IAEA

The Nuclear Data Program at IAEA

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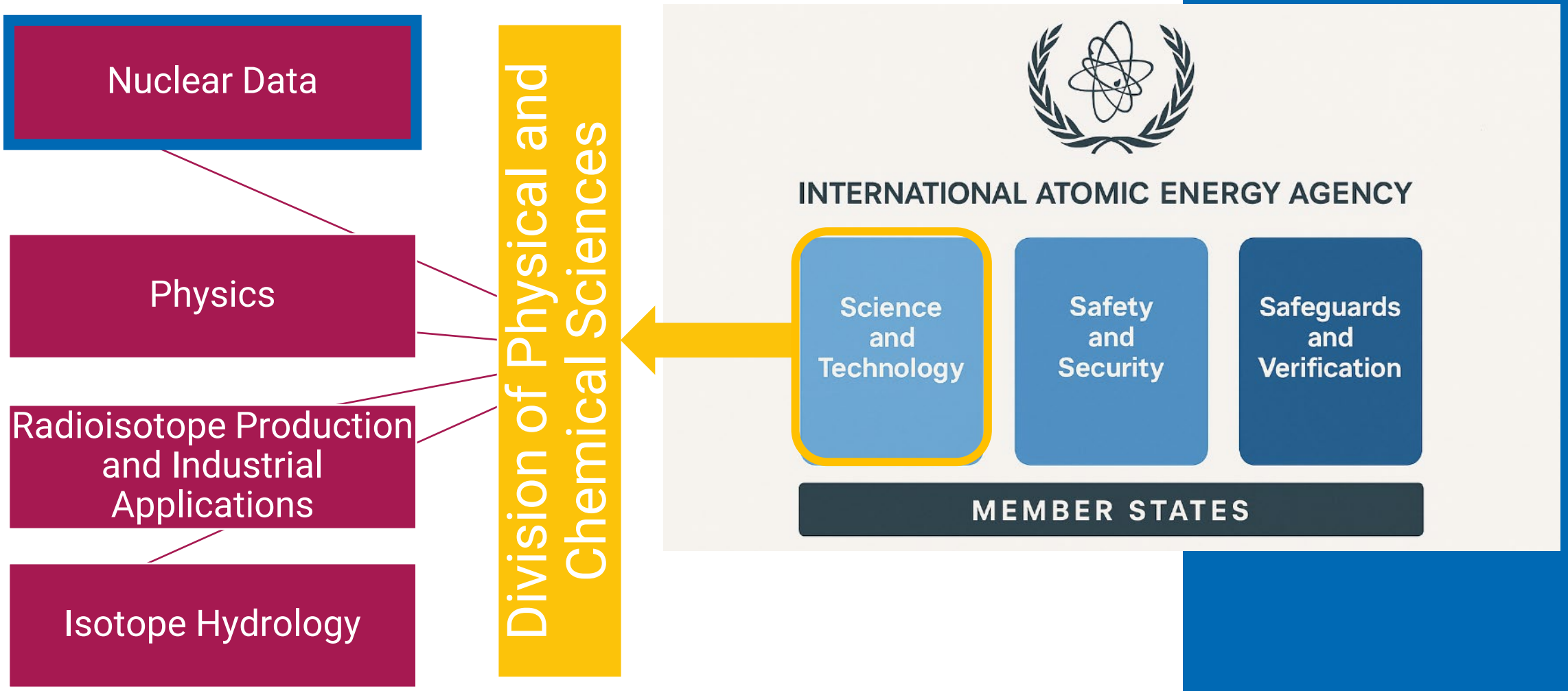
International Atomic Energy Agency

Promoting safe, secure and peaceful use of atomic energy



Nuclear Data Section

Mission

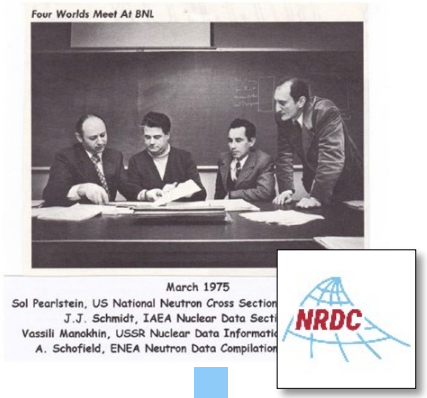
Provide accurate, reliable and globally consistent nuclear data to support energy and non-energy applications and enable Member States to use nuclear science safely and effectively

- **Looking to the future**
  - ✓ moving to a new era of interoperable and reusable databases and software (common formats – JSON, uniform metadata, traceability and version control, automated and AI assisted pipelines)
  - ✓ preparing databases and IT infrastructure to be used by AI
  - ✓ working with the nuclear research and applications community to maintain nuclear data expertise and train the next generation of nuclear data experts

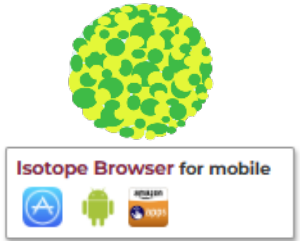
- ➢ **Serves as global authority for nuclear data**
- ➢ **Leads international cooperation**
- ➢ **Captures cutting-edge research and emerging technologies in the nuclear domain**
- ➢ **Builds global capacity by training the next generation of nuclear data specialists**

Over 60 years of nuclear data services

INDSWG-Meeting 1964 in Warsaw

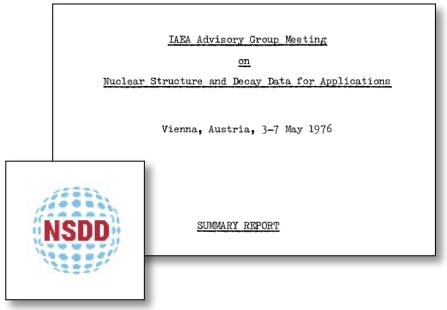


International Nuclear Data Evaluation Network (INDEN)



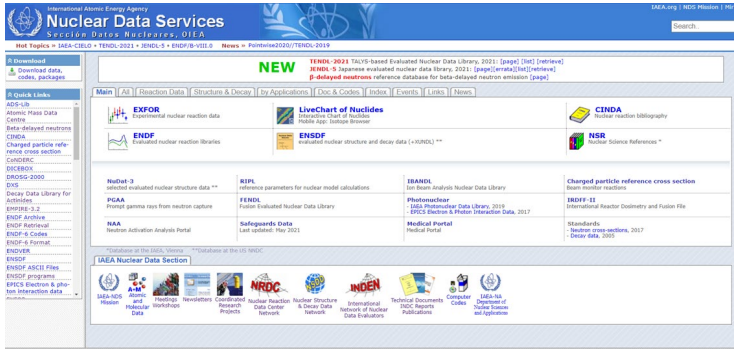
1953 | 1957 | 1963 | 1964 | 1964+ | 1975 | 1974-1976 | 1960s-2000s | 2000s | 2014 | 2017 | 2025…

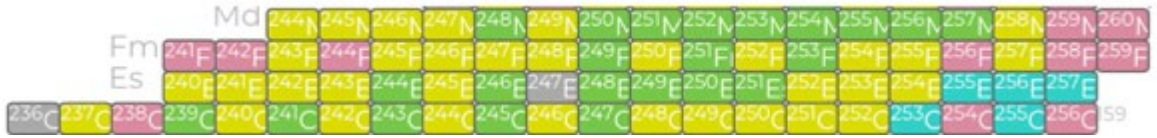
1953 Eisenhower: "Atoms for Peace"



Live Chart of Nuclides
nuclear structure and decay data

NRDC Experimental Nuclear Reaction Data (EXFOR)
Database Version of 2025-06-11
Software Version of 2025-02-20

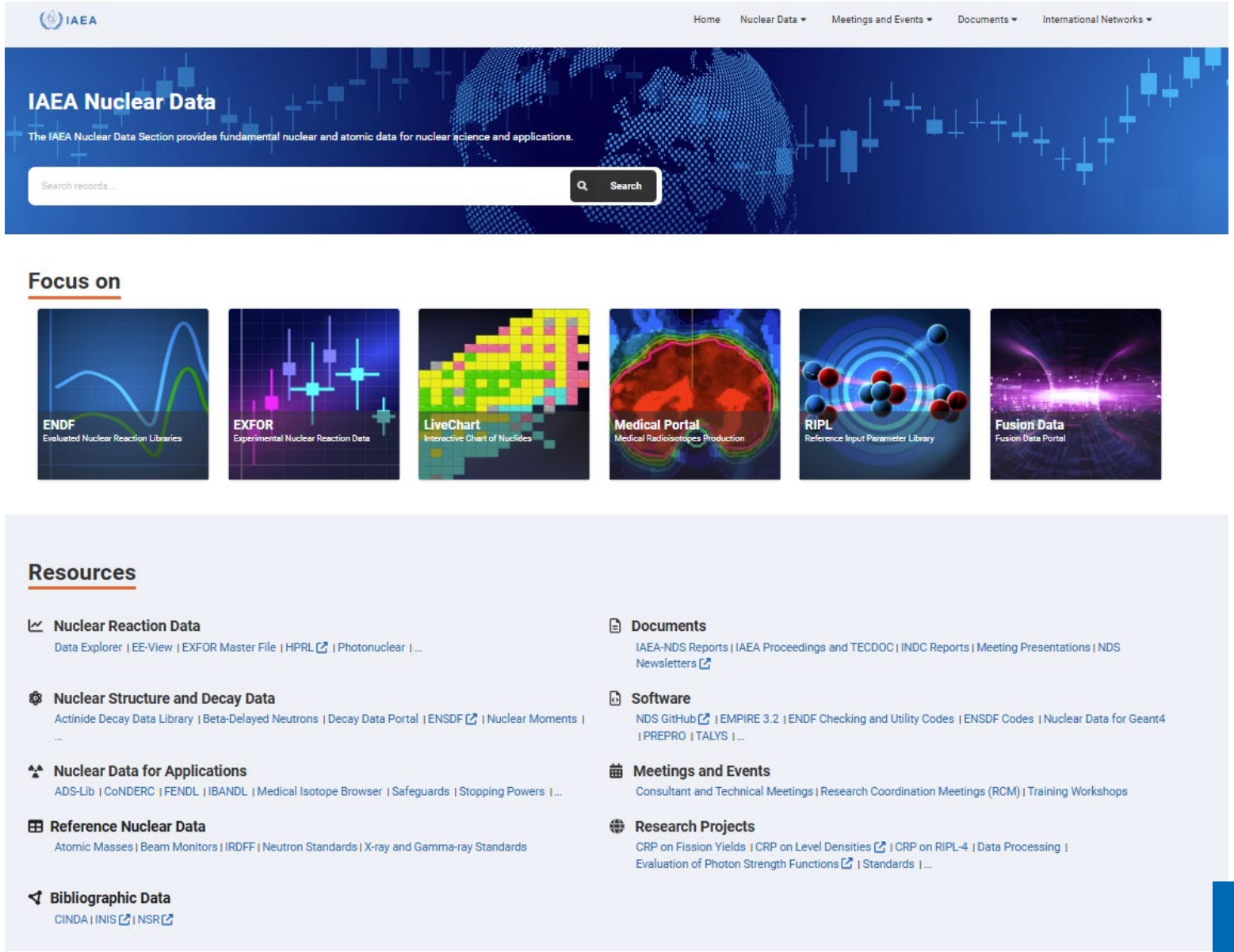




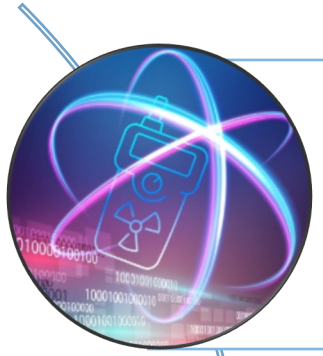
New era – Nuclear Data Section homepage

- ✓ Powered by InvenioRDM
- ✓ Powerful search capabilities linking databases, events and documents
- ✓ Easy to maintain

https://nds.iaea.org/

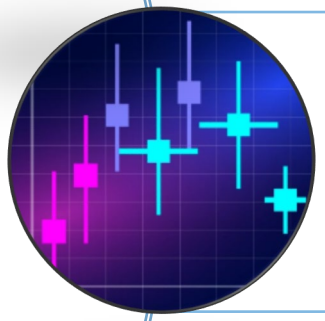


Authority in nuclear data



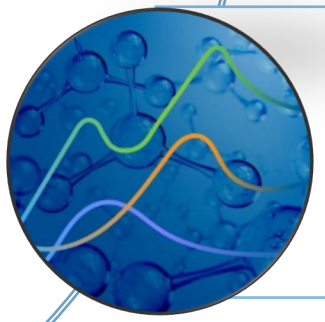
Standards and reference data

- Neutron Standards
- International Fission and Fusion Radiation Dosimetry
- X-ray and Gamma-ray Standards



General purpose databases

- Experimental nuclear reaction data – EXFOR
- Nuclear structure and decay – Live Chart
- Evaluated nuclear reaction data – ENDF



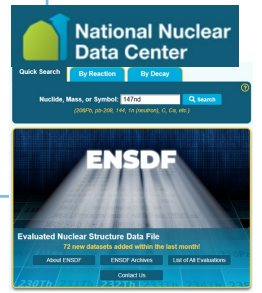
Special purpose data libraries

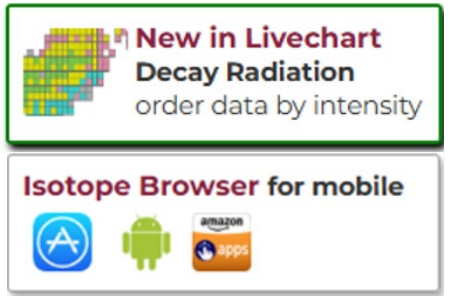
- Medical isotope production – Medical Portal
- Fusion Evaluated Data Library – FENDL
- Ion Beam Analysis Data Library – IBANDL

Leading international cooperation

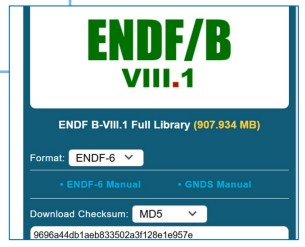
International Nuclear reaction Data Centers Network

International Nuclear Structure and Decay Data Network



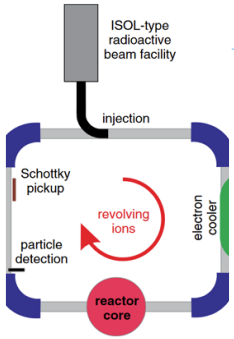


International Nuclear Data Evaluation Network



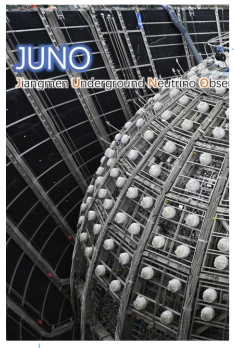
JEFF-4.0

Capturing emerging technologies and data needs



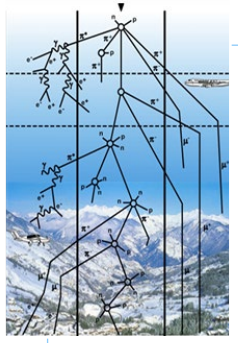
Neutron-induced Reactions on Short-lived Nuclei

Technical Meeting, 25-29 August 2025, INDC(NDS)-0932



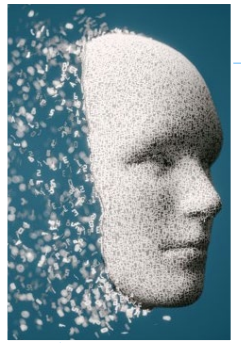
Nuclear Data Needs for Reactor Antineutrino Spectra

Technical Meeting, 7-11 April 2025, Seoul, INDC(NDS)-0925



Joint IAEA - Consultative Committee for Ionizing Radiation Workshop on Neutron Beams at High Energy: Applications and Metrology,

VIC, 7-8 July 2025



Machine Learning for Nuclear Data

Consultants' Meeting, 8-11 Dec 2020, INDC(NDS)-0823

At the forefront of nuclear research

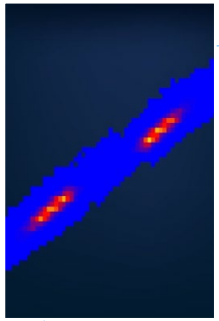
Int. Workshop on Compound Nuclear Reactions and Related Topics

VIC 8-12 July 2024, EPJ Web of Conferences 322 (2025)

New Photonuclear Data Library

Coordinated Research Project

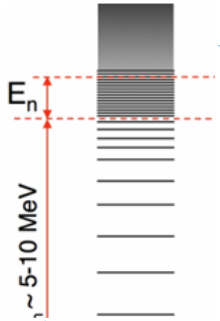
2016-2019



Updating Fission Product Yields

Coordinated Research Project

2020-2025

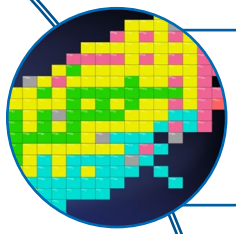


Improving Nuclear Level Densities

Coordinated Research Project

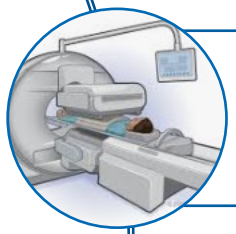
2025-2028

Building human capacity worldwide



Joint ICTP-IAEA Workshop on Nuclear Structure and Decay Data

- Series of workshops since 2003

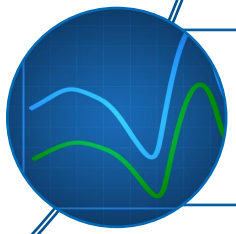


Joint ICTP-IAEA Workshop on Monte Carlo Radiation Transport for Medical Applications

- Series of workshops since 2005

TALYS

Joint ICTP-IAEA Workshop on Simulation of Nuclear Reaction Data with the TALYS Code



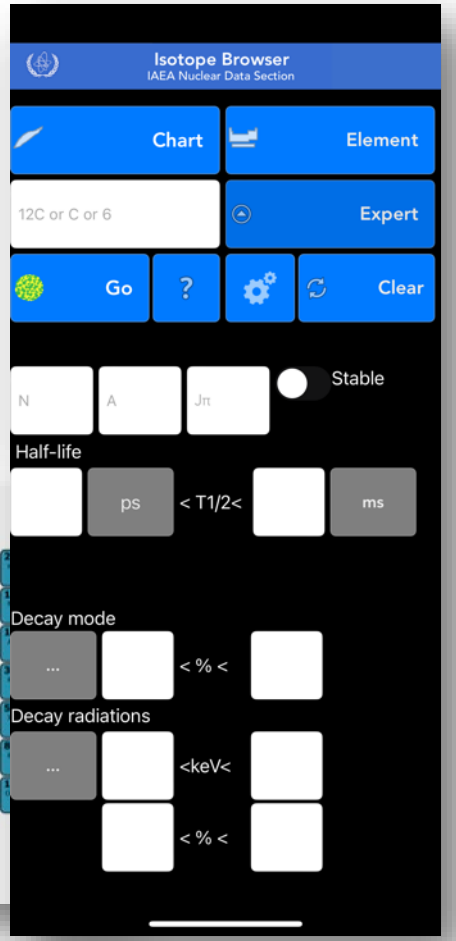
Joint ICTP-IAEA Workshop on the Evaluation of Nuclear Reaction Data for Applications

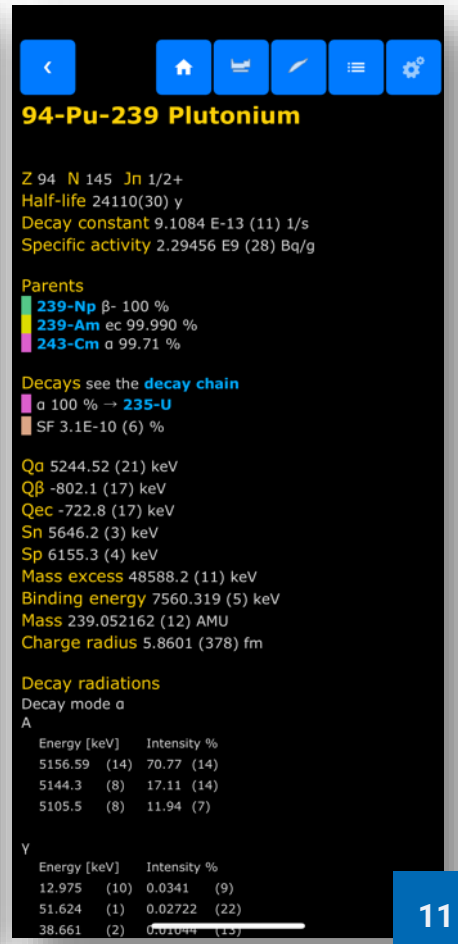
Providing services to member states

IAEA Isotope Browser – App for Mobile Devices

Available for both
- Android
- Apple

- ✓ Properties of over 4,000 isotopes from ENSDF/AME
- ✓ No internet connection needed
- ✓ 2025: Reached 200,000 downloads, 4.8 ⭐
- ✓ 11 languages (Arabic, Chinese, English, French, Spanish, Russian, Japanese, Slovenian, Italian, Trad. Chinese, German)
- ✓ Regularly updated with new features and data

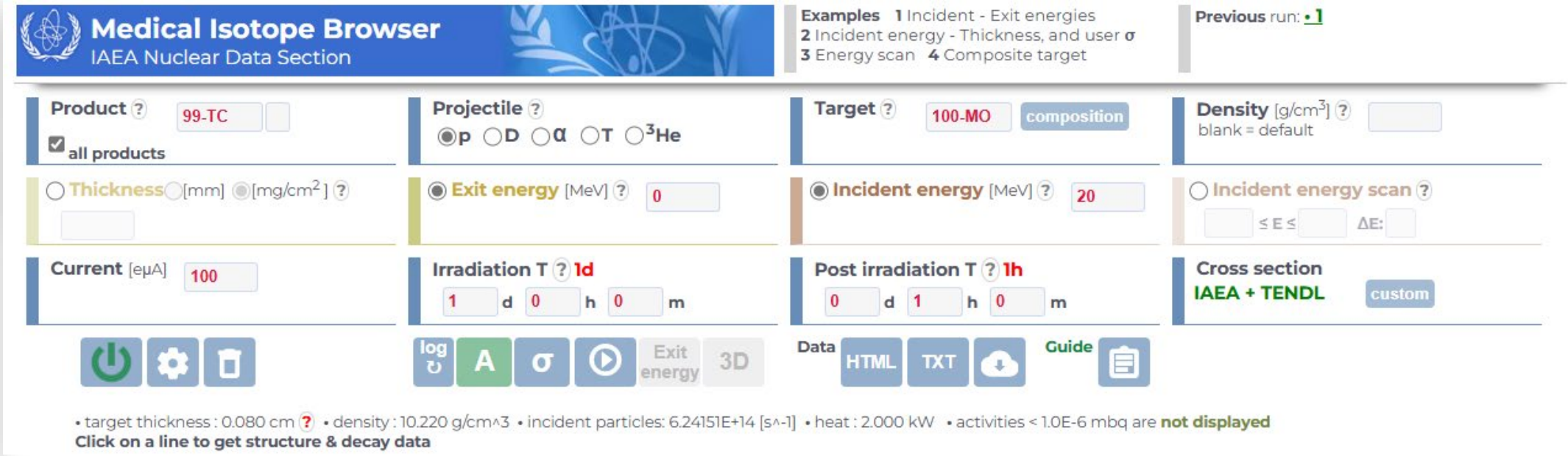




WebApp: Medical isotope browser

Simulates Medical Isotope Production with an accelerator

- ✓ Run the simulation online (accessible from any browser)
- ✓ Set up target, projectile, the intensity and duration of irradiation, cooling time



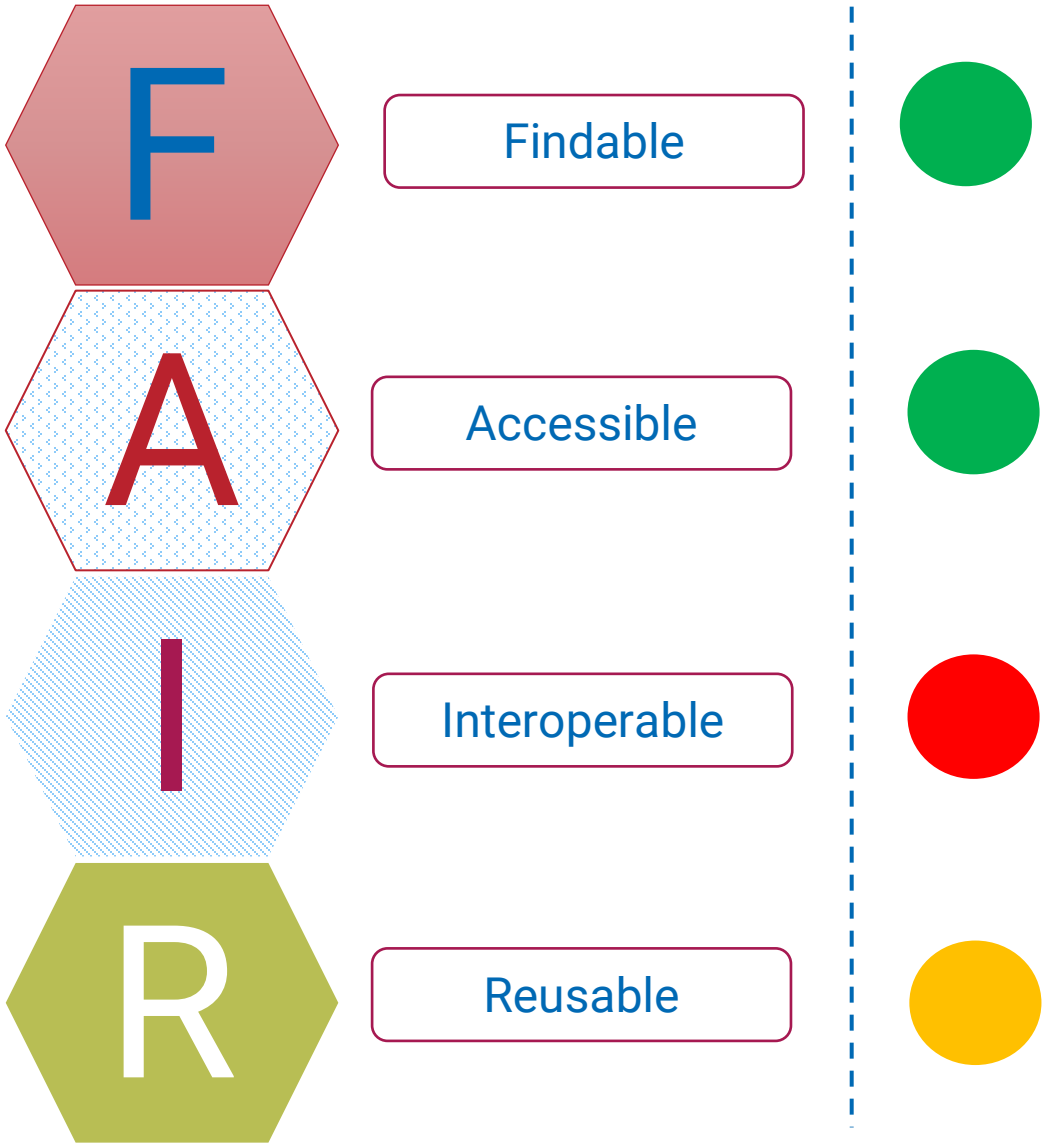
- ✓ Calculates production yield
- ✓ Uses latest IAEA evaluations

+ the TENDL nuclear data library

Positron Emitters: nds.iaea.org/medical/positron_emitters.html
Gamma Emitters: nds.iaea.org/medical/gamma_emitters.html
Therapeutic radionuclides: nds.iaea.org/medical/therapeutic.html

TENDL-2023 nuclear data library

New Era - Open Science and Open Data



All IAEA nuclear databases, data libraries, datafiles, software, and documents satisfy **Findable** and **Accessible** conditions

Additional requirements:

common formats, uniform metadata, APIs

open source licenses, traceability and version control

Reusable

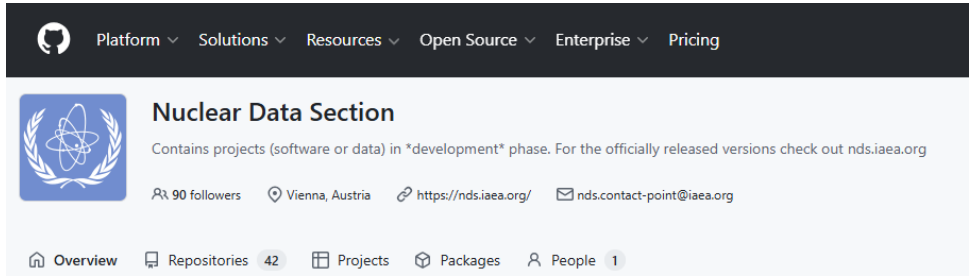
Reusable

Traceability

Version Control

User Licenses

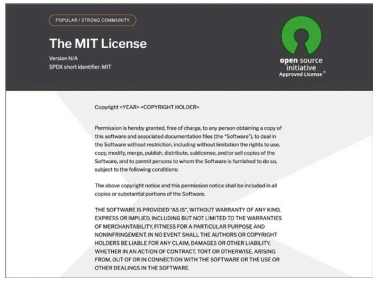
✓ **NDS on Git: databases, web tools and software development on IAEA-NDS GitHub and GitLab (github.com/IAEA-NDS)**



✓ **Open Source Licenses**

- For data libraries released as open data: **CC-BY-4.0 International License**

- For software released as open source: **MIT License** + disclaimer* *(for now)*



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Interoperable

Interoperable

Common formats (JSON, XML)

Uniform semantics in metadata

Application Program Interface (API)

Challenge

Overhauling legacy infrastructure while maintaining capabilities and quality of data and data services

Leadership

Nuclear Data Retrieval, Dissemination and Data Portals
11-15 Nov 2024, INDC(NDS)0909

Information Exchange on Developments and Operations of Nuclear Data Dissemination Services
15-19 Jan 2024, INDC(NDS)-0899

Work in progress

- ✓ EXFOR to JSON parsers (github.com/IAEA-NDS): exforparser; exfor-parsepy;
- ✓ EXFOR in JSON format: exfor_json; exfor-couchdb-docker
- ✓ LiveChart Data Download API (ENSDF)
- ✓ New databases built on APIs – Stopping Powers Database

Nuclear Structure and Decay Data: Data API

LiveChart – Table of Nuclides

https://nds.iaea.org/relnsd/vcharthtml/VChartHTML.html

https://nds.iaea.org/relnsd/vcharthtml/VChartHTML.html

2008 SINCE JAVA based, open source project

Interactive live chart of nuclides

- Nuclear structure and decay data (ENSDF) viewer
  - Levels, schema plot
  - Gammas, decay radiation
  - Nuclear moments
  - Fission yields, beta and neutrino spectra

Since 2013!

Mobile App

- Properties of over 4,000 isotopes
- No internet connection needed
- More than 180,000 downloads, 4.8 ⭐
- In 11 languages

Data API
Direct data download

launch binder **Notebook**

Jupyter lab

The **Livechart API** works very effectively with Python data analysis libraries (**pandas** and **plotly** in these examples), the first step to build models for Machine Learning.
Many examples, including 3D plotting, are detailed in this **Notebook**

Livechart API + Data Science packages
Version 1

This notebook makes use of

Pandas : a library for data manipulation: https://pandas.pydata.org
Plotly http://plotly.com : a package for interactive data visualization, here how to get it work with jupyter lab

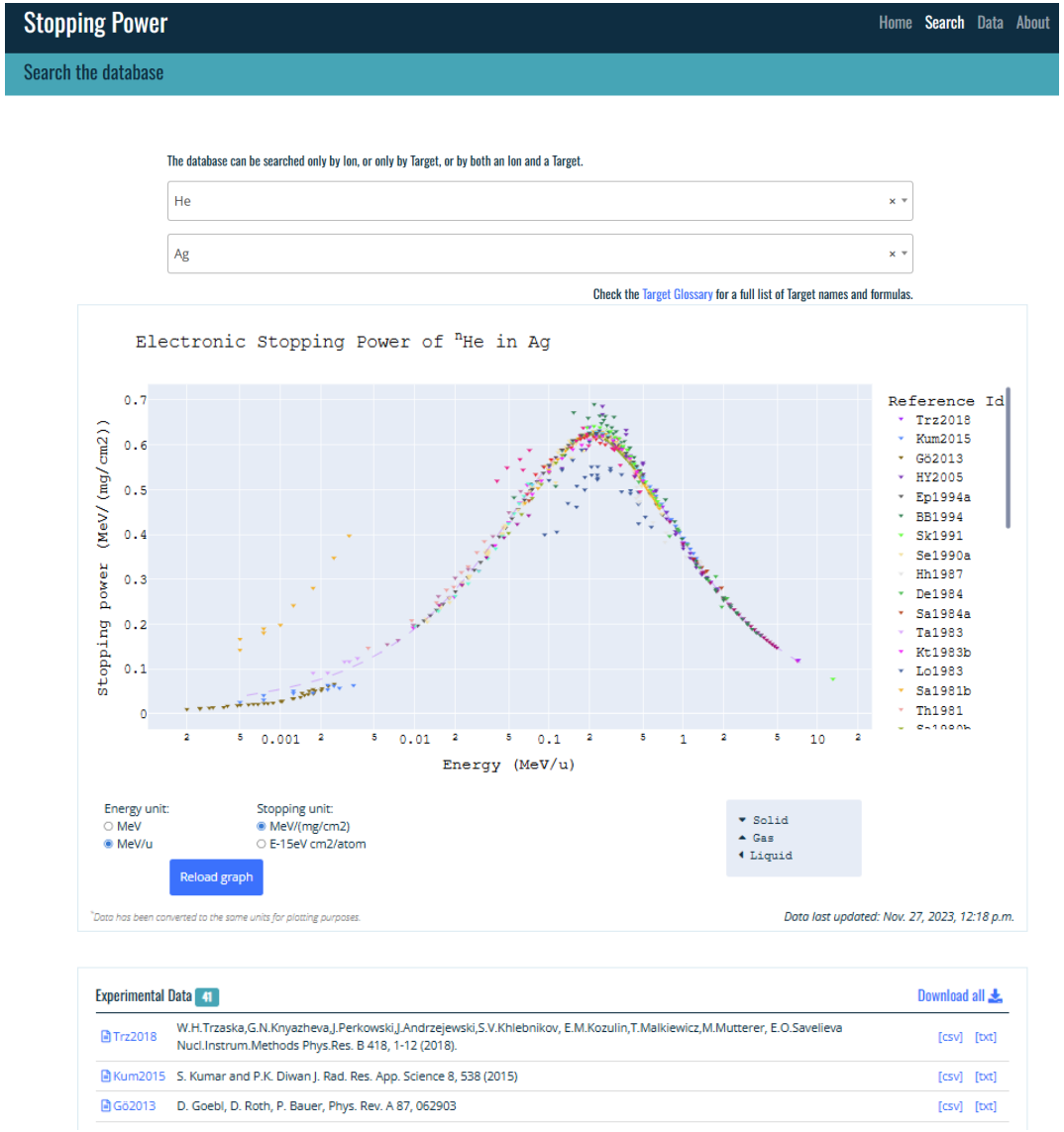
In short :

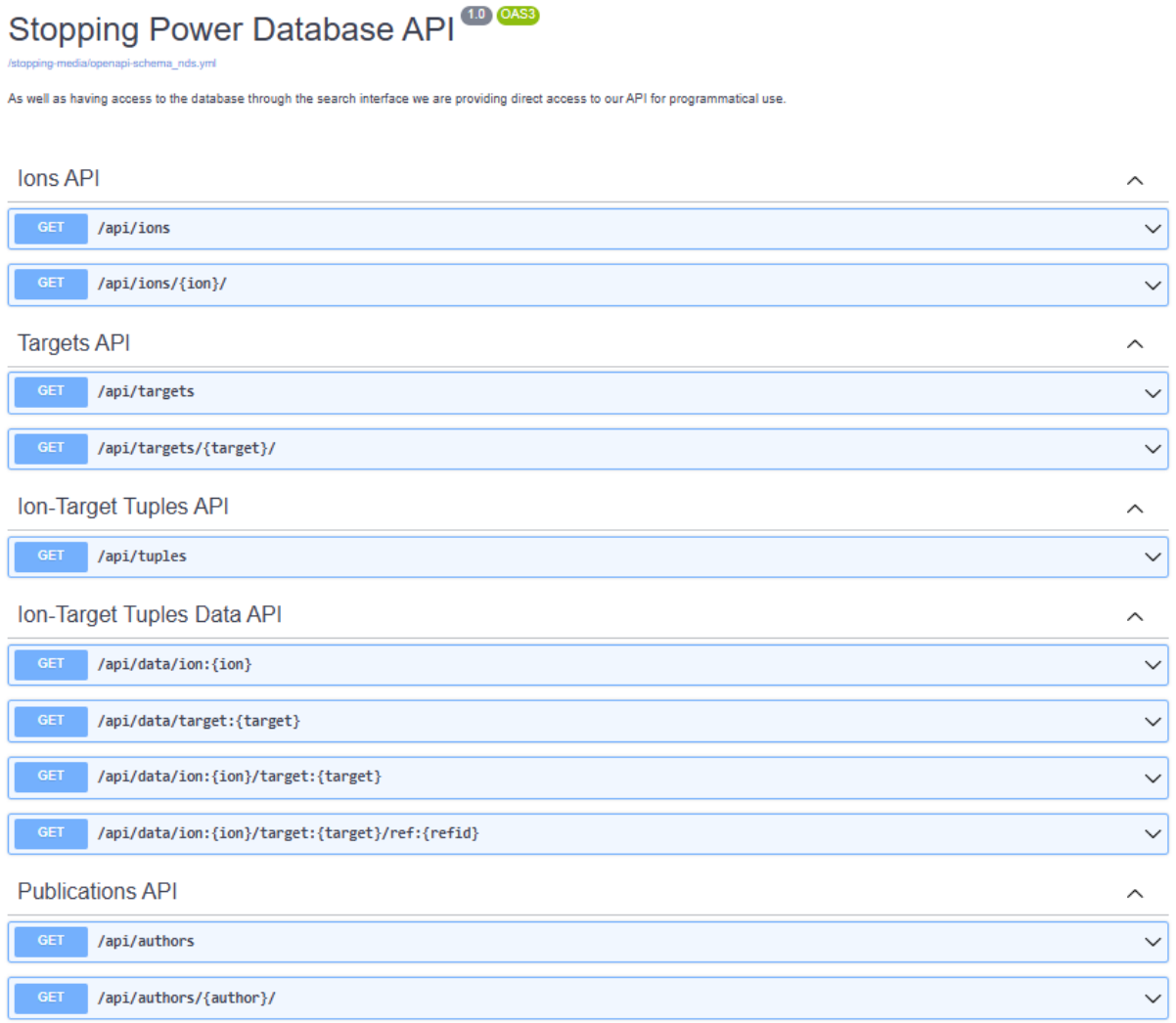
```
$ pip install pandas
$ pip install plotly
$ pip install ipywidgets
$ jupyter labextension install jupyterlab-plotly
```

Write your feedback to nds.contact-point@iaea.org

Stopping database – Data API

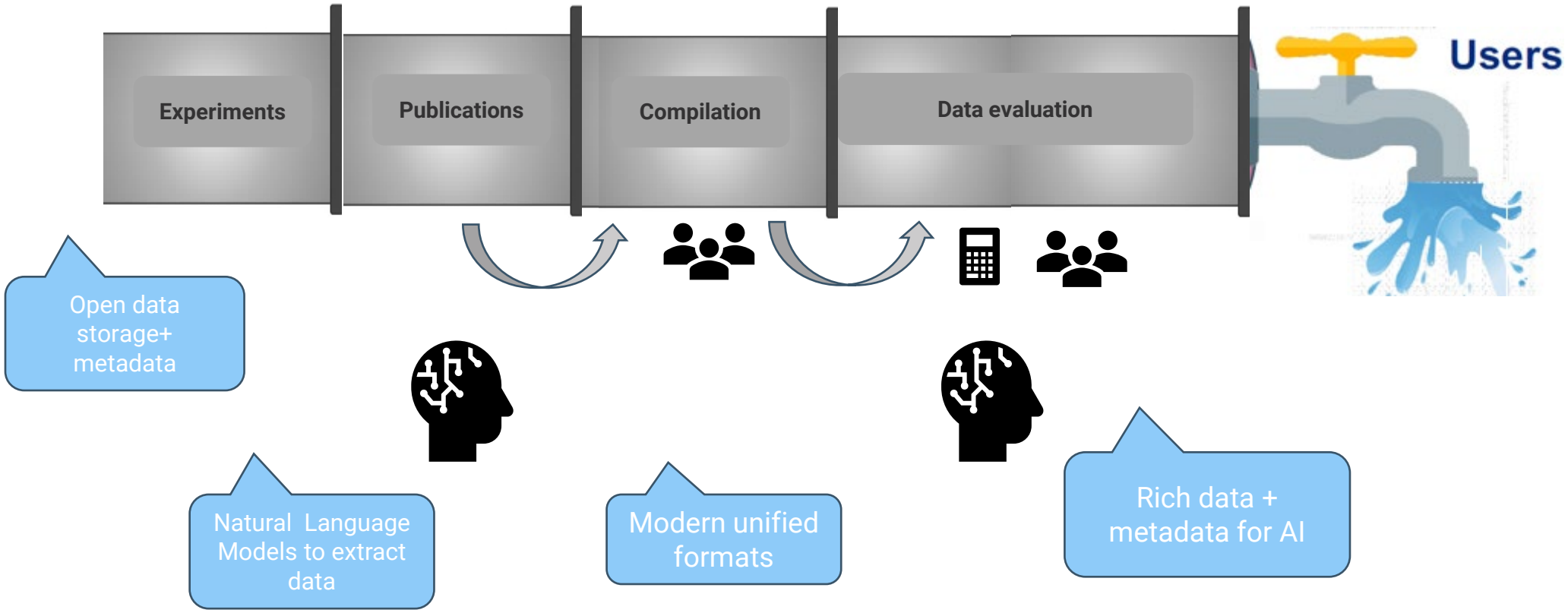
Web interface





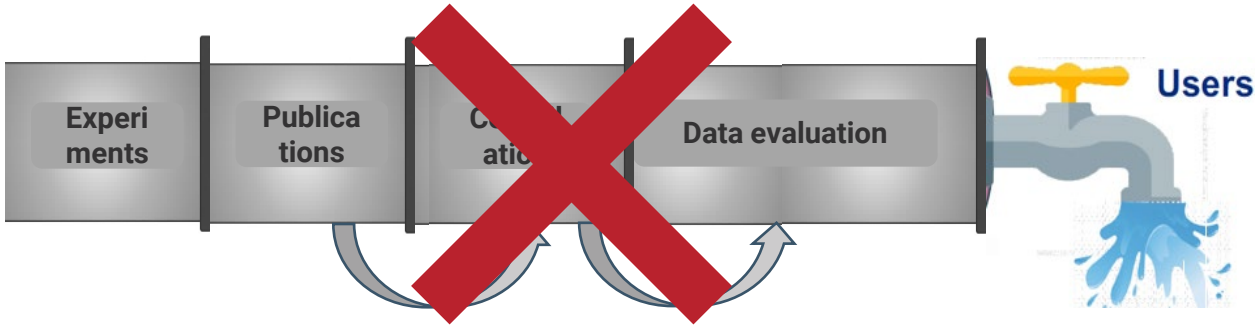
AI in nuclear data: opportunities and challenges

Opportunities: harness ML/AI tools to optimize the data pipeline



AI in nuclear data: opportunities and challenges

Opportunities: AI assisted tools to optimize the data pipeline

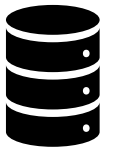


Instruct

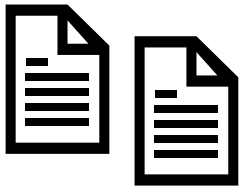
AI Agent

Delivers

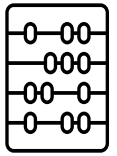
Final data product



Databases

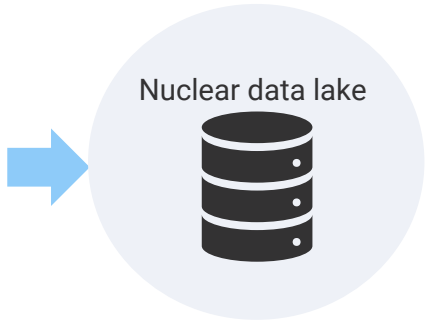


Articles



Analysis

Codes



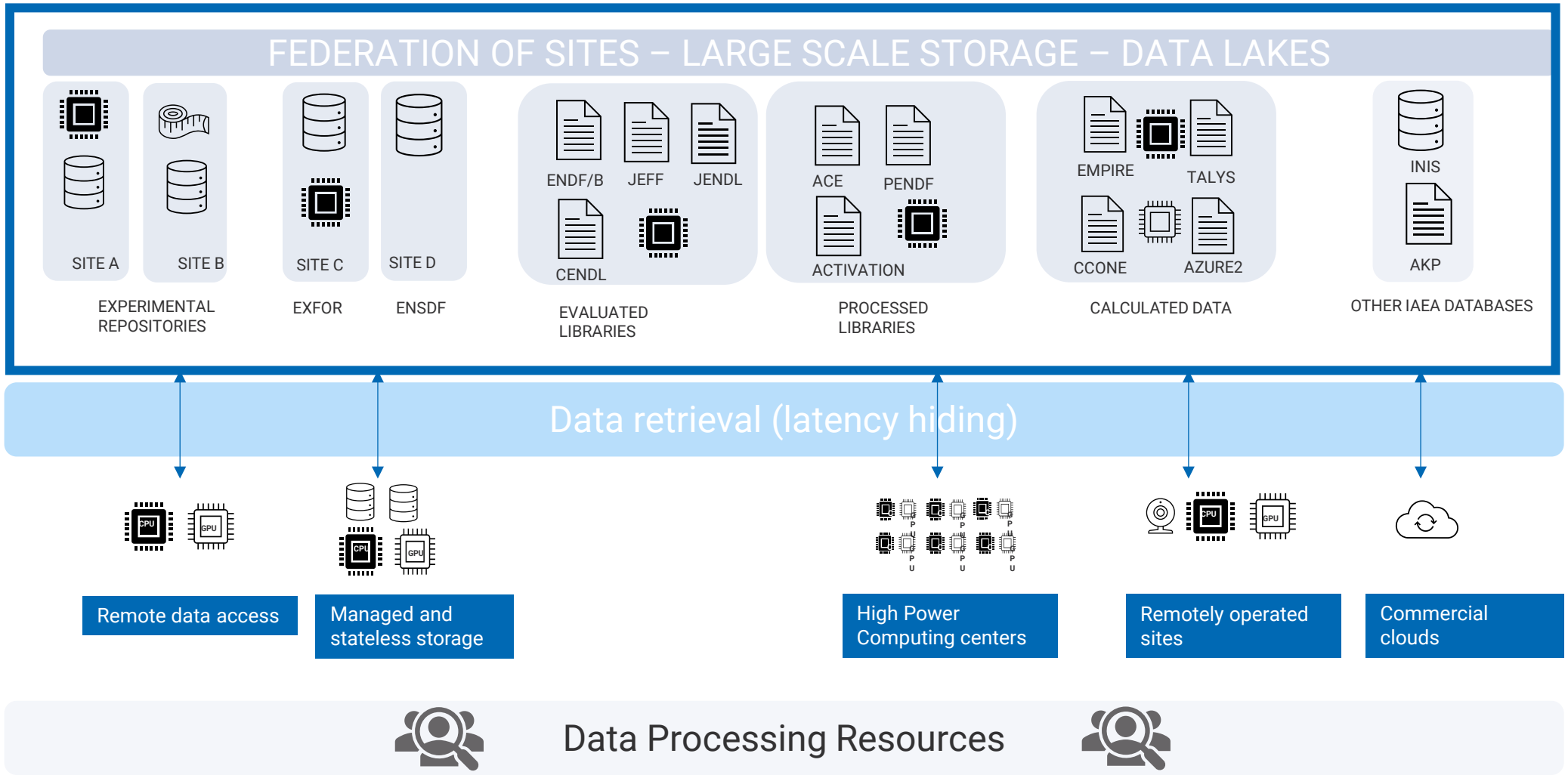
AI and nuclear data

Challenges

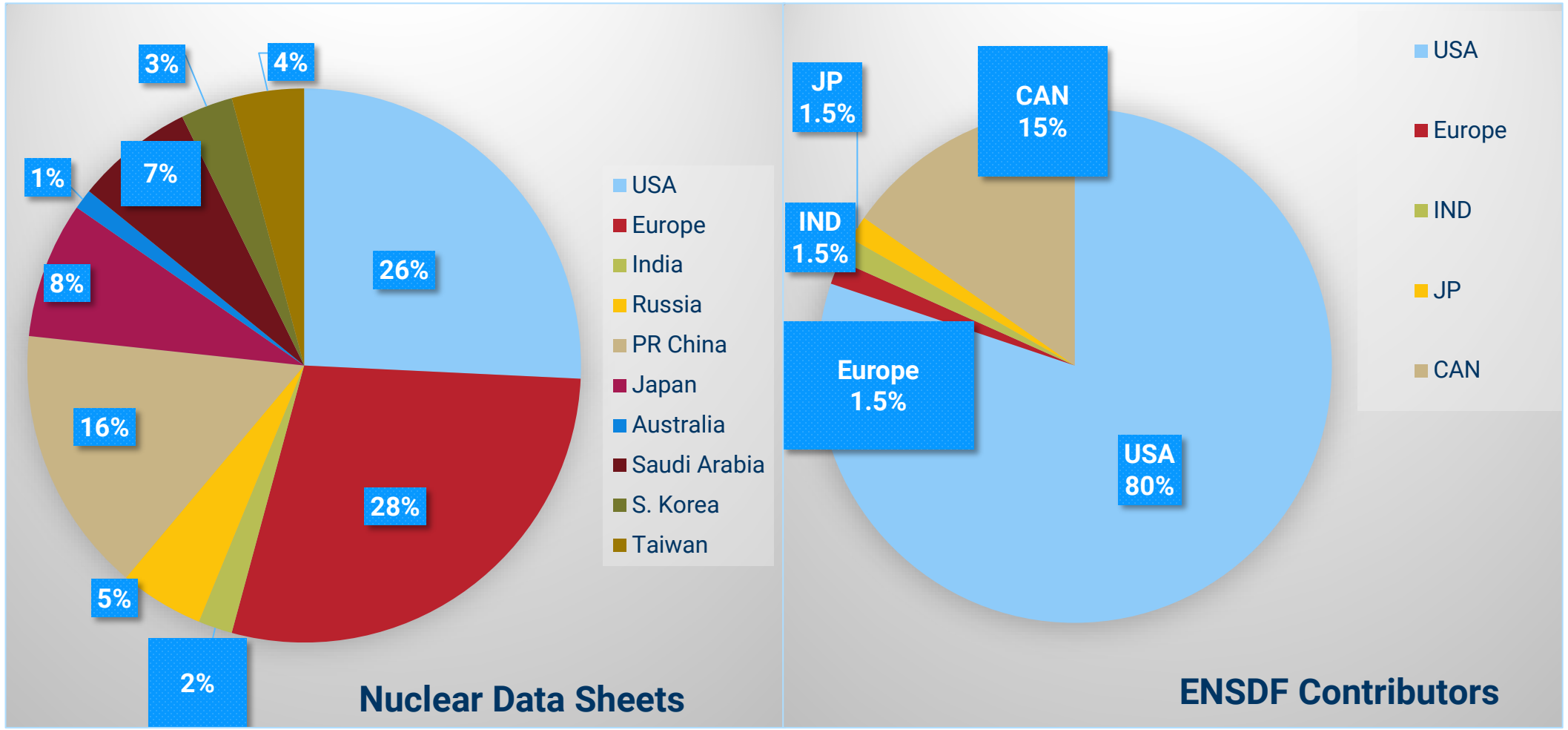
- Separate hype from utility: Integrate AI capabilities responsibly into nuclear data workflows where they really help
- Remove technological barriers (legacy data formats, complex manual workflows, lack of public software tools) and align with broadly adopted IT norms and standards
- Validation and benchmarking measurements of AI
- Strengthen and facilitate communication across the various segments of the nuclear data pipeline
- Establish education pipelines and durable career paths in the nuclear data domain

Future: Data lake, data portal, data management

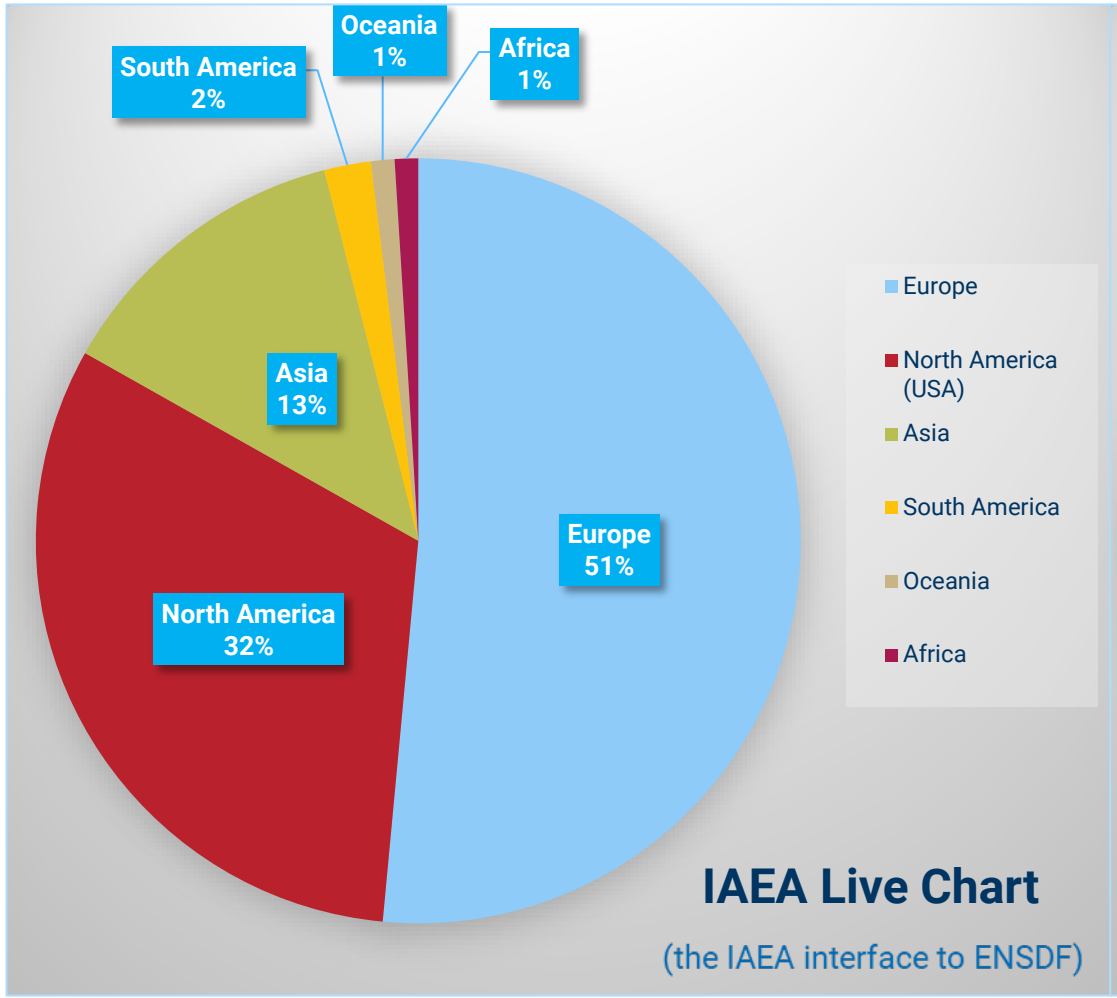
Task: Develop a format for the lake with rich data and metadata to make nuclear data accessible to AI

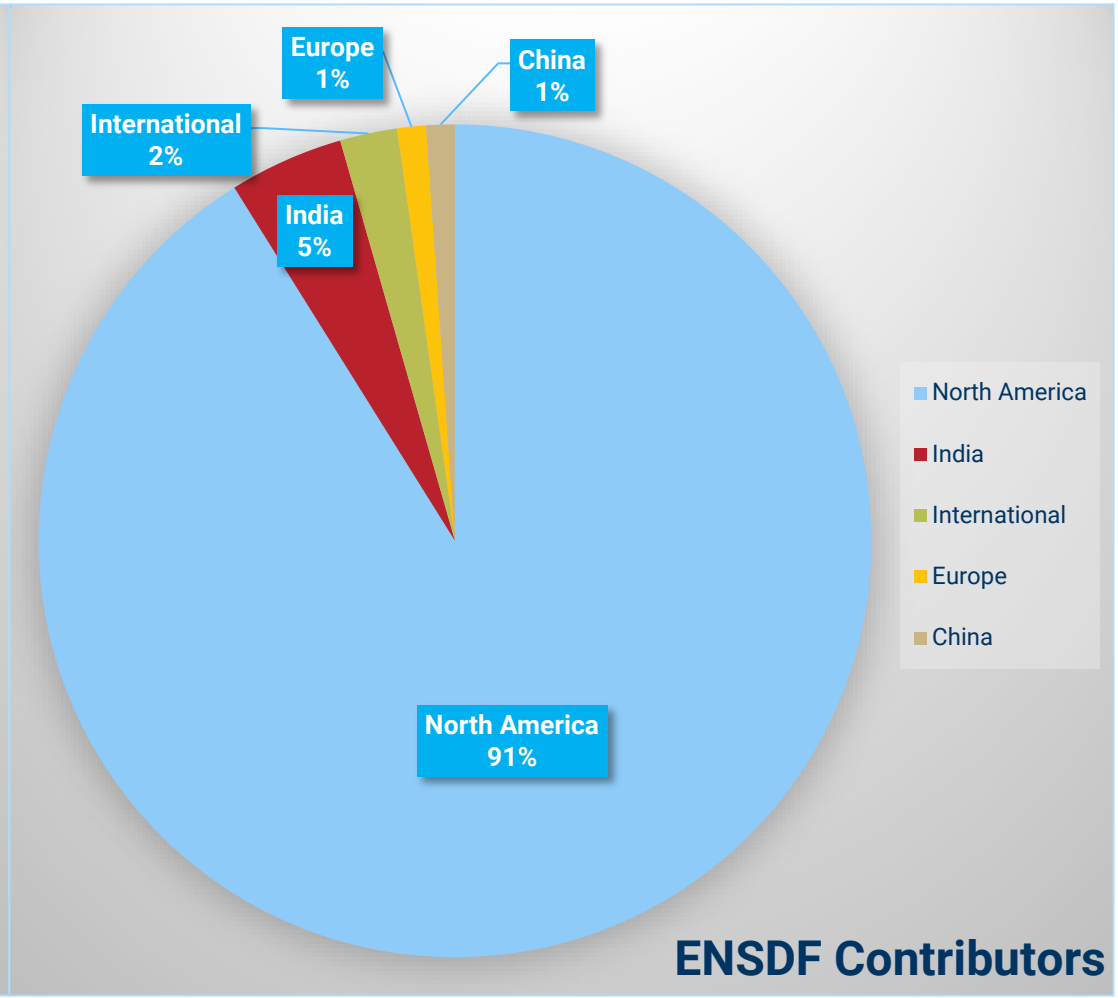


ND Users vs Providers: ENSDF 2018 – 2022

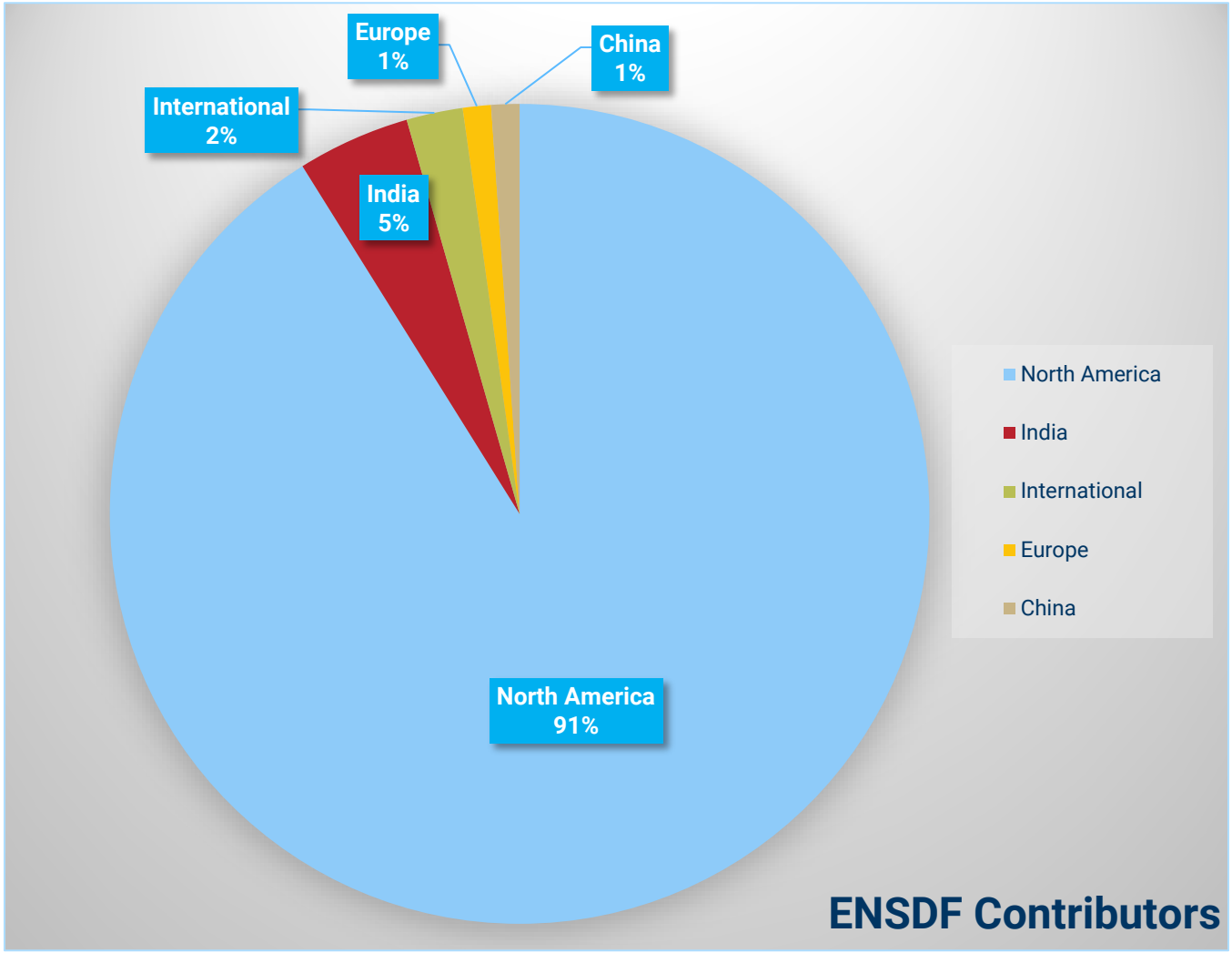


Users vs Providers: ENSDF Jan 2023 – Apr 2026





Over 90% of ENSDF is provided by a single national program: USNDP

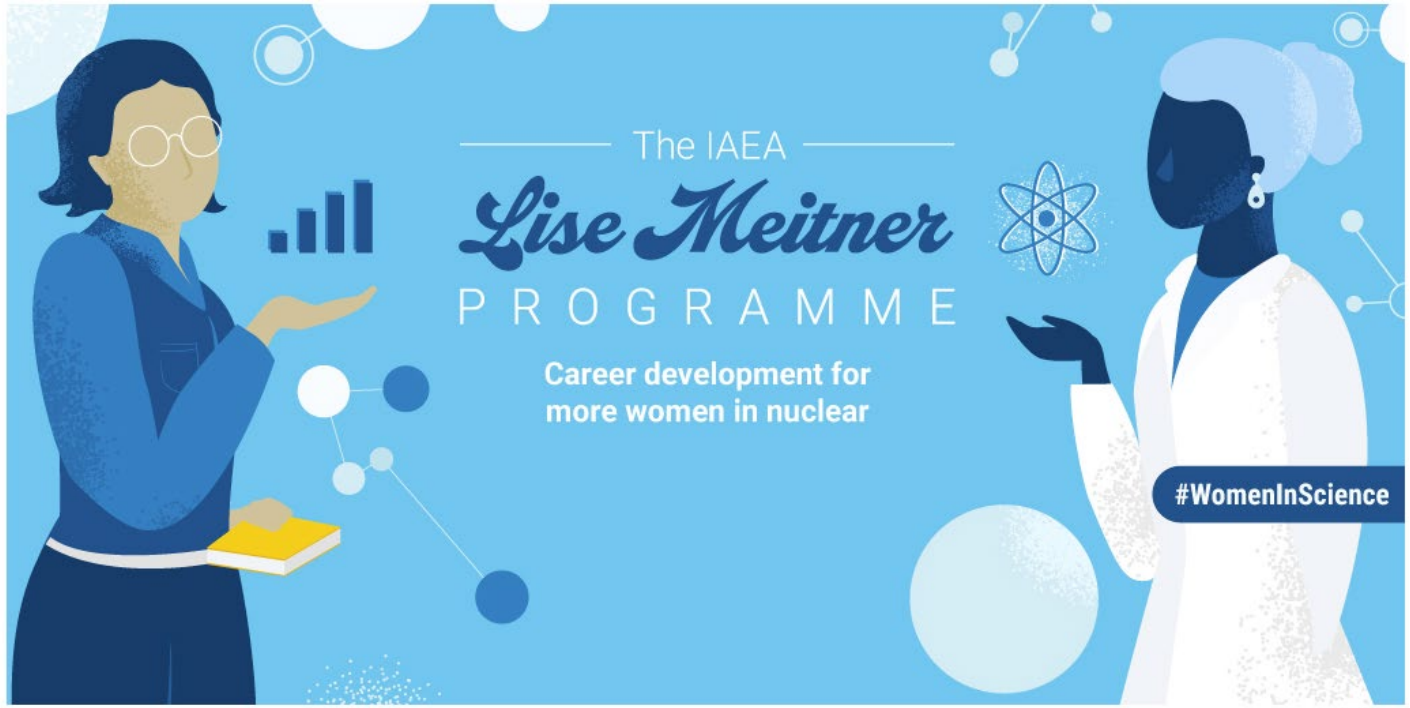


Opportunities at the IAEA

Supporting women around the world with costs related to their master's degrees in the nuclear field.

https://www.iaea.org/services/key-programmes/iaea-marie-sklodowska-curie-fellowship-programme/information-for-applicants

More opportunities



A new professional development programme: the IAEA Lise Meitner Programme (LMP) focuses on the development of women's technical and managerial skills through a multiweek visiting professional programme.

https://www.iaea.org/services/key-programmes/together-for-more-women-in-nuclear/lise-meitner-programme

Thank you!

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