

# NUC-RIA

## Automation of AlfaMC

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Supervisor:

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Luís Peralta



# Goal

- ▶ Make AlfaMC more easily usable;
- ▶ Automation of AlfaMC;
- ▶ Obtain the thickness of films;
- ▶ Comparison with Bethe Bloch.

# AlfaMC

- ▶ Monte Carlo simulation;
- ▶ Transport of alpha particles;
- ▶ Developed in Fortran.

Alpha Particle ( $\alpha$ )



${}^4_2\text{He}$

Peralta, L., & Louro, A. (2014). AlfaMC: A fast alpha particle transport Monte Carlo code. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*

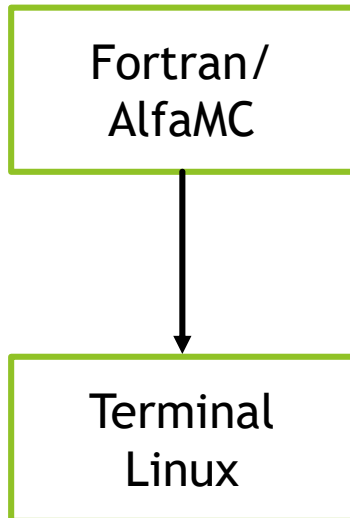
# AlfaMC-Usage

Fortran/  
AlfaMC

- ▶ Choose the material and thickness of the foil;
- ▶ Save the spectrum in a file.

# AlfaMC-usage

- Insert the thickness of the foil and the material



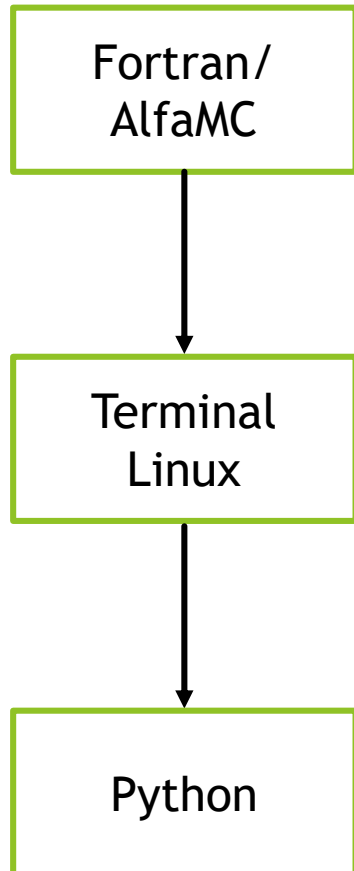
```
beatriz@beatriz-VirtualBox:~/bin/AlfaMC_pack4x/5_var_thick_foil$ ./main.sh
-----
          ULYSSES geometry package
          Version: 5.x
-----

-----
          ULHISTOS histogramming package
          Version: 5.5
-----

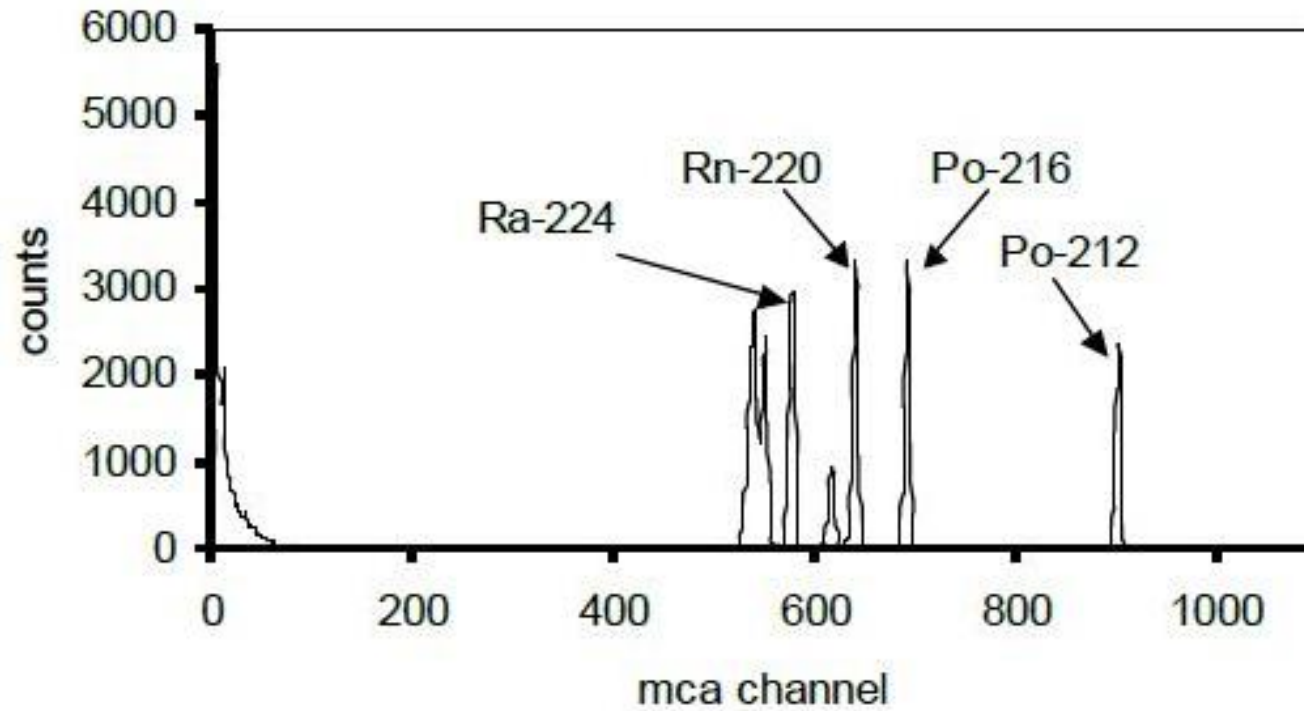
*****
          AlfaMC version 4.0
*****

Reading Geometry -----
Foil Thickness .d-4
4.d-4
4.000000000000000002E-004
Escolher 1=My 2=Vac 3=Au 4=Si 5=Al 6=Ag 7=Pb
```

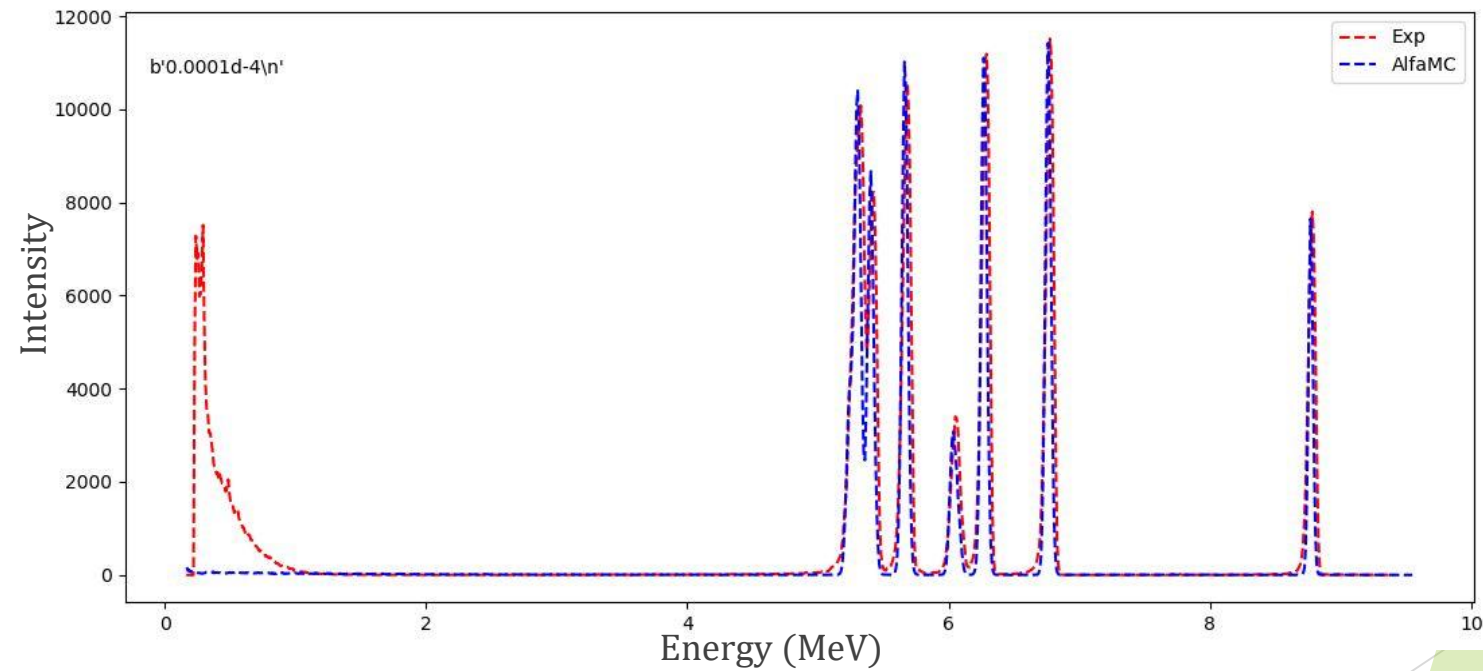
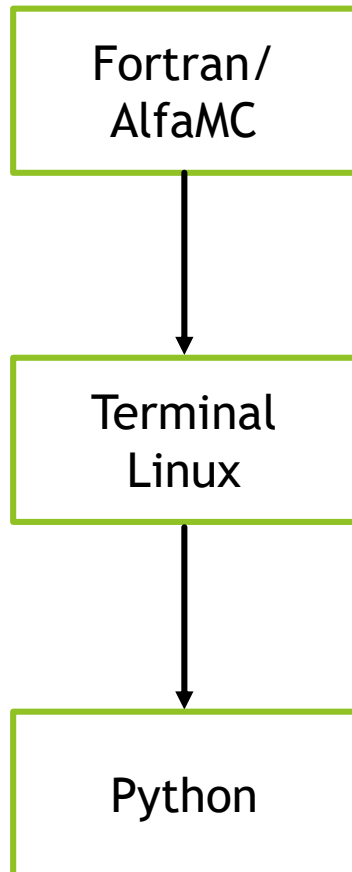
# Energy Calibration



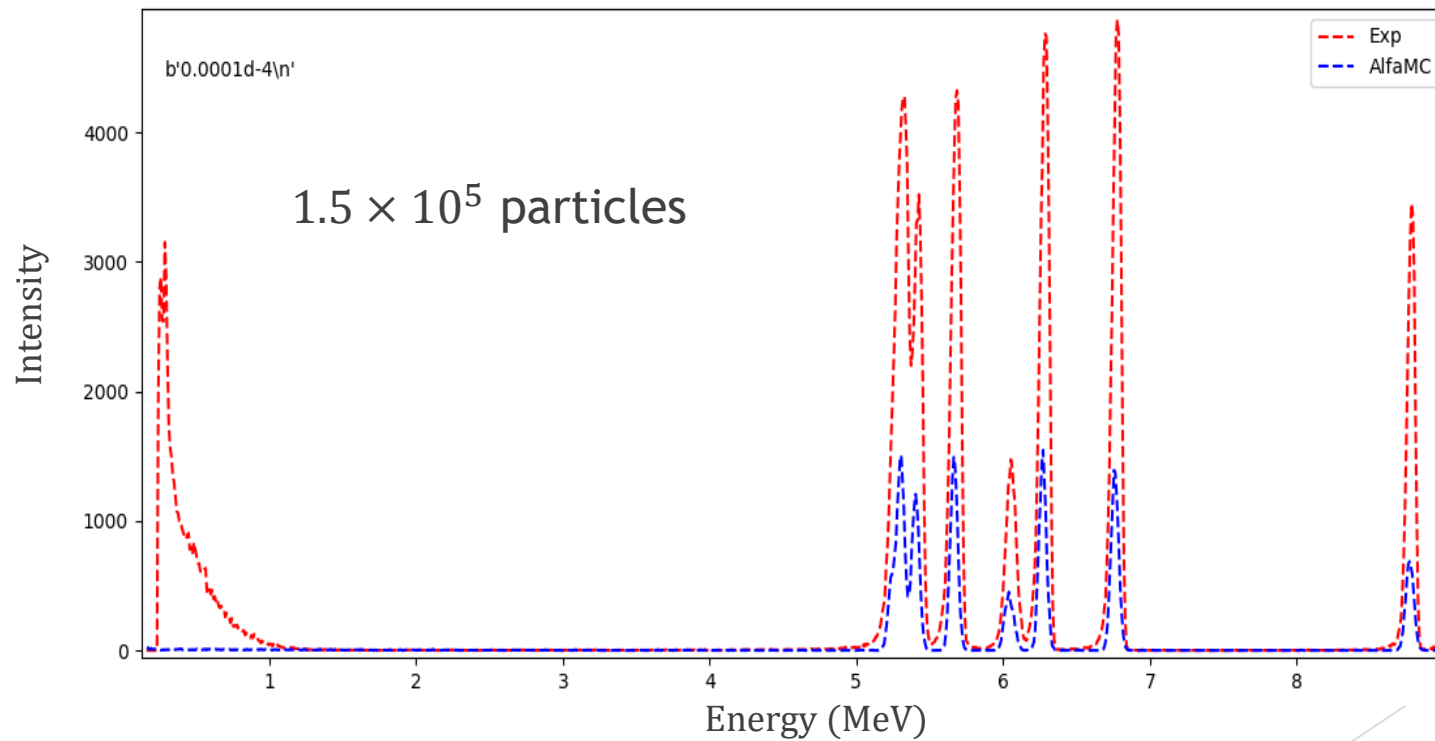
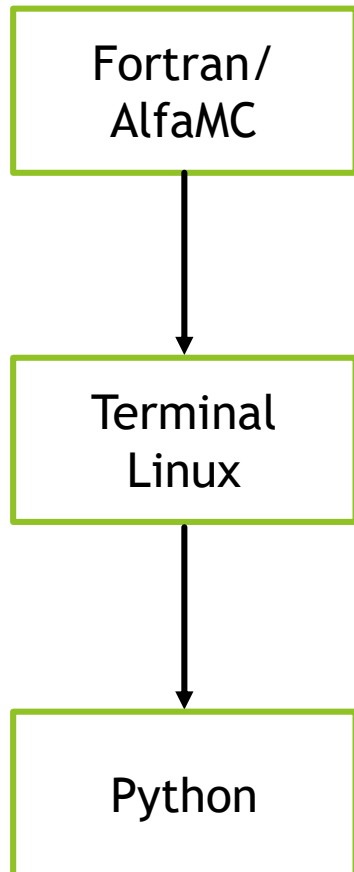
Alpha spectrum  $^{232}\text{U}$



# Energy Calibration

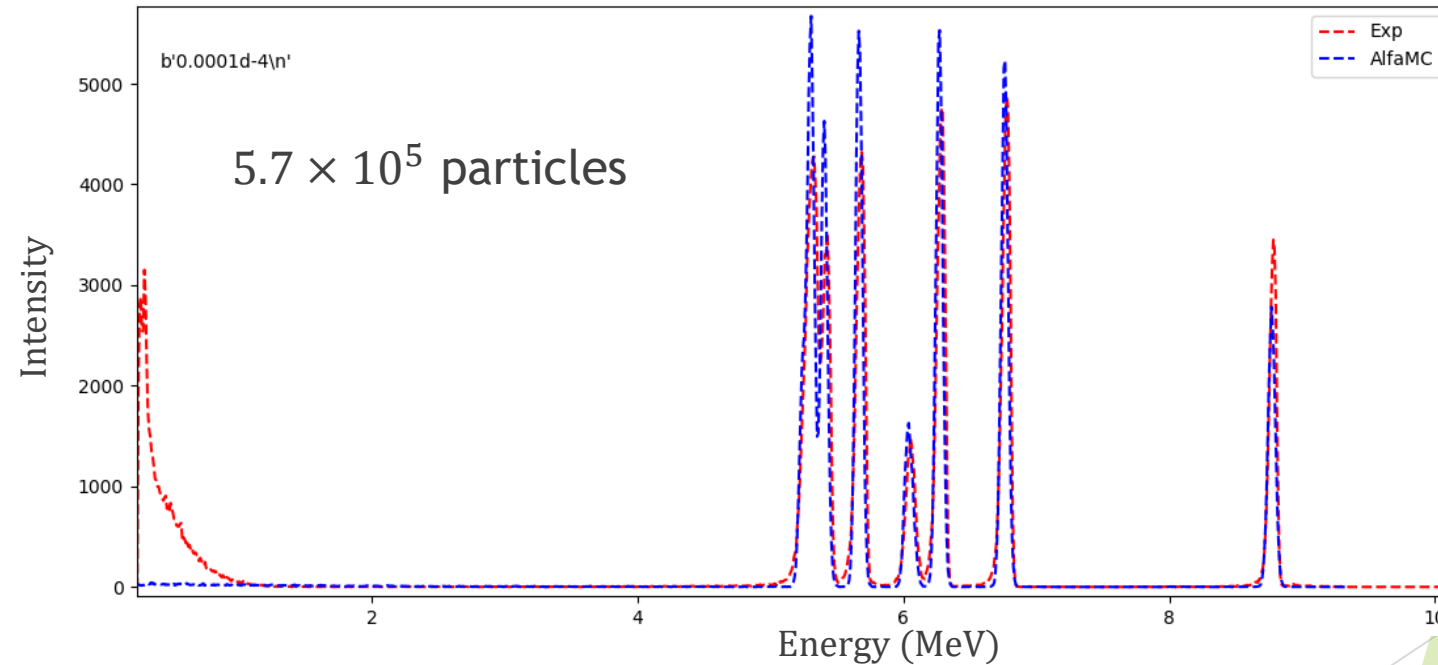
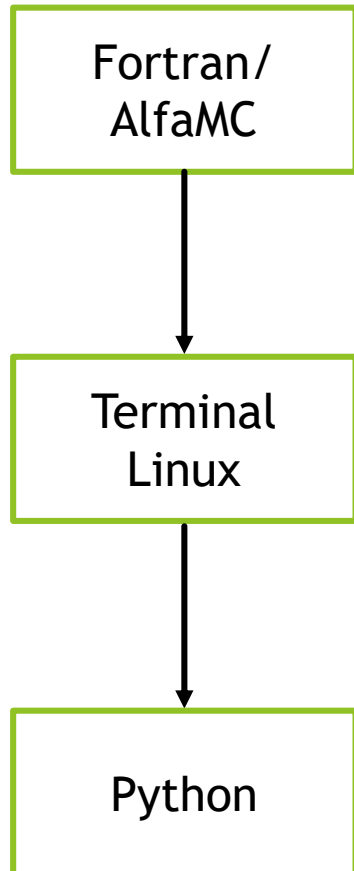


# Intensity Calibration - Change the amount of alfa particles

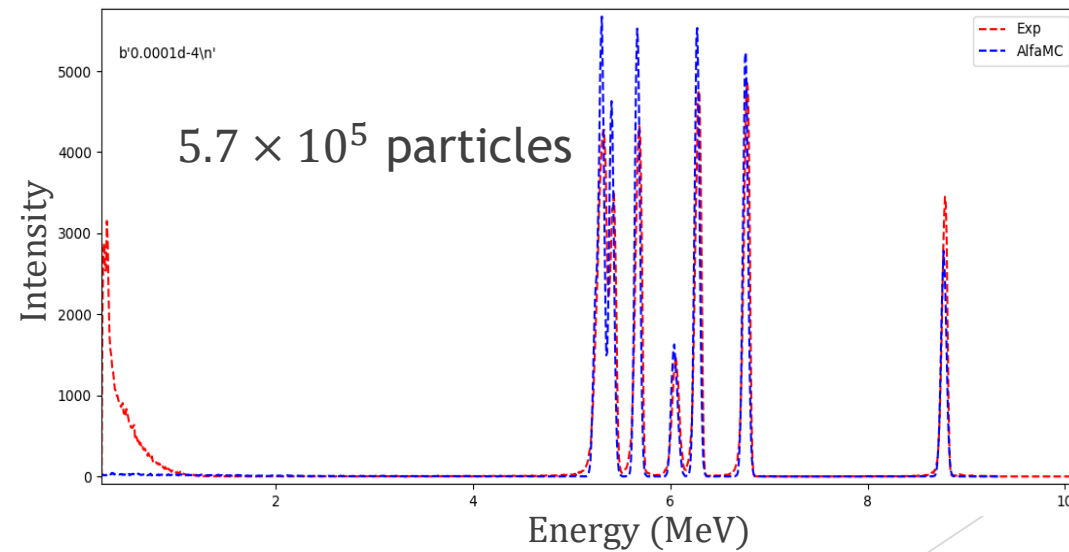
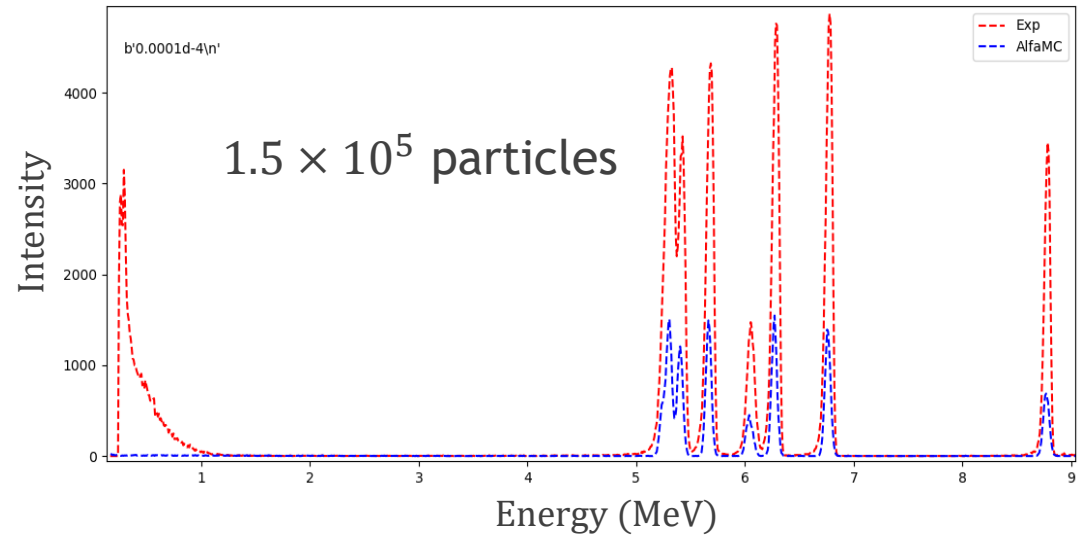
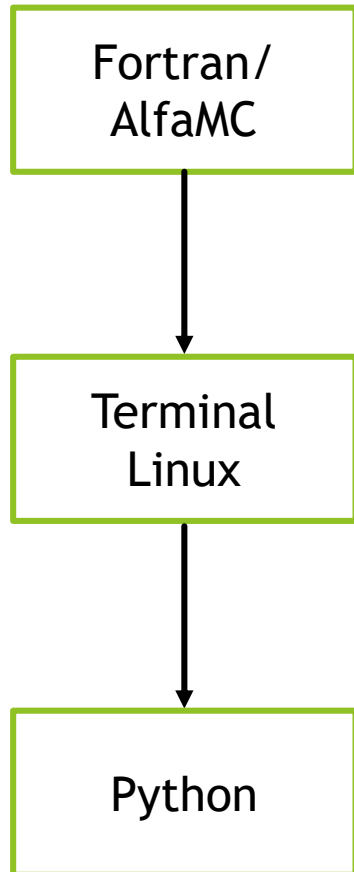




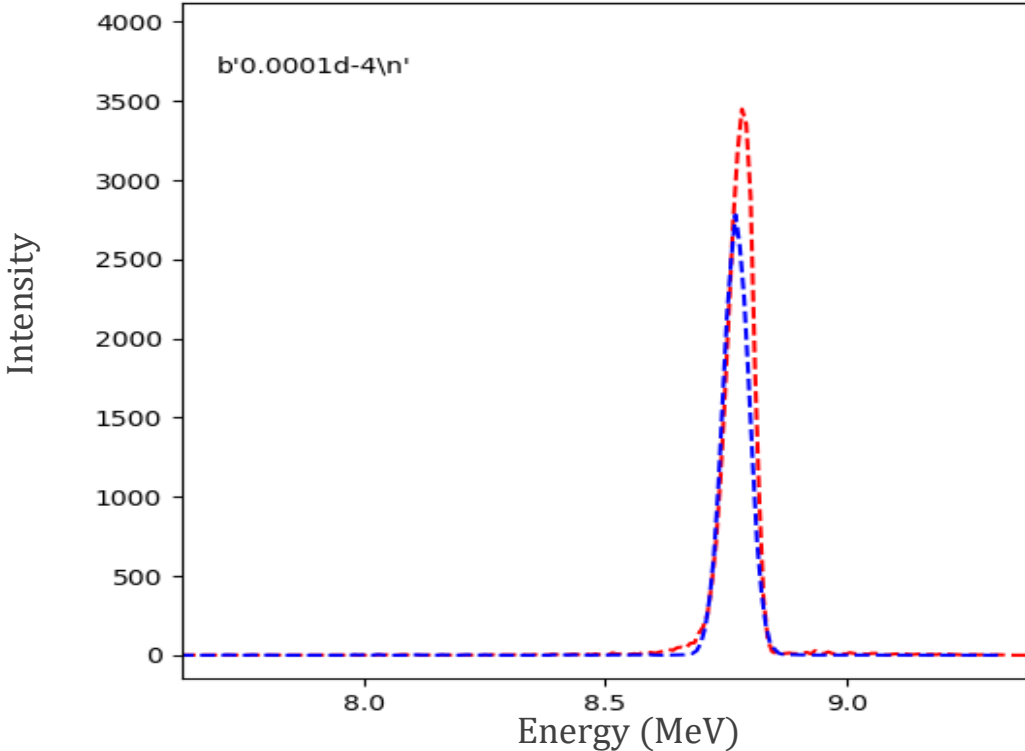
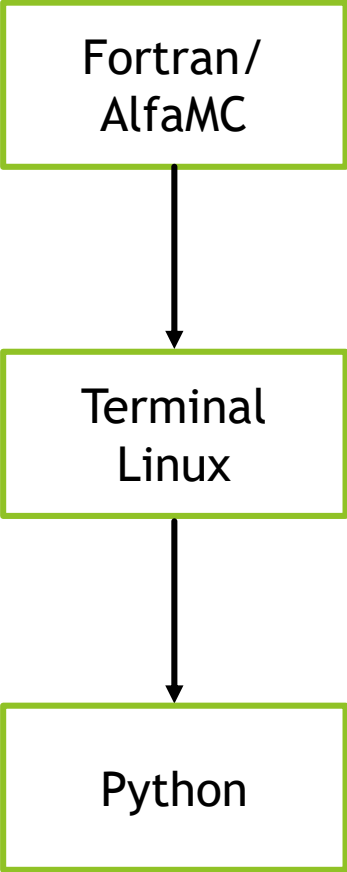
# Intensity Calibration - Change the amount of alfa particles



# Intensity Calibration



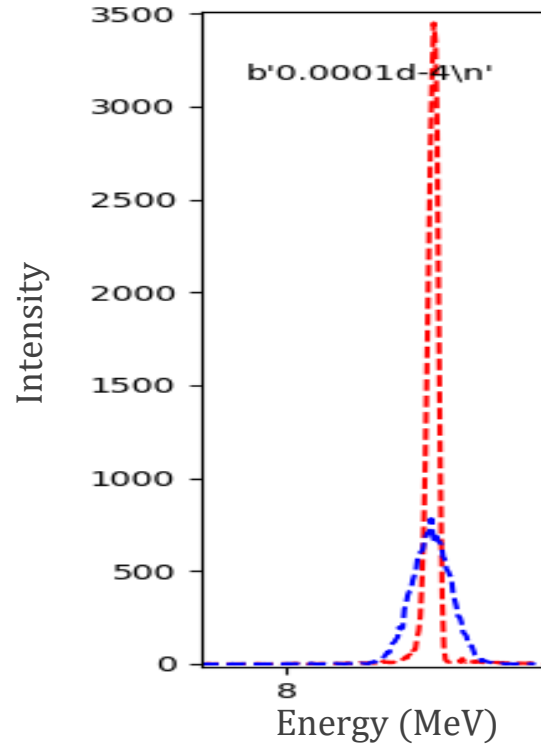
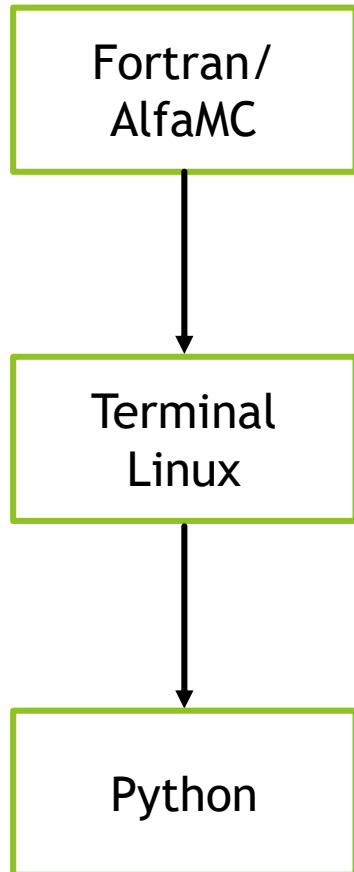
# Resolution Calibration - Detector



$$a = 1.5 \times 10^{-2}$$
$$b = -3 \times 10^{-3}$$

►  $\frac{a}{\sqrt{energy}} + b$

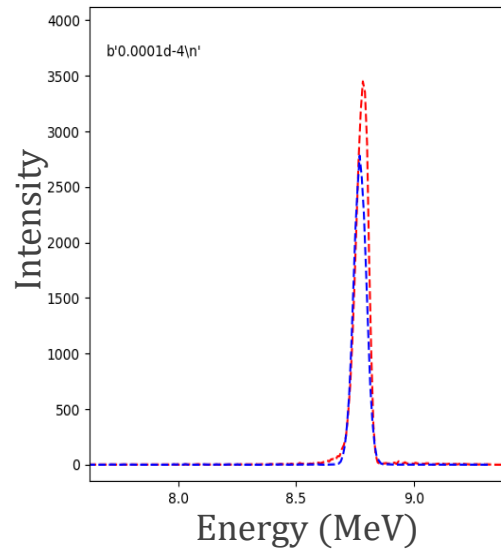
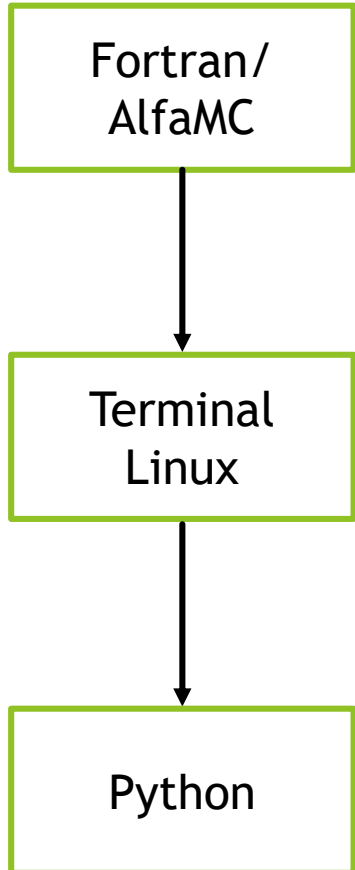
# Resolution Calibration - Detector



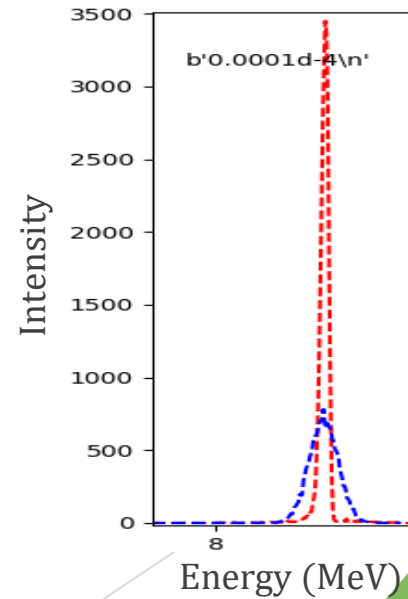
$$a = 5 \times 10^{-2}$$
$$b = -5 \times 10^{-3}$$

►  $\frac{a}{\sqrt{\text{energy}}} + b$

# Resolution Calibration - Detector

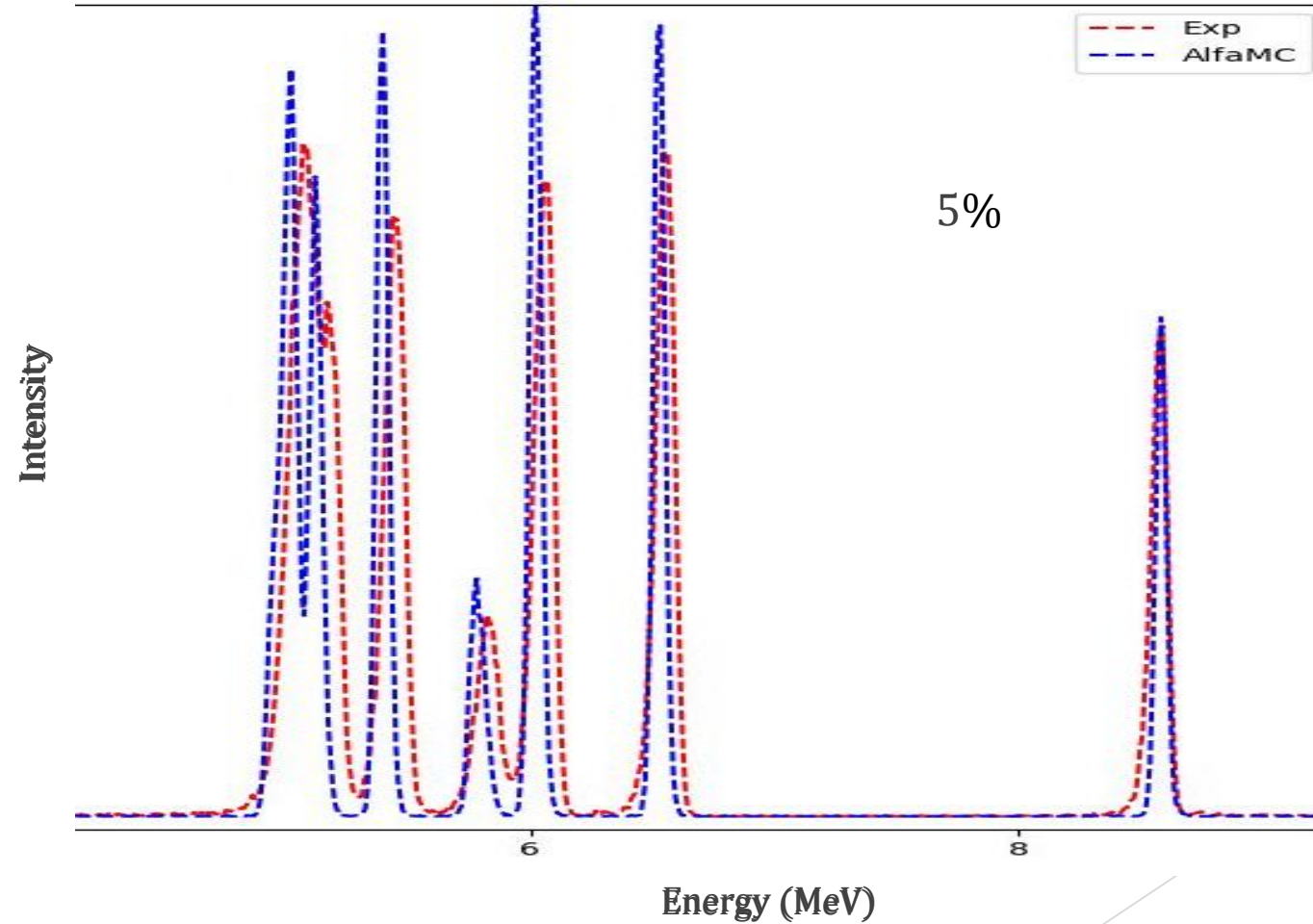
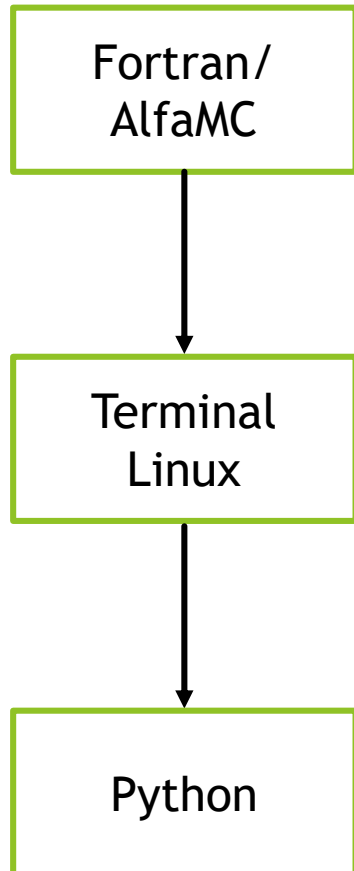


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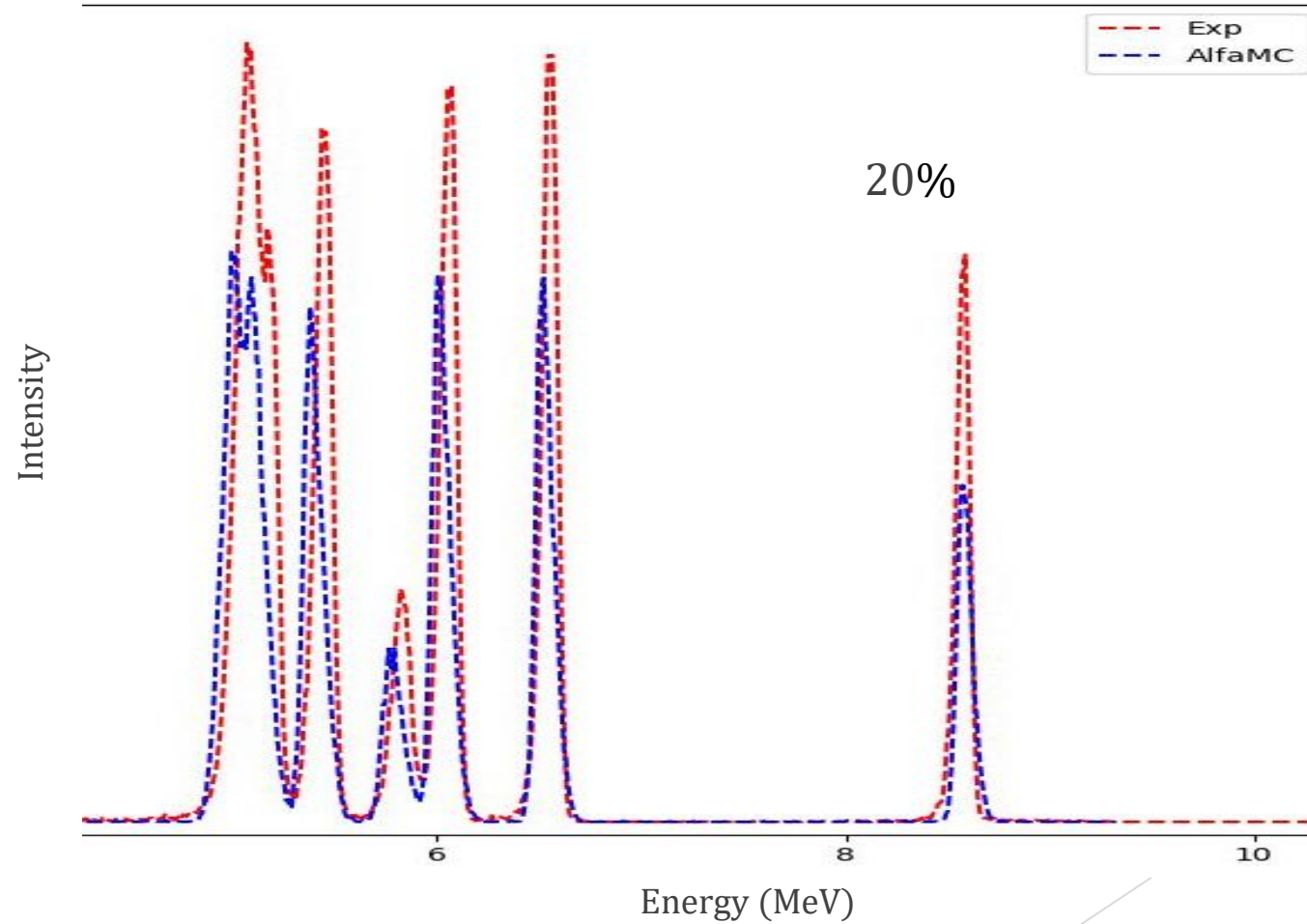
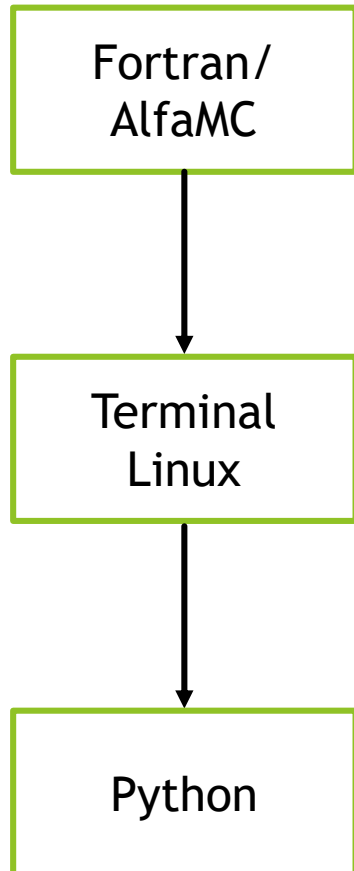


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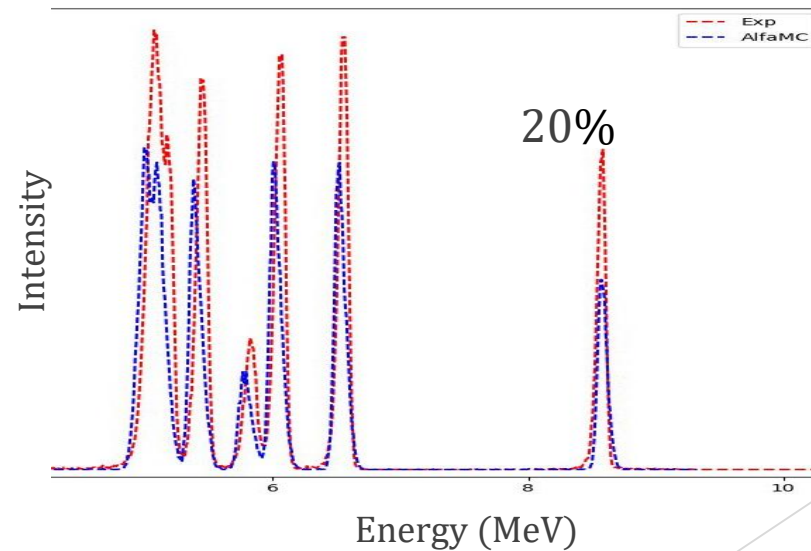
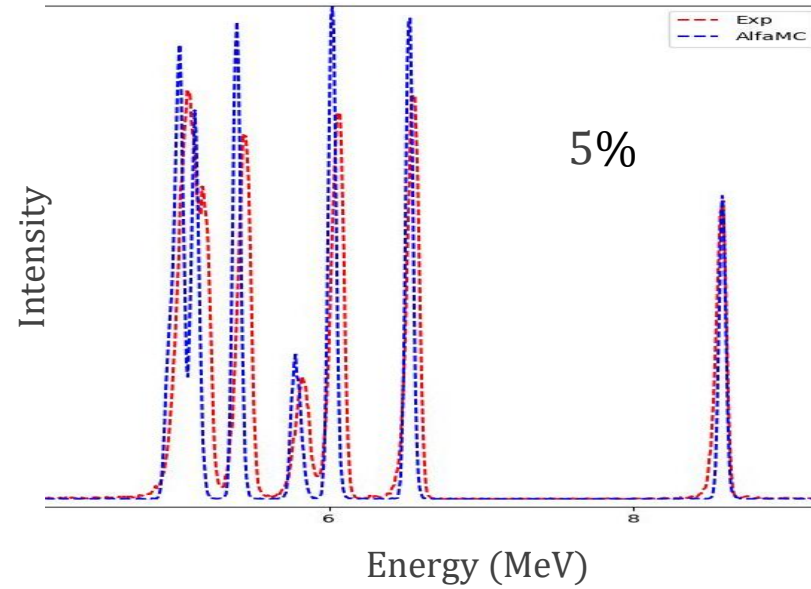
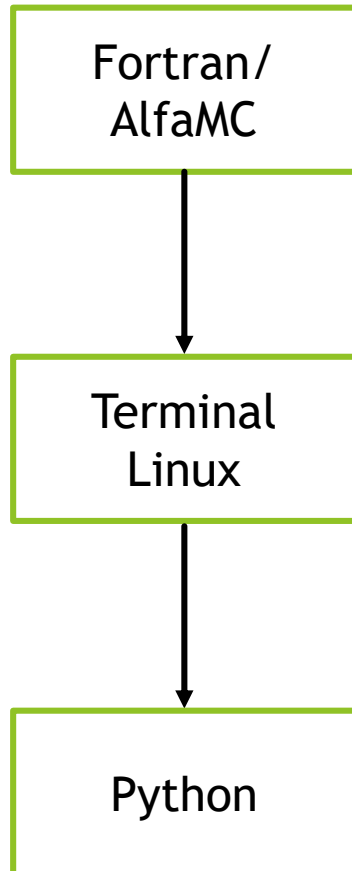
# Foil Homogeneity Calibration



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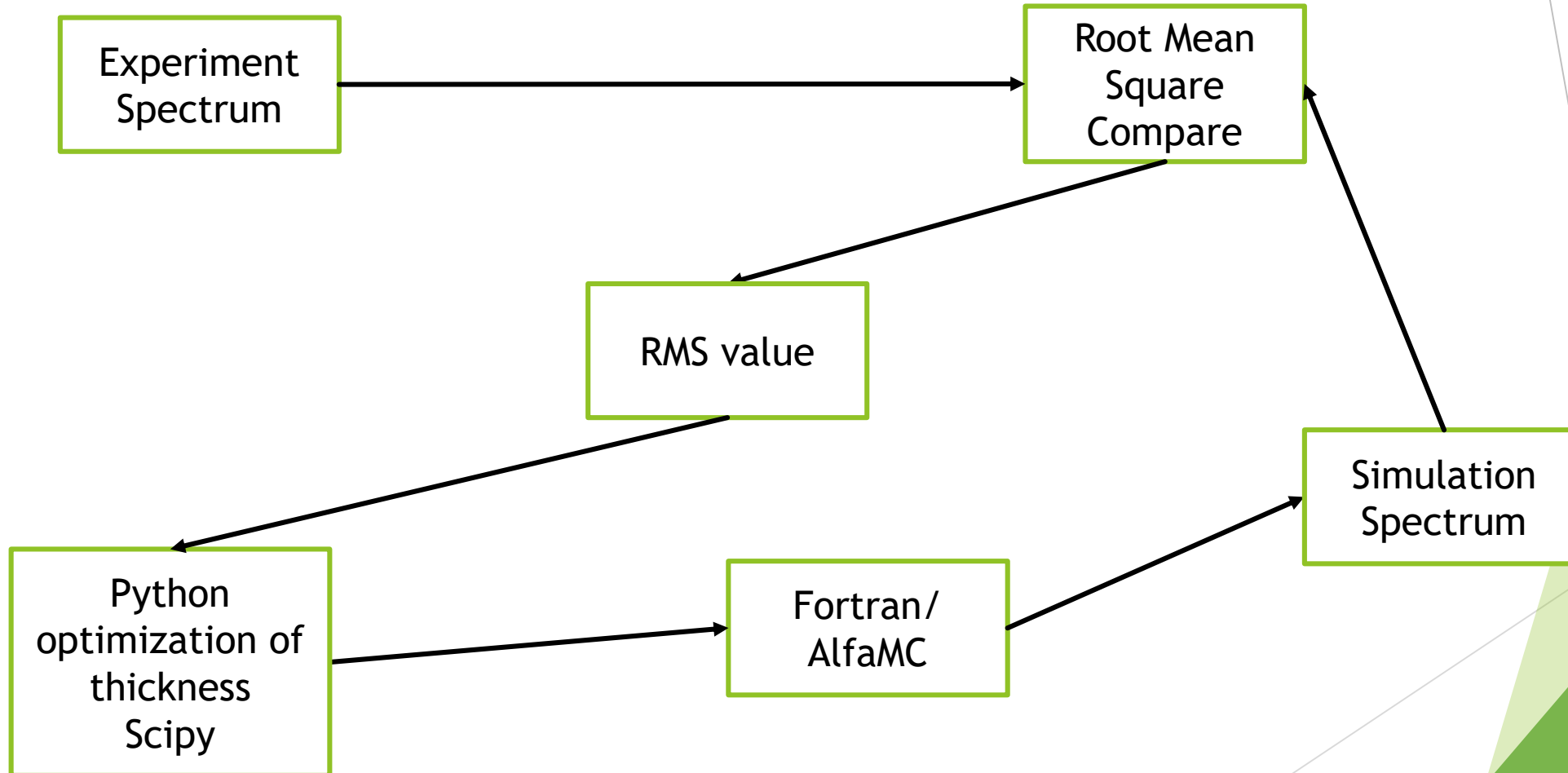


# Foil Homogeneity Calibration

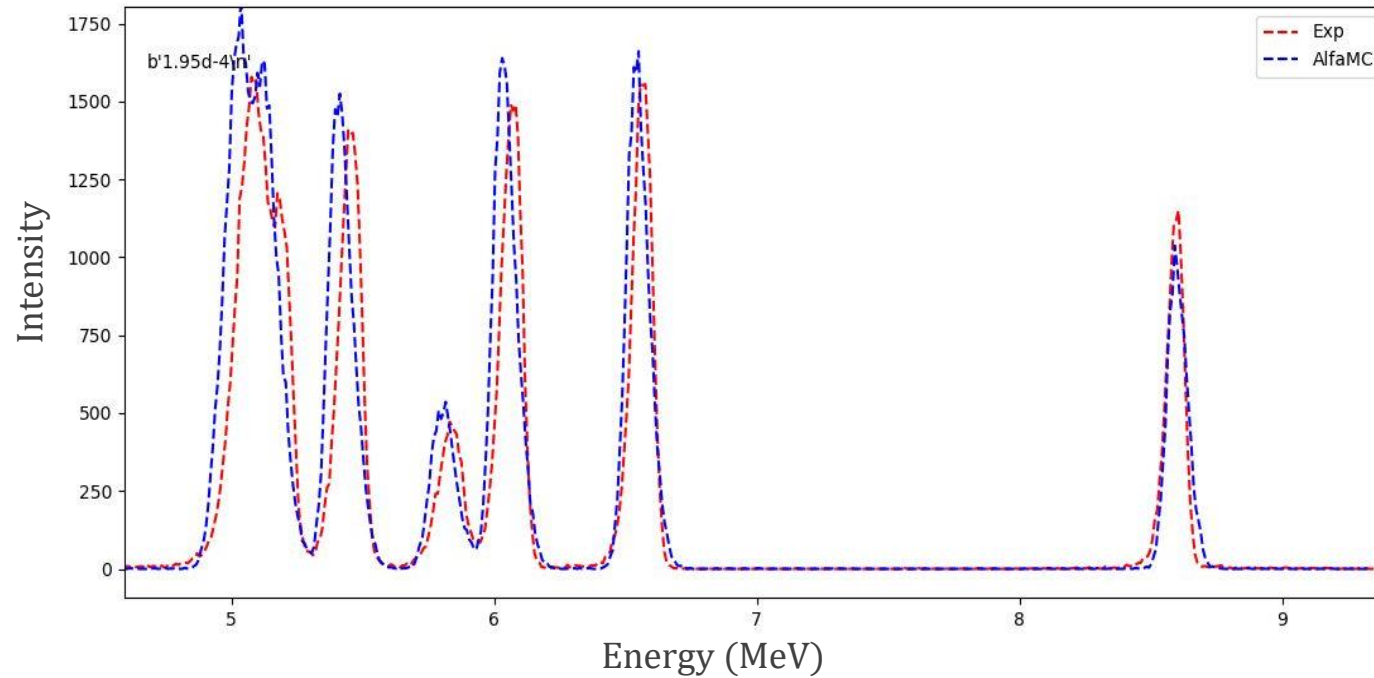
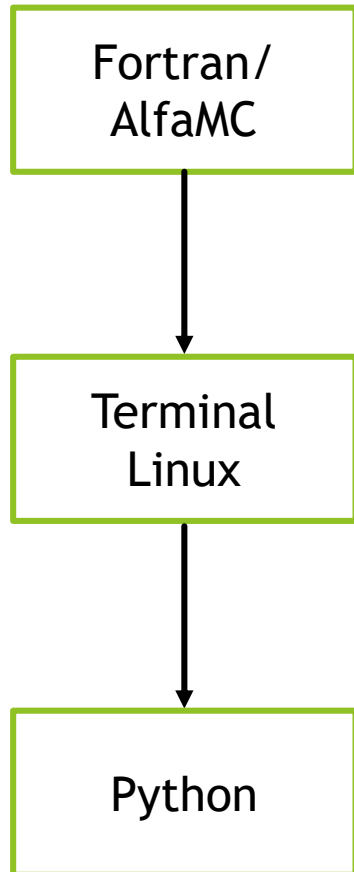




# Optimization

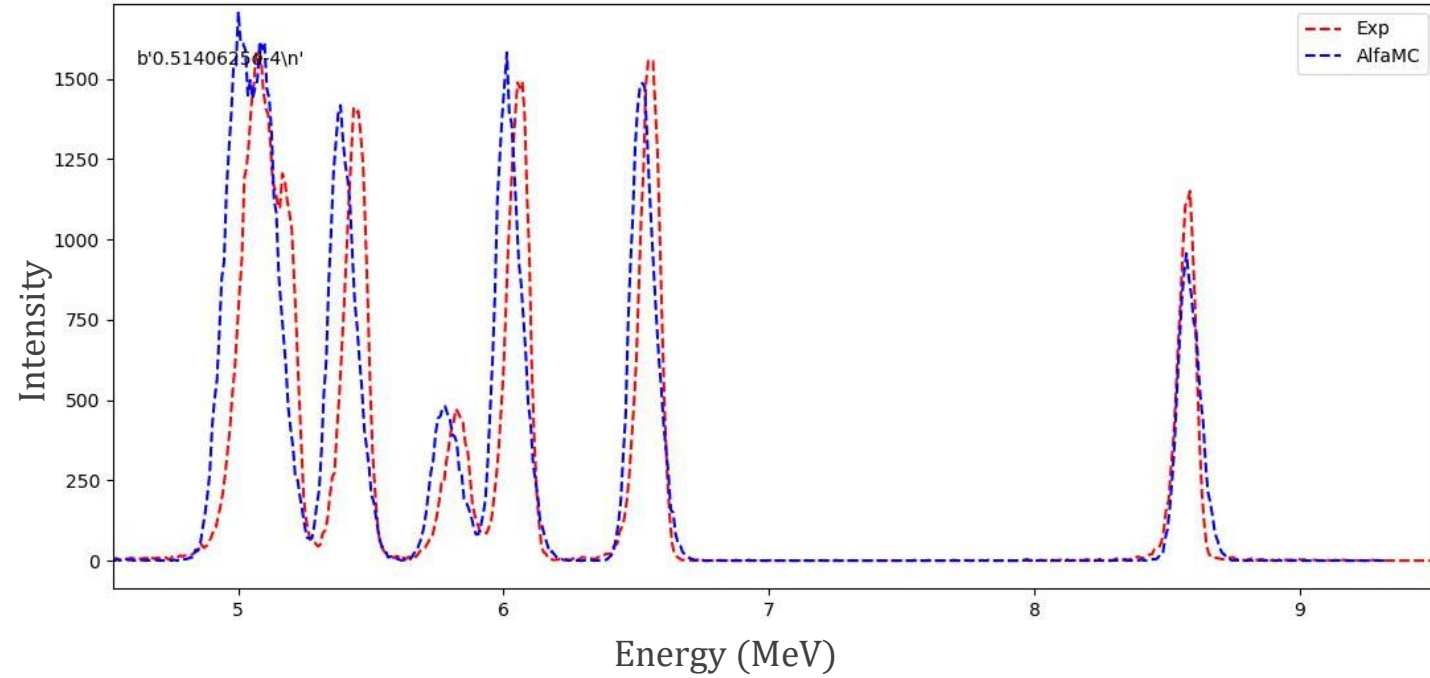
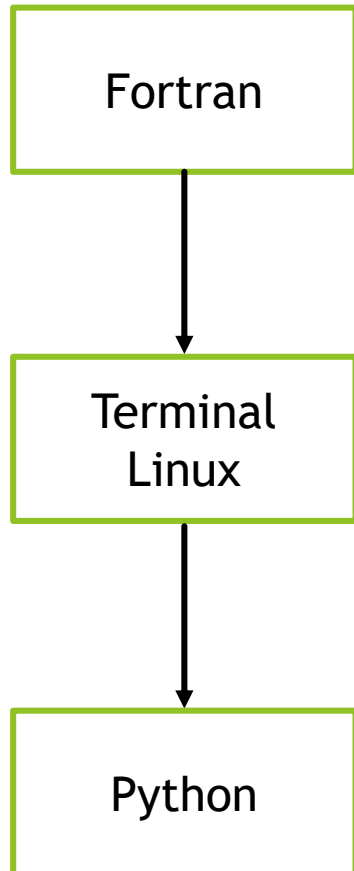


# Optimization



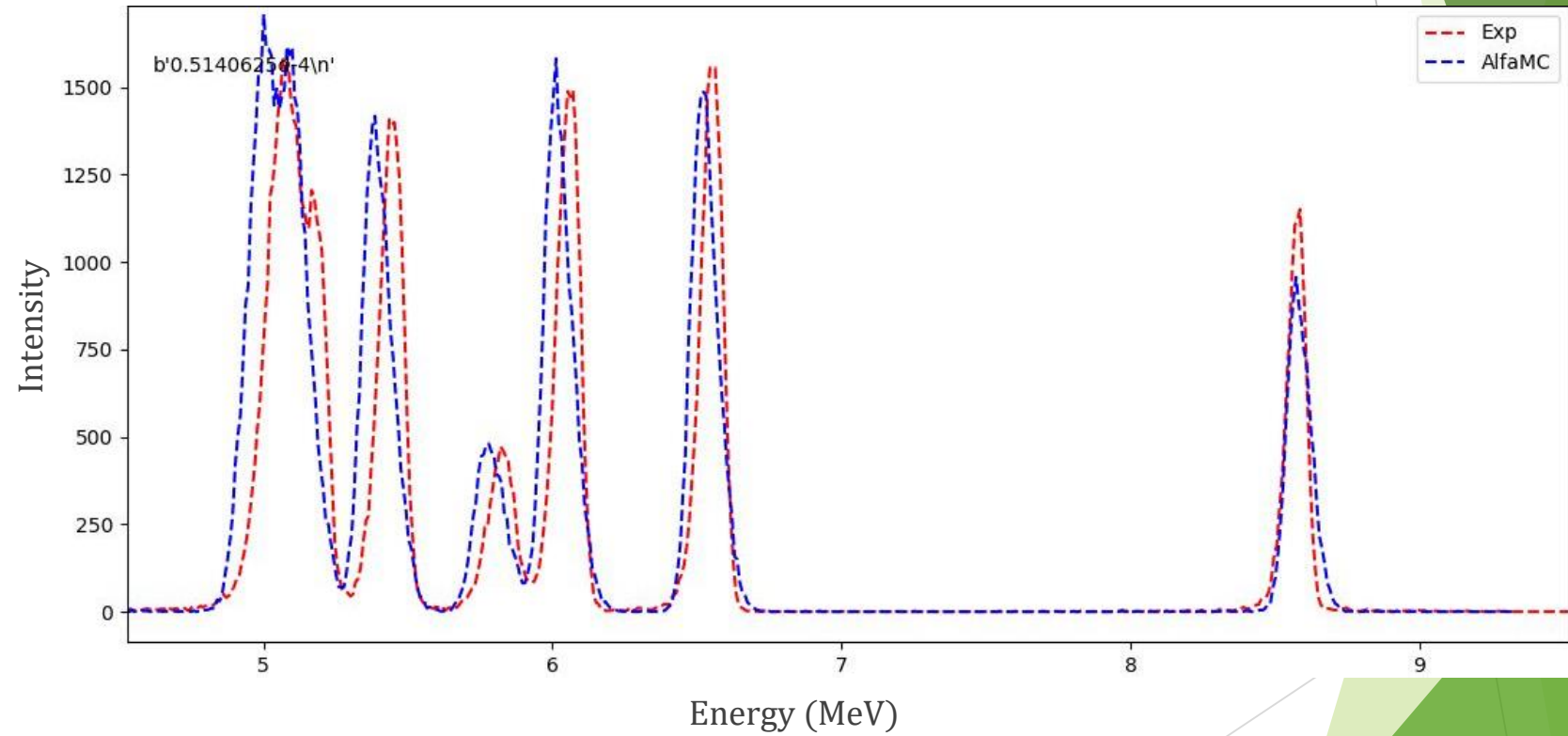
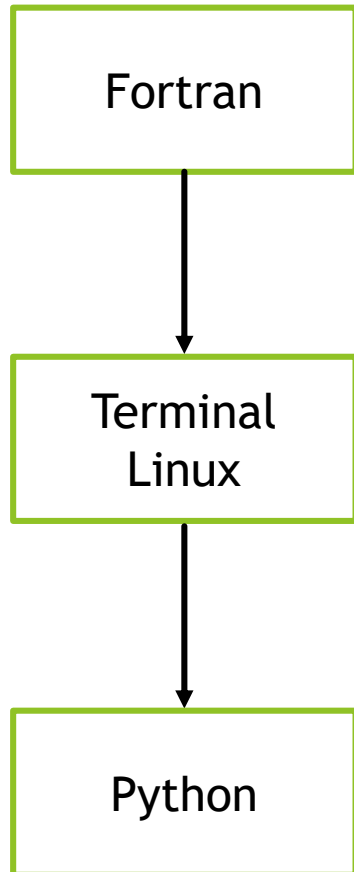
- ▶ Lead
- ▶ Thickness 1.95  $\mu\text{m}$

# Result



- ▶ Silver
- ▶ Python+AlfaMC value 0.51  $\mu\text{m}$
- ▶ Bethe Bloch value 0.74  $\mu\text{m}$
- ▶ Difference of 45%

# Problems



# Conclusion

- ▶ Learned basic Fortran concepts;
- ▶ Learned to use Linux terminal;
- ▶ Processes for production of thin films.