

# Rozdział 6

## Programy symulacyjne



W planowaniu eksperymentów, kontrolowaniu ich przebiegu, a także w trakcie analizy zebranych wyników bardzo ważną rolę odgrywają programy, które pozwalają realistycznie symulować procesy separacji i identyfikacji jonów w separatorze fragmentów.

Najważniejsze (najbardziej rozpowszechnione) są dwa programy :

- ▶ **LISE** – program na platformie Windows, działający w oparciu o przybliżenia analityczne. Oprócz symulacji separatora zawiera cały pakiet programów pomocniczych. Samowystarczalny i stosunkowo łatwy w użyciu, pozwala na bardzo szybkie obliczenia dla wielu nuklidów. Wywodzi się z GANIL, gdzie stworzono go do symulacji separatora LISE.
- ▶ **MOCADI** – program Monte Carlo, na platformie UNIX. Elastyczny i uniwersalny, pozwala na realistyczne symulacje dowolnych układów jonowo-optycznych. Raczej niewygodny w użyciu, i powolny. Wymaga plików z macierzami optycznymi. Wywodzi się z GSI, gdzie stworzono go głównie do symulacji separatora FRS.



# Program LISE

Address <http://groups.nsl.msu.edu/lise/lise.html>

version 7.1

## SIMULATION OF FRAGMENT SEPARATORS

### Range of application

The program **LISE** has been developed to calculate the transmission and yields of fragments produced and collected in a spectrometer. This code allows to simulate an experiment, beginning from the parameters of the reaction mechanism and finishing with the registration of products selected by a spectrometer. The program allows to quickly optimize the parameters of the spectrometer before or during the experiment. It also makes it possible to estimate and work in conditions of maximum output of studied reaction products and their unambiguous identification. Wedge and Wien filter selections are also included in the program.

**LISE++** is the new generation of the **LISE** code, which allows the creation of a spectrometer through the use of different "blocks". The number of blocks used to create a spectrometer in **LISE++** is limited by operating memory of your PC and your imagination.

built-in Energy loss, Time-of-Flight, Position, Angular, Charge, Cross-Section distribution plots and dE-E, dE-TOF, Z-A/Q and dE-X two-dimensional plots allow to visualize the results of the program calculations. An application of transport integral lies in the basis of fast calculations of the program for the estimation of temporary evolution of distributions of phase space.

The **LISE** code may be applied at medium-energy and high-energy facilities (**fragment- and recoil-separators with electrostatic and/or magnetic selections**). A number of these facilities, like **A1900** at NSCL, **LISE3**, **SISSI/LISE3** and **SPEQ** at GANIL, **FRS** at GSI, **COMBAS** and **ACCULINA** at Dubna, and **RIPS** at RIKEN, based on the separation of projectile-like fragments and fusion residues are included or might be easily added to the existing optical configuration files.

The **projectile fragmentation**, **fusion-evaporation**, and **Coulomb fission** assumed in this program as the production reaction mechanism allows to simulate experiments at beam energies above the Coulomb barrier.

**Built-in powerful tools:**

Done Internet

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The **projectile fragmentation**, **fusion-evaporation**, and **Coulomb fission** assumed in this program as the production reaction mechanism allows to simulate experiments at beam energies above the Coulomb barrier.

**Built-in powerful tools:**

- «Physical Calculator»,
- «Relativistic Kinematics Calculator»,
- «Evaporation Calculator»,
- «Spectroscopic calculator" (of J.Kantele»,
- «Matrix calculator",
- «PACE4» (fusion-evaporation code),
- «Global» (charge-state distribution code),
- «Charge» (charge-state distribution code),
- Nuclide Database utilities,
- Units converter,
- Transport calculations,
- Brho analyzer,
- Monte Carlo simulation of fission fragment kinematics,
- «B!» - the automatized search of two-dimensional peaks in spectra and definition of their characteristics

permit to work well below this energy limit, and this makes the program **very attractive for all users dealing with physics of heavy ions** from 10 keV up to some GeV per nucleon.

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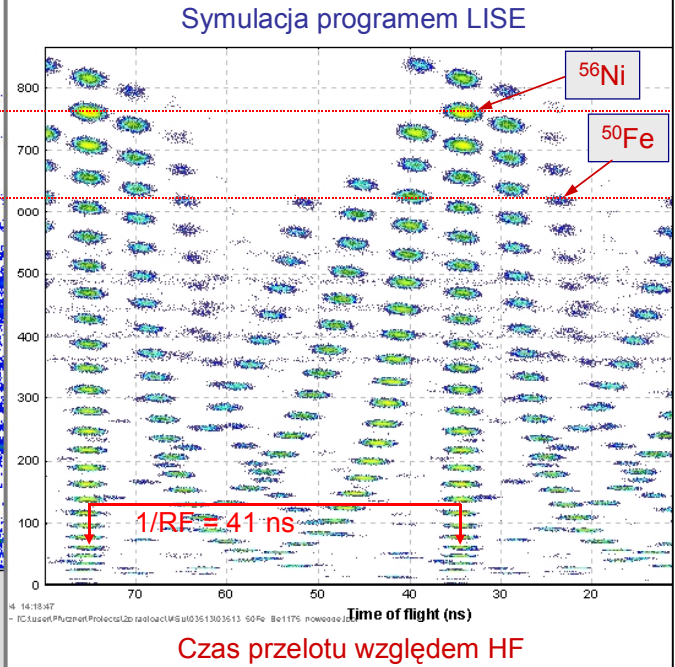
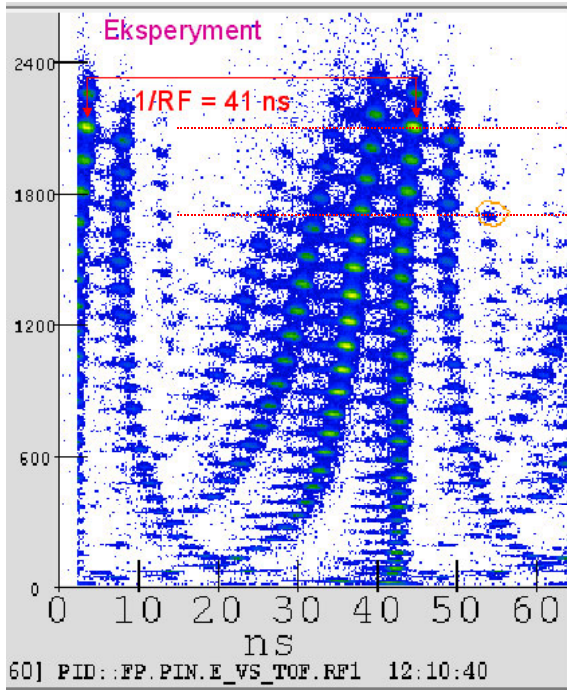
[LISE++ presentation - PowerPoint \(4 MB\)](#)  
[LISE++ fission - PowerPoint \(3 MB\)](#)  
[LISE++ first steps - PDF \(131 KB\)](#)

LISE

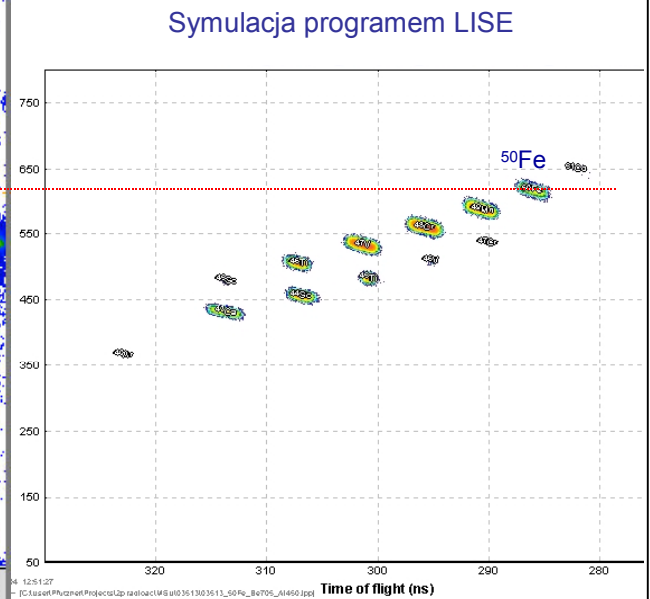
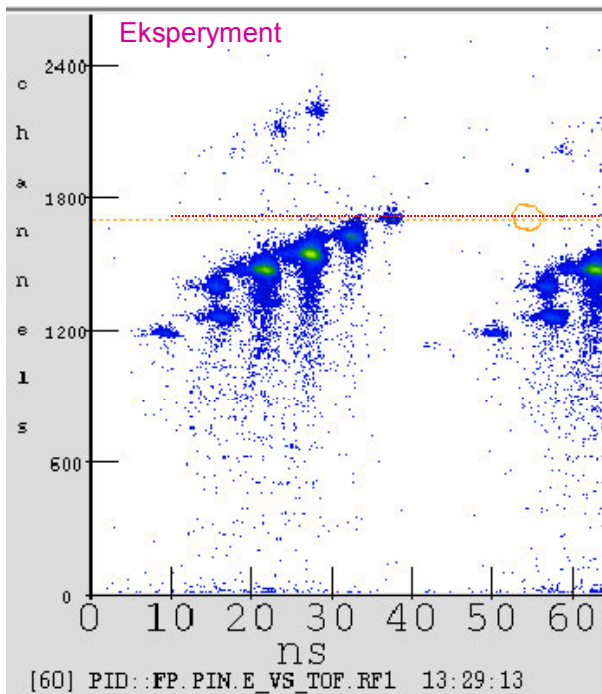
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Fragmety  $^{58}\text{Ni}$  @ 160 AMeV, MSU

Ustawienie na  $^{50}\text{Fe}$ , tarcza Be  $1175\text{ mg/cm}^2$ , bez degradera



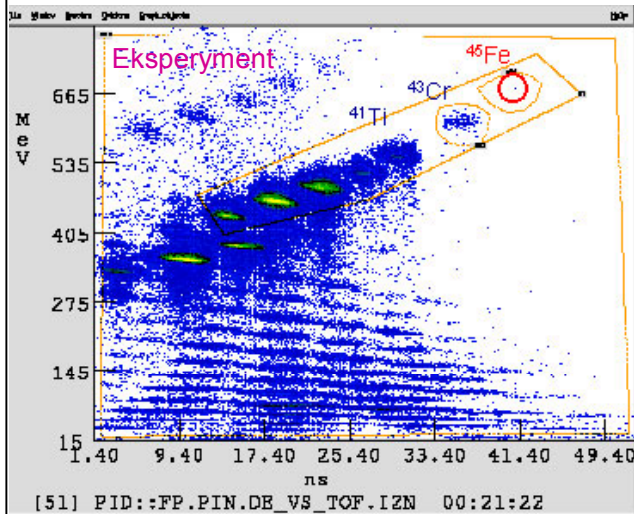
Degrader w ognisku środkowym  
tarcza Be  $705\text{ mg/cm}^2$ , degrader Al  $450\text{ mg/cm}^2$



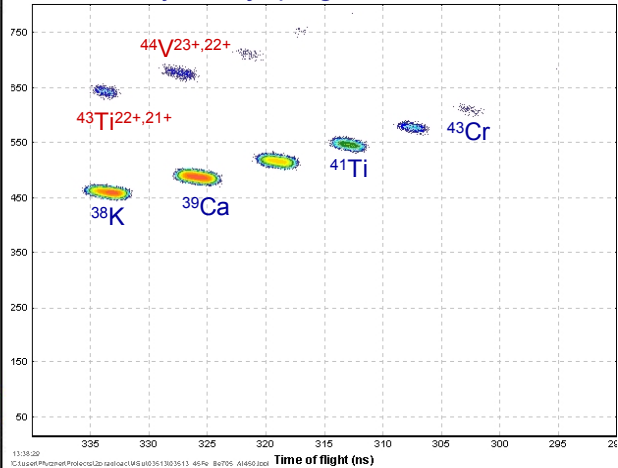


## Ustawienie na $^{45}\text{Fe}$

Degrader w ognisku środkowym  
tarcza Be 705 mg/cm<sup>2</sup>, degrader Al 450 mg/cm<sup>2</sup>



## Symulacja programem LISE



# Program MOCADI

Address: <http://www-linux.gsi.de/~weick/mocadi/index.html>

**HOT MOCADI 1.34-2.10 HOT**

Mocadi home **Manual** Download Area Wedge

### Introduction

MOCADI is a [Monte Carlo](#) simulation program to calculate the transport of primary beams, projectile fragments, and fission fragments through ion optical systems described by third order transfer matrices and through layers of matter. The ion optical matrices can be calculated with the program [GICO](#). Currently, input data describing the FRS from the target to F4, F6, Cave B and Cave C are available for a variety of ion optical settings. Atomic interactions [1] and nuclear interactions of relativistic heavy ions with matter are calculated according to [2]. Charge state distributions are not calculated but have to be given explicitly as an input parameter. They can be obtained from the programs [CHARGE](#) or [GLOBAL](#). In the case of projectile fragments the calculation of cross sections via the [EPAX](#) formula is included. [CERN](#)-standard histograms ([HBOOK](#)) and list-mode output ([Ntuple](#)) for particle mass, charge, rigidity, energy, positions, angles, TOF, and more are available at any position along the optical system. They can conveniently be analyzed with [PAW](#).

### How to use MOCADI at GSI

MOCADI at GSI is currently available on the [VMS Alpha cluster](#) and on the [LINUX-FARM](#). The input parameters for MOCADI like beam properties, magnet settings and the geometric information of the experimental setup (magnets, collimators, wedges etc.) are supplied by an ASCII input file. This input file also includes references to the data files containing the matrices for the particle transfer through the various magnets. The easiest way to use MOCADI is to [get an example input file](#) for the setup to be calculated and adapt it to special needs. To run the VMS-MOCADI type:

```
/u/weick/mocadi/mocadi < filename >
```

where < filename > is the name of the MOCADI input file. The default extension of the input file is ".in" and can be omitted. For more details see the [MOCADI manual](#). To download an example input file or for information about the available ion optical settings go to the [MOCADI download area](#).

MOCADI IS FUN!

Plik wejściowy do obliczeń energii jonów i ich sztywności magnetycznej po wyjściu z tarczy oraz przejściu przez warstwy materiału. Bez elementów optyki jonowej!

Target\_177Ta.in

> **Mbcadi target\_177Ta.in**

Plik wyjściowy zawierający wyniki obliczeń :

Target\_177Ta.out

Plik wejściowy do pełnej symulacji dla separatora FRS. Obliczenie produkcji i separacji  $^{177}\text{Ta}$  oraz wybranych sąsiednich nuklidów.

Full\_177Ta.in

W rezultacie pełnych obliczeń tworzą się następujące pliki :

Full\_177Ta.out

- plik wynikowy (zawsze) : **nnn.out**
- tabela wybranych parametrów : **nnn.tab**
- plik binarny w standardzie HBOOK zawierający pełną informację „zdarzenie po zdarzeniu” do analizy programem PAW : **nnn.hbk**

Full\_177Ta.tab



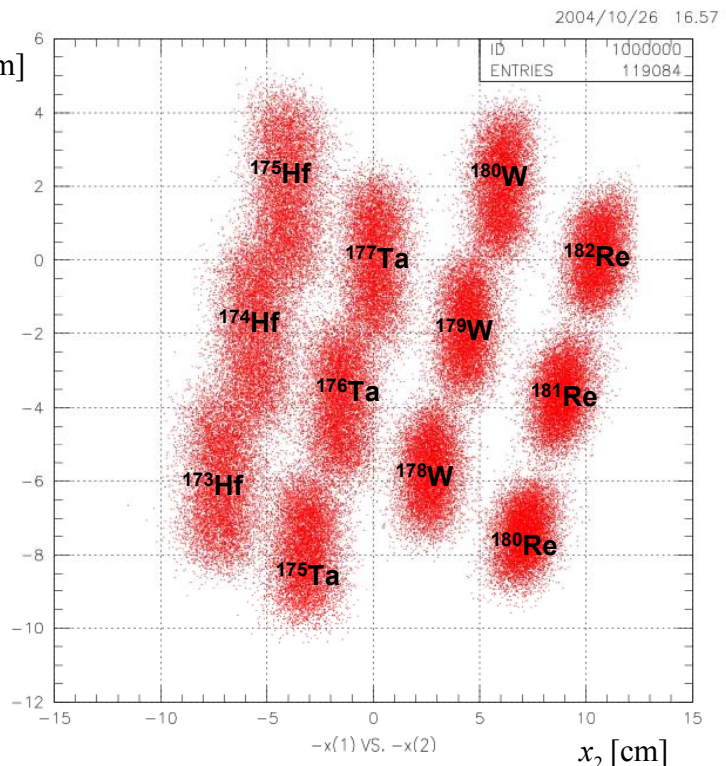
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### Przykłady analizy pliku Full\_177Ta.hbk

Symulacja reakcji :  
 $^{208}\text{Pb} (1 \text{ AGeV}) + ^9\text{Be} \rightarrow ^{177}\text{Ta}$

Tarcza : 1.623 g/cm<sup>2</sup>, Be

Degrader : 5.547 g/cm<sup>2</sup>, Al.  
achromatyczny  $\theta_K = 0.33^\circ$



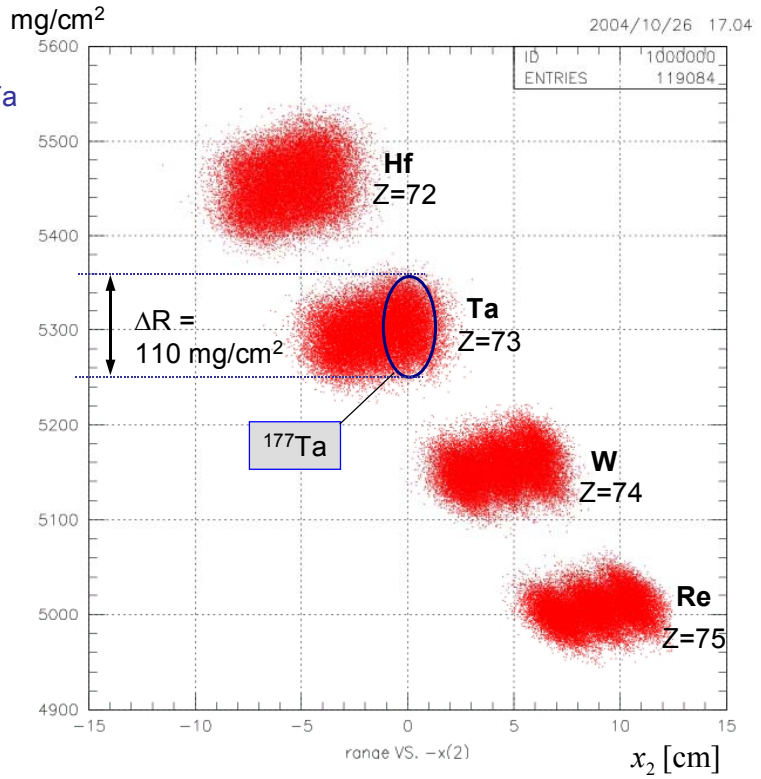
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$^{208}\text{Pb}$  (1 AGeV) +  $^9\text{Be}$   $\rightarrow$   $^{177}\text{Ta}$

Degrader achromatyczny

$$\theta_K = 0.33^\circ$$

Zasięg jonów w krzemie w ognisku końcowym



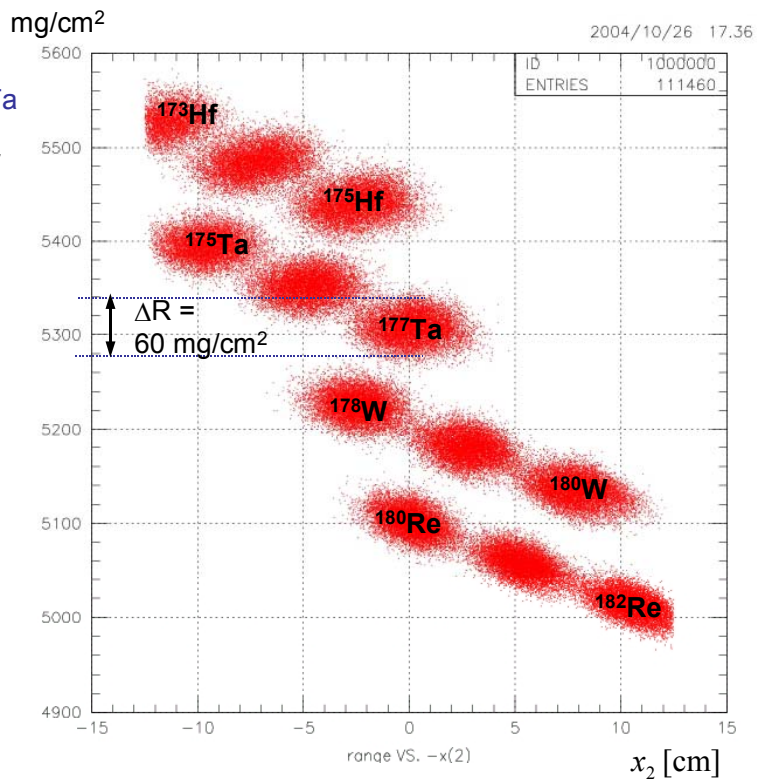
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$^{208}\text{Pb}$  (1 AGeV) +  $^9\text{Be}$   $\rightarrow$   $^{177}\text{Ta}$

Degrader monoenergetyczny

$$\theta_K = 0.74^\circ$$

Zasięg jonów w krzemie w ognisku końcowym



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