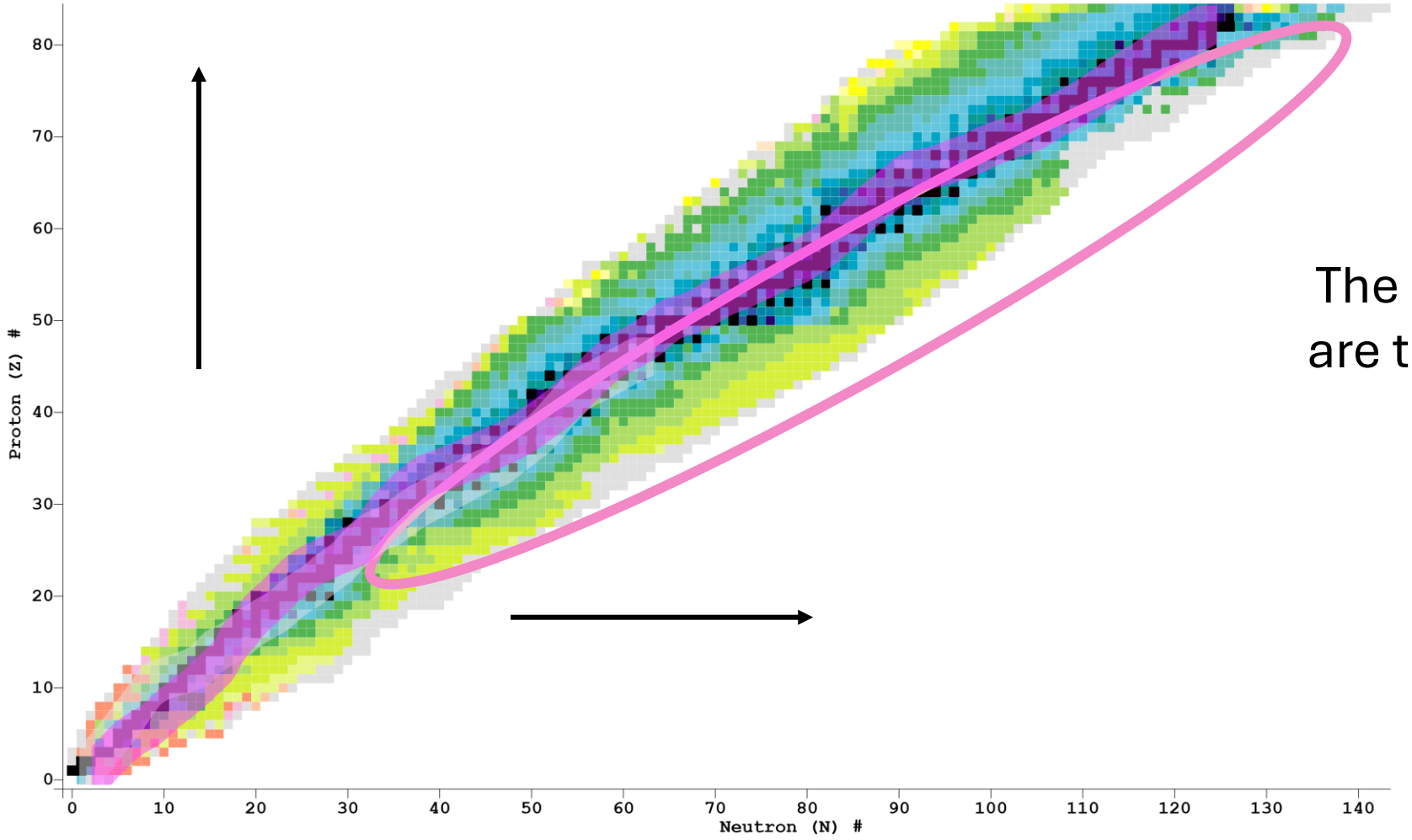
Elastic α-scattering on ^{116,118}Sn at energies around the Coulomb barrier

20th Russbach School on Nuclear Astrophysics

Raquel Nunes

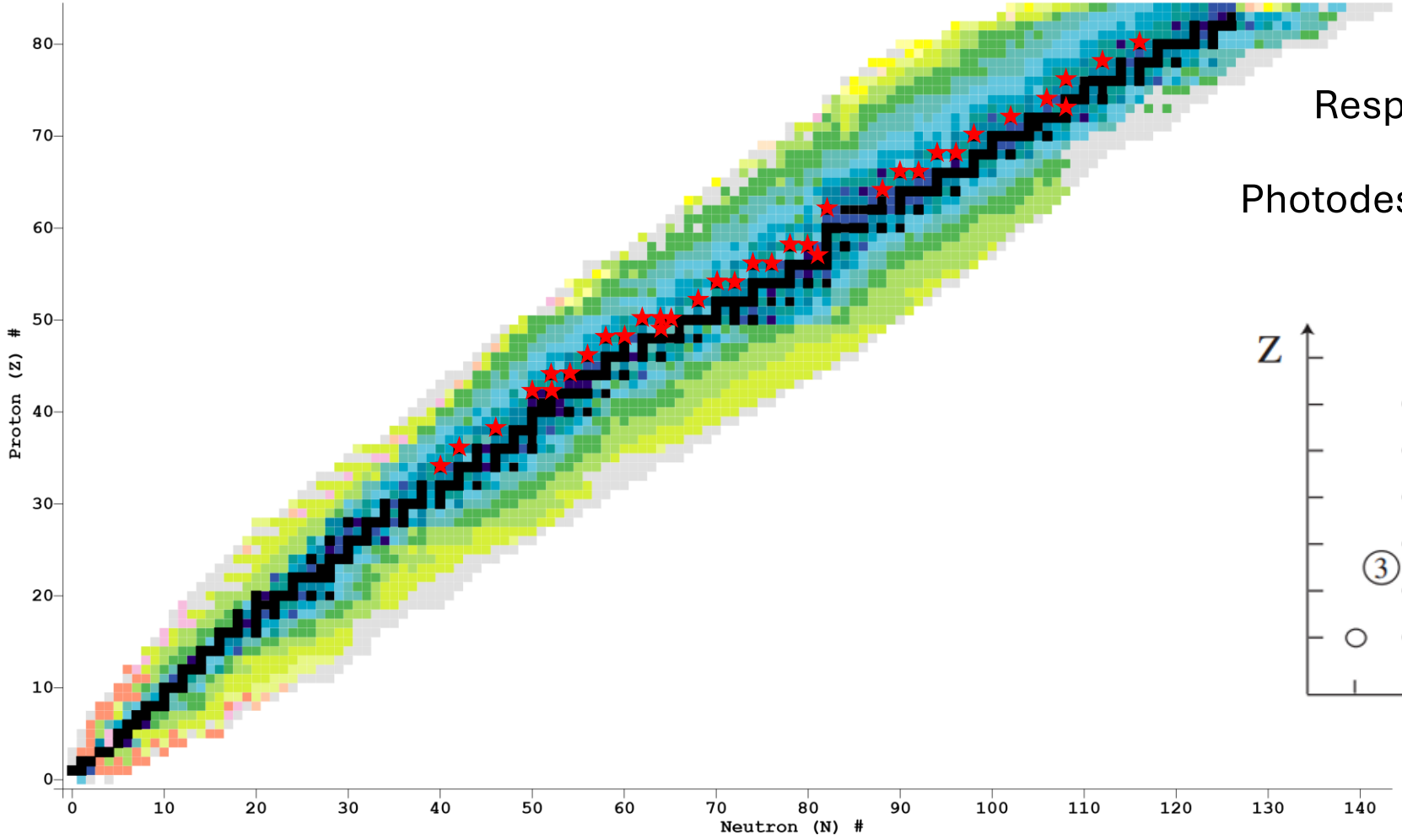
19/03/2025

Introduction



The s-process and r-process are the main neutron capture mechanisms

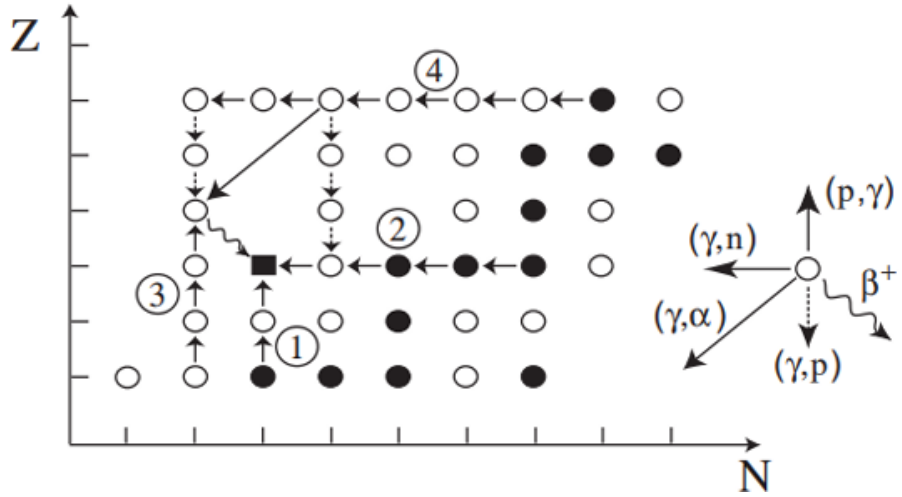
Introduction



p-process

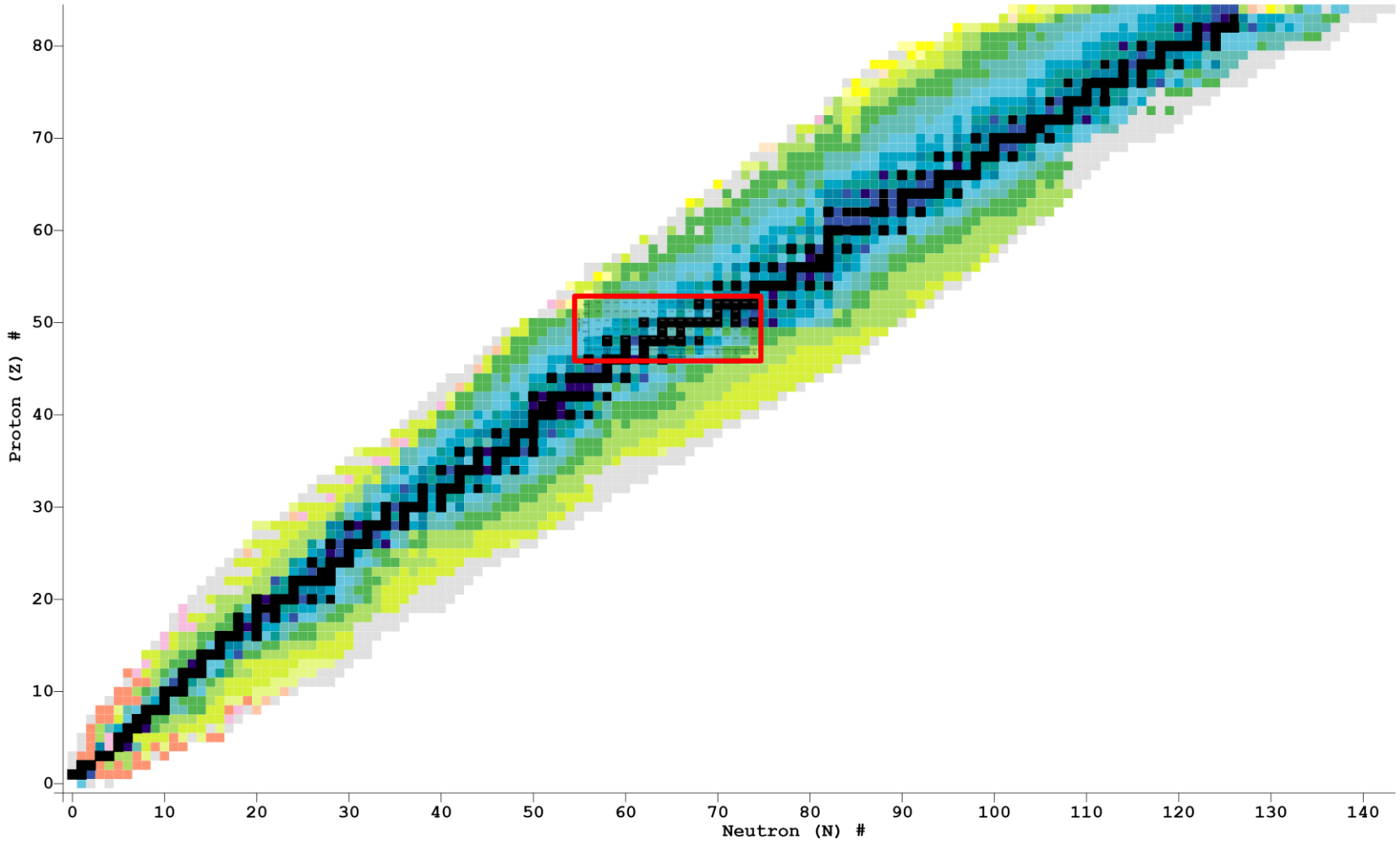
Responsible for the production of 35 nuclides heavier than Fe.

Photodesintegrations reactions are the main mechanism.



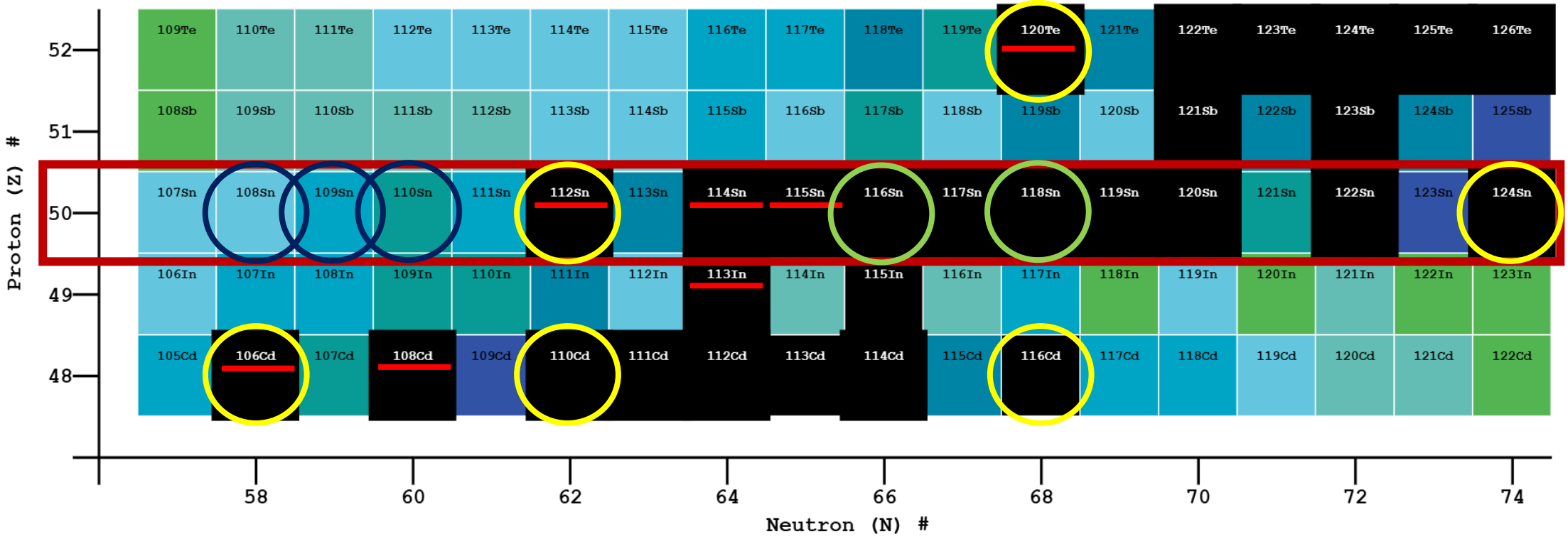
Arnould, M. & Goriely, S., Physics Reports, 2003, 384(1), 1-84

Introduction



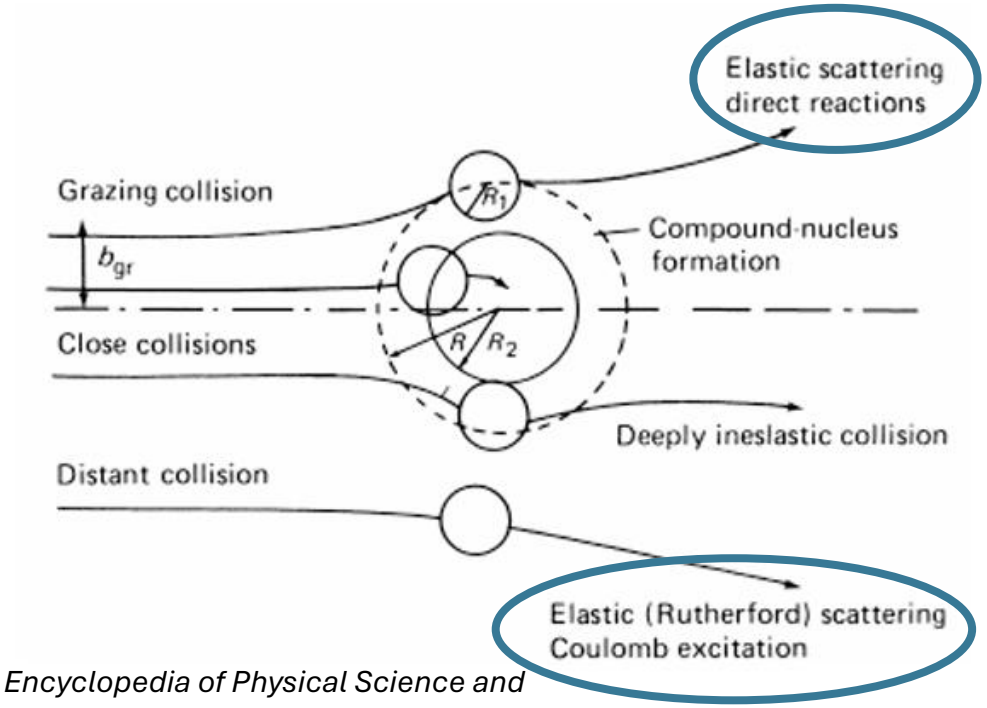
Introduction

- **What motivated this experiment? Why Sn isotopes?**



Introduction

- **Elastic scattering**



Loveland, W., *Encyclopedia of Physical Science and Technology* (3ª ed.), Academic Press, 2003, pp. 597–615.

$$\left(\frac{d\sigma}{d\Omega}\right)_{Ruth}(\theta_{c.m.}) = \left(\frac{zZe^2}{4\pi\varepsilon_0}\right)^2 \left(\frac{1}{4E_{c.m.}}\right)^2 \frac{1}{sin^4\frac{\theta_{c.m.}}{2}}$$

Elastic scattering depends on the **energy of incident particle** and on the **impact parameter**

Experiment

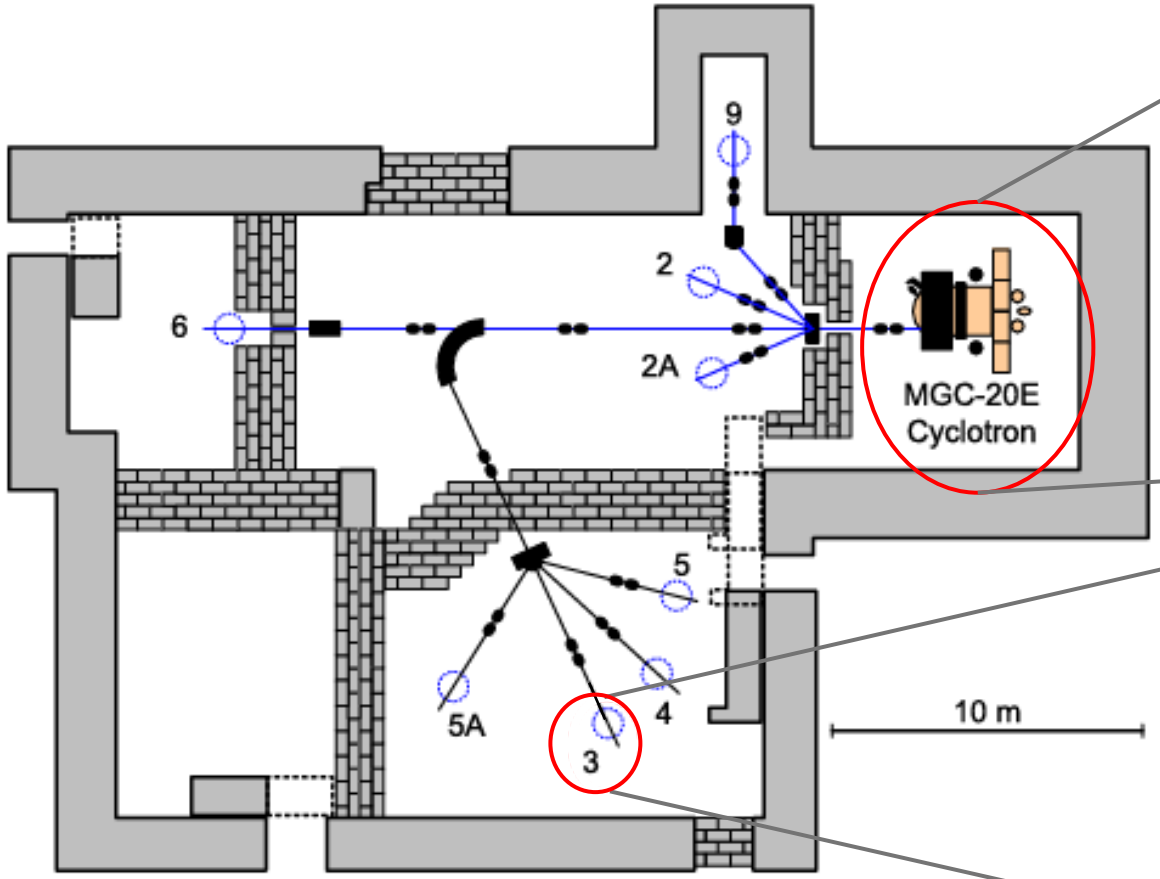
Three angular distribution were measured for both targets at energies around the **Coulomb Barrier.**

Isotope	$E_\alpha(MeV)$	Coulomb Barrier (MeV)
^{116}Sn	16.12; 17.00; 19.50	18.57
^{118}Sn	16.12; 17.00; 19.50	18.49

Why?

Experiment

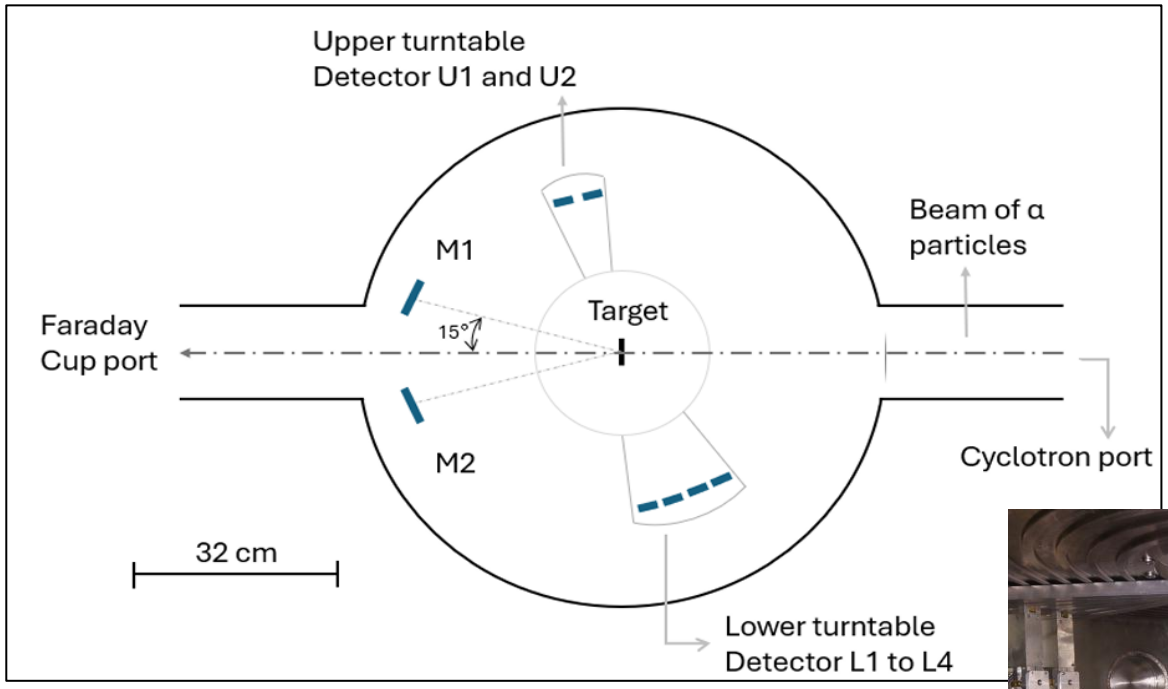
- **Experiment: ATOMKI cyclotron laboratory, Hungary**

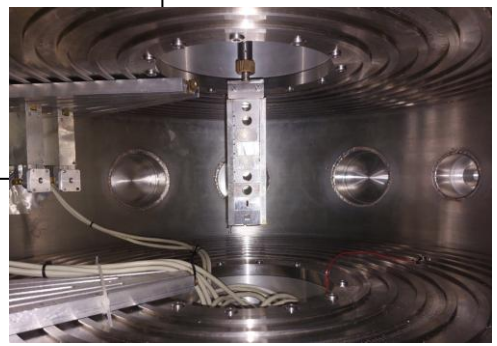


Experiment

- **Scattering chamber**

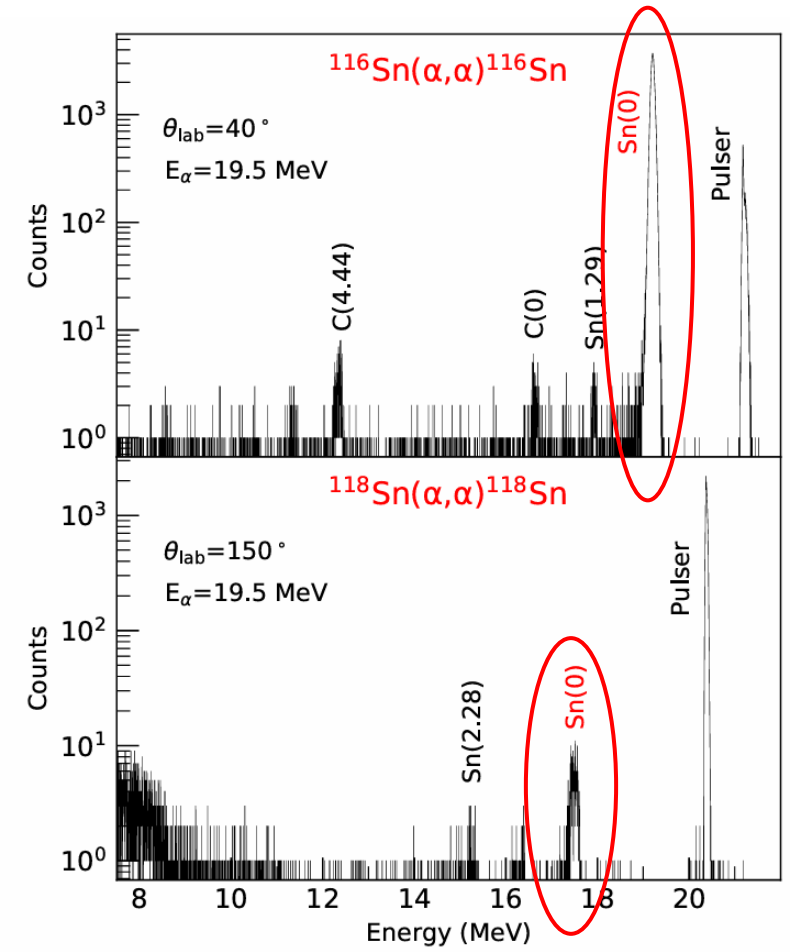
The scattering chamber contains a target ladder in the center of the chamber and several surface barrier silicon detectors around the target.





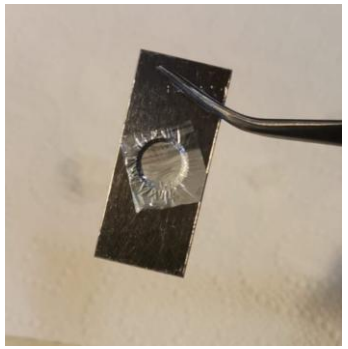
Data Analysis

- **Spectrum Analysis**



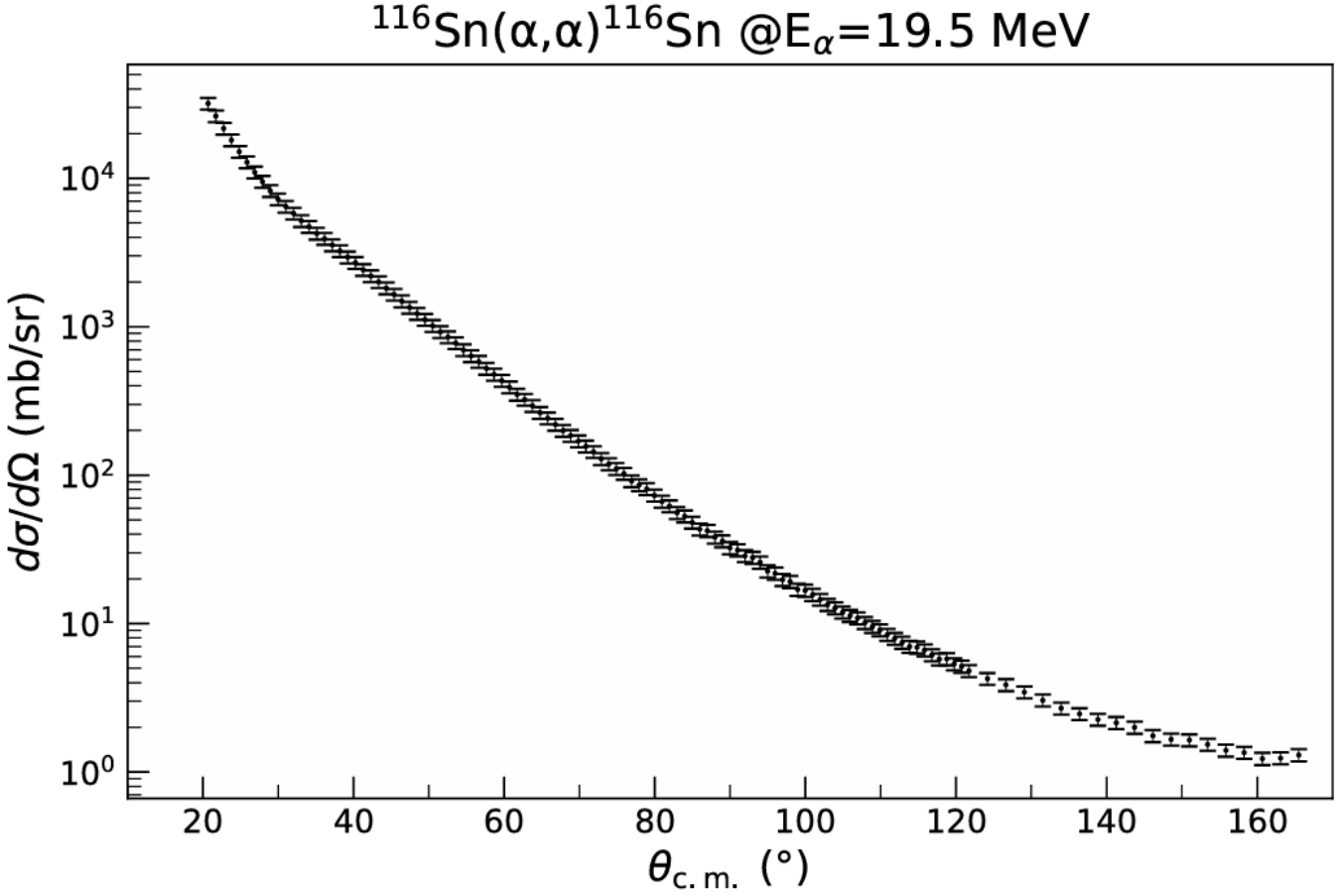
If you need targets you can contact our team in Lisbon!!!

^{116}Sn Target



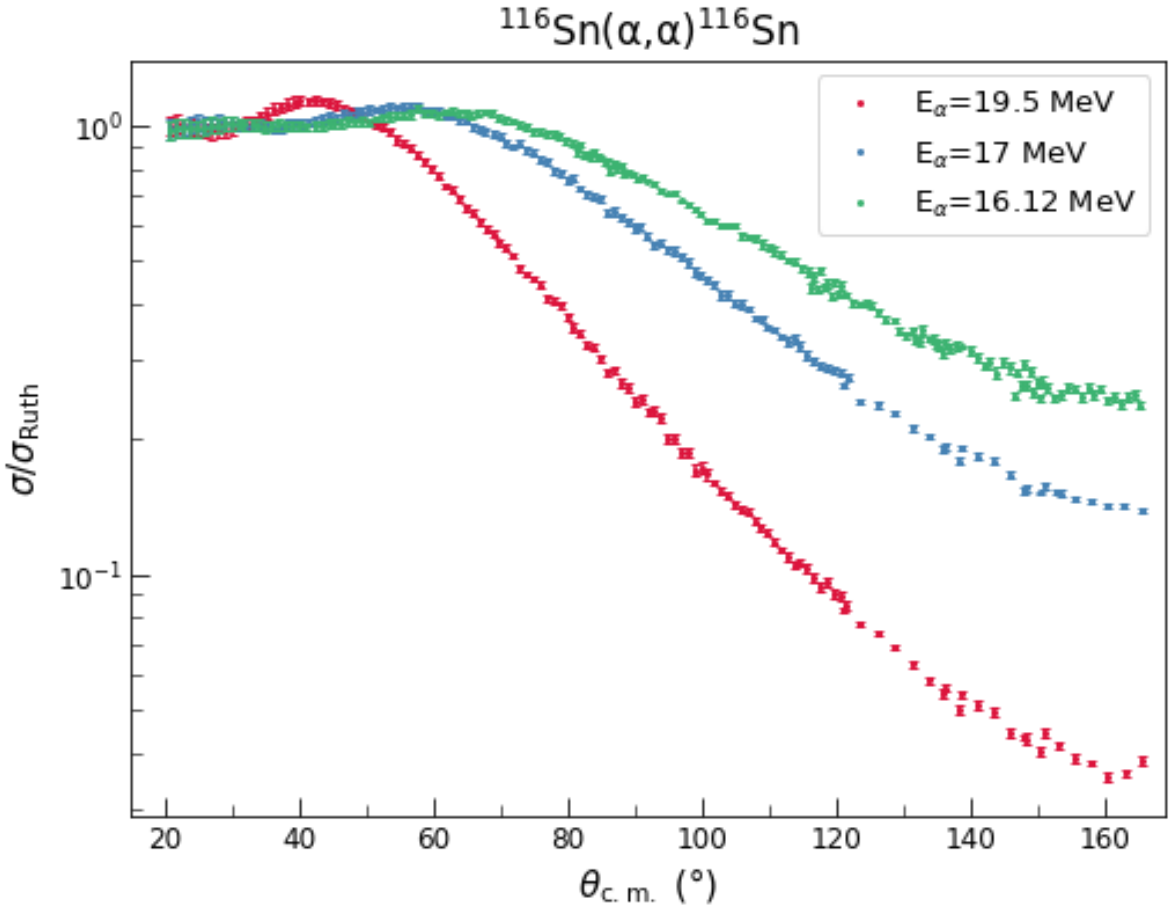
Results

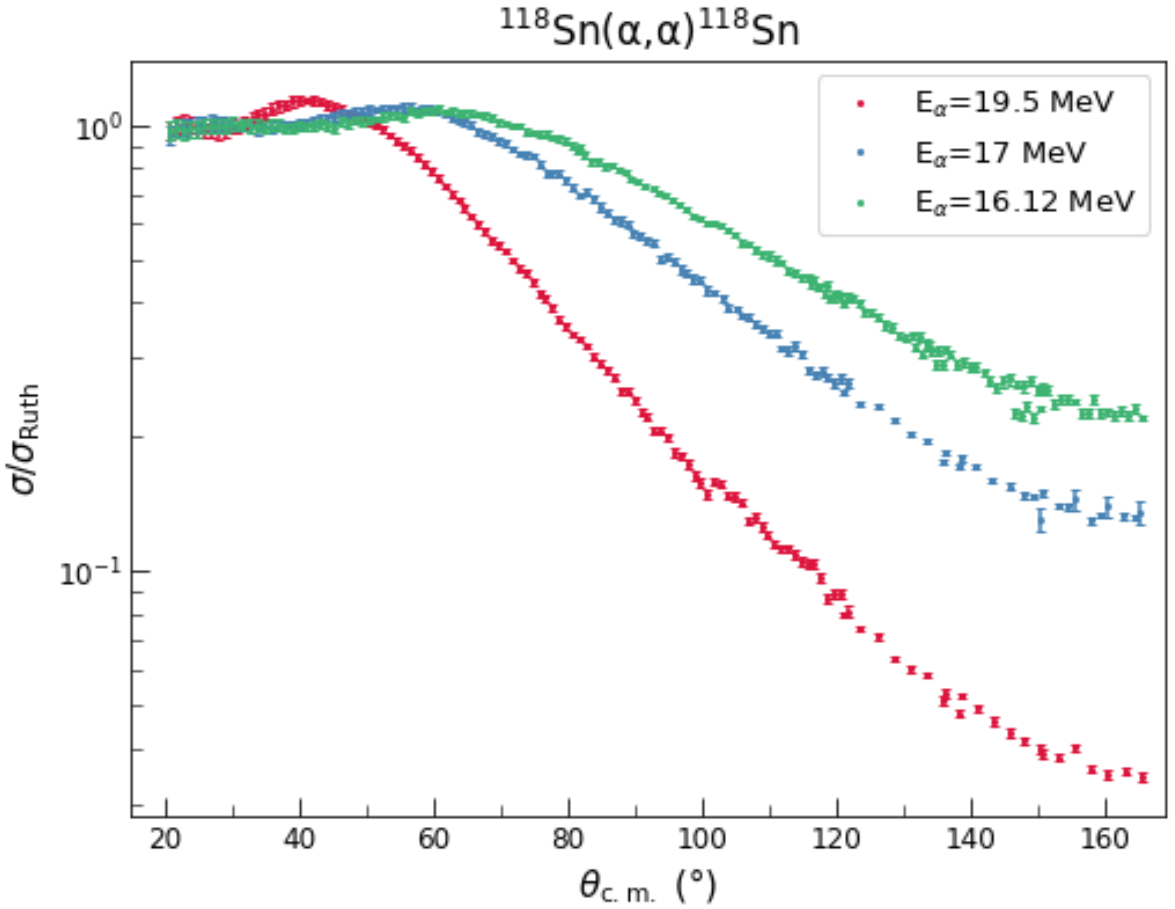
- **Differential Cross Section**



Results

- **Rutherford Normalized Differential Cross Section**





Results

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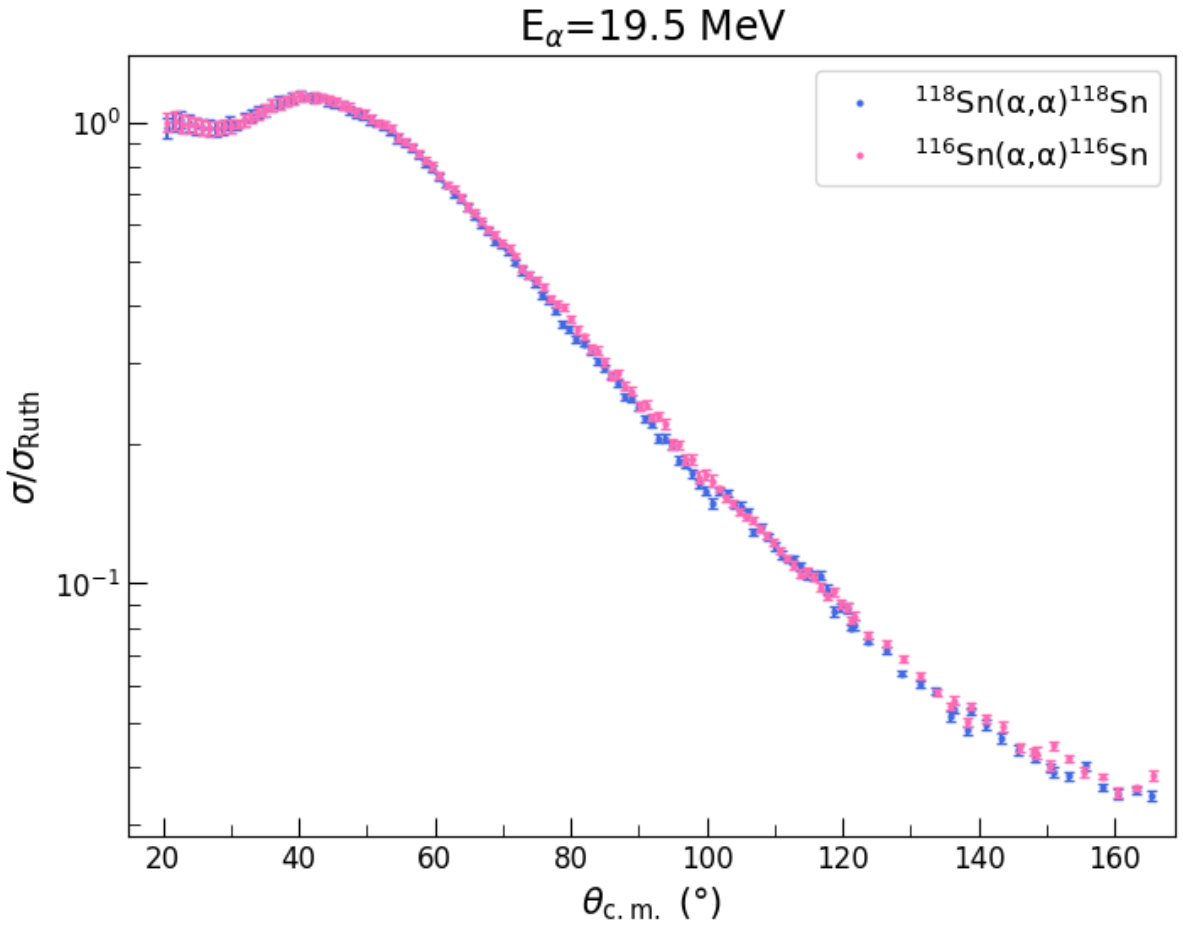
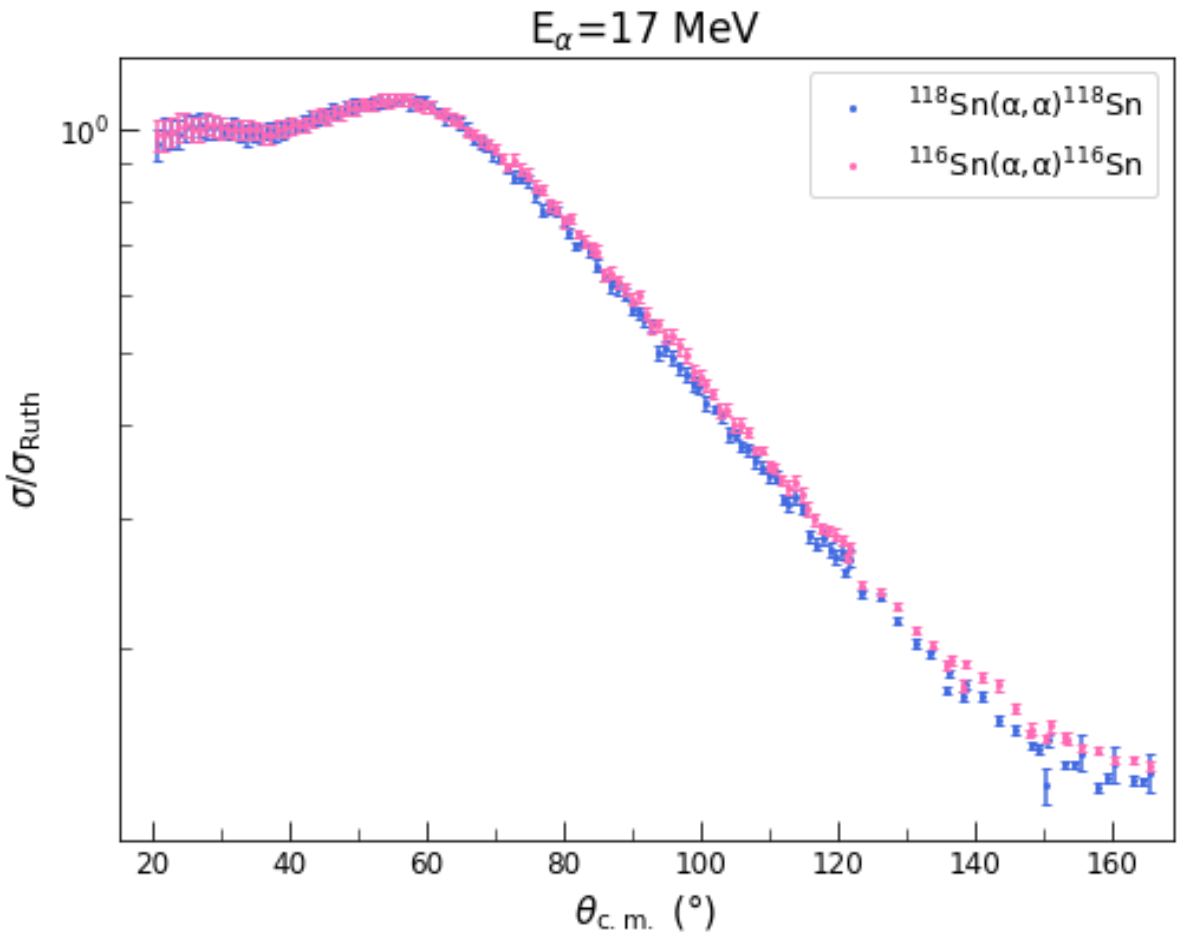
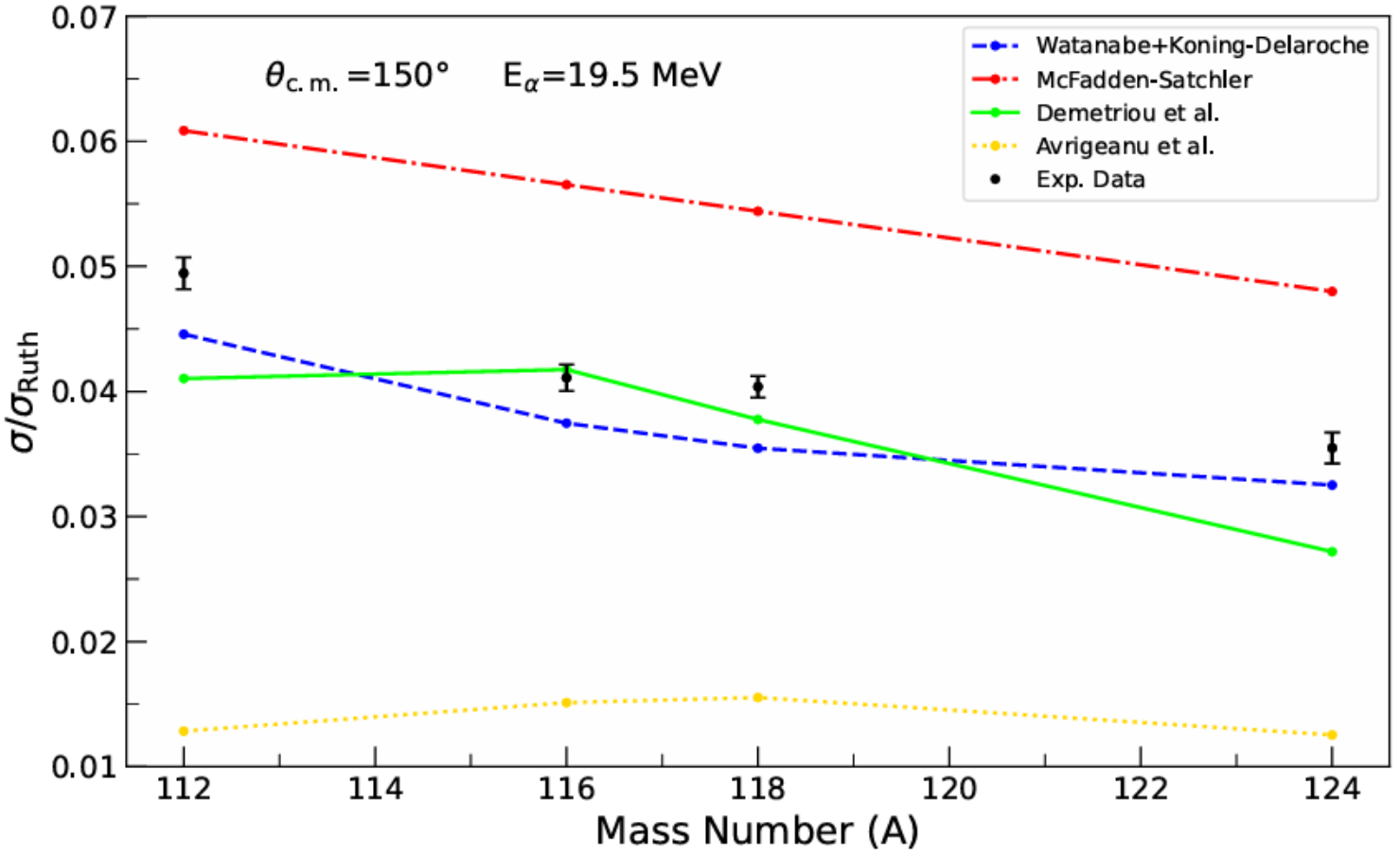




Results

- **Mass studies**



Talys 2.0

- For neutron-rich isotopes, the nuclear surface becomes more diffuse → **lower proton density** near the **surface**.
- For neutron-rich isotopes the α particles feel a **reduced Coulomb repulsion**

Summary

- Interest of α scattering experiments in stable isotopes
- Targets allowed high quality spectra
- Measurement of cross section at different energies

Future work

- Parameterize the α nuclear potential

Thank you!

Supervisor: Daniel Galaviz

ATOMKI team: Tamás Szücs, Gabor Kiss