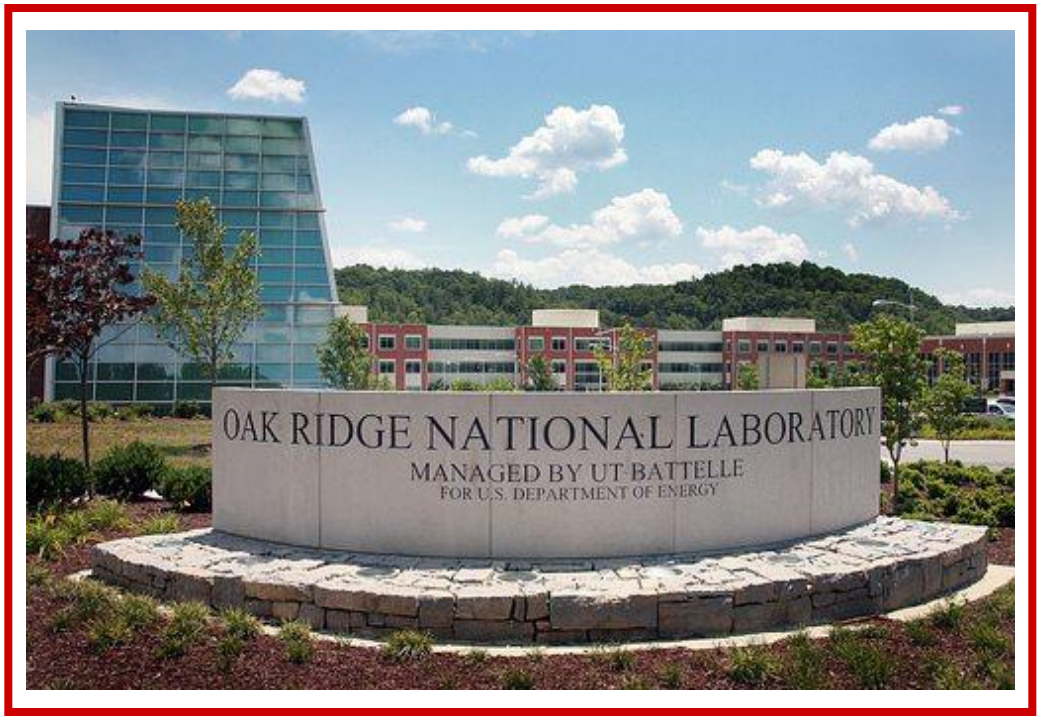
Recent Activities & Initiatives in the ORNL Nuclear Data Program – USNDP 2013



Caroline D. Nesaraja,
Michael S. Smith,
Murray J. Martin
Physics Division, ORNL

Eric J. Lingerfelt
Computer Science and Mathematics Division, ORNL

NUCLEAR DATA ACTIVITIES

Nuclear Structure Data

(M. Martin & C. Nesaraja)

- A-chain Evaluations

Nuclear Astrophysics Data

(M. Smith)

- Evaluation and assessments of reactions & structure critical for stellar explosion studies

- Closely coupling research and data activities

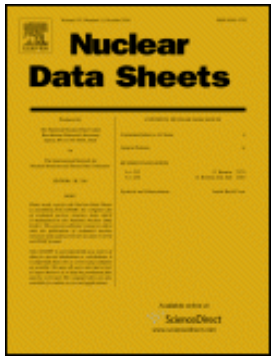
Online Software Systems

(M. Smith & E. Lingerfelt)

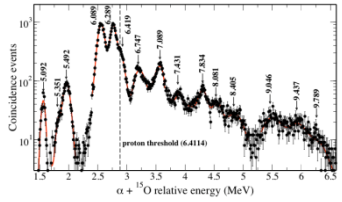
- Recent enhancements to nucastrodata.org and the Computational Infrastructure for Nuclear Astrophysics (CINA)

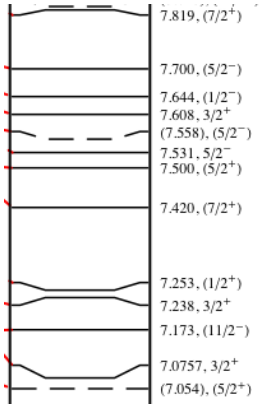
- Recent enhancements to nuclearmasses.org and the Nuclear Masses Toolkit (NMT)

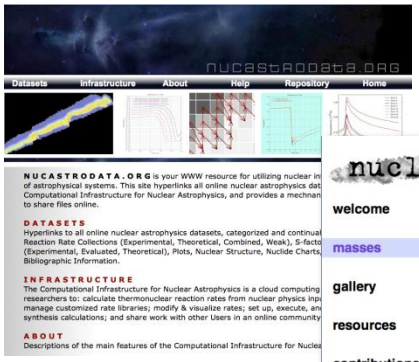
- Cloud Computing Initiative in Nuclear Data (ndc3.net)

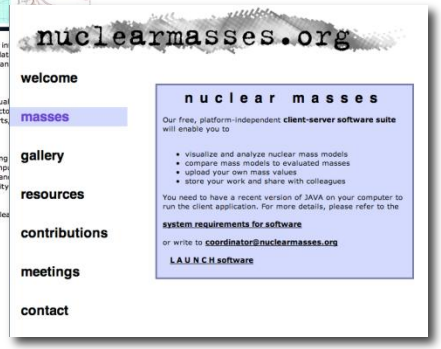


Evaluated Nuclear Structure Data File (ENSDF)









NUCLEAR STRUCTURE DATA

Responsibility:
Actinide Evaluations **A=241 – 249** or others requested from NNDC

Activities:

1.Finalized Mass Chain Evaluation

A=152 (M. Martin)

A=69 (C. Nesaraja)

2. Reviewed Mass Chain Evaluation

A=69 (M. Martin)

A=54 (C. Nesaraja)

NUCLEAR STRUCTURE DATA

Activities (continued):

3. ENSDF/ XUNDL discussions (1 May, 2013)

B. Singh, M. Martin , M. Smith, and C. Nesaraja at ORNL

4. Workshop on XUNDL database at TUNL (16-17 May, 2013)
Online participation

5. Visited NNDC (12-16 August,2013)

i) Familiarized with the features and usage of the EVP editor (A. Sonzogni, NNDC).

The editor streamlines data input, runs ENSDF codes and has other features such as checking for missing gammas or levels etc. **It is a tremendous aid to the evaluation work.**

NUCLEAR STRUCTURE DATA

Activities (continued):

ii) collaborated with Libby McCutchan (NNDC) on mass chain evaluation A=243
^{243}Np-^{243}Fm

Importance of decay and nuclear structure data for the actinide series (Z=89-103)

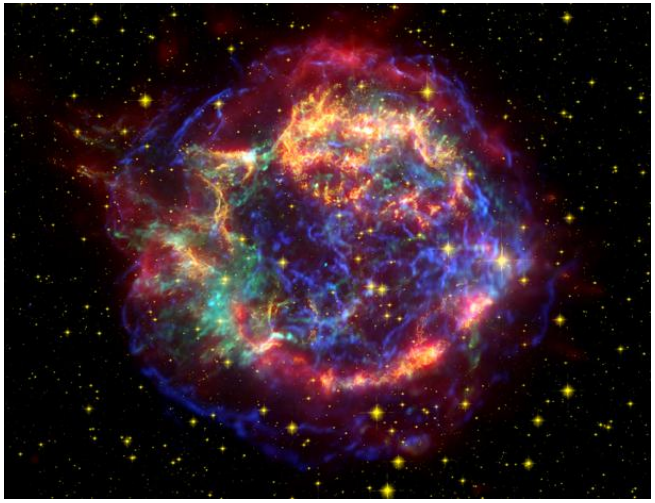
•Minor actinide generated in spent nuclear fuel of nuclear reactors: Nuclear data needed in reactor designs, spent nuclear fuel burn-up rates, nuclear waste management , and safeguard application.

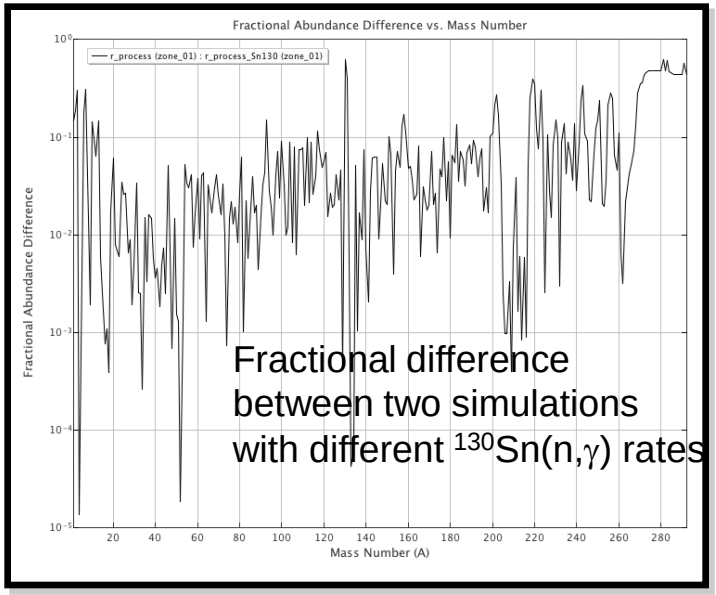
•Research and Synthesis of superheavy elements requires nuclear data such as decay branching and halflife information

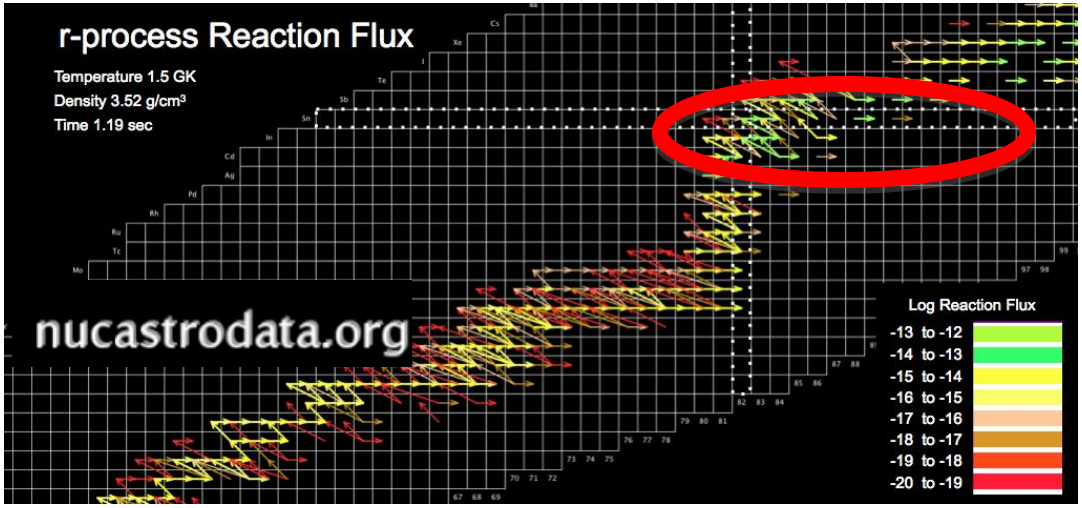
NUCLEAR ASTROPHYSICS DATA

Structure & neutron capture on Exotic Sn nuclei lying in / near the r-process path

Motivation: variations in ^{130}Sn(n,γ) shown to make **global** changes in r-process abundances







NUCLEAR ASTROPHYSICS DATA

Structure & neutron capture on Exotic Sn nuclei lying in / near the r-process path

Projects:

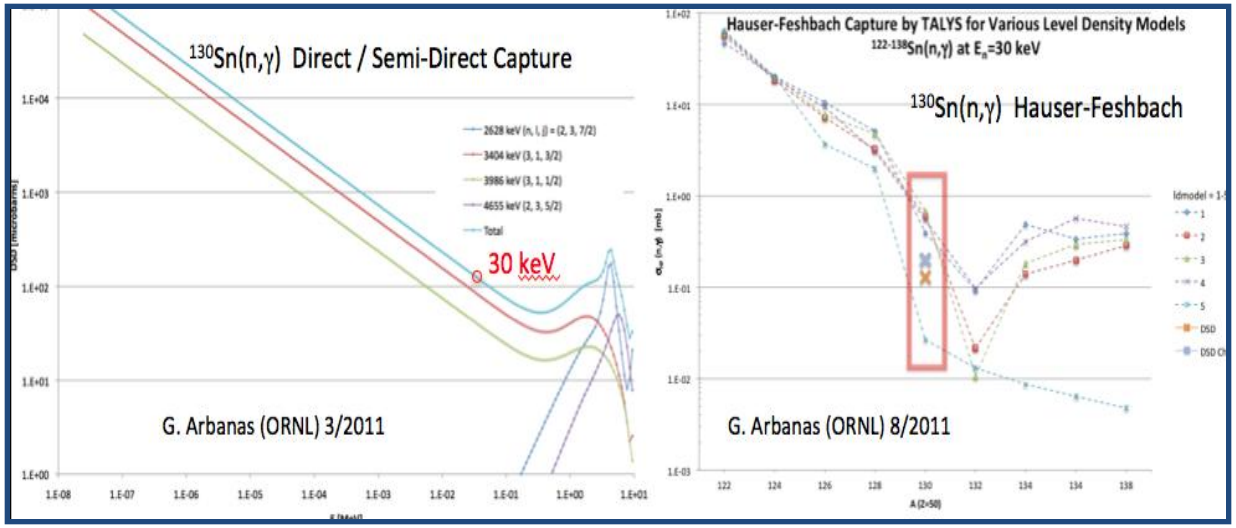
- Examining evolution of single particle levels and shell structure off stability for exotic Sn isotopes

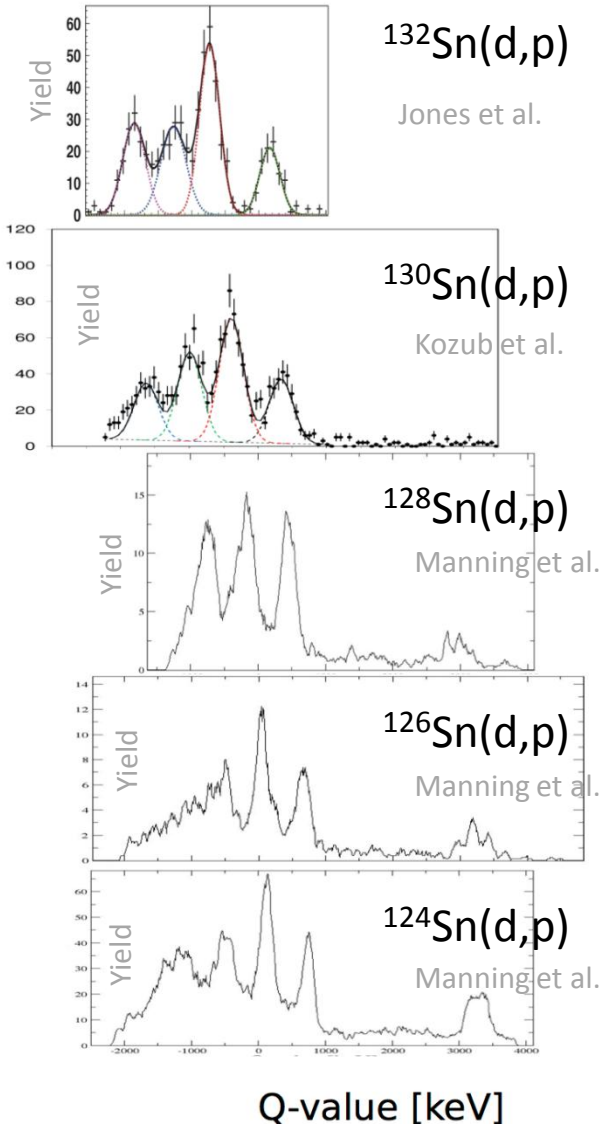
  Experimental: Brett Manning et al.

  Theoretical: Shisheng Zhang et al.

- Examining neutron capture rates on exotic Sn nuclei

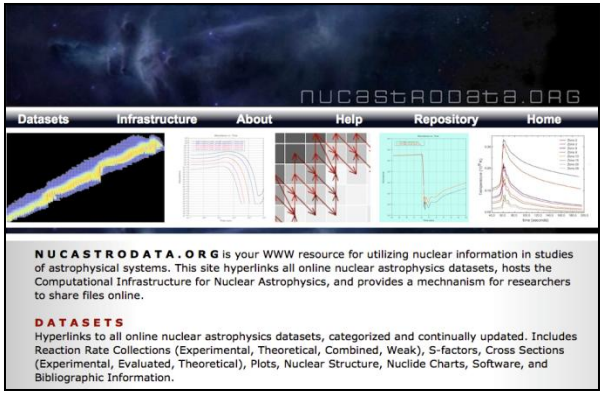
  Smith, Zhang, Kozub, Arbanas, Peng …





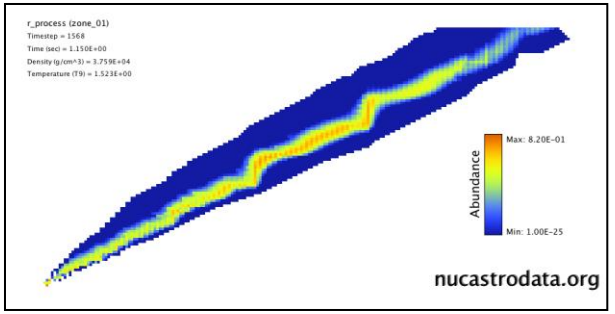
ONLINE SOFTWARE SYSTEMS - CINA

Computational Infrastructure for Nuclear Astrophysics (CINA) is a cloud computing system available at **nucastrodata.org** which streamlines the incorporation of the latest data into nuclear astrophysics simulations.
Accessible via an easy-to-use, web-deliverable, cross-platform Java application.



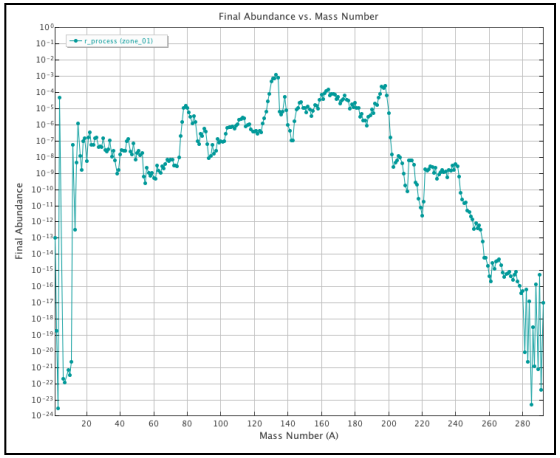
New features in CINA include:

•Online core-collapse supernova r-process and cold r-process simulations with over 4500 isotopes and > 51,000 thermonuclear reactions rates.



•A new 1D plotting tool enabling analysis of r-process and cold r-process results.

- Compare results to observations of solar and halo star abundances.
- Plot the fractional abundance difference of any two simulations and / or observations.



•Create and export customized animations of r-process and cold r-process results on an interactive chart of the nuclides.

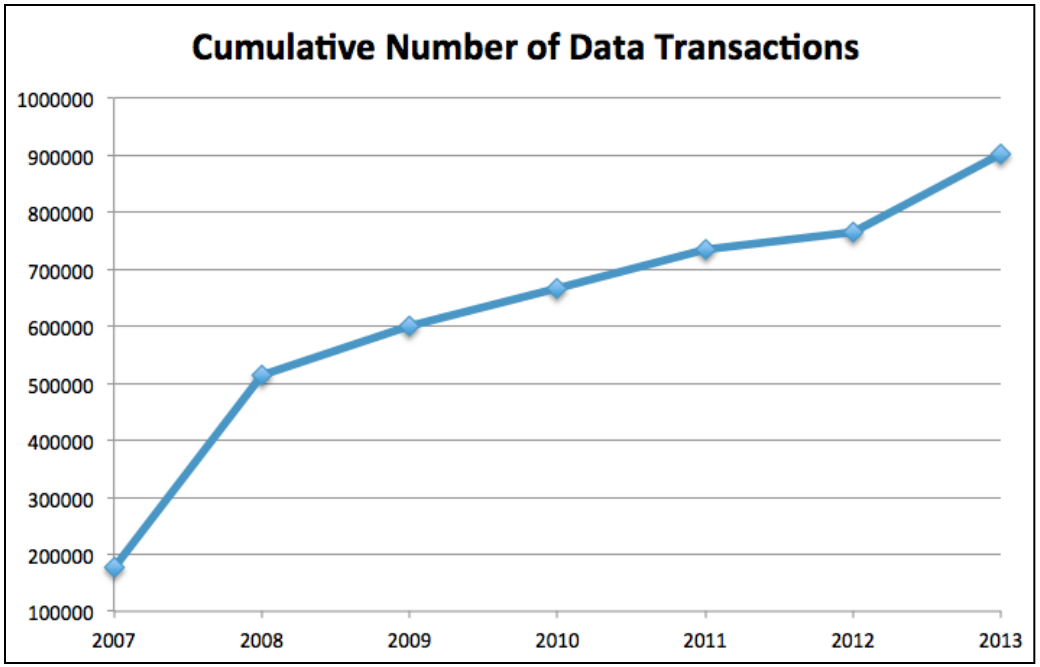
•Employs the latest JINA REACLIB libraries in simulations.

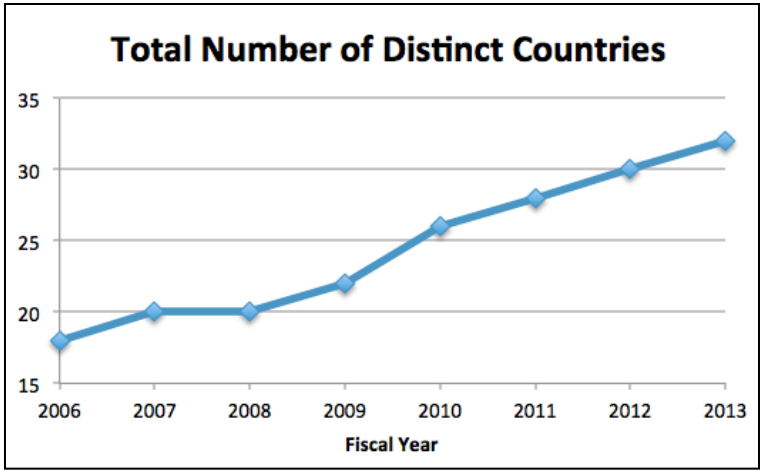
ONLINE SOFTWARE SYSTEMS - CINA

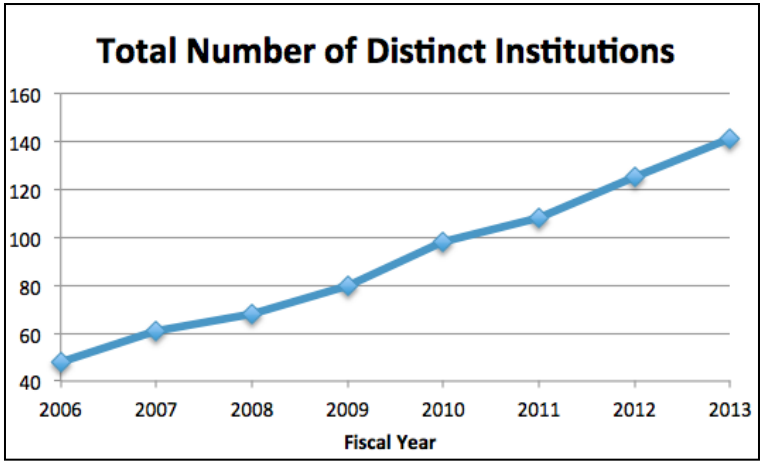
New improvements and content at *nucastrodata.org* include:

- Redesign of website's "Look and Feel" and menu options for enhanced usability.
- Updated lists of online nuclear astrophysics datasets and libraries.

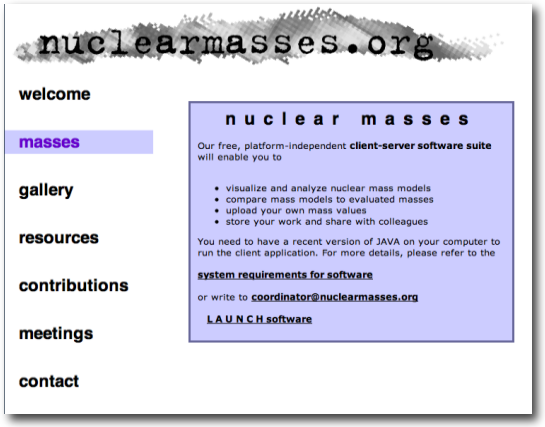
CINA currently has Registered Users from over 32 countries and 144 institutions with an average of one new User/week over a six year period.
Since the beginning of FY2007, CINA has logged over 900k data transactions

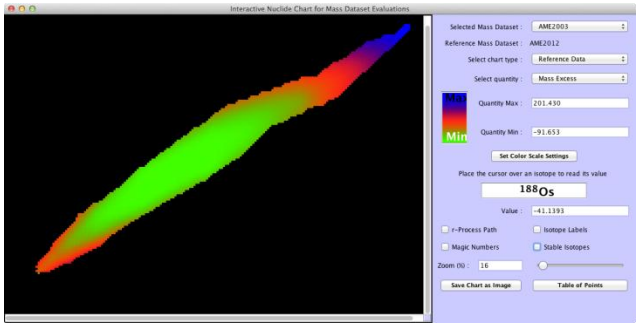




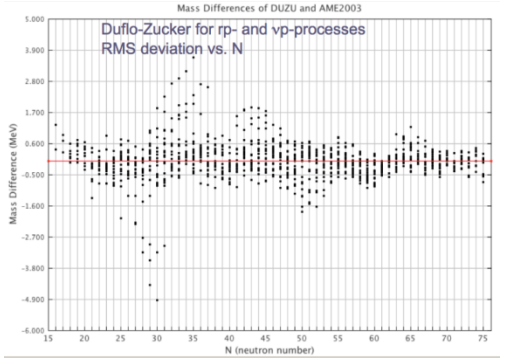


ONLINE SOFTWARE SYSTEMS - Nuclear Masses Toolkit





plot of the chosen reference dataset - AME2012 evaluated masses



simple analyses of datasets are possible

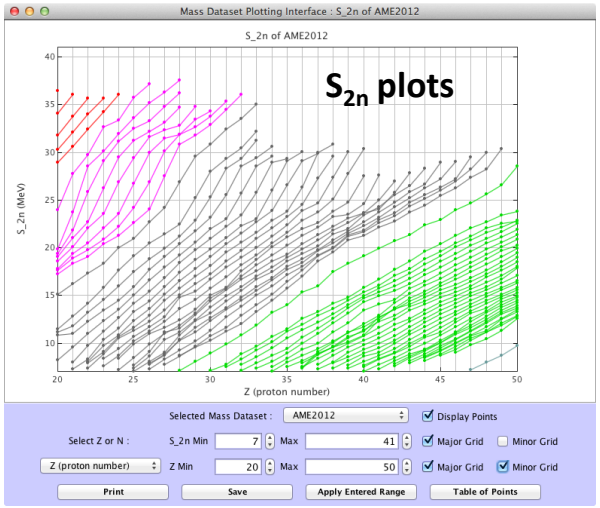
nuclearmasses.org and the Nuclear Masses Toolkit launched to aid research in nuclear masses and provide software support for new mass evaluation efforts worldwide

•SHARE and ACCESS work with scientific community (experimentalist, theorist, evaluators)

•VISUALIZE, ANALYZE & COMPARE mass datasets

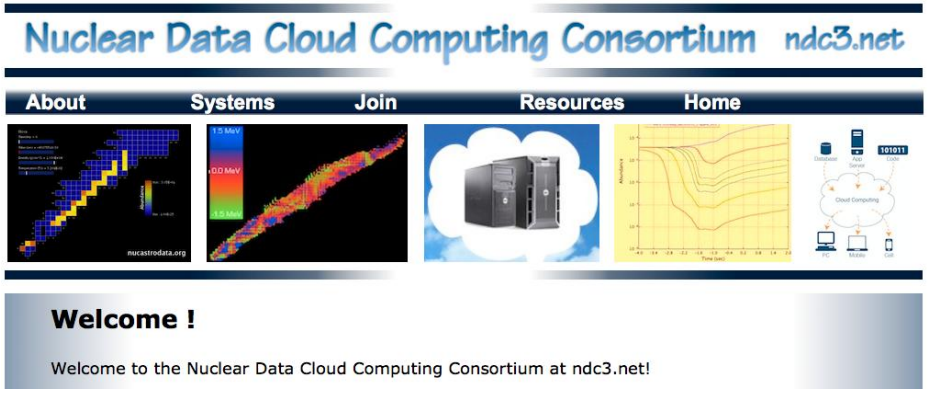
New in 2013:

- The AME2012 atomic mass evaluations from M. Wang *et al.* Chinese Phys. C 36 (2012) 1603.
- Seven new experimental mass dataset compilations from B. Singh et. al. (McMaster Univ.)
- Enhancements to S_{2n} and Mass Difference 1D plotting tools.



ONLINE SOFTWARE SYSTEMS – NDC3.NET

The Nuclear Data Cloud Computing Consortium (NDCCC or NDC3) at *ndc3.net* is a Working Group interested in developing new cloud computing systems, sites, and tools in nuclear science and closely related fields, as well as improving and promoting those already running in the cloud.



What is a cloud computing system?

A collection of computer codes that are stored and executed on remote servers ("in the cloud") by users controlling them over the internet.

What are the advantages of cloud computing systems?

You never have to download, install, maintain, upgrade, or debug tools that run in the cloud - all of those hassles are handled by the tool owner. You only have to connect to the tool over the internet and run it !

How can cloud computing help nuclear science?

- Streamline repetitive tasks and improve your productivity
- Enable you to work with the latest versions of codes and data libraries to improve your accuracy
- Enable you to work with validated tools to improve your reliability
- Help you share your work with colleagues in specialized online communities
- Assist you in managing your workflow
- Attract students to work in the latest trends in computer science

NDC3 would like to help get your codes online in the cloud

Publications / Presentations / Highlights

Publications

1. **Phys. Rev. Lett. 109, 172501 (2012)**
R.L. Kozub, *et al*. Neutron Single Particle Structure in ^{131}Sn and Direct Neutron Capture Cross Sections
2. **Phys. Rev. C 87. 024312 (2013)**
J. Su, *et al*. *Reexamining the β decay of ^{53,54}Ni, ^{52,53}Co, ^{51}Fe, and ^{50}Mn*

Oral Presentations

1. **20th International Network of Nuclear Structure and Decay Data Evaluators** held at the Kuwait Foundation for the Advancement of Sciences (KFAS) Safat, Kuwait from 27-31 January 2013.
ORNL Progress Report - C. Nesaraja *et al.*
2. **International Conference on Nuclear Data for Science and Technology** held in New York from March 4-8.
Cloud Computing for Nuclear Data- M.S. Smith

Poster Presentations

1. **International Conference on Nuclear Data for Science and Technology** held in New York from March 4-8.
Nuclear Data Processing and Dissemination Efforts for Nuclear Astrophysics at ORNL- C. Nesaraja *et al.*
Low level densities of exotic ^{131,133}Sn isotopes & impact on r-process nucleosynthesis- Zhang S. *et al.*

Highlights

1. **ORNL CSMD Summer 2013 Newsletter.**
Nuclear Mass Dataset Dissemination and Analysis with the Nuclear Masses Toolkit and nuclearmasses.org. -Lingerfelt *et al.*
2. **ORNL CSMD Fall 2013 Newsletter.**
Simulating Element Creation in Supernovae with the Computational Infrastructure for Nuclear Astrophysics at nucastrodata.org. -Lingerfelt *et al.*

Summary / Future Work

Nuclear Structure/ Nuclear Astrophysics Data Evaluation and Assessments

- Mass chain evaluation A=241-249
- Collaborate with evaluators at NNDC
- Study on neutron capture on exotic Sn isotopes

Computational Infrastructure for Nuclear Astrophysics

- Enhance utilization of online nuclear data libraries

Nuclear Masses

- Develop tools at nuclearmasses.org for future mass evaluation efforts

Nuclear Data Cloud Computing Consortium

- Assist researchers to get their codes online in the cloud

FY13 Metrics Table

NSR Compilations	
EXFOR Compilations	
XUNDL Compilations	
ENSDF Evaluations submitted	8
ENDF Evaluations	
Disseminations (in thousands)	40
Articles	2
Reports	
Invited Talks	7

FY13 FTE Table

PhD Permanent	1.2
PhD Temporary	0.15
Tech. & Admin.	0.5
Grad. Student	
Total	1.85

A-chains to be submitted in FY14:

Two A-chains in A=241-249

A-chains to be submitted in FY15:

Two A-chains in A=241-249

Personnel & Funding

Scientific Permanent staff:
2 heads, USNDP funded 1.2 FTE

Scientific Temporary staff (Postdocs, long term visitors):
1 head, USNDP funded 0.15 FTE

Scientific External collaborators:
many (none funded by USNDP)

Technical/Support staff:
1 head, USNDP funded 0.5 FTE (software systems)

New hires:
- none

Resigned/Retired:
- none

Visitor:
Shisheng Zhang (Beihang Univ., Beijing)- Structure of n-rich exotic Sn isotopes