ARC-TF:
A GUI FOR THIN FILM CHARATERIZATION

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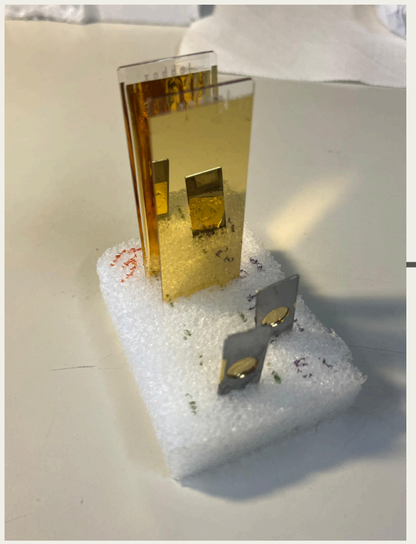
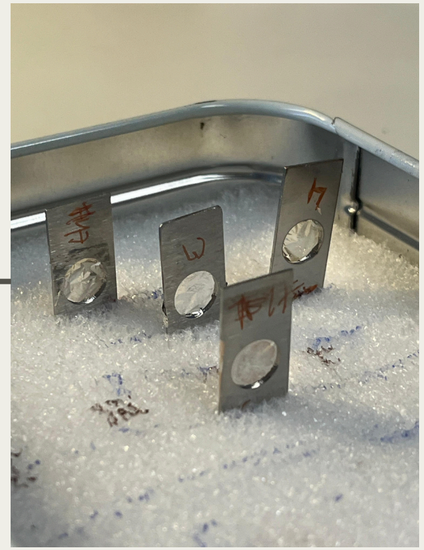
CONTEXT

Thin Films



Gold targets

Sn, Formvar, Pb, Au targets



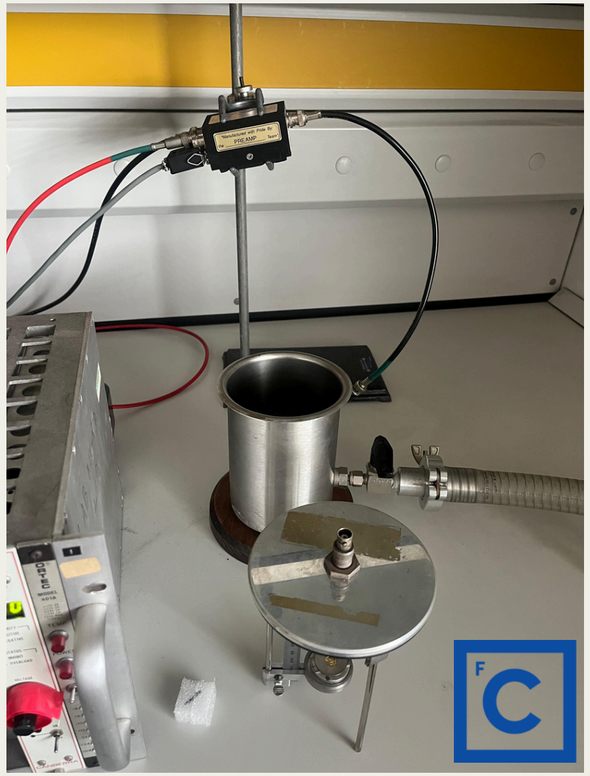
Ag targets

Physical Vapor Deposition chamber

CHARACTERIZATION

Alpha Energy Loss

- measures thickness and uniformity
- risk of damaging films due to vacuum

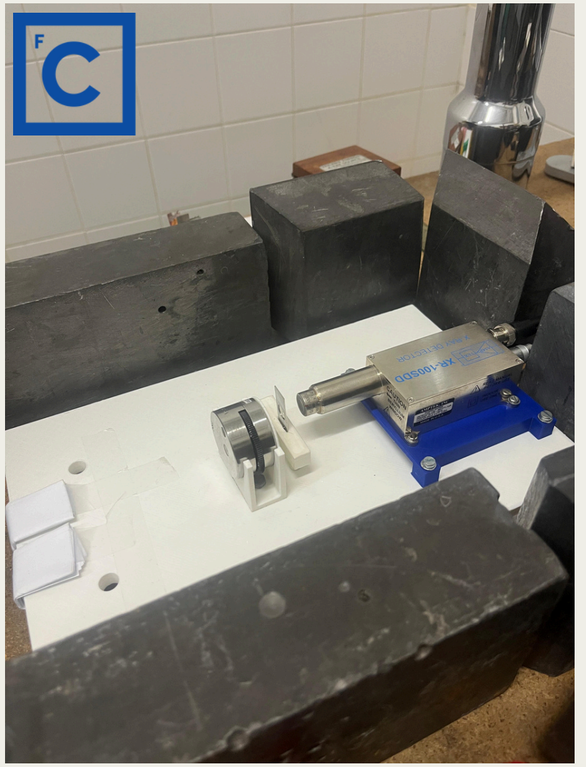


Rutherford Backscattering Spectrometry

- measures thickness, uniformity and impurities
- requires beam time request/vacuum

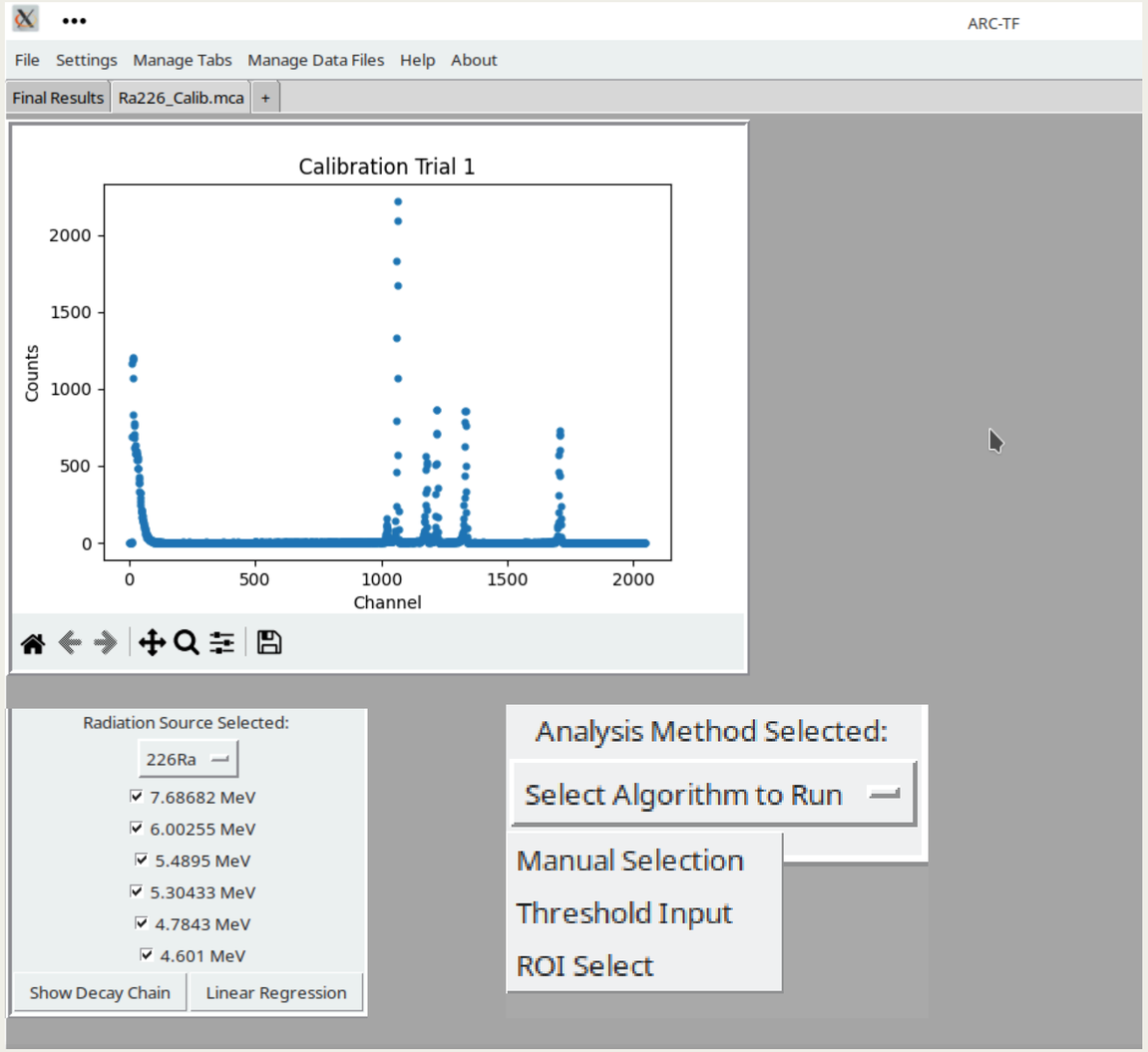
X-Ray Attenuation

- measures thickness
- Filippa already talked about it



GOAL: IMPLEMENT XRA IN INTERFACE

Initially :



- Alpha Energy Loss technique was implemented
- LIP Internships 2023
- To expedite the film analysis
- Analysing 1 film: ~10 min → 1 min

LIP-STUDENTS-23-15

Developing a GUI for thin film characterization

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Project Supervisors: R. Nunes, T. Sousa, P. Teubig

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Abstract. An article describing the methodology, workflow, creation and methods of a Graphic User Interface (GUI) that facilitates the characterization of thin films, using the Alpha Energy Loss method. This GUI was created in Python, using the Tkinter library. The calculations are based on the procedures used by the NUC-RIA team to obtain the thickness of a film, and are shown in this article. Simple algorithms were developed to detect the peaks of the energy loss data and will likewise be addressed.

Keywords: Thin Films, Characterization, AEL, Python, Tkinter

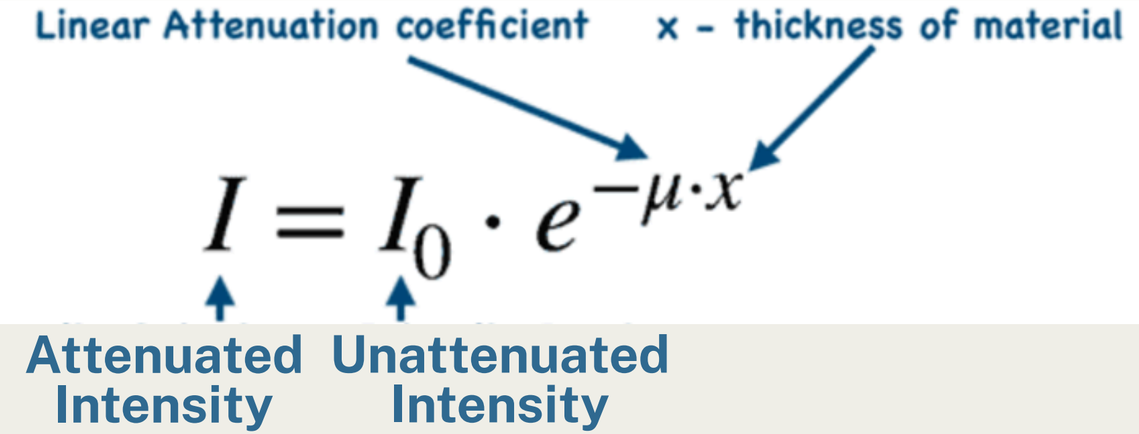
1 Introduction

The one thing all fundamental nuclear reaction studies and production of radioactive beams have in common is that

the approximated thickness of the film, in the background of the GUI, as equation 2 is very easily implemented in code. A full description of the analysis performed by the NUC-RIA group follows:

X-RAY ATTENUATION ANALYSIS

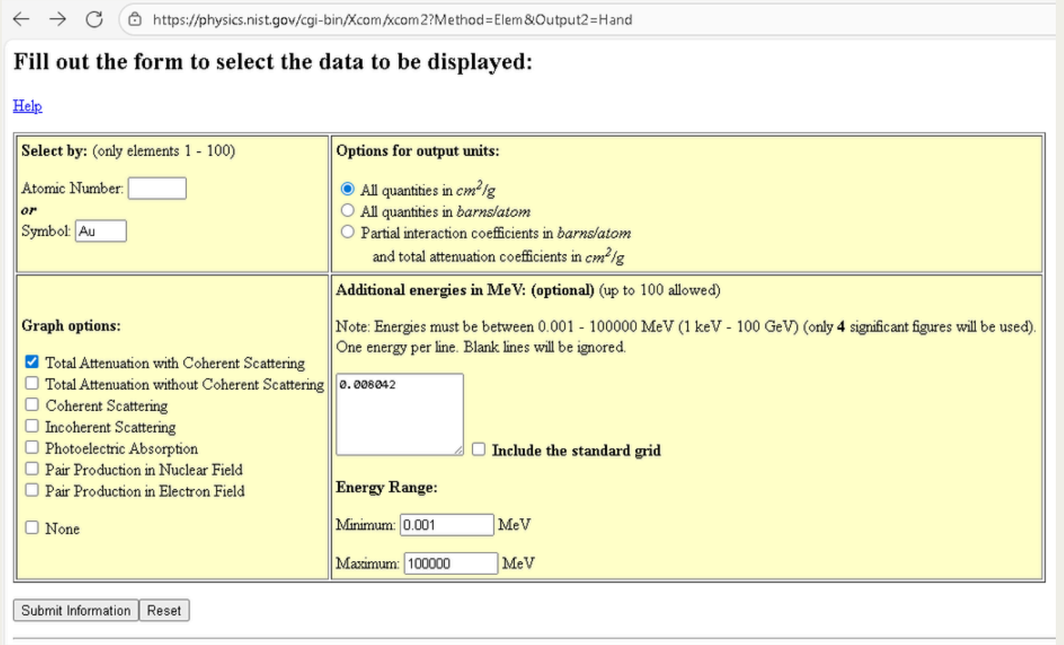
Beer-Lambert Law:



To find the film thickness:

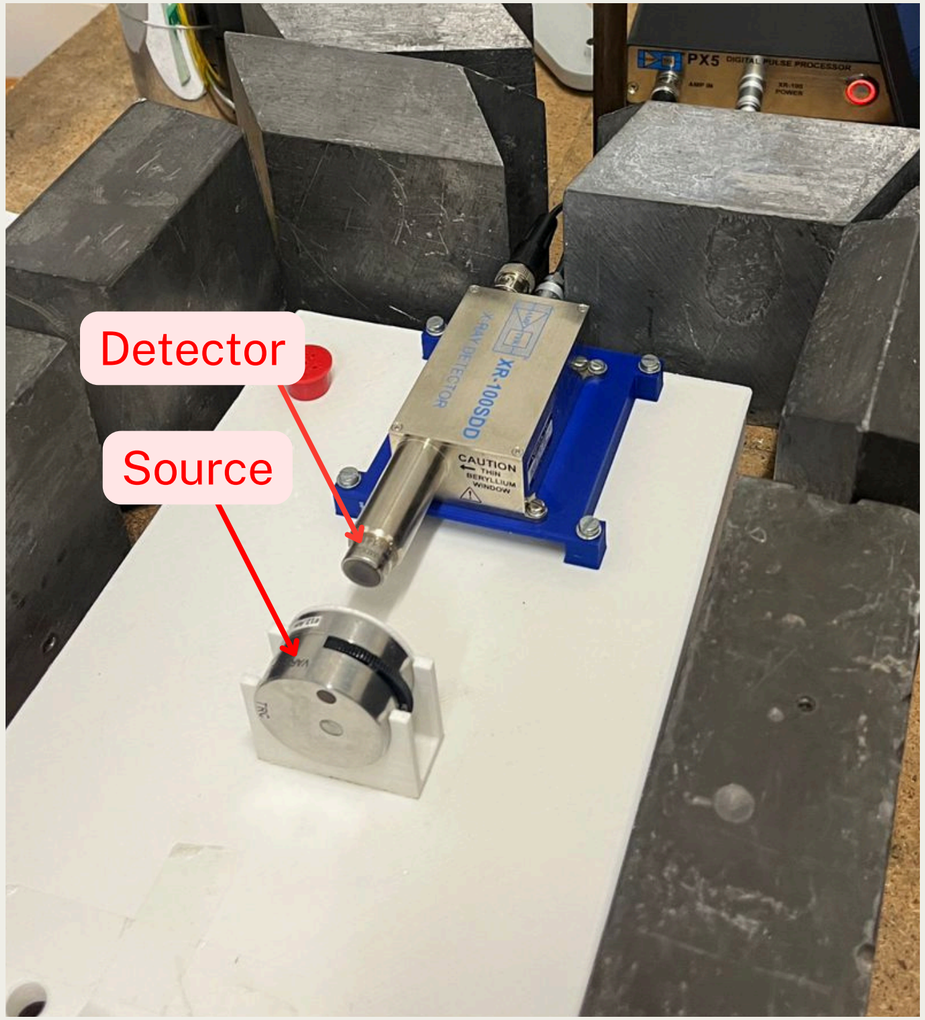
$$x = -\frac{1}{\mu} ln(\frac{I}{I_0})$$

μ – from NIST website

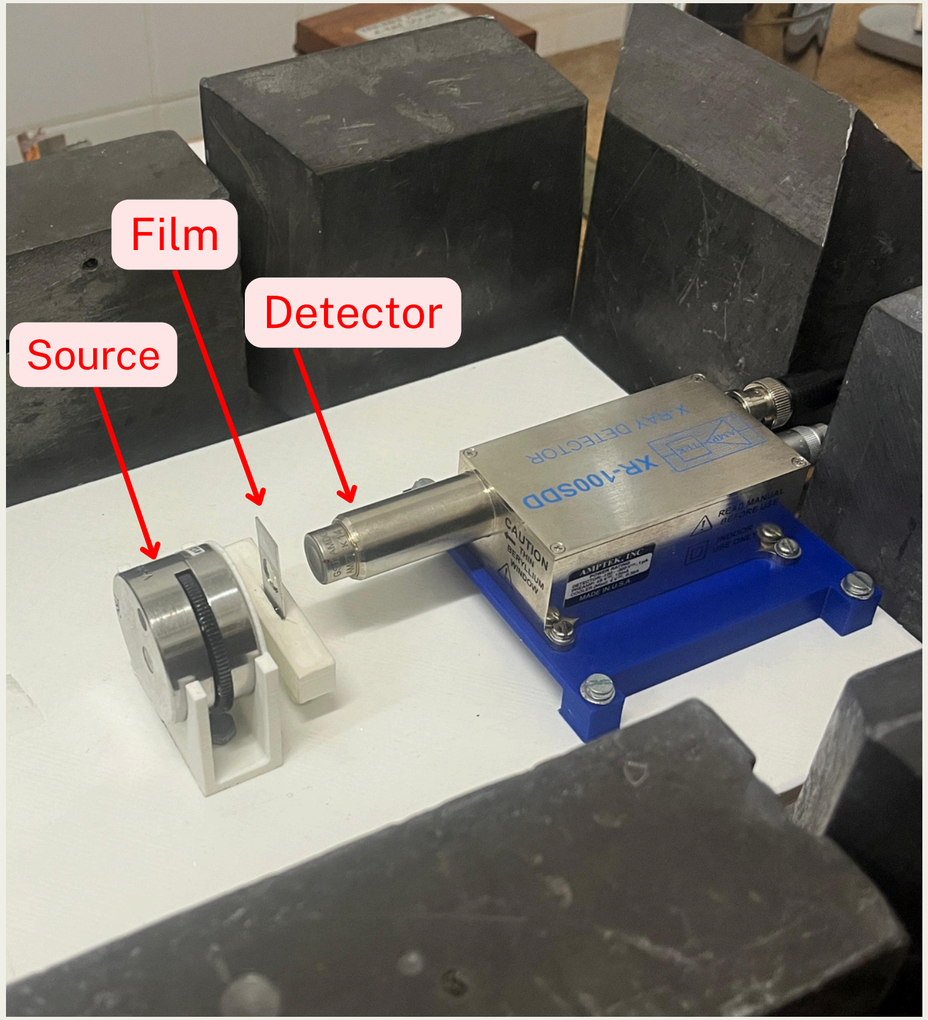


X-RAY ATTENUATION ANALYSIS

Without film:

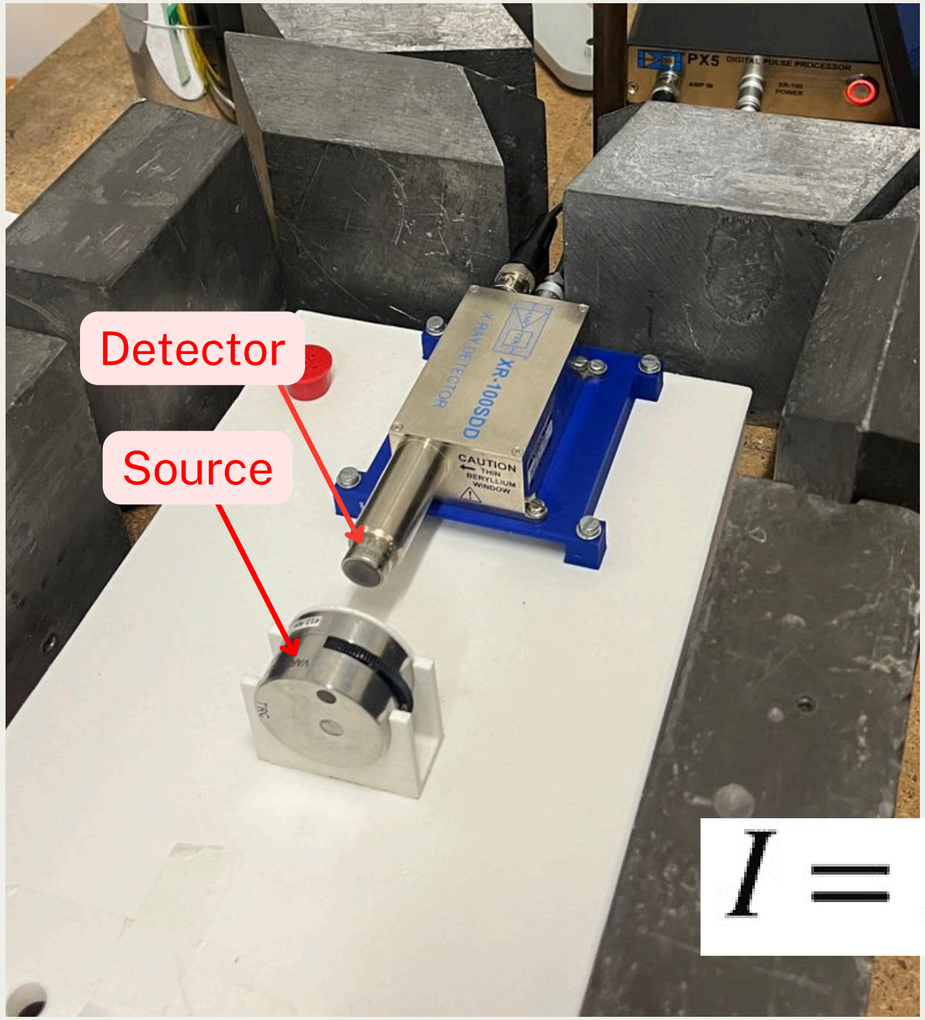


With film:

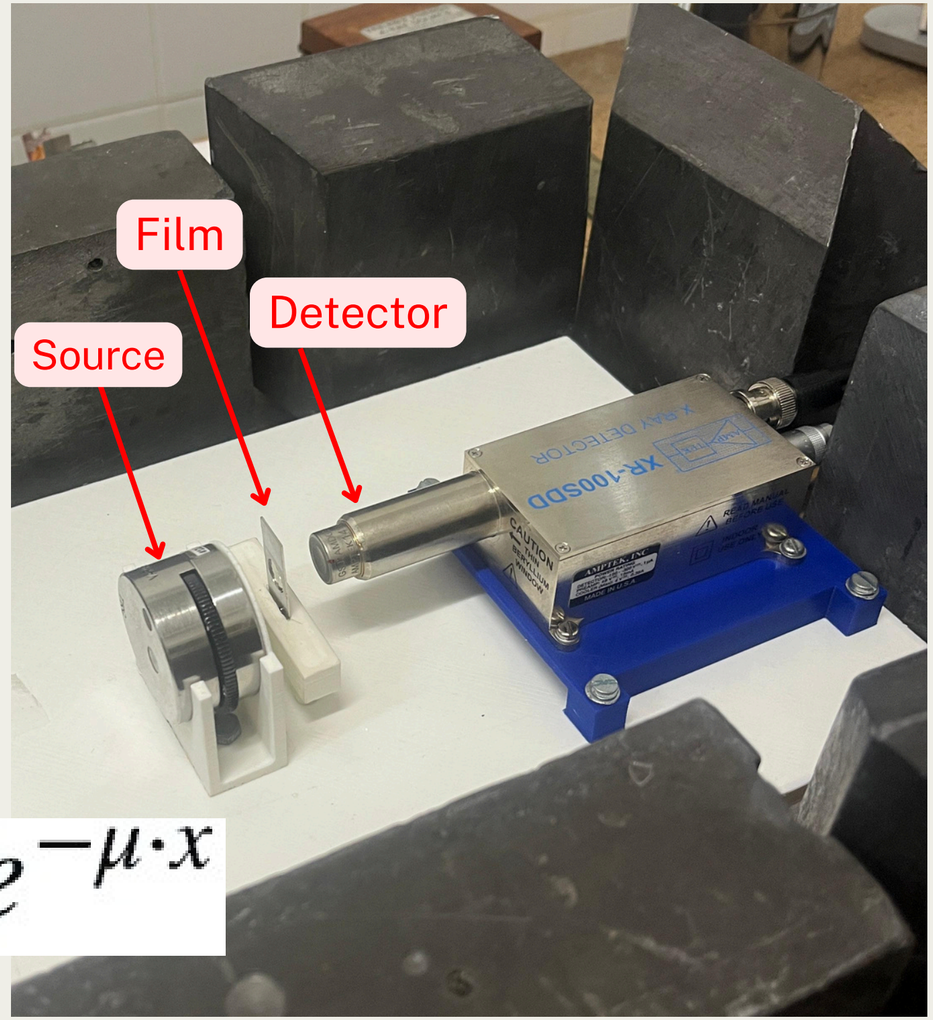


X-RAY ATTENUATION ANALYSIS

Without film:



With film:

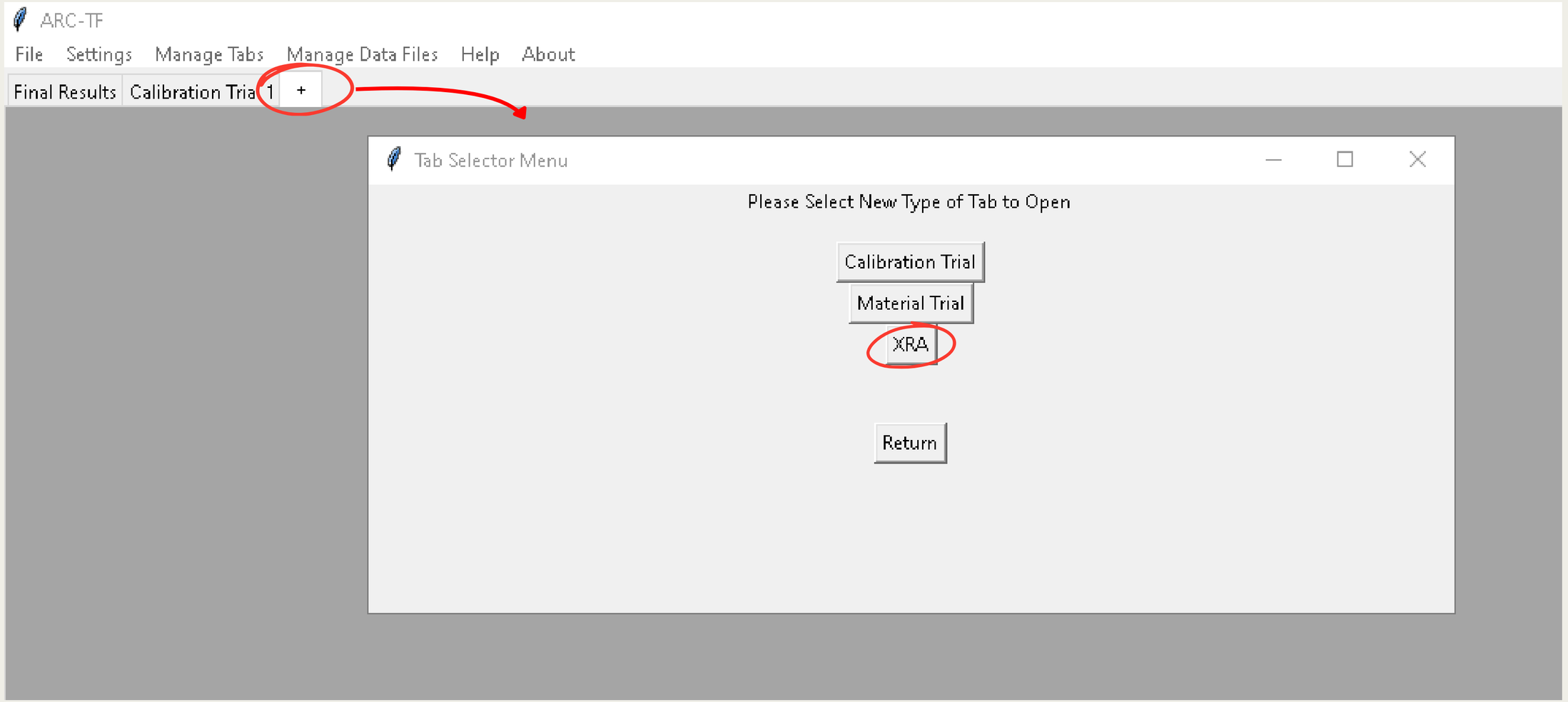


$$I = I_0 \cdot e^{-\mu \cdot x}$$

XRA WORKFLOW

New features added:

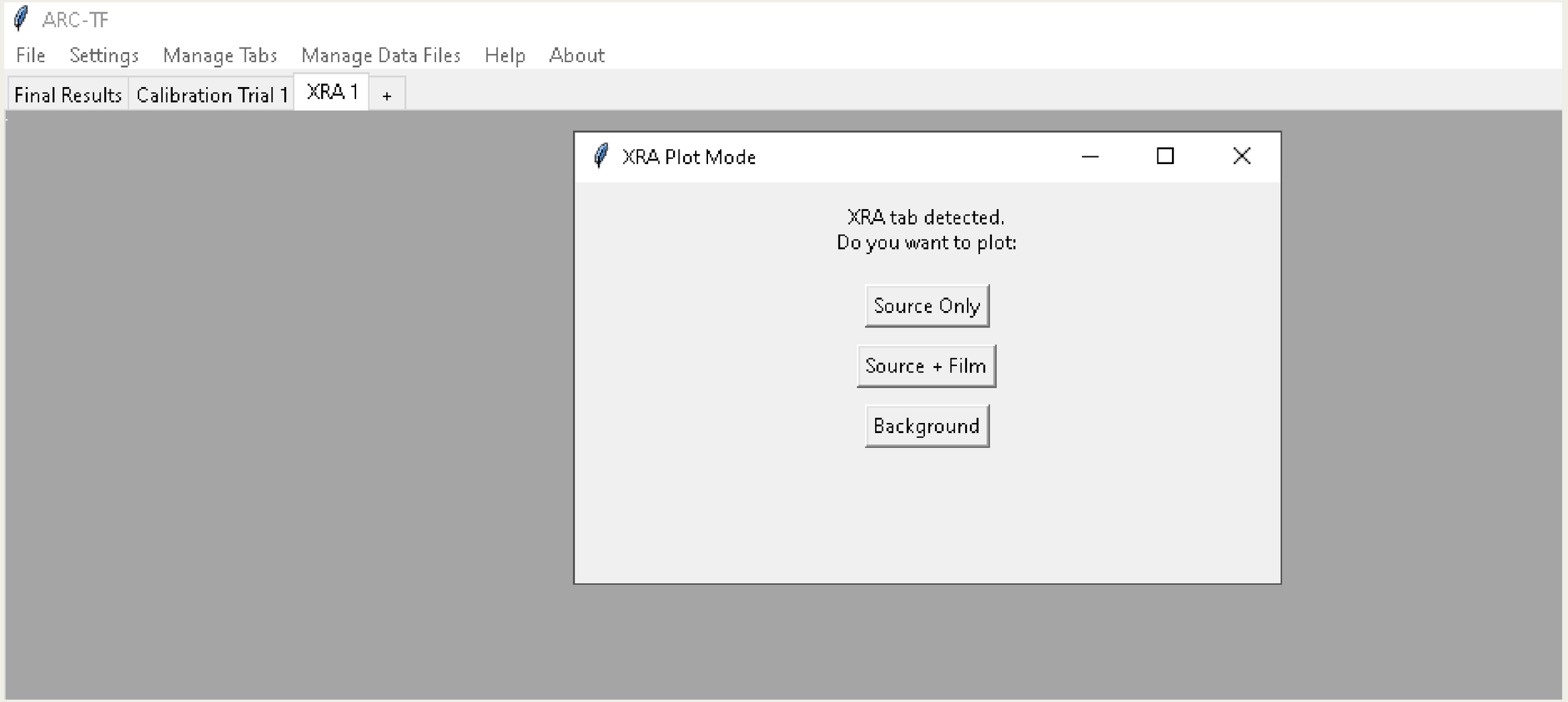
Tab Selector Menu:



XRA WORKFLOW

New features added:

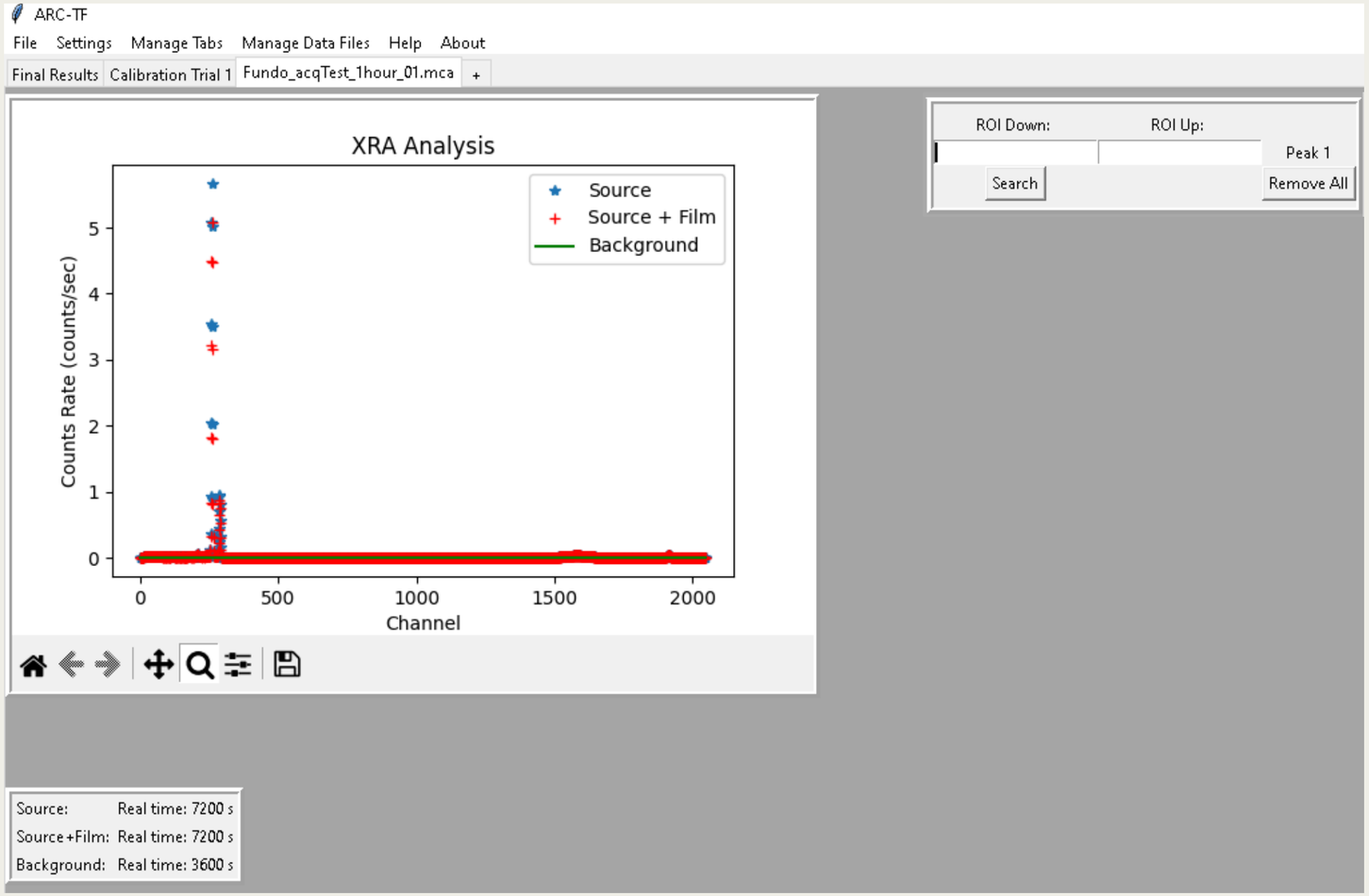
Plot Data Menu:



XRA WORKFLOW

New features added:

Algorithm Frame:



XRA WORKFLOW

New features added:

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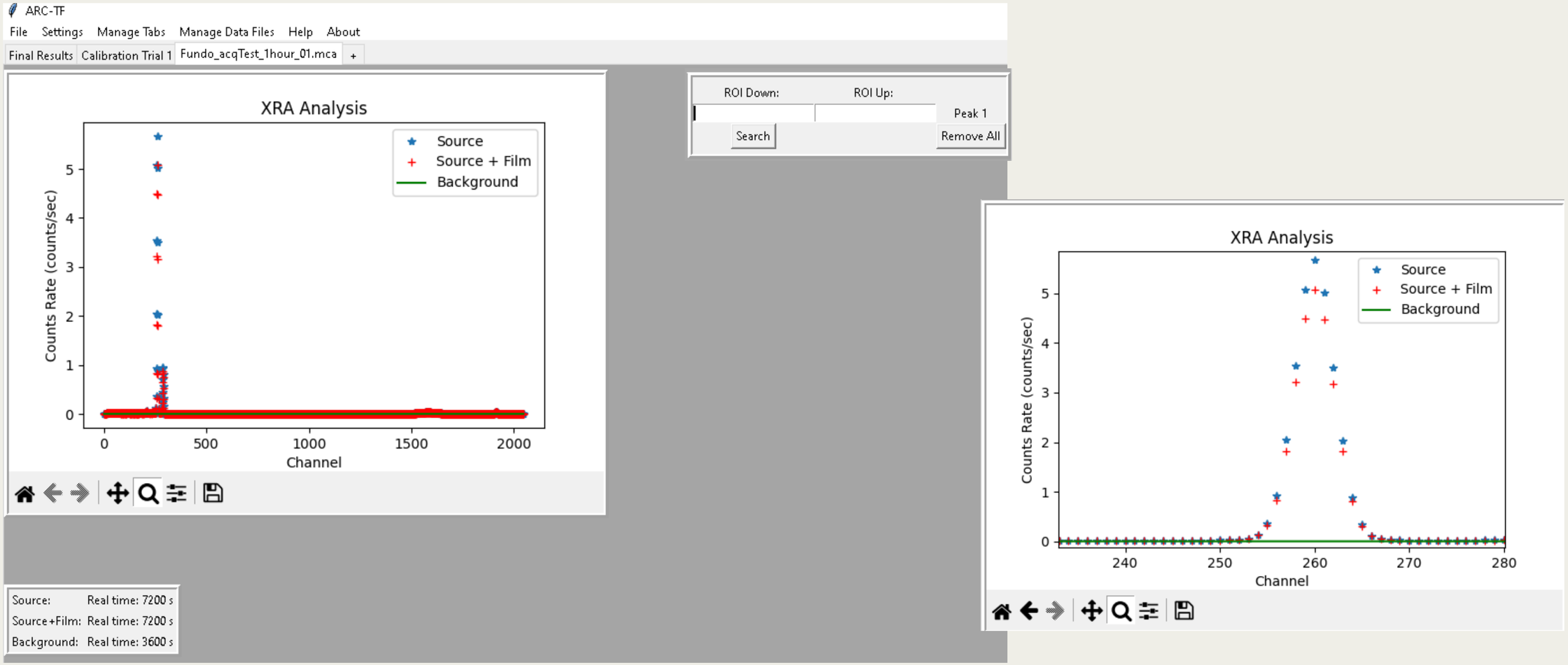
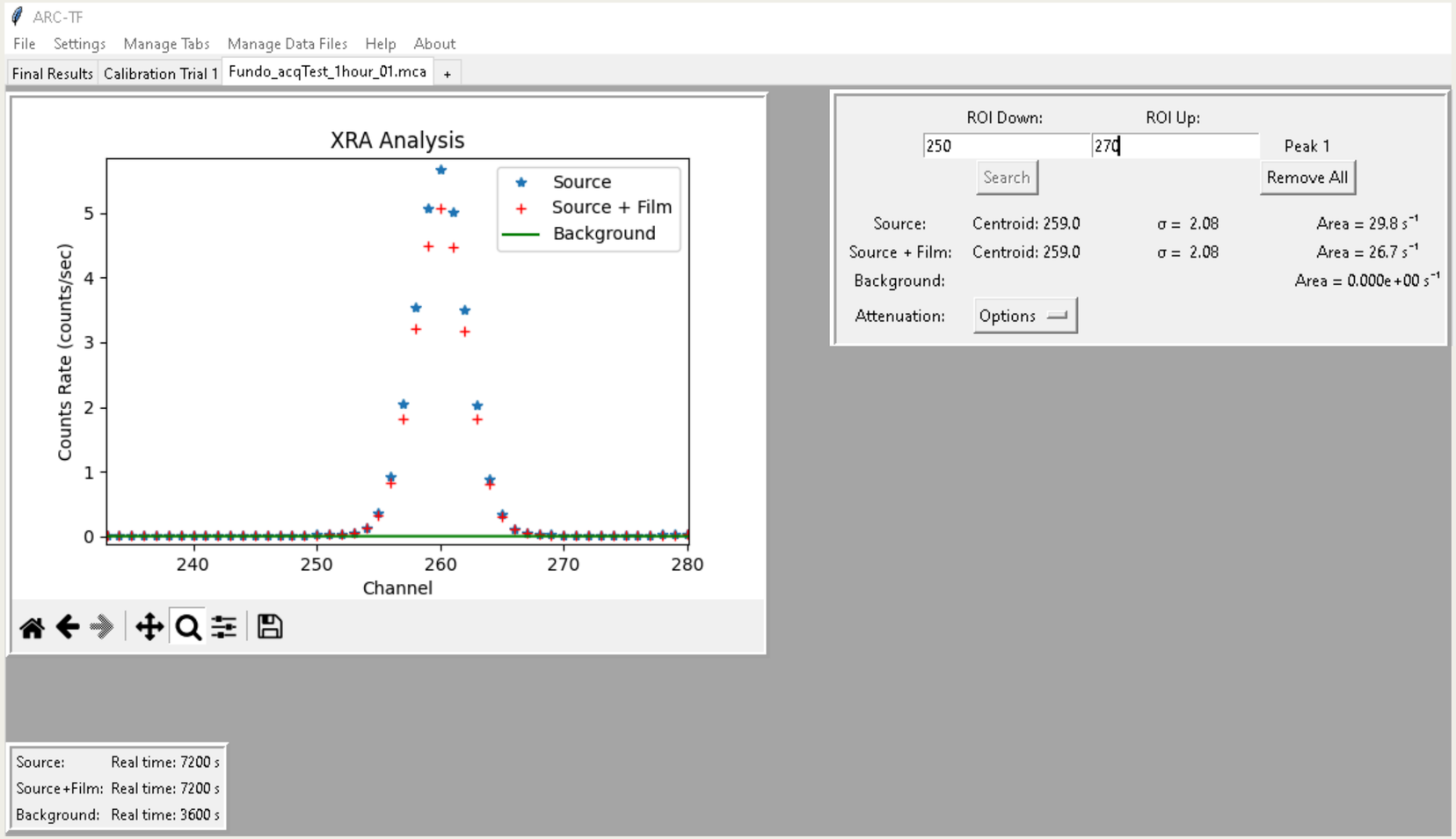


XRA WORKFLOW

New features added:

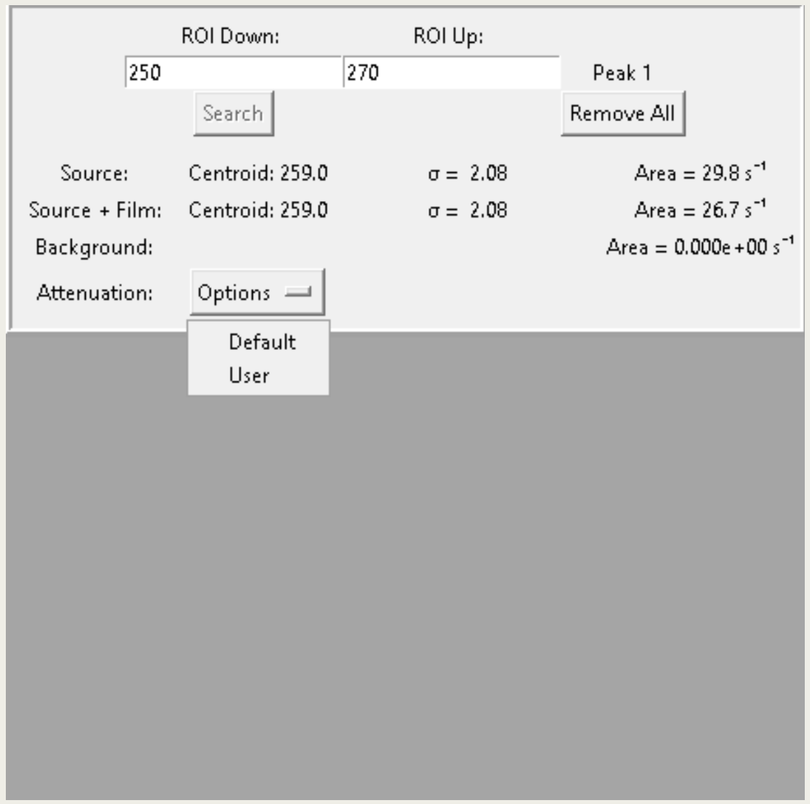
Algorithm Frame:



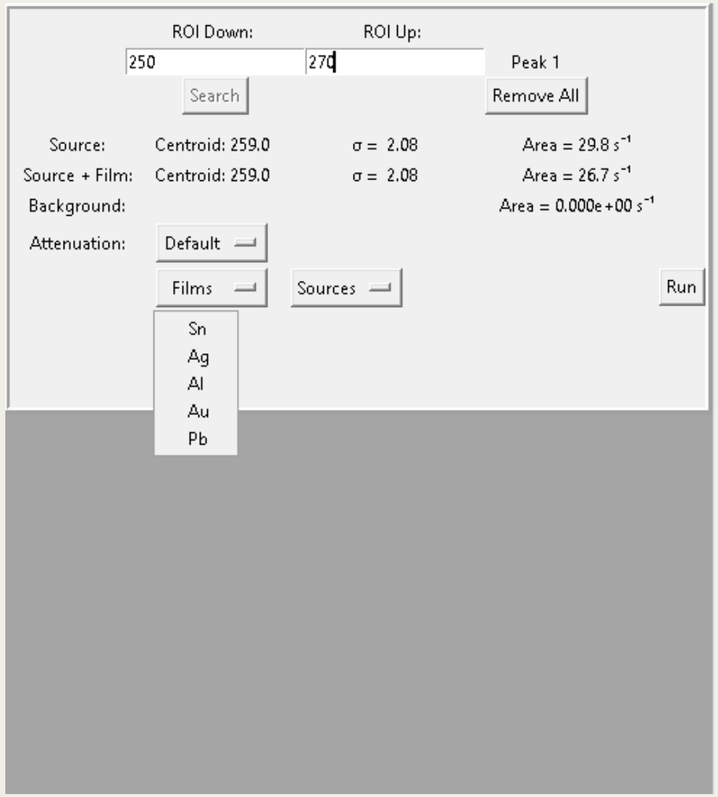
XRA WORKFLOW

New features added:

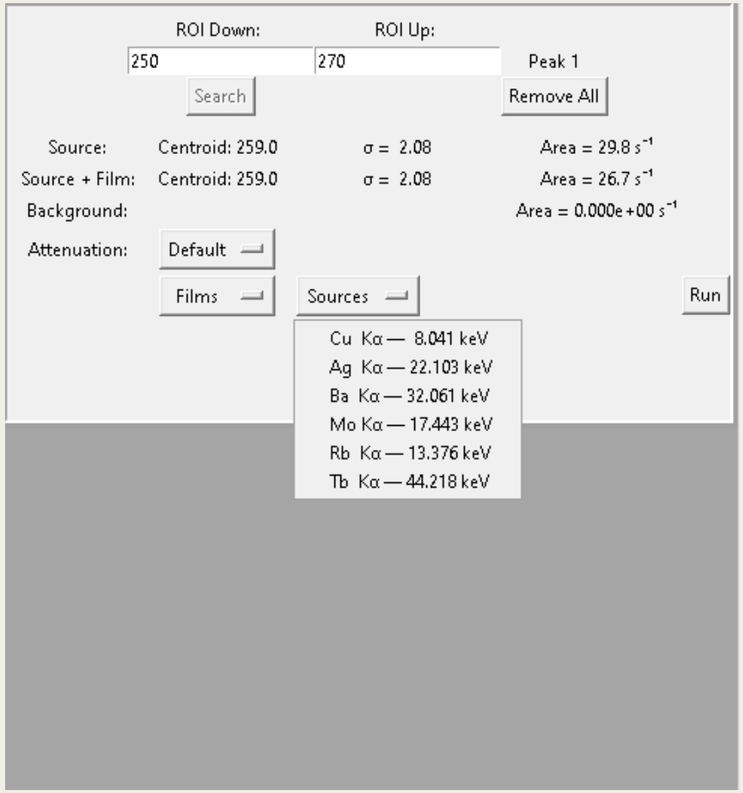
Algorithm Frame:



User chooses attenuation coefficient method



User chooses the film material

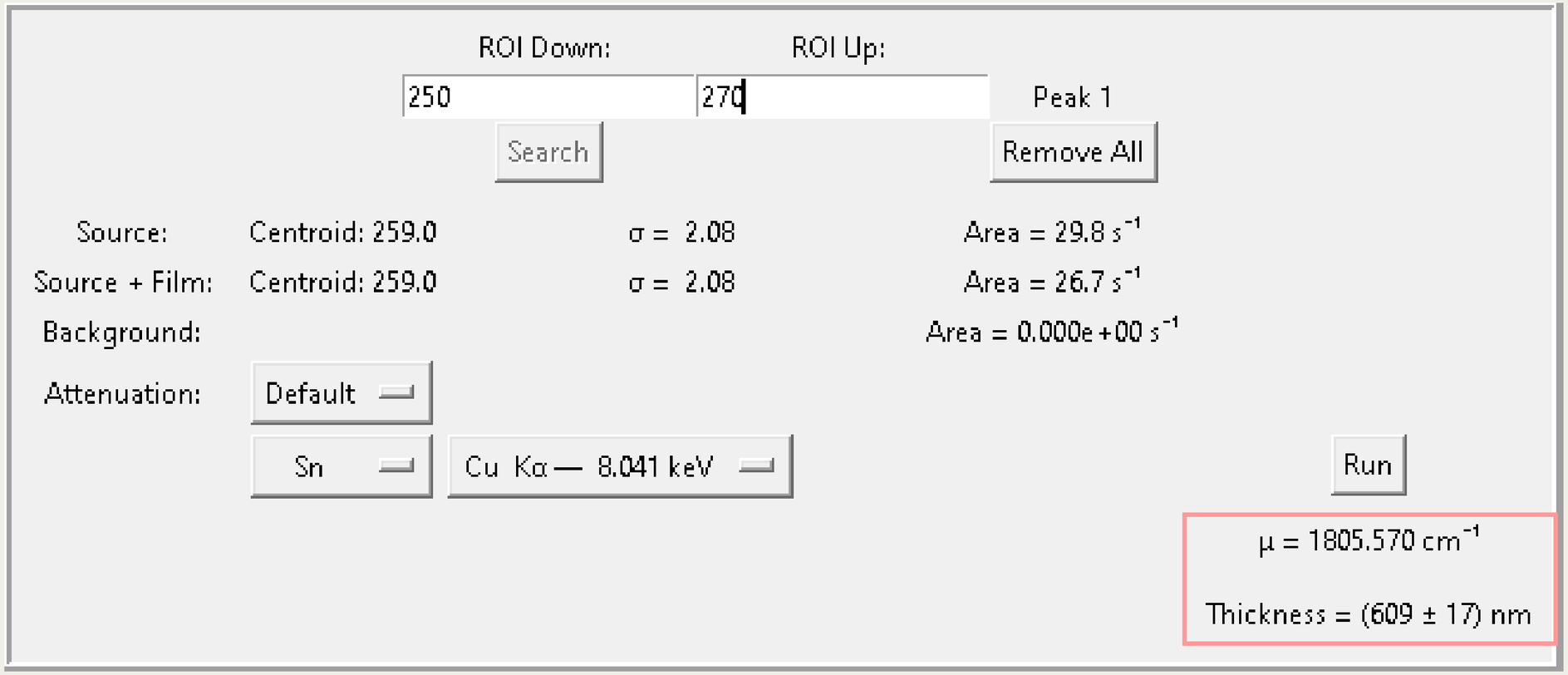


User chooses the source material

XRA WORKFLOW

New features added:

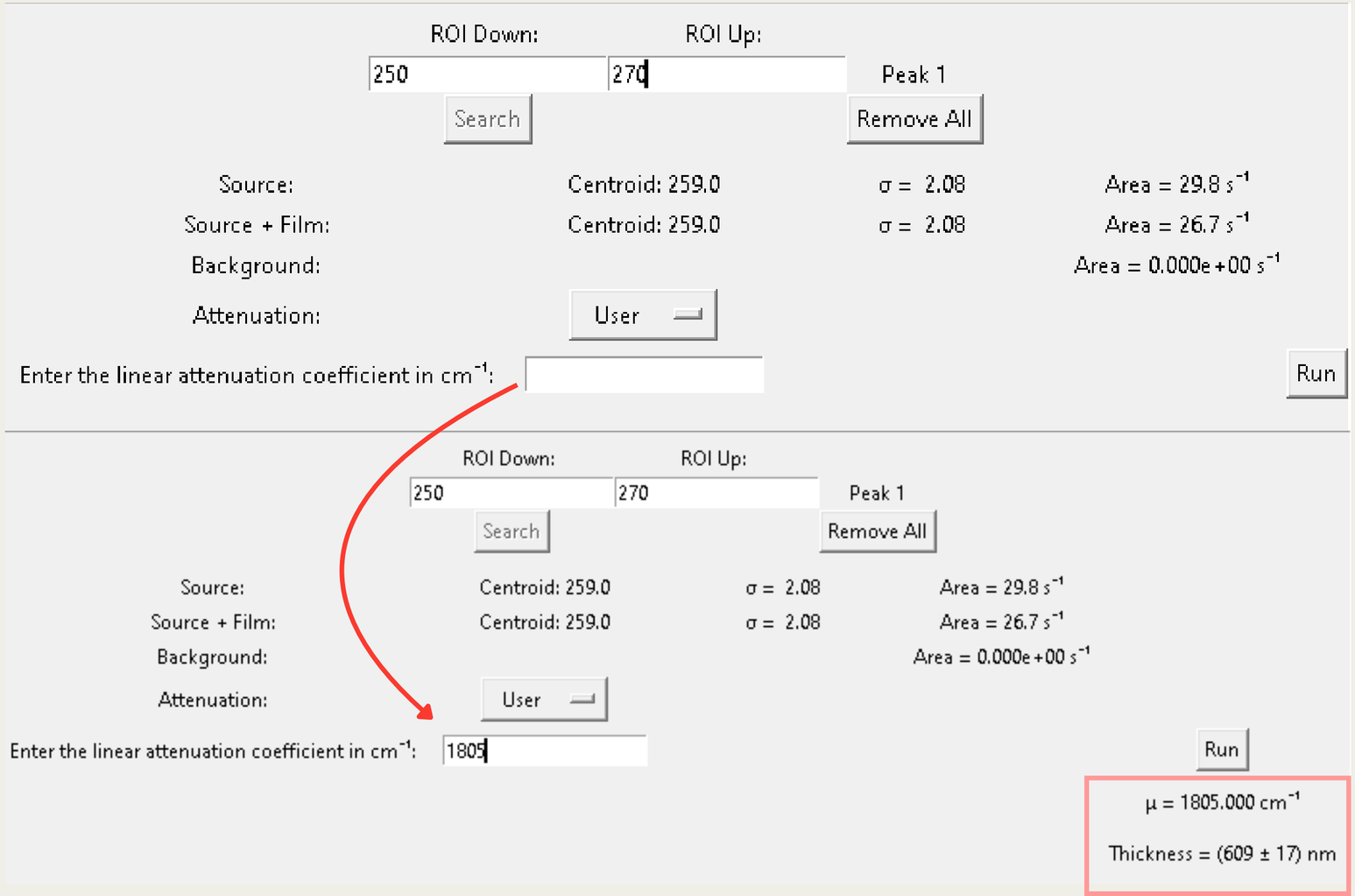
Algorithm Frame:



XRA WORKFLOW

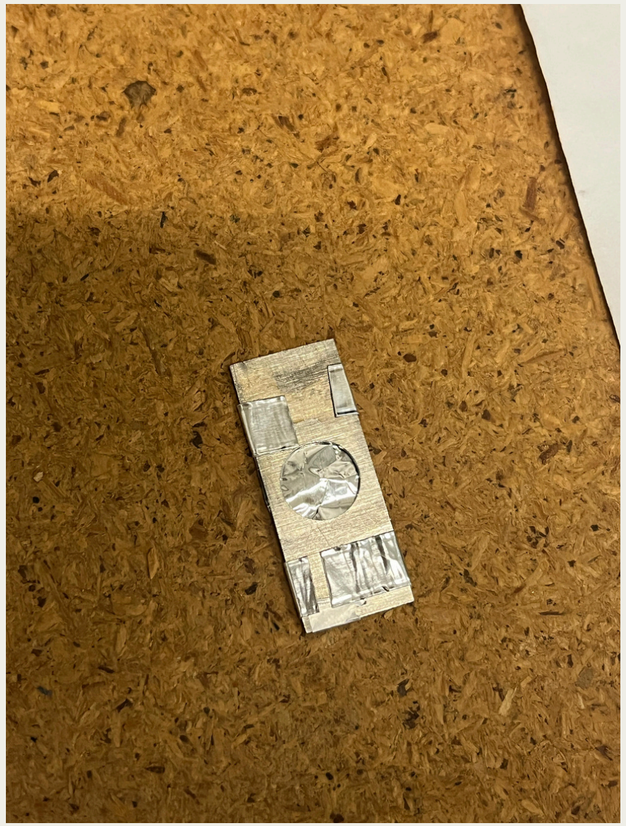
New features added:

Algorithm Frame:



RESULTS

- Household Al foil



ROI Down: 250 ROI Up: 270 Peak 1

Search Remove All

Source: Centroid: 259.0 σ = 2.10 Area = 30.0 s^{-1}

Source + Film: Centroid: 259.0 σ = 2.09 Area = 25.2 s^{-1}

Attenuation: Default

Al Cu Kα — 8.041 keV Run

$\mu = 133.920\ cm^{-1}$

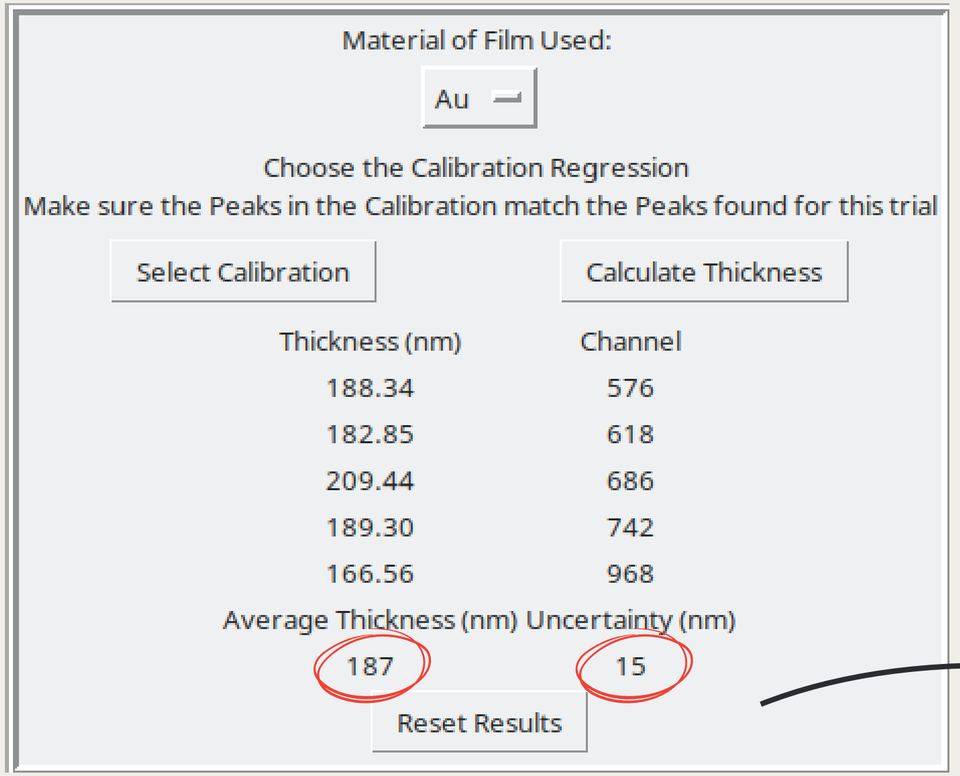
Thickness = (12.9 ± 0.5) μm

Typical value for household Al foil.

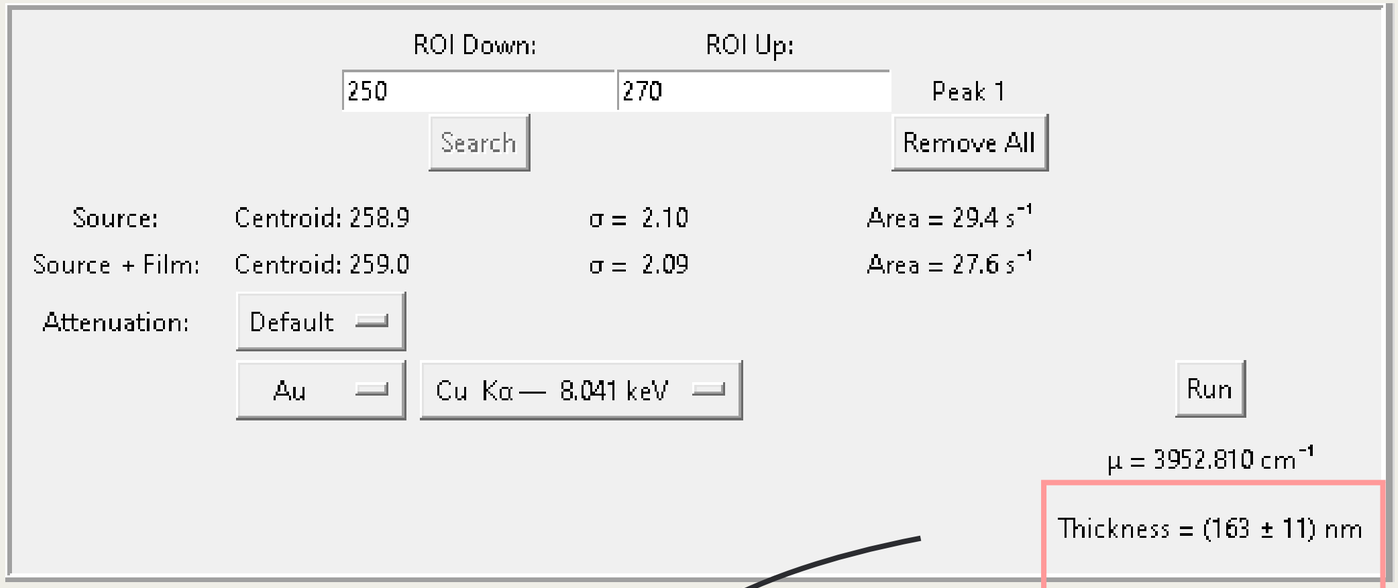
RESULTS

- Au film

Using Alpha Energy Loss technique:



Using X-Ray Attenuation analysis:



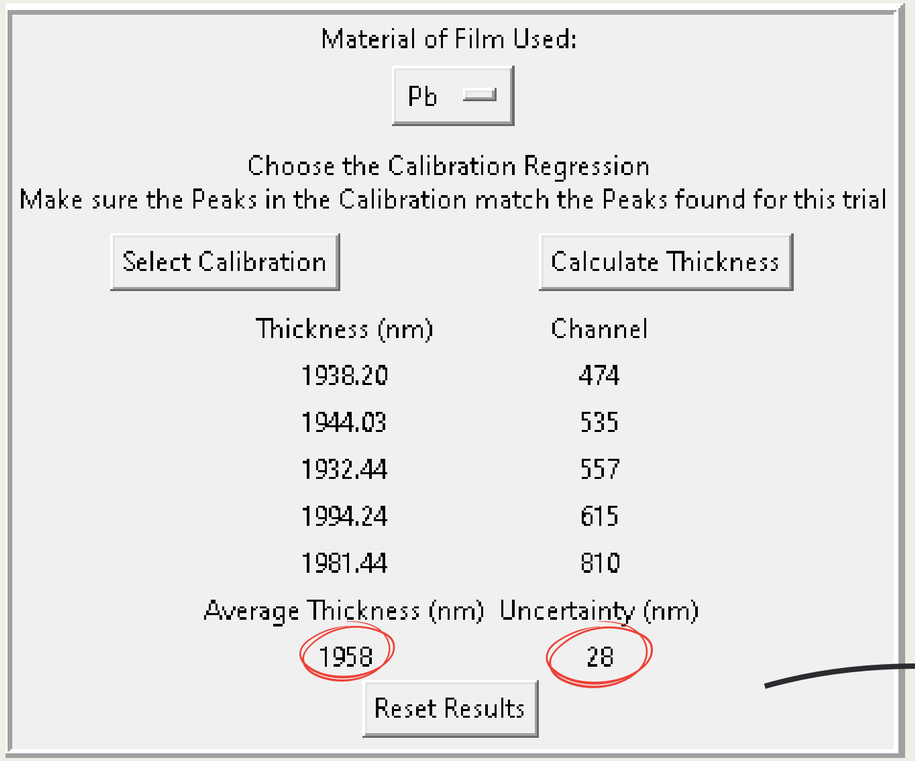
AEL: (187 ± 15) nm

XRA: (163 ± 11) nm

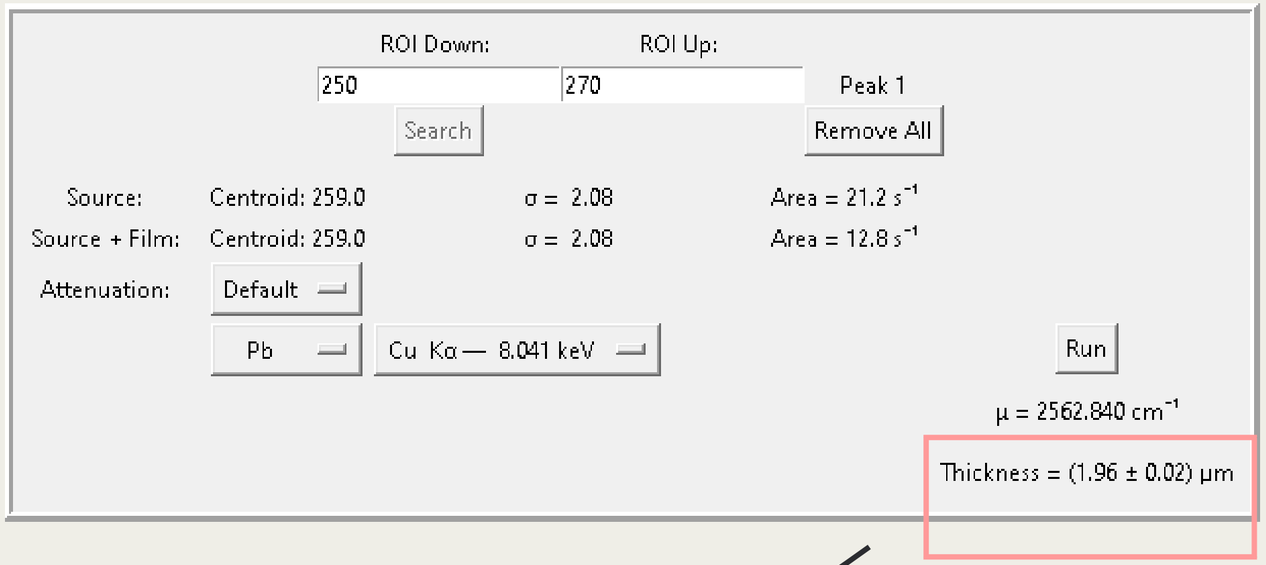
RESULTS

- Pb film

Using Alpha Energy Loss technique:



Using X-Ray Attenuation analysis:



AEL: (1.96 ± 0.03) μm

XRA: (1.96 ± 0.02) μm

CONCLUSION

- **Objective achieved:** XRA method integrated into interface
- **Future perspectives:** New features could be implemented

Acquired skills:

- Learned and Developed Python skills
- GUI development using Python (Tkinter library)
- Git and GitHub basic skills
- Knowledge on Radioactive Sources
- Knowledge on Thin Film Technology, Application and Production

Thank you!

ARC-TF at: https://github.com/RiPires/GUI_thin_films.git

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