Accurate Nuclear Data for nuclear Energy Sustainability

FP7 – ANDES

Enrique M. Gonzalez
CIEMAT
Accurate Nuclear Data for nuclear Energy Sustainability

The ANDES FP7-EURATOM project intends to address the nuclear data needs associated to
the new reactors and
new fuel cycles
supported by SNETP, in its SRA and in the ESNII proposal, taking into account the priority lists for nuclear data from NEA/OECD,
FP6-EURATOM projects EUROTRANS-NUDATRA and CANDIDE.

- measurement,
- evaluation,
- validation and
- dissemination
- data uncertainties & covariances
ANDES Activities and Work Packages structure

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<th>Title</th>
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<td>Measurements for advanced reactor systems</td>
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<td>2</td>
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<td>Dissemination, education &amp; training</td>
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<td>6</td>
<td>Management</td>
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General project schedule
Deliverables and Milestones

36 months from 2010/05/01
38 Deliverables: 11 + 6 + 8 + 7 + 4 + 2
37 Milestones: 16 + 6 + 7 + 6 + 1 + 1
The ANDES collaboration

Includes: R&D centers + Universities with experience on:

- measuring differential data in accelerator and reactor based facilities
- operating facilities
- performing data evaluation
- nuclear models and nuclear theory
- validation of simulation tools with integral experiments
- neutronic simulations
- international organism for nuclear data coordination and dissemination
- new reactor and advanced fuel cycles design and development, and on SNETP
- training and education

20 Institutions from 15 EU countries

<table>
<thead>
<tr>
<th>Beneficiary Number</th>
<th>Beneficiary name</th>
<th>Beneficiary short name</th>
<th>Country</th>
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<tbody>
<tr>
<td>1(coordinator)</td>
<td>CENTRO DE INVESTIGACIONES ENERGETICAS, MEDIOAMBIENTALES Y TECNOLOGICAS</td>
<td>CIEMAT</td>
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<td>UU</td>
<td>Sweden</td>
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ANDES main experimental facilities

Accurate Nuclear Data for nuclear Energy Sustainability

www.andes-nd.eu

CERN n_TOF

IRMM in the JRC

GANIL

IFIIN-HH

IGISOL at Jyväskylä

PROFIL at PHENIX

GSI

TSL
WP1: Measurements for advanced reactor systems

WP1 is performing high quality nuclear data measurements on key isotopes and reactions selected from a list of identified priorities with the best available facilities and techniques, to reach required uncertainties.

This list of priorities resulted from:


E. Gonzalez, coordinator, “Report of the numerical results from the evaluation of the nuclear data sensitivities, priority list and table of required accuracies for nuclear data”, Deliverable D5.11, IP-EUROTRANS (2009)

+ Coordination Action for Nuclear Data for Industrial Development in Europe, CANDIDE.
WP1 measurements

1. High accuracy measurements of neutron inelastic scattering cross sections.
   - To improve with new measurements the cross sections for neutron inelastic scattering off $^{238}\text{U}$.
   - To improve with new measurements the cross sections for neutron inelastic scattering off structural materials and inert fuel components ($^{23}\text{Na, Zr, Mo}$).
   - To provide covariances and the limits of accuracy for measurements with the (n,n'-$\gamma$)-technique.

2. High accuracy measurements of neutron total and capture cross sections.
   - To improve with new measurements the n+$^{238}\text{U}$ radiative neutron capture cross sections.
   - To improve with new measurements the n+$^{241}\text{Am}$ radiative neutron capture cross sections.
   - To assess the use of transfer reactions for the determination of neutron-induced capture cross sections for actinide targets.

3. High accuracy measurements of fission cross sections
   - To improve with new measurements the neutron-induced fission cross section of Pu isotopes ($^{238}\text{Pu (TR), 240,242Pu}$).
   - To improve with new experimental results the fission cross sections of the minor actinides ($^{241,243}\text{Am and 245Cm}$).
   - To improve the experimental knowledge of the fast neutron induced fission yields for isotopes of Np, Pu and Cm by surrogate neutrons and inverse kinematics.

4. State of the art decay data measurements for reactor kinetics and decay heat
   - To improve the experimental information for the beta decay probability and strength functions of relevant fission fragments ($^{88}\text{Br, 94Rb, 95Rb and 137I}$).
   - To improve the experimental information for the delayed neutron emission probabilities of relevant fission fragments ($^{88}\text{Br, 94Rb, 95Rb and 137I}$).
### Priority needs for advanced reactors and transmutation

**Table 32. Summary of Highest Priority Target Accuracies for Fast Reactors**

<table>
<thead>
<tr>
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<th>Energy Range</th>
<th>Current Accuracy (%)</th>
<th>Target Accuracy (%)</th>
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</thead>
<tbody>
<tr>
<td>U238</td>
<td>$\sigma_{\text{inel}}$</td>
<td>$6.07 \div 0.498$ MeV</td>
<td>$10 \div 20$</td>
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<tr>
<td></td>
<td>$\sigma_{\text{capt}}$</td>
<td>$24.8 \div 2.04$ keV</td>
<td>$3 \div 9$</td>
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<tr>
<td>Pu241</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$1.35$ MeV $\div 454$ eV</td>
<td>$8 \div 20$</td>
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<tr>
<td>Pu239</td>
<td>$\sigma_{\text{capt}}$</td>
<td>$498 \div 2.04$ keV</td>
<td>$7 \div 15$</td>
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<tr>
<td>Pu240</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$1.35 \div 0.498$ MeV</td>
<td>$6$</td>
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<tr>
<td></td>
<td>$\nu$</td>
<td>$1.35 \div 0.498$ MeV</td>
<td>$4$</td>
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<tr>
<td>Pu242</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$2.23 \div 0.498$ MeV</td>
<td>$19 \div 21$</td>
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<tr>
<td>Pu238</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$1.35 \div 0.183$ MeV</td>
<td>$17$</td>
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<tr>
<td>Am242m</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$1.35$ MeV $\div 67.4$ keV</td>
<td>$17$</td>
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<tr>
<td>Am241</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$6.07 \div 2.23$ MeV</td>
<td>$12$</td>
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<tr>
<td>Cm244</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$1.35 \div 0.498$ MeV</td>
<td>$50$</td>
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<tr>
<td>Cm245</td>
<td>$\sigma_{\text{fiss}}$</td>
<td>$183 \div 67.4$ keV</td>
<td>$47$</td>
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<table>
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<tr>
<th></th>
<th>Energy Range</th>
<th>Current Accuracy (%)</th>
<th>Target Accuracy (%)</th>
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<tbody>
<tr>
<td>Fe56</td>
<td>$\sigma_{\text{inel}}$</td>
<td>$2.23 \div 0.498$ MeV</td>
<td>$16 \div 25$</td>
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<tr>
<td>Na23</td>
<td>$\sigma_{\text{inel}}$</td>
<td>$1.35 \div 0.498$ MeV</td>
<td>$28$</td>
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<td>Pb206</td>
<td>$\sigma_{\text{inel}}$</td>
<td>$2.23 \div 1.35$ MeV</td>
<td>$14$</td>
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<tr>
<td>Pb207</td>
<td>$\sigma_{\text{inel}}$</td>
<td>$1.35 \div 0.498$ MeV</td>
<td>$11$</td>
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<tr>
<td>Si28</td>
<td>$\sigma_{\text{inel}}$</td>
<td>$6.07 \div 1.35$ MeV</td>
<td>$14 \div 50$</td>
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<tr>
<td></td>
<td>$\sigma_{\text{capt}}$</td>
<td>$19.6 \div 6.07$ MeV</td>
<td>$53$</td>
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</table>
WP1 measurements

Inelastic scattering off $^{238}\text{U}$
WP1 measurements

Inelastic scattering off $^{23}$Na, Zr, Mo, $^{76}$Ge
WP1 measurements

$n^+^{241}\text{Am}$ radiative neutron capture

$^{241}\text{Am}(n,\gamma)$ at n_TOF

$^{243}\text{Am}(n,\gamma)$ at n_TOF (100 BPD, $E_{\text{thr}}=280$ keV)

$^{241}\text{Am}$ activity

IRMM

Actual limit of the RRR in the evaluations
WP1 measurements

\(n^+^{238}\text{U radiative neutron capture}\)

\[ \text{Counts (1/ns)} \]

\[ \text{TOF (ns)} \]

\[ 10^3 \]

\[ 10^2 \]

\[ 10^1 \]

\[ 10^0 \]

\[ 10^{-1} \]

\[ 10^{-2} \]

\[ 10^{-3} \]

\[ 10^{-4} \]

\[ 10^{-5} \]

\[ \text{Neutron energy (eV)} \]

\[ \text{Counts/1e12 protons} \]

\[ \text{Time} - T_Y (ns) \]

\[ \text{Counts/bin/prompt} \]

\[ \text{U8 Background Subtracted (m_{cr} > 2, 2.5 < E_{sum} (MeV) < 5.5) [0.5 pulses]} \]

\[ \text{n_TOF TAC Preliminary} \]

\[ \text{n_TOF C_6D_6 Preliminary} \]

\[ \text{IRMM} \]

\[ \text{n_TOF TAC Preliminary} \]
n-induced fission cross section of Pu isotopes (\(^{238}\text{Pu (TR)}, ^{240,242}\text{Pu}\))

WP1 measurements

\[ \sigma \text{(barns)} \]

E\(_n\) (MeV)

- ENDF/B-VII.0
- JENDL-4.0
- This experiment

\[^{242}\text{Pu IRMM new measurements}\]

Neutrons flux

PP foil (1µm)

Al cathode 0,5mm

inner Anode

outer Anode

Gas circulation (CF\(_4\))

MicroMegas as e- amplifier

CENBG setup

n_TOF new measurements

10% of the available statistics so far
WP1 measurements

n-induced fission cross section of minor actinides ($^{241,243}$Am & $^{245}$Cm)

n_TOF measurements
WP1 measurements
beta decay and strength f. and delayed neutrons ($^{88}$Br, $^{94}$Rb, $^{95}$Rb and $^{137}$I)

First Measurements in 2010:
- Beta decay probability and strength functions using total absorption spectrometer (TAS)
- Delayed neutron emission probabilities with BEta deLayEd Neutron detector, BELEN-20

Possibly new measurements after Jyväskylä IGISOL move
WP2: Uncertainties and covariances of nuclear data

Uncertainty estimation and covariance data is a top priority in reactor and fuel cycle analysis:

- Answers alone are not enough, we also need the quality of the answers!
- The precision of all data we use must be provided in computational form for applied calculations
- Enables safe nuclear designs in a cost-effective manner
- Needed for uncertainty propagation in reactor simulation
- Gives reactor physicists a means to post-adjust data to integral measurements
- Good covariance data, if combined with a reliable sensitivity study, gives the best justification for new differential measurements for nuclear technology.

Objectives of the WP:
Enhance the European capability to produce covariance data for isotopes important for advanced reactors

Three aspects of nuclear data evaluation come together:

- Uncertainty/covariance evaluation of experimental data
- Uncertainty/covariance evaluation of data from nuclear reaction models
- A proper theoretical treatment and evaluation of nuclear reactions on actinides (especially fission models) and its relation with 1. and 2.

In addition:

- Covariances for radioactive decay and fission yield data
- Use all of the above in processing, reactor and fuel cycle codes.
WP2: Uncertainties and covariances of nuclear data

Covariance tool developments:

- Experimental covariance tool
  Software under development (implementation of covariance formulae + EXFOR interface)

- CONRAD (CEA-DEN) evaluation tool

- GENEUS evaluation tool (TU Wien):
  Rigorous theoretical formulation
  Fully bayesian
  Extension of GENEUS (based on TALYS-1.2) for fission channels
  Extension to Structural Materials Library and multiple experiments
WP2: Uncertainties and covariances of nuclear data

Covariance data evaluation:

Covariance evaluation for actinides:
- Complete in ENDF-6 format
- Improved new complete evaluation of Pu-239 including full covariance data.
  - Comparison of multiple libraries to estimate uncertainties and optimize data
  - Total Monte Carlo uncertainty propagation
  - The TENDL-2011,2012...libraries
  - Automatic optimization using integral benchmarks
WP2: Uncertainties and covariances of nuclear data

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WP2: Uncertainties and covariances of nuclear data

Covariances for activation, decay and fission yields:

- Fission yield and decay data
- ACAB methods for these data
- Method available for including each individual fissioning system.
- Correlations with decay data and time dependence are being studied
- Covariance data for spent fuel inventories and decay heat

Task 2.5: Application to advanced reactors

Use covariance files in reactor and fuel cycle codes for designs from other EU projects. Determine uncertainty for most important parameters)

![Diagram showing the process of generating and using covariance data.]

**Method 1**
Generate COVARIANCE condensing X random libraries

**ND libraries with COVARIANCE**

**1 file**

**x1000 files**

**Random ND libraries**

**Nuclear Model Parameters**

**pdf**

**Samplig** **ACAB** **Results**

\[ \begin{align*}
\lambda_1, \gamma_1, \sigma_1 & \quad N_1 \\
\lambda_2, \gamma_2, \sigma_2 & \quad N_2 \\
\vdots & \quad \vdots \\
\lambda_n, \gamma_n, \sigma_n & \quad N_n
\end{align*} \]
WP3: Integral experiments for validation of nuclear data and constraints on uncertainties

Objectives:
- Agree on a **common methodology to use the integral experiments** to validate and constraints the nuclear data improvement.
- Define and **share these methodology** between the participants,
- Apply it to different kind of integral experiments mainly of public domain
- Provide Trends on ND using the C/E and S, Covariance matrices on ND and provide a recommendation on Nuclear Data validity
- At the end of the project at least an **estimation of the impact of the new evaluations** of covariance to the knowledge of the neutronic behaviors measured in the integral experiments that have been analyzed.
- Provide to end users improved uncertainties on neutronic behaviors due to Nuclear Data
WP3: Integral experiments for validation of nuclear data and constraints on uncertainties

Integral experiments data:

MUSE Ref Core characterization
- This experiment is available via the MUSE project of FP5 of EURATOM
- Neutronic behaviors: $K_{\text{eff}}$, Spectral indices, reaction rates of Na cooled Fast reactor with steel reflector.

ZPPR10A experiment proposed in IRPHE data base of NEA data Bank
- This experiment is available IRPHE of the NEA data bank
- Neutronic behaviors: $K_{\text{eff}}$, Spectral indices, and sodium void effects.

PROFIL experiments made in PHENIX on separate isotopes irradiation
- This experiment is available via CEA
- Neutronic behaviors: separated irradiated samples of different isotopes, Actinides and Minor Actinides, Post irradiated chemical analysis of the samples, information on Capture cross sections.

A large criticality and shielding benchmark used for validation of JEFF-3.1 from ICSBEP
- These experiments are available via ISCBEP data bank
- Neutronic behaviors: $K_{\text{eff}}$, Spectral indices

A problem based on data GUINEVERE VENUS-F experimental facilities at SCK-CEN
- These experiments are available via project EUROTRANS of EURATOM
- Neutronic behaviors: $K_{\text{eff}}$, Spectral indices, … of a lead cooled uranium core.
The MUSE-4 (ref and Pb) subcritical experiments

Andes WP3 Integral experiments facilities
Andes WP3 Integral experiments facilities

The PROFIL sample irradiation experiments:
Ongoing benchmark

- PHENIX : 563 MWTh

1/ sub-assembly to be burned

2/ burn up : 3 cycles in PX

3/ Extraction of the containers

4/ chemical analysis

5/ Neutronic analysis for ND improvement
SNEAK 7A AND 7B
PU-FUELLED FAST CRITICAL ASSEMBLIES IN THE KARLSRUHE FAST CRITICAL FACILITY

SNEAK-LMFR-EXP-001
CRIT-BUCK-SPEC-COEF-KIN-RRATE-MISC
ZPPR-10A EXPERIMENT:
A 650 MWe-CLASS SODIUM-COOLED MOX-FUELED FBR CORE MOCK-UP CRITICAL EXPERIMENT WITH TWO-HOMOGENEOUS ZONES AND CONTROL-ROD WITHDRAWAL facility at ANL-Idaho
Andes WP3 Integral experiments facilities

GUINEVERE

- Very representative core of a “lead cooled” ADS at Mol (SCK-CEN)
- High performance D-T source operating in pulse and CW mode (with trips)
- Commissioning End 2009-Beg 2010 + short experimental campaign.
- An additional experimental campaign of several years proposed

VENUS reactor room

GENEPI acc.

GENEPI acc.
WP3: Integral experiments for validation of nuclear data and constraints on uncertainties

<table>
<thead>
<tr>
<th>Element</th>
<th>C/E</th>
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<td>234U</td>
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ISCBEP data bank
WP4: High energy model validation in the 150-600 MeV domain

Although the optimal proton energy for spallation is around 1GeV first demonstrators will be operated with lower energy protons. E.g.: MYRRHA : 600 MeV - 2.5 mA p beam onto a liquid Pb-Bi spallation target

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
Evaluation of the state-of-the-art of high-energy model predicting capability in the 150-600 MeV domain

- 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

- Assessment of uncertainties on key parameters resulting from the uncertainties in the models: spallation neutron yield, total and major contributors to activity of the target and structure materials, production rate of helium and radioactive gases…

\[ p(200\text{MeV}) + \text{Au, INCL4.6.0 ABLA07} \]
\[ n(175\text{MeV}) + \text{Bi from Bevilacqua et al.} \]
SPALADIN/SOFIA p+Pb at 500 MeV: measurement of the fission fragments and evaporation residues in coincidence with light ions

- Importance of predicting gases from the liquid target: He, t, volatile elements from fission, Hg
- Discrepancies between different sets of data, difficulty for models to predict data at different energies
- SPALADIN → SOFIA experiment at GSI on Pb+p
  - Total fission cross-sections
  - Isotopic distributions
  - Coincidence with neutrons
- Test runs at June and September 2011
Measurement of neutron-induced light ion cross-sections at 175 MeV on Fe, Bi and U

- 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 175MeV already completed
  - Light-ion production cross-sections (uncertainty ≈ 10%)
  - Publication in preparation with comparison with INCL4.5-ABLA07.
Improving of the predicting capabilities of the models to reduce the uncertainties on the demonstration facility spallation target

- Improving the high-energy models
  - Validation against experimental data set used in Intern. benchmarks
- Investigation of the possibility to use High-Energy Evaluated Nuclear Data Files generated from the TALYS+BRIC reaction codes
  - Validation against experimental data set used in Intern. benchmarks
- 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)

Curing the deficiencies pointed out during the IAEA benchmark ....Without destroying good results

Green = new version
Red = IAEA benchmark version

Nucleons back as spectators when \( E < T_f + S(B_c) \)
WP4: High energy model validation in the 150-600 MeV domain

Extension to low energies

INCL4.6 + ABLA07

4He + Bi209

Reaction cross-section vs. energy/nucleon (MeV)

Cross Section (mb)

Alpha tot kin energy (MeV)

10 20 30 40 50 60 70

1400 1200 1000 800 600 400 200

0.1 1 10 100

0 20 40 60 80 100

From the graph, it can be observed that the reaction cross-section increases with energy/nucleon. The green line and the black line represent the theoretical predictions by INCL4.6 and ABLA07, respectively. The data points show the experimental results for different reactions, such as 4He+208Pb, 3He+Pb, 4He+Bi, and 4He+60Ni, with error bars indicating the uncertainty.
WP4: High energy model: Improvement of the de-excitation code ABLA

1200 MeV p + target

Scaling factors for displaying:
- 30 deg * 10
- 75 deg * 0.1
- 150 deg * 0.01.

Average evaporated neutron (2-20 MeV) multiplicity
Average evaporated LCPs (0-100 MeV) multiplicity
Validation on the results from the post irradiation analysis of MEGAPIE samples

Analysis of samples from the MEGAPIE liquid Pb-Bi target irradiated during 4 months at SINQ and from ISOLDE

- Target already cut into disks. Samples should be available mid-2010

List of isotopes that could be analysed: $^{208/209}$Po, $^{194}$Hg, $^{108m}$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
- quality of the new models concerning the production of key isotopes in the MEGAPIE samples will be assessed and discussed with end-users

**Surface enrichment of Po**

**First MEGAPIE spectra**

*Comparison of α-spectra before and after homogenization (Sample T1-1C-bulk)*
WP5: Dissemination, education & training

- Coordination of the education and training activities
- Coordination of the cooperation with NEA and IAEA and Dissemination activities
- Coordination and support to End-Users group

Training and education

- PhD and Master theses
- Organization of one training course specialized in Nuclear Data for Sustainable Nuclear Energy open to the participants in other EU projects related to the field:
  - Special edition of one known school on nuclear research mostly dedicated to the topics of the ANDES project (EXTEND 2012)
    ⇒ Budapest, September 17-28
Dissemination and plan for use of the results

• The time between ND measurement and regular utilization often too long. This time was already reduced in the EUROTRANS-NUDATRA project by teams also participating in the ANDES project.

• The first step for dissemination is to distribute the nuclear data. This is done by their incorporation into one of the nuclear data bases distributed by international centers, particularly, NEA/OECD or IAEA.
  • Special collaboration with the NEA & AIEA expert groups
  • Active members of the project within the related expert groups of NEA and IAEA will lead his coordination.

• Large number of scientific publications and contributions to international conferences. Knowledge widely distributed in the open literature.

• Internet web sites

• Transfer of the know-how to future generations (Education & Training)

ERINDA and EUFRAT:
  transnational access to accelerator facilities
<table>
<thead>
<tr>
<th>Session 1: WP1 Measurements for advanced reactor systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:00  <strong>Introduction.</strong> A. Plompen, IRMM</td>
</tr>
<tr>
<td><strong>Inelastic scattering</strong></td>
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<tr>
<td>14:20  <strong>Neutron-inelastic scattering of U-238</strong>. A. Bacquias, IPHC</td>
</tr>
<tr>
<td>14:40  <strong>Covariances for inelastic scattering.</strong> A. Negret, IFIN-HH</td>
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<tr>
<td><strong>Capture</strong></td>
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<tr>
<td>15:00  <strong>Capture measurements at n_TOF, U-238, Am-241.</strong> D. Cano Ott, CIEMAT</td>
</tr>
<tr>
<td>15:20  <strong>Capture measurements at IRMM, U-238, Am-241.</strong> C. Lampoudis, CEA</td>
</tr>
<tr>
<td>15:40  <strong>Capture measurements using surrogate reactions.</strong> L. Mathieu, CENBG</td>
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<tr>
<td>16:00  <strong>break</strong></td>
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<tr>
<td><strong>Fission</strong></td>
</tr>
<tr>
<td>16:20  <strong>Fission cross section measurements at n_TOF.</strong> M. Calviani, CERN</td>
</tr>
<tr>
<td>16:40  <strong>Fission cross section measurements of $^{240, 242}$Pu at IRMM.</strong> P. Salvador, IRMM</td>
</tr>
<tr>
<td>17:00  <strong>Fission yields and fission probabilities for transuranium nuclei using inverse kinematics and multinucleon transfer reactions.</strong> C. Rodriguez, GANIL</td>
</tr>
<tr>
<td><strong>Fission product decay data</strong></td>
</tr>
<tr>
<td>17:20  <strong>Beta-delayed neutron emission.</strong> D. Cano Ott, CIEMAT</td>
</tr>
<tr>
<td>17:40  <strong>The new IGISOL facility.</strong> H. Penttilä, JYU</td>
</tr>
<tr>
<td>18:00  <strong>End of day 1</strong></td>
</tr>
</tbody>
</table>
**Adoption of the agenda 24/04/2012 morning**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session 2: Uncertainties and covariances of nuclear data</th>
</tr>
</thead>
<tbody>
<tr>
<td>08:45</td>
<td>General overview of WP2 progress. A. Koning, NRG</td>
</tr>
<tr>
<td>09:05</td>
<td>Covariance tool development</td>
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<tr>
<td>09:05</td>
<td>Development of experimental covariance tool. Suzanne Varet, CEA-BRC</td>
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<tr>
<td>09:25</td>
<td>The GENEUS covariance tool: A summary. H. Leeb, TUW</td>
</tr>
<tr>
<td>09:45</td>
<td>Covariance data evaluation</td>
</tr>
<tr>
<td>09:45</td>
<td>Progress on TALYS data evaluation system. A. Koning, NRG</td>
</tr>
<tr>
<td>10:05</td>
<td>Covariances for activation, decay and fission yields</td>
</tr>
<tr>
<td>10:05</td>
<td>Uncertainty propagation in fuel cycle codes. C. Diez, UPM</td>
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<tr>
<td>10:25</td>
<td>New updates incorporated in the ACAB code. O. Cabellos, UPM</td>
</tr>
<tr>
<td>10:35</td>
<td>ACAB and EVOLCODE. D. Cano Ott, CIEMAT</td>
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<tr>
<td>10:40</td>
<td>Covariance information for decay and fission yield data. R. Mills, NNL</td>
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<tr>
<td>11:00</td>
<td>break</td>
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<tr>
<td>11:15</td>
<td>Session 3: Integral experiments for validation of nuclear data and constraints on uncertainties</td>
</tr>
<tr>
<td>11:15</td>
<td>Introduction. D. Bernard, CEA</td>
</tr>
<tr>
<td>11:35</td>
<td>A common validation process</td>
</tr>
<tr>
<td>11:35</td>
<td>&quot;Common Validation Process&quot;, D. Bernard, CEA</td>
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<tr>
<td>11:55</td>
<td>Analysis of integral experiments with the common process</td>
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<tr>
<td>11:55</td>
<td>Sensitivity and uncertainty analysis of the $k_{eff}$ and $\beta_{eff}$ for the ICSBEP and IRPhE benchmarks. I. Kodeli</td>
</tr>
<tr>
<td>12:15</td>
<td>ICSBEP benchmarking of random Pu239 data libraries. A. Koning, NRG</td>
</tr>
<tr>
<td>12:30</td>
<td>WP5: Training and Education actions</td>
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<tr>
<td>12:30</td>
<td>ANDES - EXTEND 2012 - Summer school. S. Pomp, UU</td>
</tr>
<tr>
<td>12:40</td>
<td>Lunch</td>
</tr>
</tbody>
</table>
## Adoption of the agenda 24/04/2012 afternoon

<table>
<thead>
<tr>
<th>14:00</th>
<th><strong>Introduction.</strong> S. Leray, CEA</th>
</tr>
</thead>
<tbody>
<tr>
<td>14:10</td>
<td><strong>Spaladin p+Pb at 500 MeV</strong></td>
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<tr>
<td>14:10</td>
<td><strong>Status of the SPALADIN/SOFIA experiment.</strong> J. Benlliure, USC</td>
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<tr>
<td>14:30</td>
<td><strong>Neutron-induced light ion cross sections at 175 MeV for Fe, Bi and U</strong></td>
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<tr>
<td>14:30</td>
<td><strong>Neutron-induced light ion cross sections at 175 MeV for Fe, Bi and U</strong> S. Pomp</td>
</tr>
<tr>
<td>14:50</td>
<td><strong>Improving predictive power of models to reduce uncertainties for demonstrators</strong></td>
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<tr>
<td>14:50</td>
<td><strong>Implementation of the INCL4-ABLA into transport codes.</strong> J.C. David</td>
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<tr>
<td>15:10</td>
<td><strong>Recent improvements in the INCL4 and ABLA models.</strong> D. Mancusi</td>
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<tr>
<td>15:30</td>
<td><strong>Validation using MEGAPIE</strong></td>
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<td>15:30</td>
<td><strong>First results of the MEGAPIE sample analysis.</strong> D. Schumann, PSI</td>
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<tr>
<td>15:50</td>
<td><strong>Data libraries up to 600 MeV?</strong> A. Koning, NRG</td>
</tr>
<tr>
<td>16:00</td>
<td><strong>break</strong></td>
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</tbody>
</table>

### Closing Session

<p>| 16:15 | <strong>Towards Horizon 2020, News from the European Commission.</strong> R. Garbil |
| 16:45 | <strong>ERINDA and EUFRAT, transnational access to accelerator facilities.</strong> F.J. Hambsch, IRMM |
| 17:00 | <strong>General discussion</strong> |
| 17:30 | <strong>Summary by the project coordinator.</strong> E. Gonzalez Romero, CIEMAT |
| 17:45 | <strong>Summary on behalf of NEA and JEFF.</strong> R. Jacqmin, CEA |
| 18:00 | <strong>End of day 2</strong> |</p>
<table>
<thead>
<tr>
<th>Time</th>
<th>Event Description</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>9:00</td>
<td>Welcome and adoption of the agenda</td>
<td>H. Leeb, TUW</td>
</tr>
<tr>
<td>9:15</td>
<td>General Status of the ANDES Project, Including</td>
<td>E. Gonzalez Romero, CIEMAT</td>
</tr>
<tr>
<td></td>
<td>- the summary of the 18th month first reporting process</td>
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<tr>
<td></td>
<td>- Summary of news from EU</td>
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<tr>
<td>9:45</td>
<td>WP1: progress and plan for the next 12 months</td>
<td>A. Plompen, IRMM</td>
</tr>
<tr>
<td>10:15</td>
<td>WP2: progress and plan for the next 12 months</td>
<td>A. Koning, NRG</td>
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<tr>
<td>10:45</td>
<td>Break</td>
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<tr>
<td>11:00</td>
<td>WP3: progress and plan for the next 12 months</td>
<td>D. Bernard, CEA</td>
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<tr>
<td>11:30</td>
<td>WP4: progress and plan for the next 12 months</td>
<td>S. Leray, CEA</td>
</tr>
<tr>
<td>12:00</td>
<td>WP5+WP6: progress and plan for the next 12 months. Including</td>
<td>E. Gonzalez Romero, CIEMAT</td>
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<td></td>
<td>- the proposal for distribution of the second payment from the EU</td>
<td></td>
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<tr>
<td></td>
<td>- Conclusions and action list</td>
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</tr>
<tr>
<td>12:30</td>
<td>A.O.B.</td>
<td></td>
</tr>
<tr>
<td>12:45</td>
<td>End of meeting</td>
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</tbody>
</table>
ANDES Second annual meeting  
April 23-25, 2011 @ NEA (Paris)

- EVO

http://evo.caltech.edu:
The title of the EVO sessions is "ANDES ANNUAL Meeting 23/05/2012" and the code word for April 23rd and 24th is “nucleardata“ (use Search/Search for meetings and then Filter_Titles+ From_all_communities to search for ANDES). (there is a direct link in the ANDES web page / draft agenda of each day)

- Presentations @ ANDES web page (when loaded)

http://www.andes-nd.eu

You will find the available presentations following the links in the "Calendar" section or in the "News" panel in the "Home" page, to get the agenda of each day of the meeting.
Then follow the link of each presentation (when available) to get the pdf display of the presentation.

- WIFI