



## Novel DPA Estimation Approach for EUROFER, Tungsten, CuCrZr Specimens for IFMIF-DONES Based on Gamma Activities

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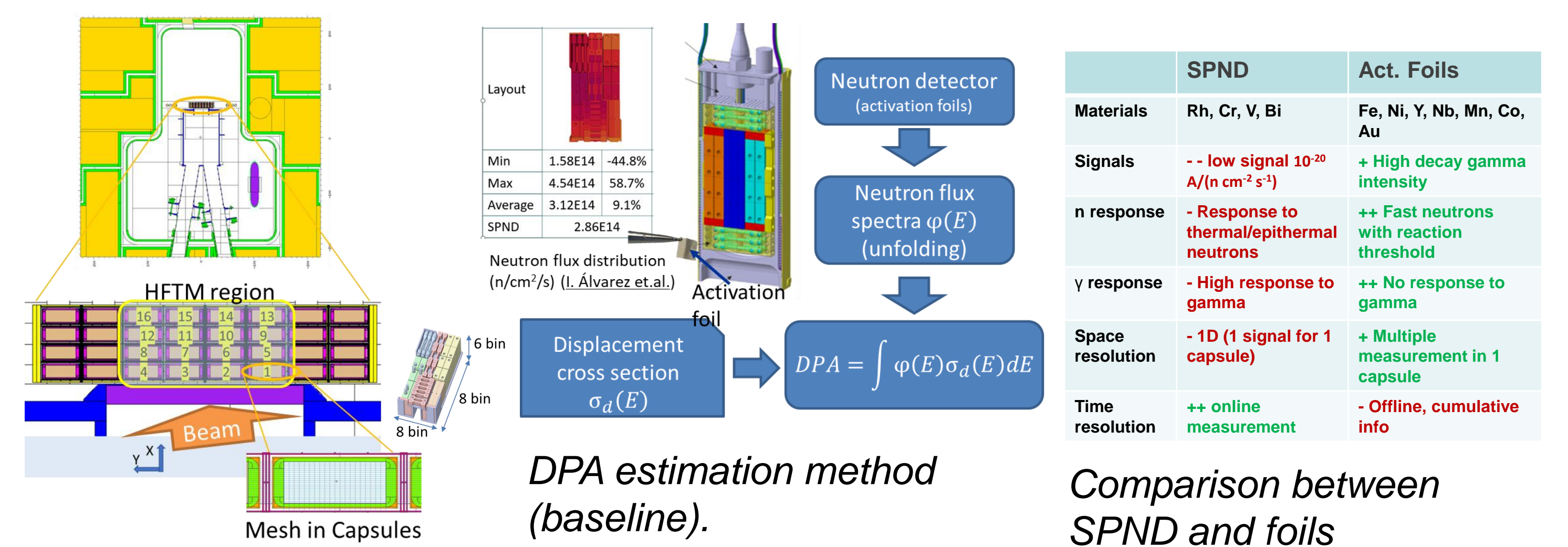
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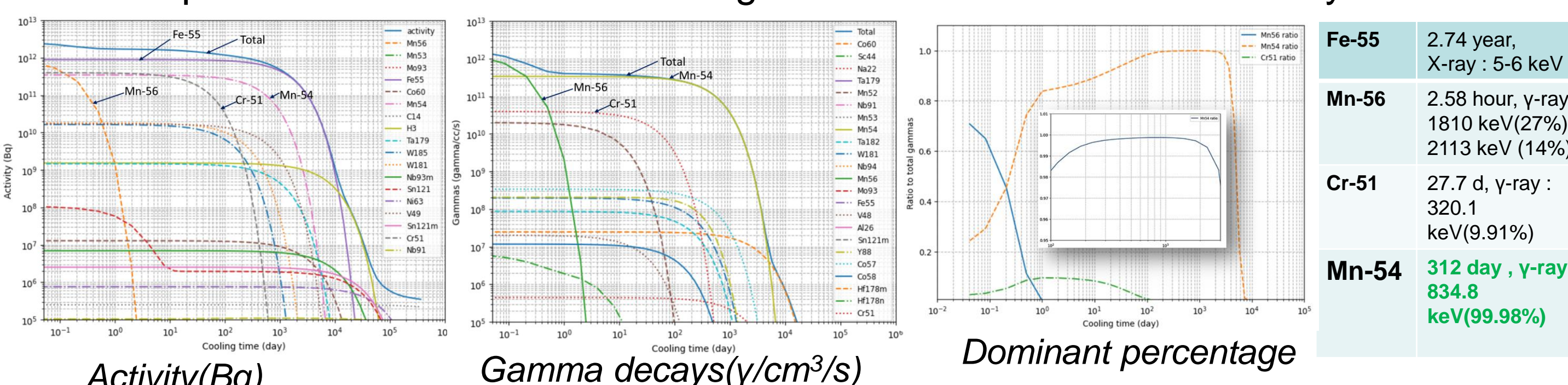
### Introduction

- IFMIF-DONES is an accelerator-based neutron irradiation facility that provides the necessary irradiation data for the qualification of materials for the DEMO fusion power plant. The High Flux Test Module (HFTM) is used for housing small-scale (SST) specimens of various structural materials.
- Although HFTM has self-power neutron detectors SPND and activation foils, accurately estimating the actual neutron flux and damage dose received by specimens remains challenging.
- Motivation:** develop a sample-wise DPA estimation method based on material activations and decay gammas measurements.

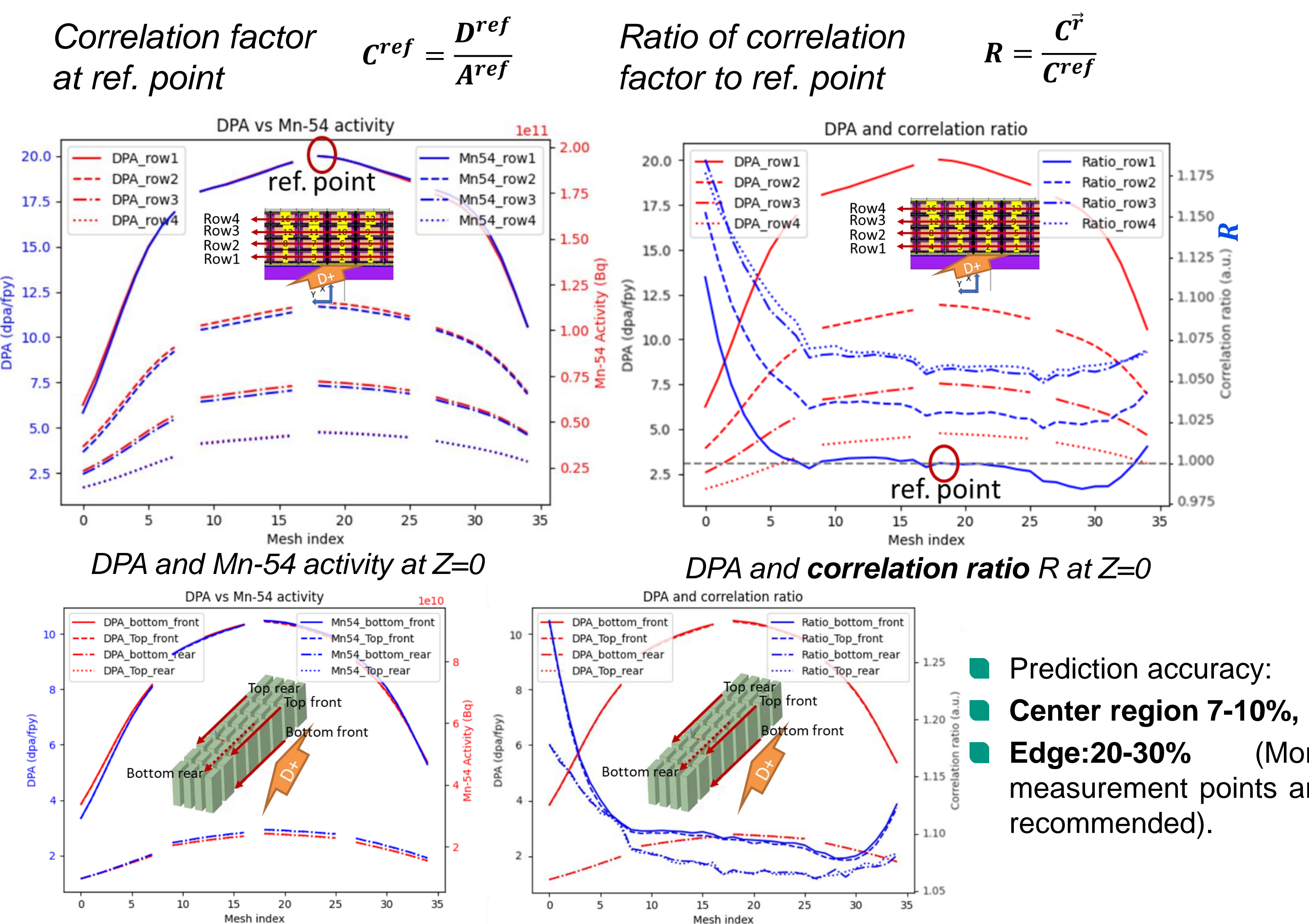


### EUROFER: activations, gamma emissions, and DPA correlations

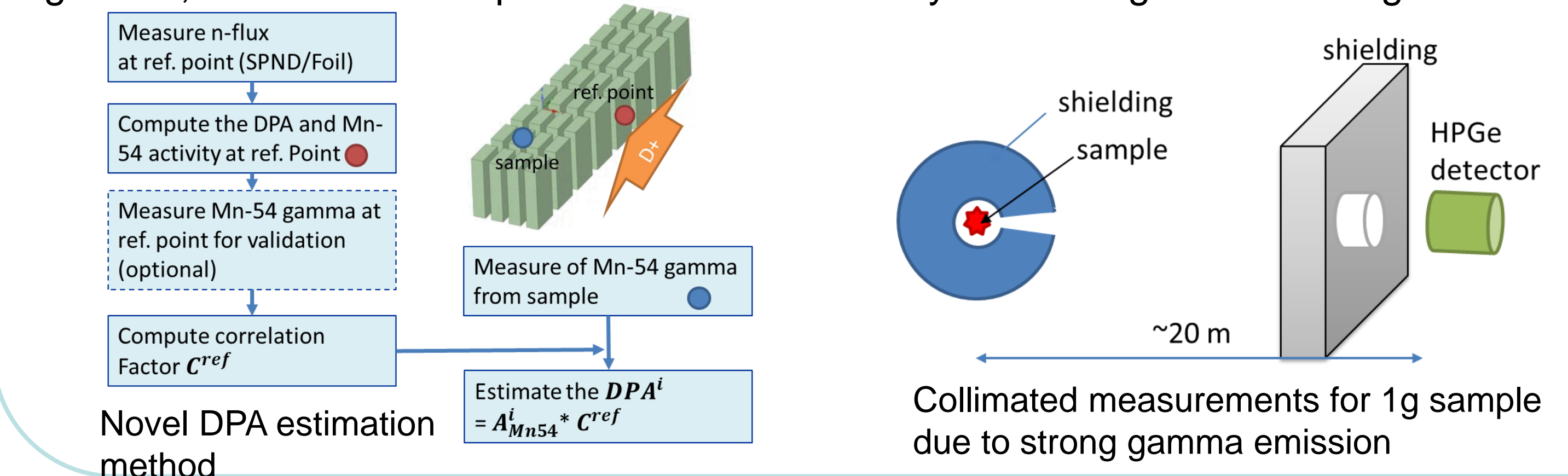
- Dominant nuclei for activity, contact dose, and gamma decays were analyzed on the capsule-3. Mn-54 dominates the gamma activities in 180-2000 days.



- Mn-54 is produced mainly from Fe (95%) and Mn (4.3%). The production cross section is consistent with the Fe displacement cross section in energy and trend.
- Mn-54 activity and DPA value demonstrate excellent correlations in a linear scale.

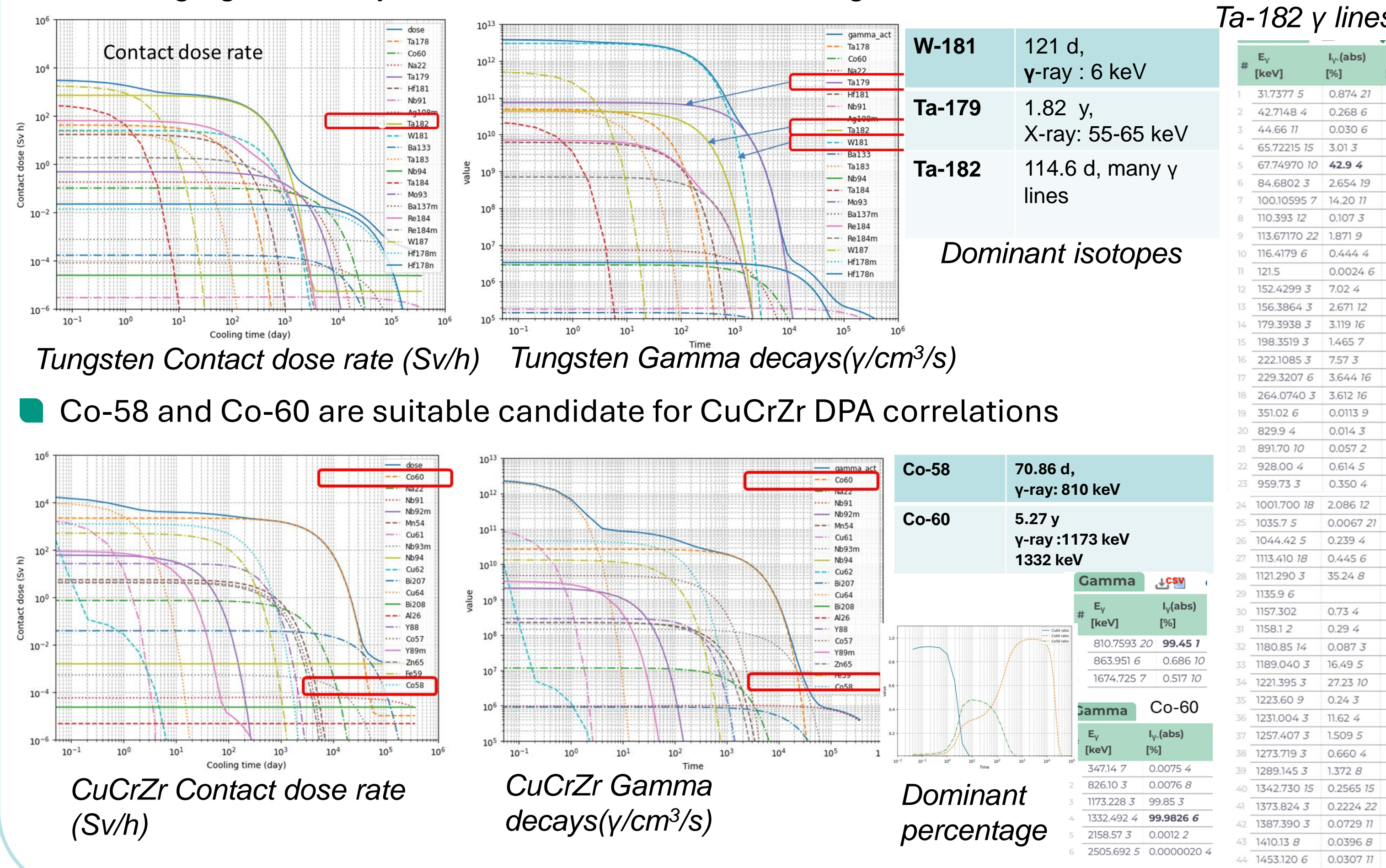


- New DPA estimation method: theoretically, one measurement for n-spectra and Mn-54 gamma, and DPA of samples can be estimated by measuring their Mn-54 gammas.



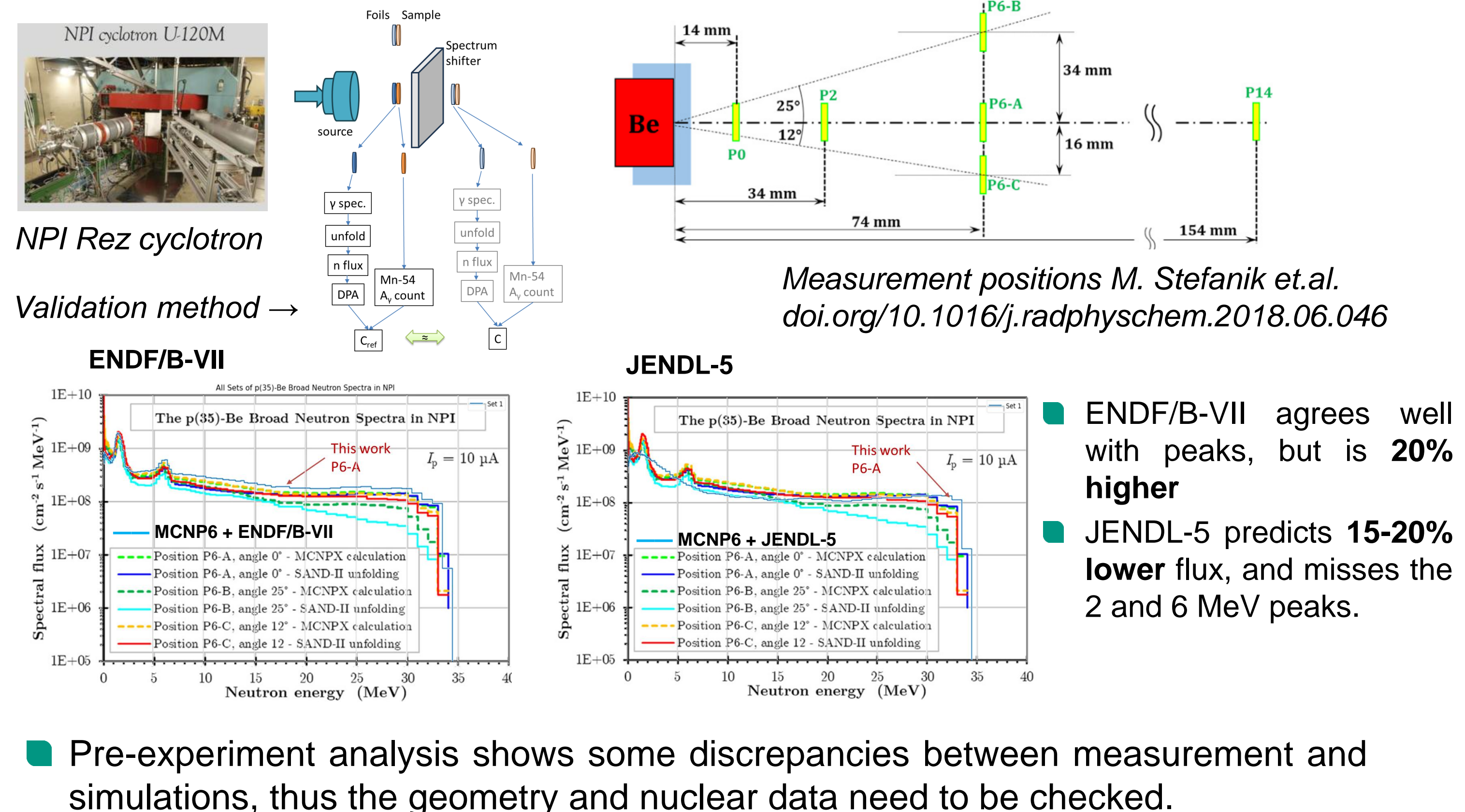
### Tungsten and CuCrZr: activations, gamma emissions

- Ta-182 is the candidate for W DPA estimation, yet the gamma lines are challenging to identify. Need to find suitable feature gamma lines.



### Experimental Validation of the novel DPA estimation approach

- Experiment design using activation foil set with the EUROFER sample, to be irradiated in the NPI Rez U128m cyclotron (p-Be source with E<sub>n</sub> up to 33 MeV).



### Conclusions and Outlook

- A novel DPA estimation method has been proposed for EUROFER, based on the correlations between DPA and **Mn-54** gamma activities.
- Mn-54 (312 d) emits one γ (835 keV). It accumulates along the 1-year irradiation, and dominates the gamma activities during 180-1000 days. It has good correlation with DPA, optimistically 7-10% in the center (best case 1-2%), and 20% at the edges.
- By studying the tungsten irradiation, we found **Ta-182** is a good candidate for DPA estimation, and also CuCrZr produced **Co-58** and **Co-60**, which have similar potential.
- Experimental validation of this approach has been planned at NPI-Rez, Czech Republic. Pre-experiment analysis has been provided to plan the irradiation, and agreements need to be improved before carrying out the experiments.