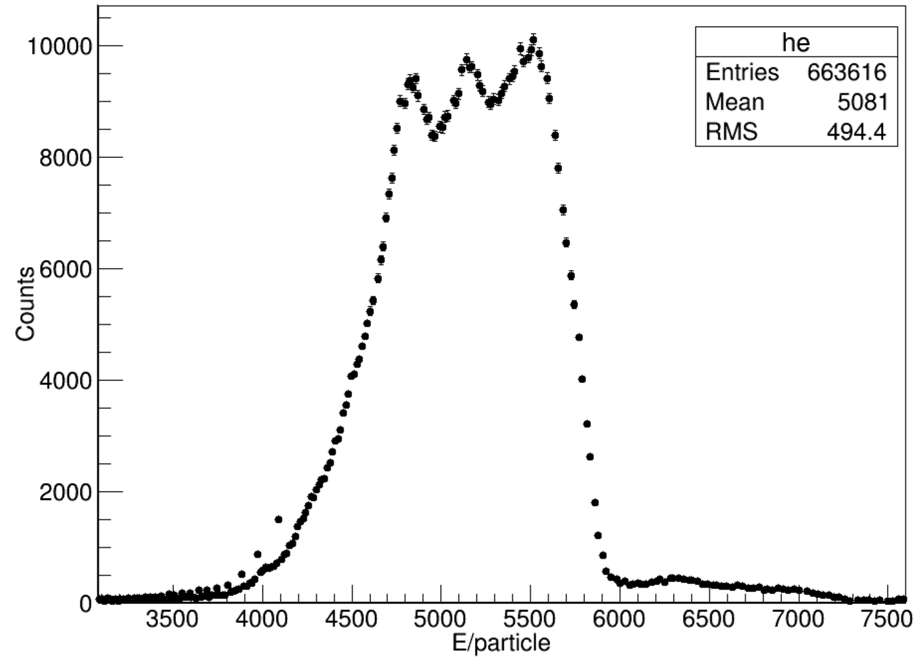


The results of the calibration



Two-dimensional spectrum of coordinates X and Y obtained by calibration of the detector using the alpha source

Calibrated energy spectrum of the alpha particles obtained from the ToF spectrum



A typical experiment

Beam	p, n, heavy ions
Target	Heavy target (± backing)
E_{beam}	$\sim V_C = \frac{Z_p Z_t e^2}{4\pi\varepsilon_0 R}$

M-TKE reconstruction

1. **Momentum conservation law:**

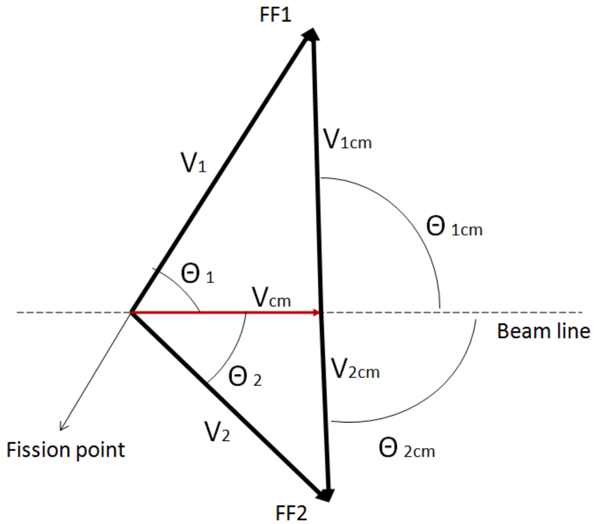
$$m_{proj}\overline{V_{proj}} = m_1\overline{V_1} + m_2\overline{V_2}$$

$$m_{proj}V_{proj} = m_1V_1\cos\Theta_1 + m_2V_2\cos\Theta_2$$

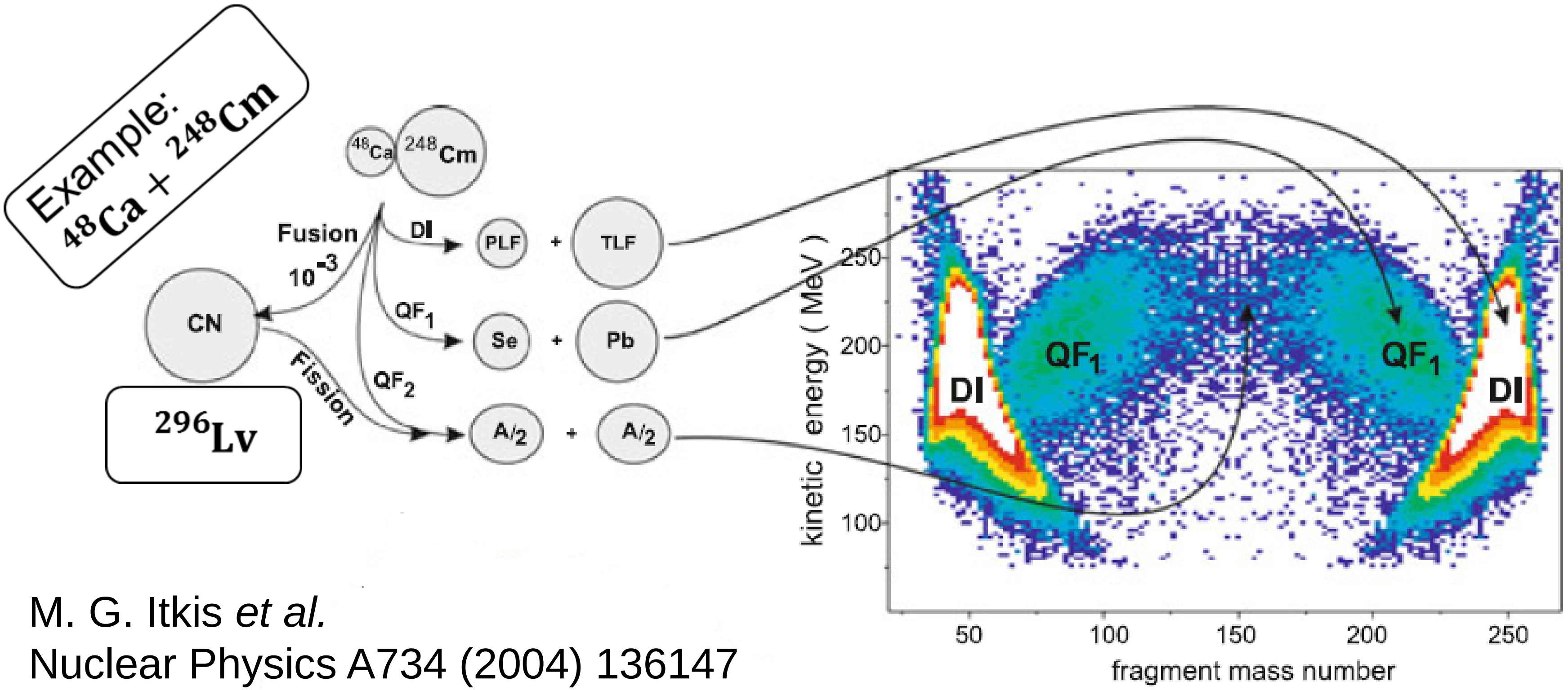
$$0 = m_1V_1\sin\Theta_1 + m_2V_2\sin\Theta_2$$

2. **Conservation of total amount of nucleons.**

$$m_{proj} + m_{tar} = m_1 + m_2 + \nu$$

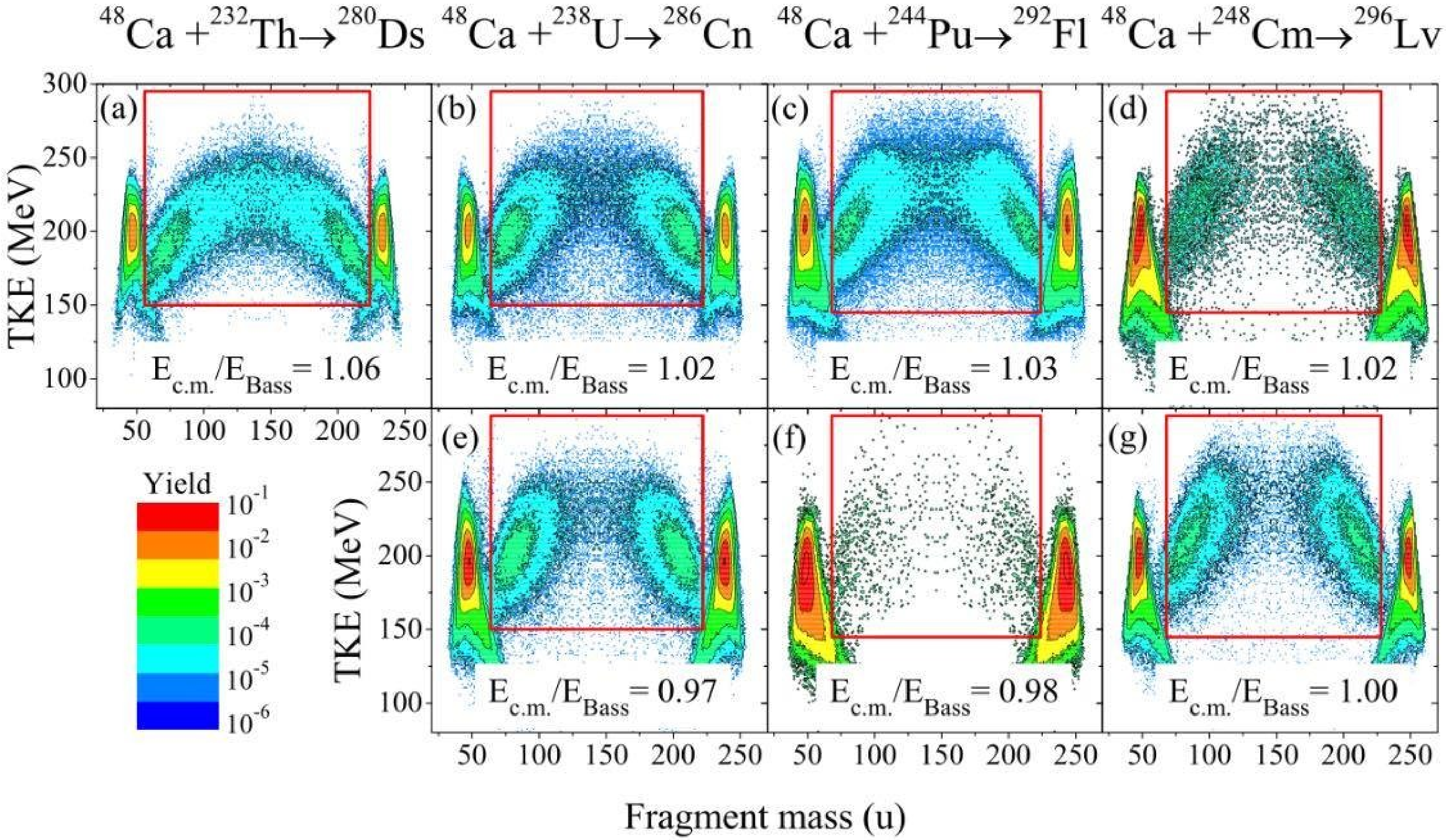


A typical experiment with CORSET

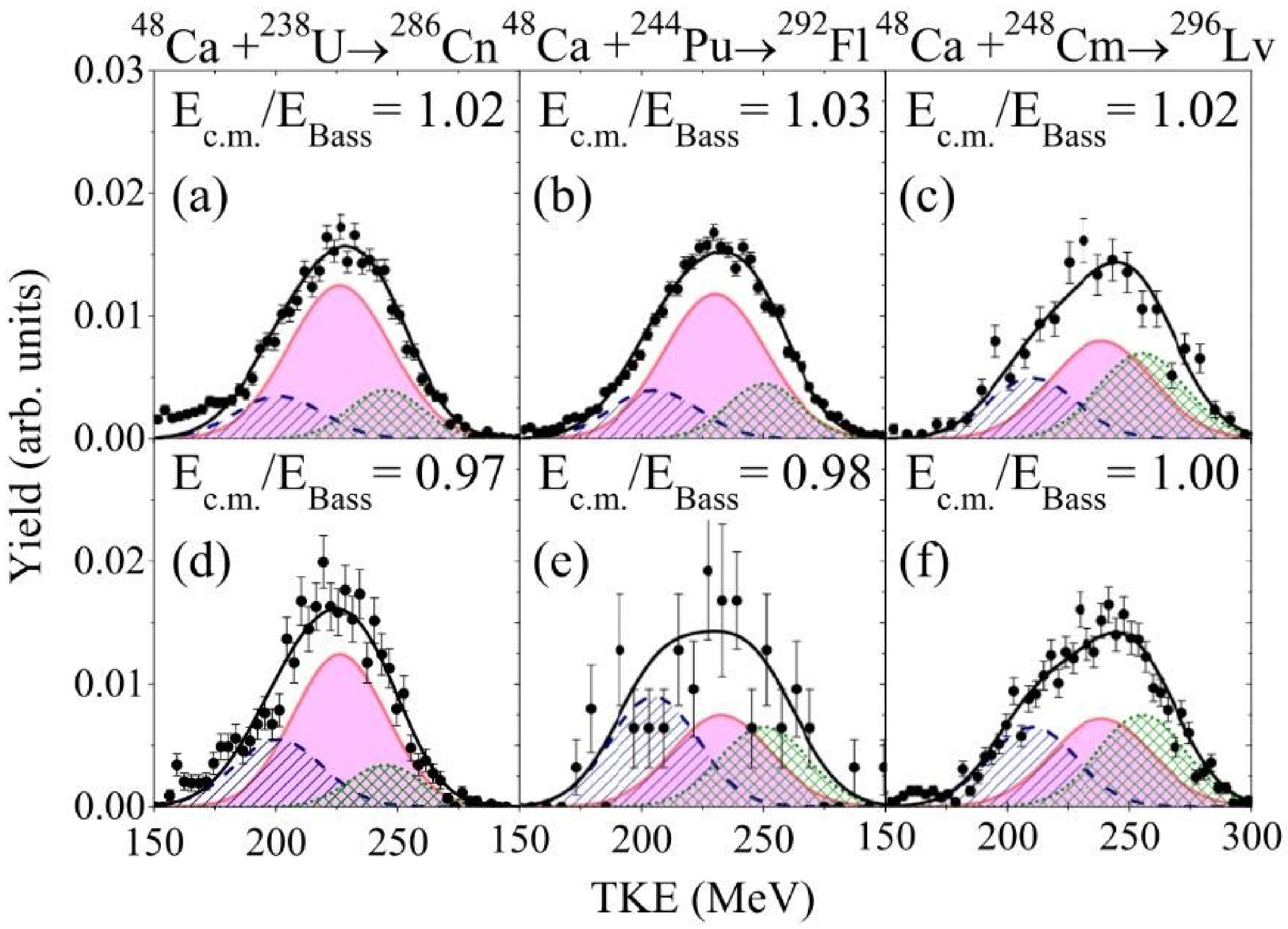


M. G. Itkis *et al.*
Nuclear Physics A734 (2004) 136147

A typical experiment with CORSET



A typical experiment with CORSET

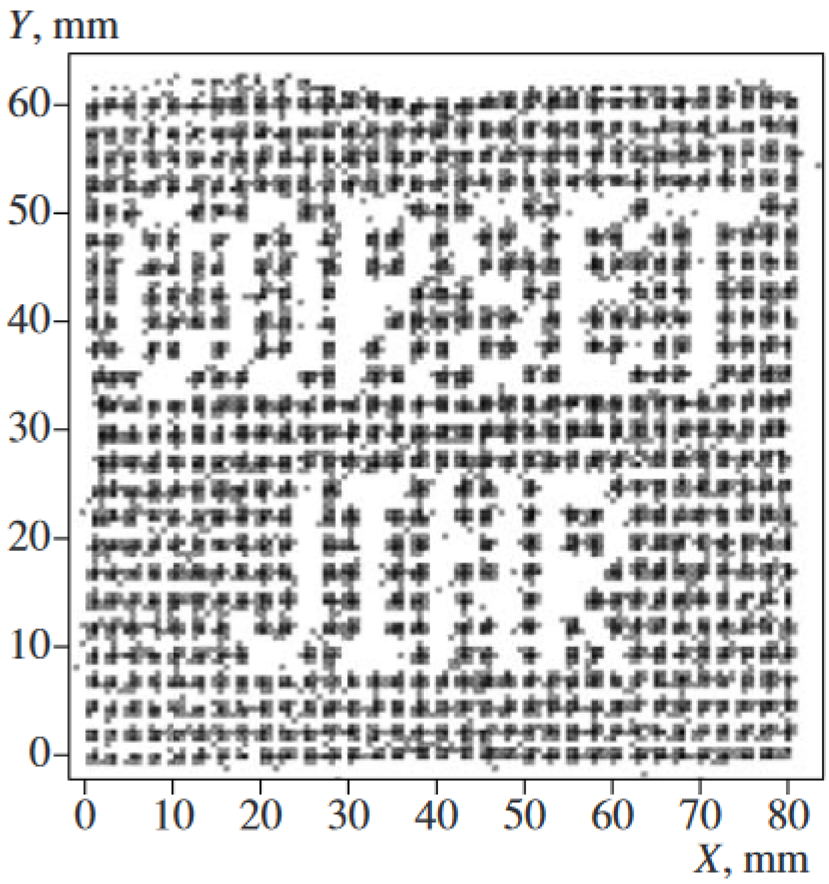


Conclusions

- The ToF-ToF method is a precise method for mass and energy of binary reaction products reconstruction.

- CORSET is a spectrometer suited for the study of the compound nucleus fission and quasi-fission competition in a heavy ion reaction.

- Before the beginning of the experiment it is mandatory to do the calibration of the detectors!



Kozulin et al.
The CORSET Time-of-Flight Spectrometer

Thank you for your attention!