



# Machine learning in neutron activation and gamma spectroscopy

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EvalSpek-ML project is funded by the BMBF in the framework of the ErUM-Data action plan (collaborative project 05D2022).

MLZ is a cooperation between:









#### **EvalSpek-ML - PGAA**



Threshold > 0% Threshold > 0.1%

Threshold > 0.5%

Threshold > 1% Threshold > 5%

Threshold > 109 Threshold > 20%

coordinator AINT TUM possibilities. . partner ۵: associated partner BASF Number of Spectra Exceeding Elemental Thresholds Hereon HSU **ESO** A: element analysis B: noisy spectra C: machine learning Jülich D: astrospectroscopy ESS + IPB, Serbia E: diffraction + FS UNS, Serbia F: QENS + FH Aachen, Germany Project funded by the **BMBF** in the framework of the ErUM-Data action plan (collaborative project 05D2022). 1000000 MW mass (g) 22.99 0.05 100000 15.000 0.0013 47.867 0.05 0.04 107.87 0.01 5.453 10000 0.1 24.9 22 196 97 0.005 50 0.01 0.0005 1000 144.24 157.25 0.0001 40 0.0001 150.36 Counts 100 value 30 10 20 1 10 0 H B C N O Na Mg Al Si 0 2000 4000 6000 8000 10000 12000 Energy (keV)

Simple methods were tested, as well as Autoencoders, currently investigating other



D.Knezevic, Machine learning in neutron activation and gamma spectroscopy, Transfer Workshop: ErUM-Scientists & Industry in Dialogue, 06.02.2025, Aachen



#### **Future Work**



#### Simulations



#### 153-Sm

153-Sm info about gamma lines and Sum(k\_0)

----- prompt gamma spectras ------

153-Sm\_spectra\_zeros.txt 153-Sm\_spectra\_zeros.root 153-Sm\_spectra\_zeros\_32\_subsets.txt.zir



## **Next projects**

R&D of forward model-based ML approaches which will be used to predict data output in various application areas.

In case of FRM2 PGAA group: Instrumental neutron activation analysis (**INAA**) and neutron depth profiling (**NDP**).



Figure 1: NDP mapping test: A 1-mmpinhole was used and the result on a 2D detector is a convolution of the pinhole and the image (TUM logo).