

Accurate Nuclear Data for
nuclear Energy Sustainability



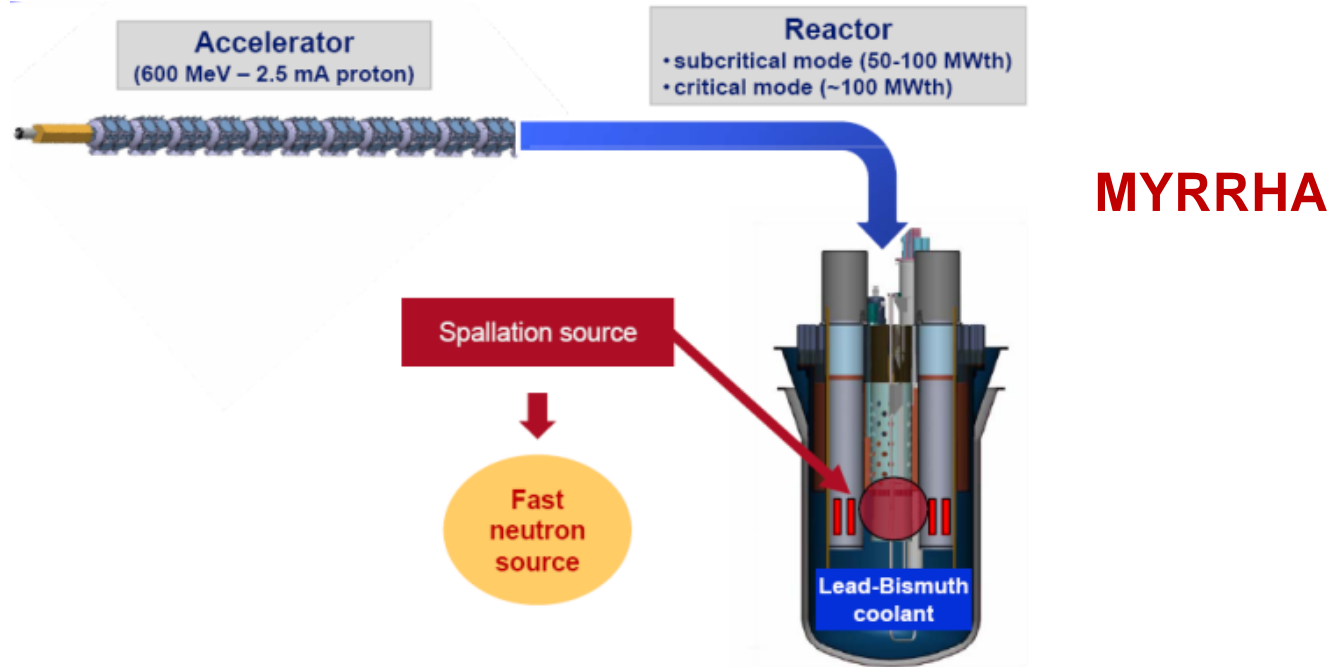
ANDES – WP4

High-energy model validation in the 150-600 MeV domain

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General overview

WP4 - High energy model validation in the 150-600 MeV domain



**ADS as an option to reduce minor actinides
amounts in dedicated systems**

↳ **ADS demonstrator: MYRRHA**

↳ **Necessity of reliable and validated simulation tools**

WP4 - High-energy model validation in the 150-600 MeV domain

General objectives:

- **To identify remaining deficiencies and not understood features of the nuclear models used in high-energy transport codes between 150 and 600 MeV**
- **to use/do a few specific experiments to solve the identified problems**
- **to further improve the models**
- **to do a few specific integral validation experiments**
- **to assess the uncertainty with which quantities related to high-energy reactions can be predicted**

WP4 - High-energy model validation in the 150-600 MeV domain

- **Task 4.1:** State-of-the-art of high-energy model predicting capability in the 150-600 MeV domain (CEA/DSM, ULG, GSI, USC)
- **Task 4.2:** SPALADIN p+Pb at 500 MeV : measurement of the fission fragments and light evaporation residues in coincidence with light ions (USC, CEA/DSM, GSI)
- **Task 4.3:** Measurement of neutron-induced light ion cross-sections at 175 MeV on Fe, Bi and U (UU, CNRS/Caen)
- **Task 4.4:** Improving of the predicting capabilities of the simulation tools in the 150-600 MeV in order to reduce the uncertainties on key parameters of the demonstration facility spallation target (ULG, CEA/DSM, GSI, CEA/DAM, NRG)
- **Task 4.5:** Validation on the results from the post irradiation analysis of MEGAPIE samples (PSI, CEA/DSM)



Task 4.1: State-of-the-art of high-energy model predicting capability in the 150-600 MeV domain (CEA/DSM, ULG, GSI)

- use of conclusions of the Benchmark of Spallation models presently organized by IAEA + specific comparisons of the models to the available elementary data (from HINDAS and NUDATRA) in the 150-600 MeV energy domain
 - ↳ Deficiencies of the models to be cured in T4.4
 - ↳ D4.1: Report on the predicting capabilities of the standard simulation tools in the 150-600 MeV energy range (CEA/DSM) has been delivered
 - ↳ Task completed

Task 4.2: p+Pb at 500 MeV: measurement of the fission fragments and evaporation residues in coincidence with light ions (USC, GSI, CEA/DAM)

- Importance of predicting gases from the liquid target: He, t, **volatile elements from fission**, Hg
- Discrepancies between different sets of data
- ↳ Experiment at GSI on Pb+p at 500 MeV

SPALADIN → SOFIA

- Total fission cross-sections
- charge distributions → **isotopic distributions**
- **Coincidence with neutrons**
- ⇒ **Foreseen mid-2012**
- ↳ **J. Benlliure: status of the SPALADIN/SOFIA experiment**



Task 4.3: Measurement of neutron-induced light ion cross-sections at 175 MeV on Fe, Bi and U (UU, CNRS/Caen)

- Importance of predicting light ion cross-sections (helium, tritium)
- Data around 150-200 MeV scarce, region between data library and nuclear models
- ↪ **experiment at TSL (Uppsala) with the MEDLEY set-ups on n+Fe, Bi, U at 175 MeV (Done Autumn 2009)**
 - Publication in preparation with comparison with INCL4.5-ABLA07 (R. Bevilacqua et al.)
- ↪ **S. Pomp: status of the Uppsal experiment analysis**



Task 4.4: Improving of the predicting capabilities of the models in the 150-600 MeV (ULG, CEA/DSM, GSI, CEA/DAM, NRG)

➤ **Objective: reduction of the model deficiencies identified in Task 4.1**

↪ **Sub-task 4.4.1: Improving the high-energy models**

↪ **Sub-task 4.4.2: Investigating the possibility to use Evaluated Data Files above 150 MeV**

▪ Implementation of the improved models or evaluated data files into standard high-energy transport codes and calculations of a real spallation target

▪ Assessment of the resulting improvement on the key parameters with the participation of end-users (MYRRHA)

↪ **J.C. David: Implementation of the INCL4-ABLA into transport codes**

↪ **D. Mancusi: recent improvements in INCL4 and ABLA**

↪ **A. Koning: Data libraries up to 600 MeV?**

Task 4.5: Validation on the results from the post irradiation analysis of MEGAPIE samples (PSI, CEA/DSM)

- Analysis of samples from the MEGAPIE liquid Pb-Bi target irradiated during 4 months at SINQ and from ISOLDE
 - ↪ **List of isotopes that could be analysed:**
 $^{208/209}\text{Po}$, ^{194}Hg , $^{108\text{m}}\text{Ag}$, ^{60}Fe , ^{53}Mn , ^{59}Ni , ^{26}Al , ^{36}Cl , ^{10}Be , ^{129}I ,
 ^{10}Be , ^{55}Fe
 - ↪ characterization of the radionuclide inventory of the ISOLDE target as model for MEGAPIE:
 - ↪ determination of the vertical and radial distributions of relevant radionuclides in MEGAPIE
 - ↪ **Test of the new models developed in T4.4**
 - ↪ **D. Schumann: First results of the MEGAPIE sample analysis**



WP4 - Milestones

- **M4.1: Identification of the main deficiencies of the models to be corrected (month 12) **DONE****
- **M4.2: Realization of the Uppsala experiment (month 12) **DONE****
- **M4.3: Realization of the GSI p+Pb experiment (month 18 → 24)**
- **M4.4: Obtaining of the MEGAPIE samples (month 18 → 20)**
- **M4.5: Preliminary high-energy evaluated data files and benchmark comparison (month 18 → 24)**
- **M4.6: Analysis of the MEGAPIE samples (month 30)**



WP4 - Deliverables

- **D4.1: Report on the predicting capabilities of the standard simulation tools in the 150-600 MeV energy range (CEA/DSM) Delivered**
- **D4.2: New versions of the INCL4 and ABLA models improved in the 150-600 MeV domain (report and codes) (Month 30) (ULG)**
- **D4.3: Final high-energy evaluated data files and benchmarks comparison (Month 30) (CEA/DAM, NRG)**
- **D4.4: Experimental results from the experiment on p+Pb at 500 MeV (report and EXFOR library)(Month 36) (USC)**
- **D4.5: Light-ion production cross-sections from n+Fe, Bi and U at 175 MeV (report and EXFOR library) (Fe, Bi available, U Month 36) (UU)**
- **D4.6: Report on the validation of the simulation tools developed in Task 4.4 and assessment of the expected reduction of uncertainty on key parameters of the ADS (Month 36) (CEA/DSM)**
- **D4.7: Experimental results from the MEGAPIE sample analysis (Report and file) (Month 36) (PSI)**

WP4 - Agenda

	Session 4 High energy model validation in the 150-600 MeV energy domain
	SPALADIN/SOFIA p+Pb at 500 MeV
14:10	Status of the SPALADIN/SOFIA experiment J. Benlliure, USC
	Neutron-induced light ion cross sections at 175 MeV for Fe, Bi and U
14:30	Neutron-induced light ion cross sections at 175 MeV for Fe, Bi and U S. Pomp
	Improving predictive power of models to reduce uncertainties for demonstrators
14:50	Implementation of the INCL4-ABLA into transport codes J.C. David
15:10	Recent improvements in the INCL4 and ABLA models D. Mancusi
15:30	Data libraries up to 600 MeV? A. Koning, NRG
	Validation using MEGAPIE
15:40	First results of the MEGAPIE sample analysis D. Schumann, PSI

