

# **Nuclear Data Project at McMaster University**

**Status Report: Oct. 1, 2003-Sept. 30, 2004**

**October 25, 2004**

**(Nov. 3-5, 2004: USNDP-04 meeting)**

# Part 1: Nuclear Structure and Decay Data

Prepared by: B. Singh

# ENSDF Work

## ■ Permanent Responsibility:

A=1 (1999), 31-37 (1999),  
38-39 (1999,w), 40 (2004),  
41 (2001), 42 (2000),  
43 (2001), 44 (1999),  
64 (1996,w), 89 (1998),  
98 (2003), 100 (1997,w),  
149 (2004), 151 (1997),  
164 (2001), 188 (2002),  
190 (2003), 194 (1996,s)

- Note: The number in parentheses gives the year of last revision in ENSDF database
- w: work in progress
- s: revision submitted
- During FY-2004, work was also done on other priority A-chains and nuclides, which are outside McMaster's A-chain responsibility



# Mass-chain Evaluations Published or Submitted Since October 2003

- **A=80:** B. Singh: NDS (submitted September 2004, at pre-review stage)
- **A=194:** B. Singh: NDS (submitted September 2004, at pre-review stage)
- **A=132:** Yu. Khazov, A. Rodionov, S. Sakharov and B. Singh:  
(submitted January 2004, at review stage)
- **A=240:** F. Chukreev and B. Singh:  
(submitted January 2004, at galley-proof stage)
- **A=40:** J.A. Cameron and B. Singh, NDS **102**, 293-514 (2004)
- **A=149:** B. Singh, NDS **102**, 1-291 (2004)
- **A=73:** B. Singh, NDS **101**, 193-323 (2004)

# Nuclide Updates

- The following nuclides have been updated for ENSDF:
- $^{32}\text{Mg}$ ,  $^{32}\text{S}$ ,  $^{89}\text{Rh}$ ,  $^{89}\text{Ru}$ ,  $^{89}\text{Tc}$ ,  $^{218}\text{Po}$ ,  $^{218}\text{Bi}$  (by B. Singh)  
(Work on A=218 nuclides done as part of training/mentoring process)
- A=267-293: Corrections made in several datasets were included in ENSDF

# Superdeformed Structures

- Data from primary publications during 2003-2004 included in ENSDF (by B. Singh) for four nuclides:  $^{88}\text{Mo}$ ,  $^{91}\text{Tc}$ ,  $^{173}\text{Hf}$ ,  $^{174}\text{Hf}$
- As of October 25, 2004, we are current on SD band data coverage in ENSDF, except for two papers on  $^{163}\text{Lu}$  and  $^{165}\text{Lu}$

These papers will be included in forthcoming nuclide update for  $^{163}\text{Lu}$  and A=165 update for ENSDF

- Continuous updates will be done as new papers appear



# XUNDL work

## Compilation of Data from Recent Literature

- Since October 2003, 226 compiled (but checked for level-scheme consistency) datasets prepared by McMaster group
- 15 datasets in XUNDL were revised/edited to incorporate newer papers from the same groups
- During summer 2004, also compiled a few high-spin papers for outdated A-chains in ENSDF database
- Frequently scan web pages of primary nuclear physics journals: (PR-C, PRL, NP-A, PL-B, EPJ-A, JP-G)
- Almost up-to-date on the coverage of data from current papers, with the exception of 10 papers published in the last 3-4 weeks.

# XUNDL work *cont.*

- Major portion of compilation work since October 2003, performed by undergraduate student, Joel Roediger
- Datasets checked thoroughly by B. Singh, before submission to NNDC for inclusion
- Communication with authors actively pursued to resolve data-related inconsistencies and/or to request additional data details
- E-mail communications (~50 in total) in 2003-2004 from original authors have been compiled into single computer file, submitted to NNDC as a computer file and a printed copy for archival storage
- A-chain Evaluators or other XUNDL users can request copies of these communications from NNDC or McMaster



# Work in Progress

(as of October 1, 2004)

**A=39, 38.** Complete all ENSDF style datasets for all reactions and adopted properties. Except for  $^{39}\text{K}$ , all nuclides of A=39 have been completed. Draft versions of some of nuclides of A=38 have been completed.

**A=64, 100.** Work just started to update all nuclides in these A-chains.

**A=74.** Work continuing in collaboration with data group in Kuwait. Except for  $^{74}\text{Se}$  and  $^{74}\text{As}$ , all nuclides completed by McMaster group and submitted to NNDC in early 2003. New papers for the nuclides evaluated at McMaster will be included after evaluations of  $^{74}\text{Se}$  and  $^{74}\text{As}$  are received from Kuwait group

# Mentoring and Training of New Data Evaluators through Collaborative work

- **A=132:** Work completed in collaboration with new team of 3 evaluators at Petersburg Nuclear Physics Institute in Gatchina, Russia. Mass chain submitted in January 2004 and currently at review stage
- **A=165, 218:** Work in collaboration with new team of 2 evaluators at Department of Physics, Indian Institute of Technology, Roorkee, India. This work is in progress.
- Dr. Alexander Rodionov from Petersburg group in Russia and Dr. Ashok Jain from IIT, Roorkee in India visited McMaster for one month each during summer 2004 for A-chain evaluation work and consultations on general evaluation procedures. The McMaster group covered their local expenses.
- Data files and comments regularly exchanged between McMaster and the centers in Russia and India.

# Other Related Activities

## International Coordination:

- The **IAEA-NSDD-2005** meeting is scheduled to be hosted by McMaster group from June 6-10, 2005 at McMaster campus. All necessary arrangements/administrative matters, including meeting website will be handled by the McMaster data group
- **Review of Fission (Shape) Isomers in Actinide Nuclei:**  
Subsequent to recent communications between B. Singh (McMaster) and Dr. Stephan Oberstedt (Neutron Physics Unit, European Commission, Geel, Belgium), a detailed review and evaluation of fission-isomer data in the actinides is planned in 2004-5. Most of the work will be done by Dr. Oberstedt at Geel, while B. Singh will assist in this effort as much as possible. It is expected that results of this evaluation will be incorporated in the ENSDF database.



# Personnel and Funding

## (Nuclear structure and decay data)

- J.C. Waddington (Professor, PI of the data group at McMaster)
- J.A. Cameron (Emeritus-Professor)
- B. Singh (Research Scientist/Nuclear Data Evaluator)
- J. Roediger (Undergraduate Student)
  
- One FTE support from DOE, USA + NSERC, Canada
- Partial support for summer undergraduate students

# Part 2: Astrophysics Data

Prepared by: A.A. Chen

# Overview of Program

- Goal: perform evaluations of reactions involving radioactive isotopes important in stellar explosions.
- Coupled to the experimental program of the McMaster group, which is centered at TRIUMF-ISAC.
- Reactions of interest:  $^{13}\text{N}(p,\gamma)^{14}\text{O}$ ,  $^{15}\text{O}(\alpha,\gamma)^{19}\text{Ne}$ ,  $^{19}\text{Ne}(p,\gamma)^{20}\text{Na}$ ,  $^{18}\text{Ne}(\alpha,p)^{21}\text{Na}$ ,  $^{21}\text{Na}(p,\gamma)^{22}\text{Mg}$ , and  $^{25}\text{Al}(p,\gamma)^{26}\text{Si}$



# Reactions evaluated in FY04

- Stellar reaction rates for  $^{21}\text{Na}(p,\gamma)^{22}\text{Mg}$  and  $^{18}\text{Ne}(\alpha,p)^{21}\text{Na}$  were updated based on recent experimental results from TRIUMF-ISAC and other laboratories using radioactive ion beams.
- $^{21}\text{Na}(p,\gamma)^{22}\text{Mg}$ : additional ISAC data analysis in progress – McMaster group as collaborators.
- $^{18}\text{Ne}(\alpha,p)^{21}\text{Na}$ : new data from Argonne measurement to be published; new measurement planned at ISAC; McMaster group collaborating on both.
- Updated reaction rates will be disseminated through the ORNL computational infrastructure and stellar reaction libraries at [www.nucastrodata.org](http://www.nucastrodata.org)

# Personnel and Funding

- A.A. Chen (Assistant Professor, PI)
- J. Pearson (Postdoc, part-time on data project)
- A. Olivieri (Summer Student 2004)

(for FY 2005: C. Ouellet, graduate student, part-time)

- DOE funding in FY04: 0.5 FTE, plus 2004 summer student