Recent Activities & Initiatives in the ORNL Nuclear Data Program – USNDP 2008

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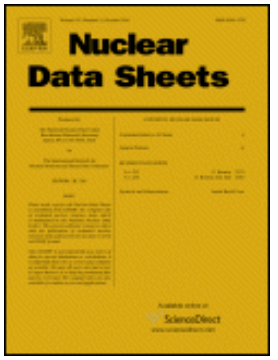
Activities

OAK RIDGE National Laboratory

NNDC

Nuclear Structure Data

- A-chain Evaluations

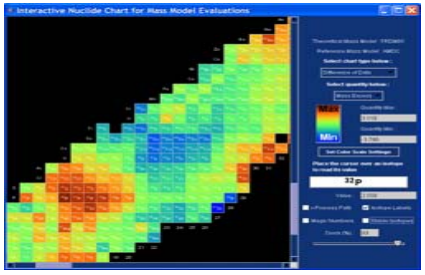


Nuclear Astrophysics Data

- Evaluation and assessments of reactions critical for stellar explosion studies
(coupling research and data activities)

- Improve and expand functionality of the Computational Infrastructure for Nuclear Astrophysics

- Facilitate a proposed new effort in nuclear mass evaluations



Nuclear Structure Data

EVALUATIONS

Responsibility: Actinide Evaluations A=241 – 249

A=152 evaluation in progress (Murray Martin)

A=58 reviewed (Murray Martin)

A=58 (working on referee's review, discussions with Murray Martin & Balraj Singh)
(Balraj Singh, Scott Geraedts, & Caroline Nesaraja)

A=69 (began preliminary work)
(* Caroline Nesaraja)

* Participated in the Joint ICTP-IAEA Workshop On Nuclear Structure and Decay Data: Theory and Evaluation (2008)

Nuclear Astrophysics Data

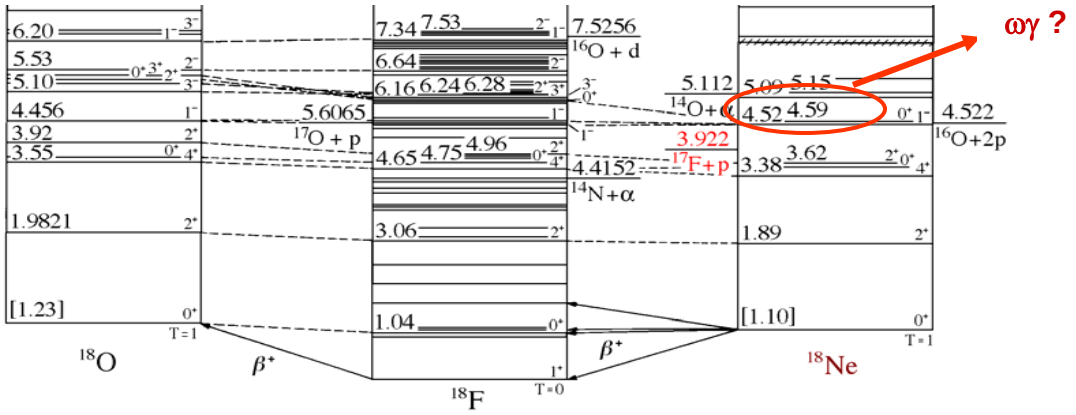
^{18}Ne

Motivation: ^{17}F(p,γ)^{18}Ne reaction is of significant importance in astrophysical events like novae and X-ray bursts

^{18}Ne levels above 3.922 MeV are of astrophysical interest

Previous evaluation (Tilley et al. 1995): a low energy 3+ state in ^{18}Ne based on the mirror ^{18}O at E_x 5.378 MeV

^{17}F(p,p)^{17}F (D. Bardayan et al. 1999) first to observe the "missing" 3+ state (Ex=4.523 MeV)



TUNL Nuclear Data Evaluation Project, "A=18 Isobar Diagram "

First direct measurement using radioactive ^{17}F nuclei produced at ORNL's HRIBF and using the DRS to directly detect the recoiling ^{18}Ne from a H_2 gas target

599.8 keV resonance
ωγ = 33±14(stat)±17(sys) meV, corresponding to a width of
Γγ = 56±24(stat)±30(sys) meV.

Ph.D. thesis for K. A. Chipps, Colorado School of Mines, 2008

PHYSICAL REVIEW LETTERS (submitted)
First Direct Measurement of the ^{17}F(p,γ)^{18}Ne Cross Section
K. A. Chipps et al.

Level Assessments in progress

Nuclear Astrophysics Data

^{16}N

Motivation: ^{15}N(n,γ)^{16}N reaction is important to nucleosynthesis calculations in AGB stars.

-Most recent evaluation (Meissner et al. 1996) concluded ^{15}N(n,γ)^{16}N dominated by direct capture which is directly proportional to C^{2}S of low-lying ^{16}N levels.

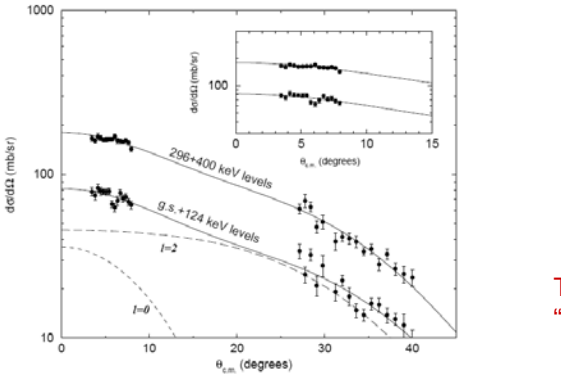
-Discrepant C^{2}S between previous measurement and shell model calculations

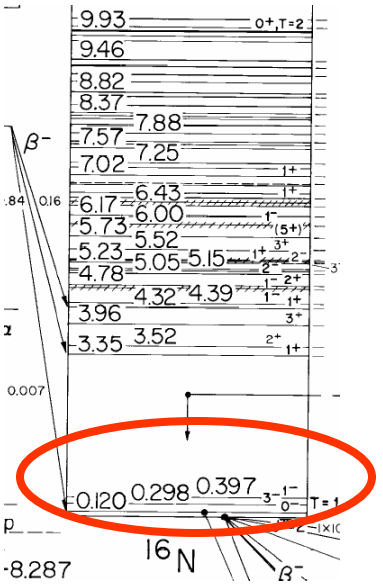
- ^{15}N(d,p)^{16}N in inverse kinematics studied at ORNL

- Cross sections extracted for the population of low lying states in ^{16}N

- Measured C^{2}S near unity as expected from shell model calculation

E_x (MeV) Expt.	J^π	l_f	C^2S Expt.[a]	C^2S OXBASH
0	2^-	$1d_{5/2}$	0.55	0.93
0.120	0^-	$2s_{1/2}$	0.46	0.95
0.296	3^-	$1d_{5/2}$	0.54	0.87
0.397	1^-	$2s_{1/2}$	0.52	0.96





TUNL Nuclear Data Evaluation Project, "Energy Level Diagram ^{16}N "

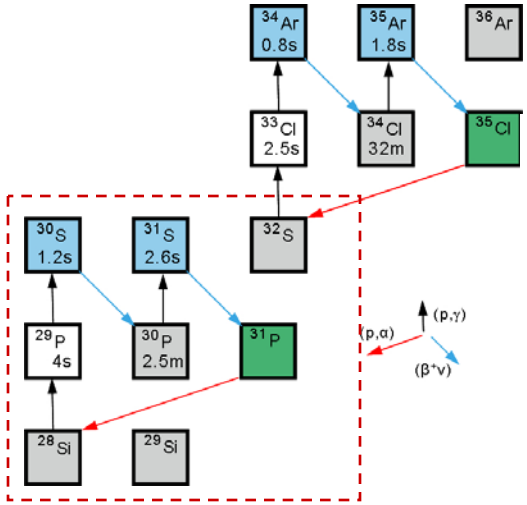
Level Assessments in progress

PHYSICAL REVIEW C (accepted for publication)
Spectroscopic study of low lying ^{16}N levels
D. W. Bardayan et al.

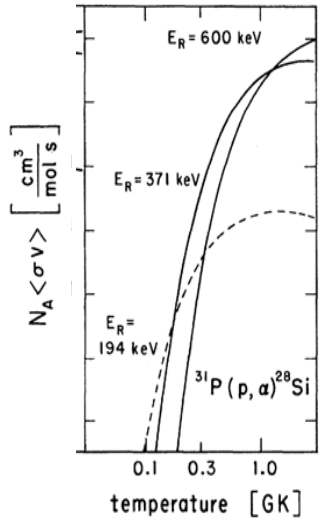
Nuclear Astrophysics Data

^{32}S

Motivation: Influence of the ^{31}P(p,α)^{28}Si reaction on cyclic processing in the Si-P mass range



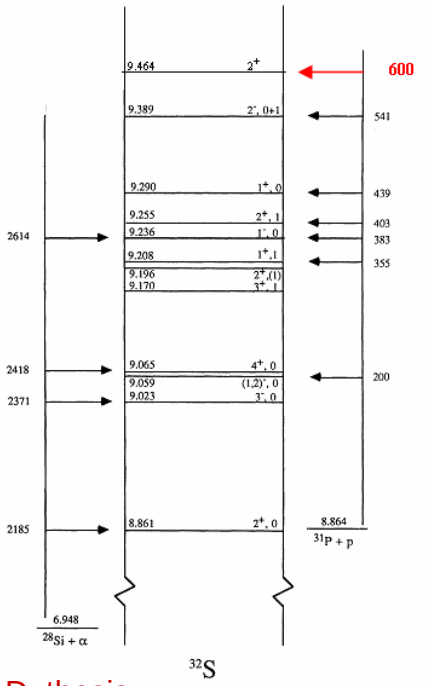
Strength of cycle depends on ratio of competing (p,γ) and (p,α) reactions



At T≥0.1G K, the reaction rate is dominated by the 600 keV resonance.

Rates uncertain by a factor of 10 due to uncertainties in resonance strengths of low lying level in ^{32}S

Novel technique using a hydrogen gas target and the ^{31}P beam from HRIBF to measure resonances in ^{32}S



Preliminary results: $\omega\gamma(p,\alpha) = (2.1\pm0.2)\times10^{-2}$ eV for the 600 keV resonance

Level Assessments in progress

Portion of Ph.D. thesis for B.H. Moazen, University of Tennessee, Knoxville

Computational Infrastructure for Nuclear Astrophysics

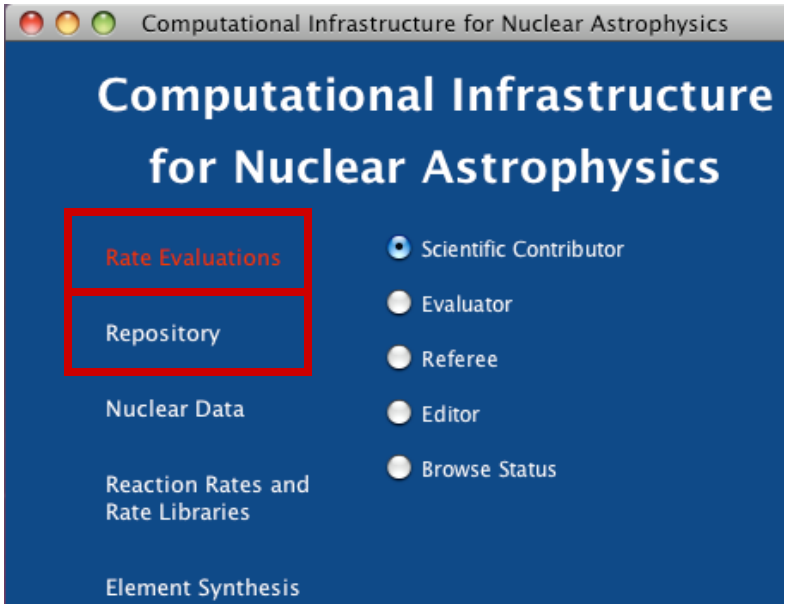
New Features since USNDP-2007 meeting

- New tools to manage workflow of evaluations are online and available for use

  (Developed from discussions at the Trento Meeting in May 2007 and Vancouver in 2004)

- New **online repository for sharing files**

- **expanded** our existing capabilities with new simulations, new rates [KADONIS], new tools [bottleneck finder, waiting point finder] and enhanced speed



users in 73 institutions in 20 countries

Presented by M.S. Smith at the Data Section Meeting for the Nuclei in the Cosmos Conference 2008

Computational Infrastructure for Nuclear Astrophysics

Rate Evaluation Toolkit

• Provide a set of software tools to handle the workflow of evaluations (from initiation to peer review to incorporation into the new REACLIB)

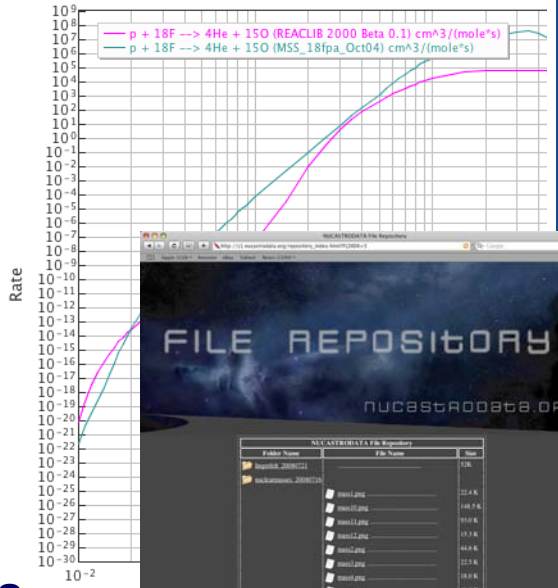
• Streamline tasks that are repetitive, mundane, or inconvenient with existing technologies

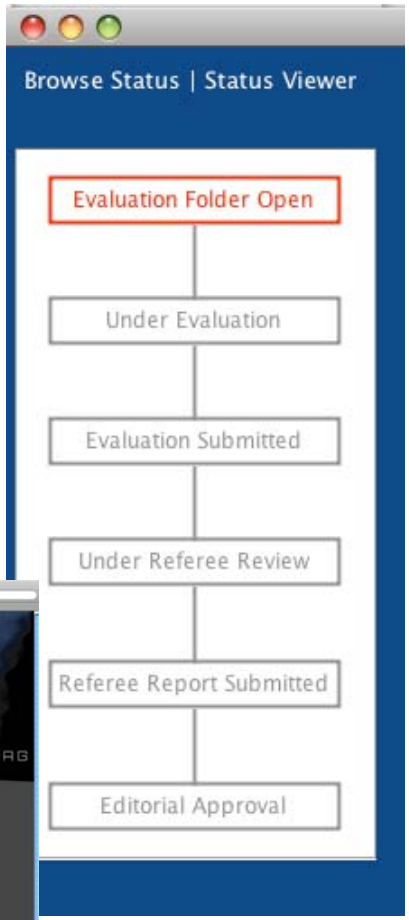
File Repository

• Share information that is not necessarily associated with any one evaluation

• browsing / downloading files can be done by our JAVA interface *or* by a web page

These tools are completely customizable and can be very helpful for all USNDP evaluations





Computational Infrastructure for Nuclear Astrophysics

Example: fitting KADONIS rates

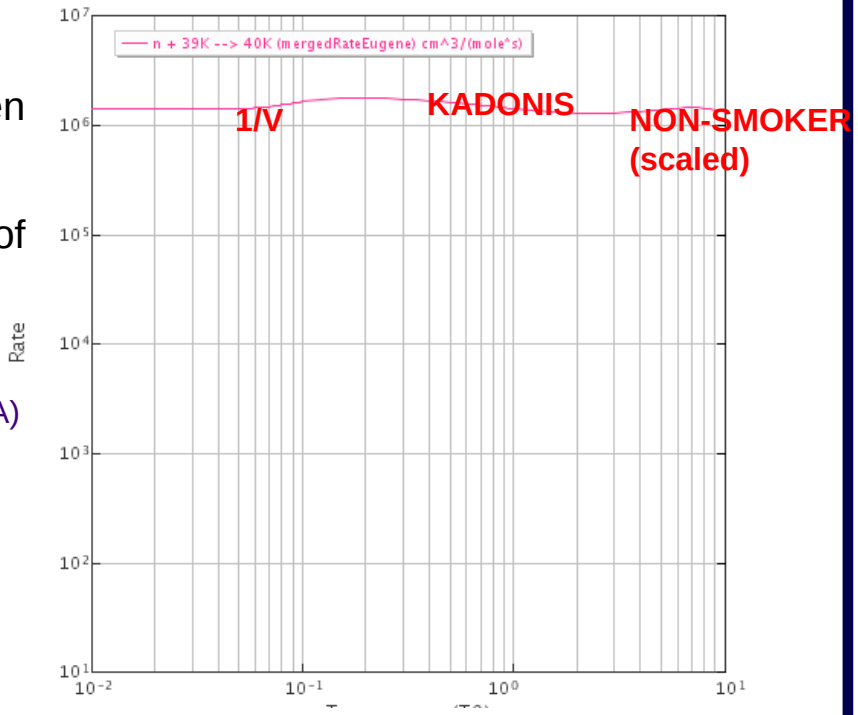
KADONIS s-process neutron capture rates are given over temperature range of 0.06 – 1.16 GK

REACLIB needs rates over the temperature range of 0.01 – 10 GK

we extended KADONIS rates (Noboyuki Iwamoto, JAEA)

at low temperatures with 1/v s-wave capture [unless data was available]

at high temperatures with NON-SMOKER rate scaled to match KADONIS rate

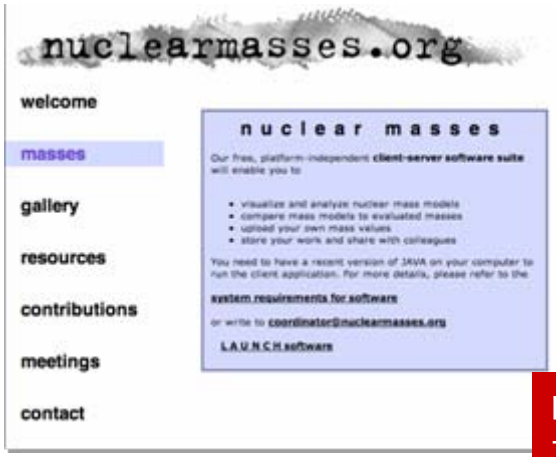


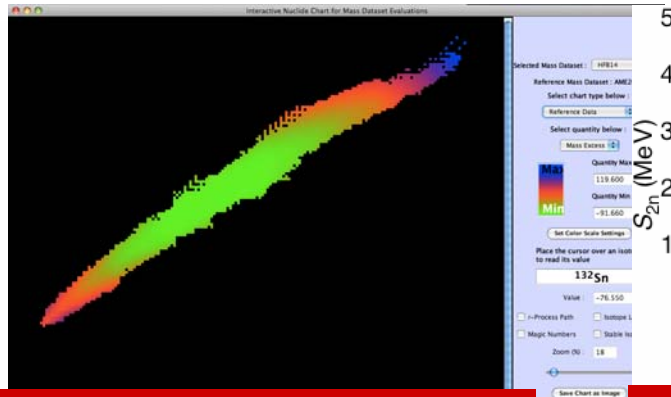
we used **our online tools** to fit these rates with REACLIB parameters

undergrad student (Eugene Harris, Alabama A&M) *fit 50 rates in 3 days*

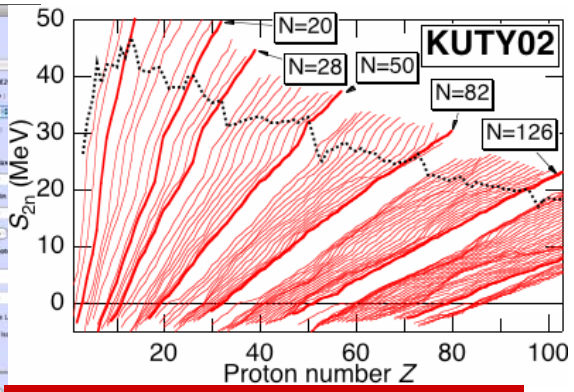
Rates are now available in a library for all to use

Nuclear Masses





plot of the chosen reference dataset - AME2003 evaluated masses



simple analyses of datasets are possible

nuclearmasses.org launched to aid research in nuclear masses and to help facilitate a proposed new effort in nuclear mass evaluations

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

VISUALIZE, ANALYZE & COMPARE mass datasets