



Horizon 2020



SUPPLYING ACCURATE NUCLEAR DATA FOR ENERGY AND NON-ENERGY APPLICATIONS

The **SANDA** EURATOM project

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on behalf of the SANDA Euratom project

H2020 Grant Agreement number: 847552

CIEMAT, Atomki, CEA, CERN, CNRS, CSIC, CVREZ, ENEA, HZDR, IFIN-HH, IRSN, IST-ID, JRC, JSI, JYU, KIT, NPI, NPL, NRG, NTUA, PSI, PTB, SCK-CEN, Sofia, TUW, UB, ULODZ, UMAINZ, UMANCH, UOI, UPC, UPM, USC, USE, UU.

SANDA Basic data

<http://www.sanda-nd.eu/>

H2020 Grant Agreement number: 847552 EURATOM WP2018 for NFRP-2018-4

Project Start date: 01/09/2019

Duration: 48 months (+12m extension proposed in the Periodic reviews)

35 Partners: [CIEMAT](#), Atomki, CEA, CERN, CNRS, CSIC, CVREZ, ENEA, HZDR, IFIN-HH, IRSN, IST-ID, JRC, JSI, JYU, KIT, NPI, NPL, NRG, NTUA, PSI, PTB, SCK-CEN, Sofia, TUW, UB, ULODZ, UMAINZ, UMANCH, UOI, UPC, UPM, USC, USE, UU.

from 18 EU-countries (Au, Be, Bu, Cz, Fi, Fr, Ge, Gr, Hu, It, Ne, Pol, Por, Ro, Sln, Sp, Sw, UK) + Switzerland. A large fraction of the European Nuclear Data community

A holistic approach for topics, partners and schedules

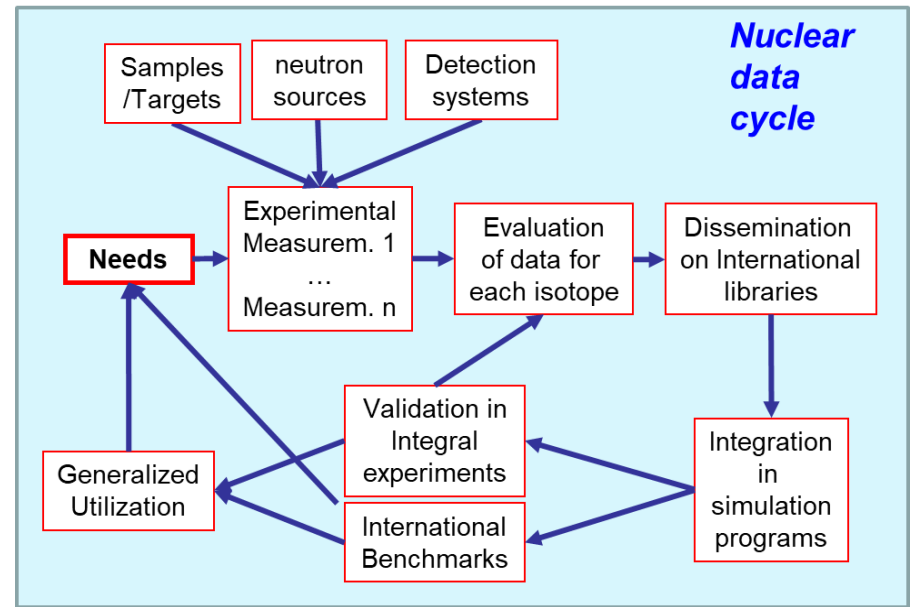
- Close collaboration with ARIEL and using other mobility tools
- Using results and tools from previous EURATOM projects: ANDES, CHANDA,...
- Well integrated with the International Agencies (IAEA, NEA/OECD, JEFF) and using their indication on priority for topics and isotopes

EU requested contribution voluntarily limited to 75% of eligible costs, to cover more activities and partners

SANDA objectives

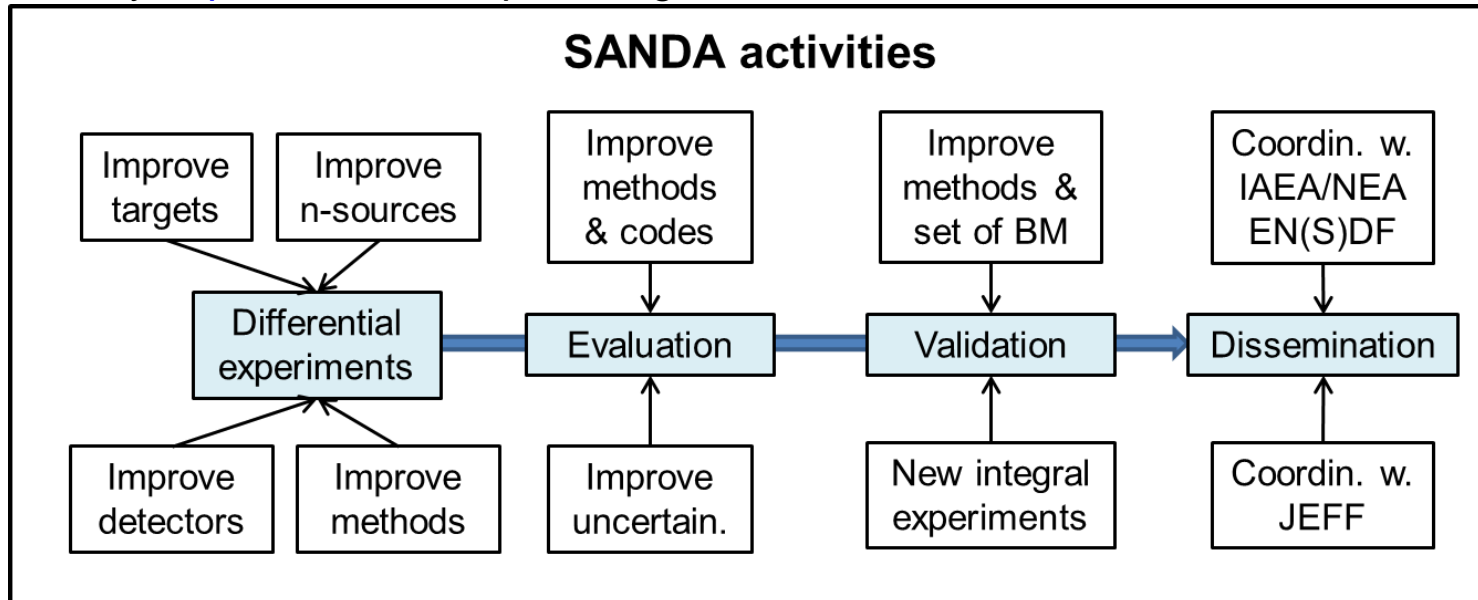
PRESENT: Improving important needs reachable with present tools ([Measurements](#), [Samples](#), [Evaluations](#), [Validation](#)).

FUTURE: Improving the tools to be able to address important not reachable needs as soon and as efficient as possible ([Detectors](#), [facilities](#), [Samples Labs](#), [Sensitivities](#), [Evaluation tools](#), [New benchmarks](#), [Data needs](#))

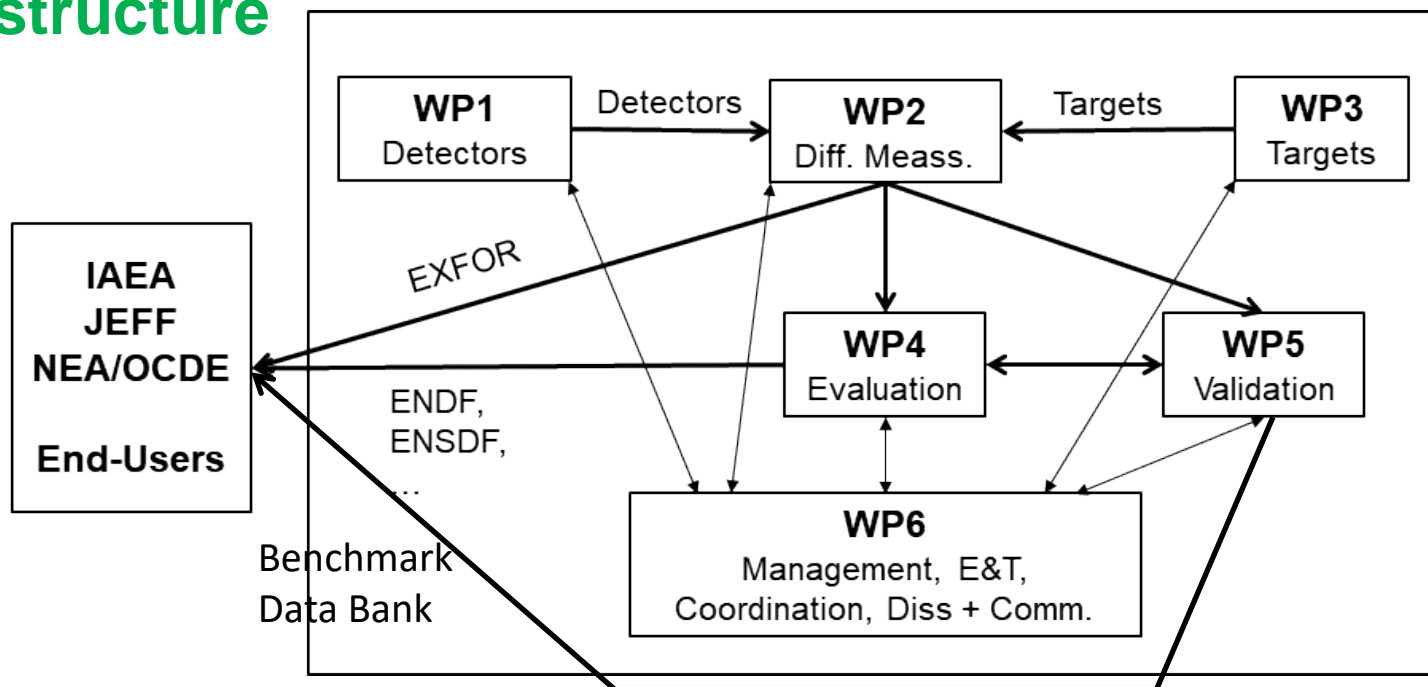


Covers [all elements](#) of the nuclear data cycle

Mostly [experimental](#) and providing [new results](#) and [new tools](#)



SANDA structure



WP #	Work Package Title	Lead P	PM
1	Developments of new innovative detector devices	CNRS	80.8
2	New nuclear data measurements for energy and non-energy applications	CIEMAT	213
3	Target Preparation for Improvement of Nuclear Data Measurements	PSI	66.2
4	Nuclear data evaluation and uncertainties	PSI	173.2
5	Nuclear data validation and integral experiments	CEA	69.2
6	Management, ND research coordination at EU level and Education and Training	CIEMAT	27.4

SANDA General Status

SANDA, despite the limitations from COVID, is progressing in all the activities proposed and providing huge amount of results including:

- Large achievements on new detectors for fission include
 - the production of a first prototype of the Micromegas XY-strip detector,
 - the experimental validation of a new Gaseous Proton Recoil Telescope,
 - that FALSTAFF has been improved and is ready for the experiment at NFS,
 - the design and test of the new n-detector BRIKEN,
 - the design and test of other neutron detectors (Stilbene, SCONE) and
 - the test of the new facility for measurements of half-lives at CEA/DRT/LNE-LNHB.
- Also large progress has been made for gamma and lcp detectors including
 - new electronics and test for HPGe at n_TOF, and
 - the construction, tests and use in actual measurements of the sTED and i-TED detectors for n_TOF (EAR1 and EAR2).
 - Detectors for non-energy application (DDX data for the n-induced emission of lchp) are also being tested with beam at n_TOF.
- And for target preparation,
 - a first set of 12 samples has been produced and delivered to the SANDA experiments.
 - Additionally, the design and simulations for the development of an isotope separator (IS) has been completed and the preparation of the site for the IS at PSI are ongoing.
- Preparation and approval of beam requests at: n_TOF, GELINA, NFS, ILL, IGISOL, RIKEN, GSI/FAIR, WPE, HIT ...

SANDA General Status / 2

- SANDA is also performing new nuclear data measurements at n_TOF, GELINA, NFS, LR-0, ILL, IGISOL, RIKEN, GSI/FAIR, Hospitals ...
 - data already taken and partly analysed at n_TOF for **fission** in ^{235}U , ^{230}Th , ^{241}Am and ^{239}Pu and nubar data taken at MONNET@JRC-Geel.
 - MEDLEY already moved to NFS and experiments started to measure $^{16}\text{O}(\text{n},\alpha)$, $^{19}\text{F}(\text{n},\alpha)$ and $\text{natC}(\text{n},\text{lchp})$ and other other (n,lchp) reactions.
 - Also $^{89}\text{Y}(\text{n},\text{xp/xd})$ was measured at NPI facilities.
 - large **irradiation experiments** were performed in the LR-0 and VR-1 reactors with foils of ^{54}Fe , Fe, Y, Mo, Au, V, Ti, Cu, Nb), ^{14}N , ^{58}Ni , ^{27}Al and ^{19}F .
 - measurements of the **$^{239}\text{Pu}(\text{n},\gamma)$ and $\text{Mo}(\text{n},\gamma)$** at GELINA and n_TOF, on-going/**completed**.
 - new measurements of **inelastic reactions** are being performed at GELINA for ^{14}N , ^{238}U , ^{233}U and ^{239}Pu . Also at GELINA, $^{209}\text{Bi}(\text{n},\text{g})$ and $^{209}\text{Bi}(\text{n},\text{tot})$ **measurements have been done**.
 - **TAGS measurement** of the $^{96,96\text{m}}\text{Y}$ isomers at the IGISOL
 - **β -delayed neutrons** were measured for isotopes from Sb to La at the RIKEN Nishina in Japan
 - new absolute measurement of **fission yields** for $^{235}\text{U}(\text{n},\text{f})$ performed at ILL with LOHENGRIN
 - $^{238}\text{U}(\text{p},2\text{p})$ fission, as a subrogate for the n-fission of ^{237}Pa , has been measured at **GSI/FAIR**.
 - data for **dosimetry** has been measured and analysed (i.e. $^{117}\text{Sn}(\text{n},\text{inl})^{117\text{m}}\text{Sn}$).
 - measurement of production and analysis of **long-lived beta+ emitters**(**^{11}C , ^{13}N and ^{15}O** used for health diagnostic) via the excitation functions: $^{12}\text{C}(\text{p},\text{x})^{11}\text{C}$, $^{14}\text{N}(\text{p},\text{x})^{11}\text{C}$, $^{14}\text{N}(\text{p},\text{x})^{13}\text{N}$, $^{14}\text{N}(\text{p},\gamma)^{15}\text{O}$, $^{16}\text{O}(\text{p},\text{x})^{11}\text{C}$, $^{16}\text{O}(\text{p},\text{x})^{13}\text{N}$ and $^{16}\text{O}(\text{p},\text{x})^{15}\text{O}$ have been performed up to **200 MeV of proton** incident energy by Univ. of Seville.
 - Also for **short lived beta+ emitters** the production cross section corresponding to $^{12}\text{C}(\text{p},\text{n})^{12}\text{N}$, $^{31}\text{P}(\text{p},\text{pnn})^{29}\text{P}$ and $^{40}\text{Ca}(\text{p},\text{ppn})^{38\text{m}}\text{K}$ from the reaction threshold up to 200 MeV have been measured.

SANDA General Status / 3

- Significant progress on evaluations and evaluation tools
 - New versions of TALYS and EMPIRE have been prepared, tested and distributed.
 - Progress on new evaluations of cross sections include the actinides like U235, U238 and Pu239, structural materials like Al27, Ti48, Ti50, Ni58, Ni60, Ni61, Ni64, Cr50, Cr52, Cr53 and Cr54 and fission fragments as Os 186, 187 and 188 , and La139.
 - Significant progress has also been made on the nuclear structure and decay evaluation of 131I and 140La, 117Sn, and the A=101, A=103 and A=107 mass chains.
- Large progress on sensitivity calculations, benchmarks and formatted libraries
 - improve processing and sensitivity calculations that have already helped to improve JEFF3-3
 - provided AMPX-formatted libraries of the most recent JEFF libraries.
 - ESFR, MYRRHA and ALFRED advanced reactor systems sensitivity/impact studies completed.
 - Identification of most relevant experimental benchmarks for validation with existing databases.
 - Large number of validations C/E with identification of trends had been performed comparing simulations with existing benchmarks specialized in different technologies / applications.
- Preparation of new integral experiments at GELINA/MINERVE, LR-0 & TAPIRO
 - First experiments at GELINA using MINERVE samples covers samples of 107Ag, 109Ag and 99Tc
 - GELINA ongoing program will provide data for samples of Sm, Nd, Cs, Mo, Ru, Eu, Gd, Rh.
 - The experiments at LR-0 has provided new benchmark for the delayed neutron fraction and prompt neutron lifetime.
 - First calibrations of reactor instrumentation at TAPIRO.
- Significant number of publications (20) in peer review journals, communications to conferences and workshops and training of PhD (27) and Master (16) students

SANDA delays because the COVID pandemic

- SANDA is largely experimental, pan-european and relies strongly on transnational mobility and access to different facilities. In consequence SANDA has been strongly affected by the COVID –pandemic:
 - Access to experimental laboratories at the different institutes
 - Many facilities closed for 6-9 months and with severe limitations for 18-24 months
 - Severe restrictions to international travels until mid-2021
 - Limited access to mechanical workshops
 - Delays for purchasing equipment from suppliers
 - Difficulties for the selection and hiring of personnel
 - Difficulties for organizing technical meetings
 - Difficulties for organizing coordination meetings
 - Difficulties for training and education courses and activities
- These delays have affected seriously many activities and induced delays on milestones and deliverables. On average the delay on deliverables is 7 months but some have or are expected to have more than 12 months delay.

Several deliverables proposed at month 36 at the limit of PR2, even when the work is well advanced, and there are intermediate results and presentations in workshops, but the deliverables are still not available (D2.8, D2.12, D3.5, D4.3 to D4.6, D5.5 and D6.2).

SANDA delays because the COVID pandemic / 2

- In addition, we have identified several deliverables that cannot be completed before the present deadline of the project:

– D1.1 Due: M48 Expected M54	Fission detectors
– D2.4 Due: M48 Expected M60	GELINA inelastic
– D2.5 Due: M48 Expected M60	“
– D2.10 Due: M48 Expected M60	DDX at CERN
– D5.10 Due: M42 Expected M51	Integral experiments at GELINA/MINERVE
– D5.11 Due: M42 Expected M51	Integral experiments at LR-0
– D5.12 Due: M42 Expected M58	Integral experiments at TAPIRO
– D5.13 Due: M48 Expected M60	Depends on the 3 previous
- SANDA partners are working strongly and efficiently, scheduling many experiments for the end of 2022 and for 2023, commissioning the detectors and tools required, committing the personnel and internal resources to be able to complete the work and the deliverables proposed as soon as possible and **within the same EU requested contribution**.
- We see no showstopper at this point, however, to achieve those deliverables we **need a project duration extension of 12 months**.
- The achievement of these deliverable is very important to complete the fission detectors for future experiments, to clarify inelastic cross sections of relevant isotopes, D2.10 will improve the safety and efficiency of hadron therapy, and the integral experiments will cover gaps in the database of benchmarks.

SANDA work-package presentations from the WP leaders

9:30	WP1 report and questions/Answers (Q/A): Detectors	Maelle Kerveno (CNRS)
10:00	WP2 report and Q/A: Differential measurements	Daniel Cano (CIEMAT)
10:45	WP3 report and Q/A: Targets and Isotope Separator	Dorothea Schumann (PSI)
11:05	Break	
11:20	WP4 report and Q/A: Evaluation and Sensitivity	Dimitri Rochman (PSI)
11:50	WP5 report and Q/A: Validation	Robert Jacqmin (CEA)
12:20	WP6 report and Q/A: Management and coordination	Enrique Gonzalez (CIEMAT)
12:50	Discussion of the preliminary findings of the review with the consortium	Review team
13:20	Concluding remarks	Katerina Ptackova (EC)

Additional comments or answers to questions from:
Arjan Plompen (JRC/NEA/JEFF),
Roberto Capote (IAEA)