A brief status report on selected Indian nuclear data physics activities submitted to the NRDC Meeting-2009

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IAEA Technical Committee Meeting of International Network of Nuclear Reaction Data Centres

(NRDC, 25-26 May 2009, IAEA Headquarters, Vienna, Austria, Europe.

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Director, BARC formed a committee in 2007 to find ways and means of forming a national nuclear data centre

In India, we are including all the national laboratories and university teams using the DAE-BRNS mechanisms in order to evolve a streamlined and coherent activity of nuclear data in India that will be sustainable.

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NUCLEAR DATA ACTIVITIES IN INDIA
 Basic nuclear data physics measurements.

•EXFOR compilations.

Nuclear model based calculations.

 Processing of evaluated nuclear data files to produce plug-in libraries for discrete ordinates and Monte Carlo codes.

•Efforts to digest the status of covariance error methodology in nuclear data and its applications

• Preparation of integral Indian experimental criticality benchmarks for integral nuclear data validation studies.

BARC is in the process of formally announcing the formation of a strong and sustainable Indian Nuclear Data Centre.

This announcement is expected to be made formally soon.

BARC is in the process of formally announcing the formation of a strong and sustainable Indian Nuclear In 2008, India attended as <u>observer</u> the IAEA Technical Committee Meeting of International Network of Nuclear Reaction Data Centres (NRDC), 22-25 September 2008 at the Institute of Physics and Power Engineering in Obninsk, Russian Federation.

India is a <u>member</u> of the NRDC since September 2008

At the time of NRDC-2009 Meeting the official count for the IAEA accepted EXFOR entries are as follows:

10 new entries in 2006,
33 in 2007, 9 in 2008
1 in 2009.

 India considers the activity of EXFOR compilation as an important activity of the Classical nuclear data physics in the Indian Nuclear Data Centre

Since NRDC-2008 (September 2008), this year, 6 new Indian EXFOR entries (Reference: EXFOR entry with no: D6064, D6067, 33020, 33021, 33022 and 33023. (Paresh Prajapati (Ph. D., Student, MS University, Vadodara, Reactor Physics Design Division, Dr. H. Naik, Dr. S. Singh (Radio Chemistry Division)) collaborated in this effort.

Workshops in India on EXFOR Compilation

India will be hosting the 2009 EXFOR training Workshop in Mumbai during November 9-13, 2009

The 2009 EXFOR training Workshop will be conducted under the auspices of proposed India Nuclear Data Centre.

Previous history:

•September 4-8, 2006, Mumbai (IAEA Faculty: Dr. Otto Schwerer)

•October 29-November 2, 2007, Mumbai (IAEA Faculty: Dr. Ms. Svetlana DUNAEVA)

Experimental generation of nuclear data in India

- 14 MeV neutron generator in Pune and IPR
- BARC-TIFR Pelletron
- Photon induced reactions (Electron accelerator based bremstrahlung)

EXCITING SURROGATE TECHNIQUE

RAPID COMMUNICATIONS

PHYSICAL REVIEW C 78, 061602(R) (2008)

Determination of the 233 Pa(n, f) reaction cross section from 11.5 to 16.5 MeV neutron energy by the hybrid surrogate ratio approach

B. K. Nayak,¹ A. Saxena,¹ D. C. Biswas,¹ E. T. Mirgule,¹ B.V. John,¹ S. Santra,¹

R. P. Vind,¹ R. K. Choudhury,¹ and S. Ganesan²

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A new hybrid surrogate ratio approach has been employed to determine neutron-induced fission cross sections of ²³³Pa in the energy range of 11.5 to 16.5 MeV for the first time. The fission probability of ²³⁴Pa and ²³⁶U compound nuclei produced in ²³²Th(⁶Li, α)²³⁴Pa and ²³²Th(⁶Li, d)²³⁶U transfer reaction channels has been measured at $E_{bb} = 38.0$ MeV in the excitation energy range of 17.0 to 22.0 MeV within the framework of the absolute surrogate method. The ²³³Pa(n, f) cross sections are then deduced from the measured fission decay probability ratios of ²³⁴Pa and ²³⁶U compound nuclei using the surrogate ratio method. The ²³³Pa(n, f) cross section data from the present experiment along with the data from the literature, covering the neutron energy range of 1.0 to 16.5 MeV have been compared with the predictions of statistical model code EMPIRE-2.19. While the present data are consistent with the model predictions, there is a discrepancy between the earlier experimental data and EMPIRE-2.19 predictions in the neutron energy range of 7.0 to 10.0 MeV.

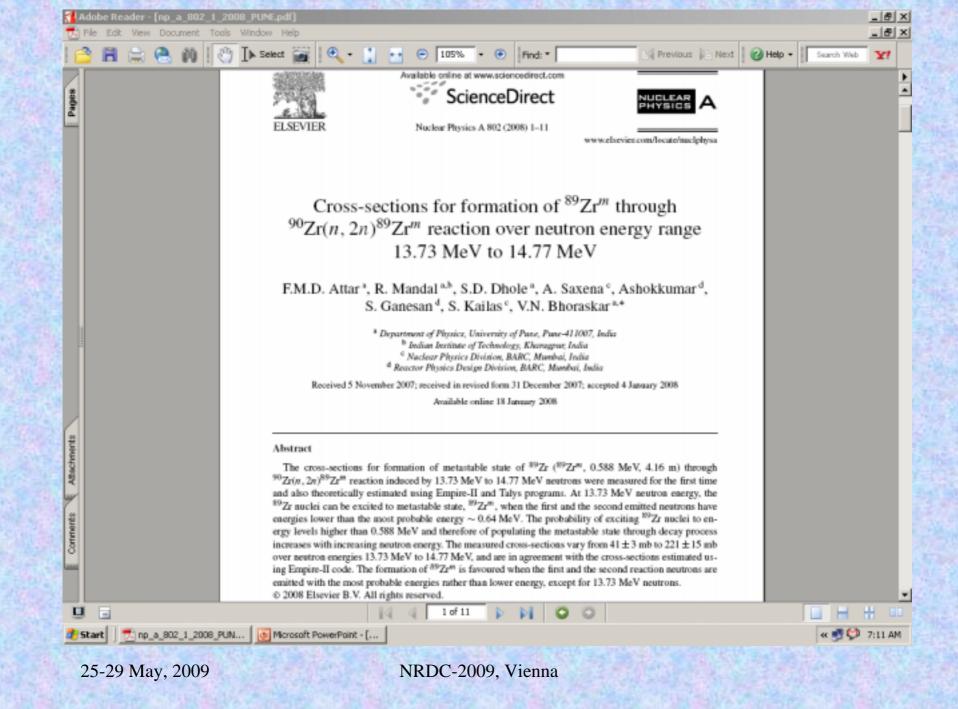
DOI: 10.1103/PhysRevC.78.061602

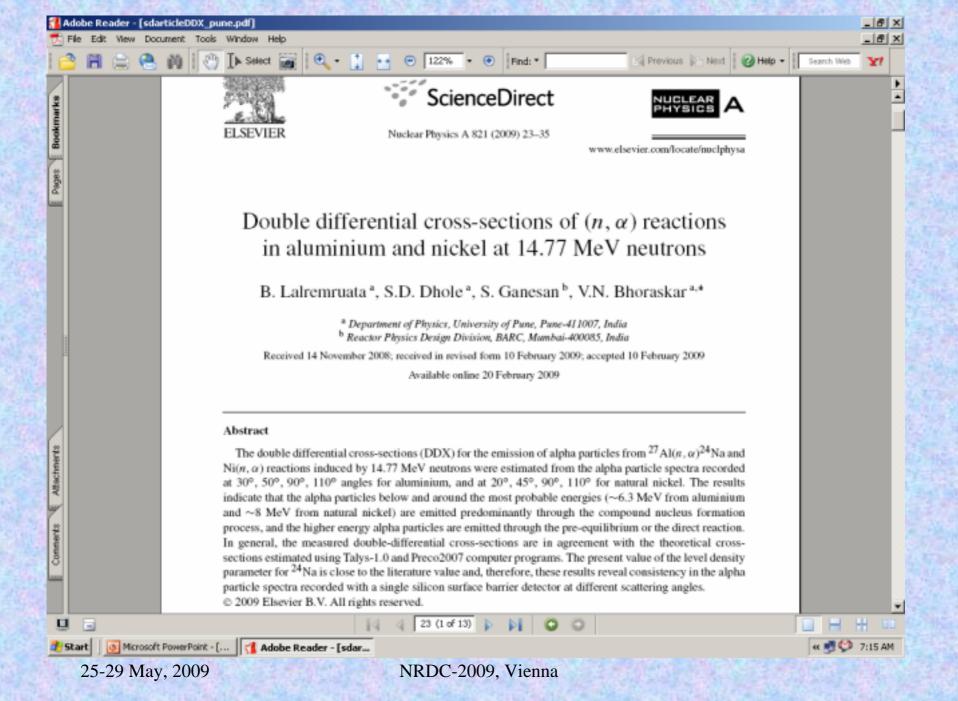
PACS number(s): 24.50.+g, 24.75.+i, 25.85.Ec, 28.20.-v

Determination of the neutron-induced fission cross sections of short-lived actinide nuclei is a major challenge for nuclear physics and nuclear astrophysics. Often indirect methods 27 day half-life of the ²³³Pa isotope. As this isotope is produced in an intermediate step during the formation of the fissile ²³³U nucleus, reactions competing with its natural decay affect the

In Progress: BARC (B. K. Nayak et al.,) working on using $Li-7+^{232}Th$ to measure $^{234}Pa(n,f)$ reaction data.

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Measurement of 67 Zn(n, p) 67 Cu, 92 Mo(n, p) 92m Nb and 98 Mo(n, $\gamma){}^{99}$ Mo reaction cross sections at incident neutron energies of $E_n = 1.6$ and 3.7 MeV

Megha Bhike, A. Saxena, B. J. Roy, R. K. Choudhury and S. Kailas Nuclear Physics Division, Bhabha Atomic Research Centre, Mumbai 400 085,

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085, India

Manuscript accepted (10 March 2008) for publication in Nuclear Science and Engineering. Journal of American Nuclear Society after a critical peer-review process.

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•Nuclear model based calculations. EVALUATION OF NUCLEAR DATA IS EXPECTED TO BE TAKEN UP SOON

•Processing of evaluated nuclear data files to produce plug-in libraries for discrete ordinates and Monte Carlo codes. Updating ORIGEN data for fast reactors, PHWRs, AHWRs and CHTRs.

•Efforts to digest the status of covariance error methodology in nuclear data and its applications

An example of calculations and study of systematics by the Pune team is shown in the next slide.

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NUCLEAR MODEL CODES:

EMPIRE AND TALYS ARE BECOMING MORE POPULAR

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Excitation functions and isotopic effects in (n,p) reactions for stable nickel isotopes from reaction threshold to 20 MeV

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ABSTRACT

The excitation function for (n, p) reactions from reaction threshold to 20 MeV on five nickel isotopes viz; ⁵⁸Ni, ⁶⁰Ni, ⁶¹Ni, ⁶¹Ni, ⁶¹Ni, ⁶⁰Ni, ⁶¹Ni, ⁶⁰Ni, ⁶¹Ni, ⁶

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CERN n_TOF international collaboration-Phase-2

- In September 2008, a formal MOU between BARC (Director, BARC) and CERN was signed.
- The annual O & M fee has also been paid by BARC in May 2009.

India -Korea collaboration on nuclear data

Dr. H. Naik, Radiochemistry Division, BARC visited Pohang as a visiting scientist for 3 months during the last quarter of 2008 and continued generation experimental data of photo-fission yields and photon induced neutron emission cross sections. (Pohang electron LINAC machines)

ENSDF Evaluation Activities

The ENSDF evaluation activities and research work are being actively continued by Ashok Jain (IIT Rourkee), M. Gupta (Manipal), Gopal Mukherjee (VECC, Kolkata) and others.

The Indian Nuclear Data Centre under formation will factor into account the continuation of these important nuclear data physics activities.

The online nuclear data services http://www-nds.indcentre.org.in/) mirror the nuclear data website of the Nuclear **Data Section of the International Atomic Energy Agency (IAEA), Vienna** http://www-nds.iaea.org. The MOU between DAE/BARC and the IAEA is expected to be continued beyond 2010.

Promoting the online nuclear data services in India is an ongoing task and in the coming years.

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India is a participant in the ITER programme.

The nuclear data needs for fusion system applications is receiving increased focus and attention in India.

Measurement of n, p and D induced activation cross sections in the MeV energy region. Calculations using TALYS and EMPIRE codes FENDL library of the IAEA: Use and QA studies Fusion integral benchmark analayis. Use of EASY-2007 package by Robin Forrest et al.

INTEGRAL NUCLEAR DATA VALIDATION STUDIES

Indian experimental nuclear criticality benchmarks

2009: Work started on PURNIMA-I (PUO₂ fast system)

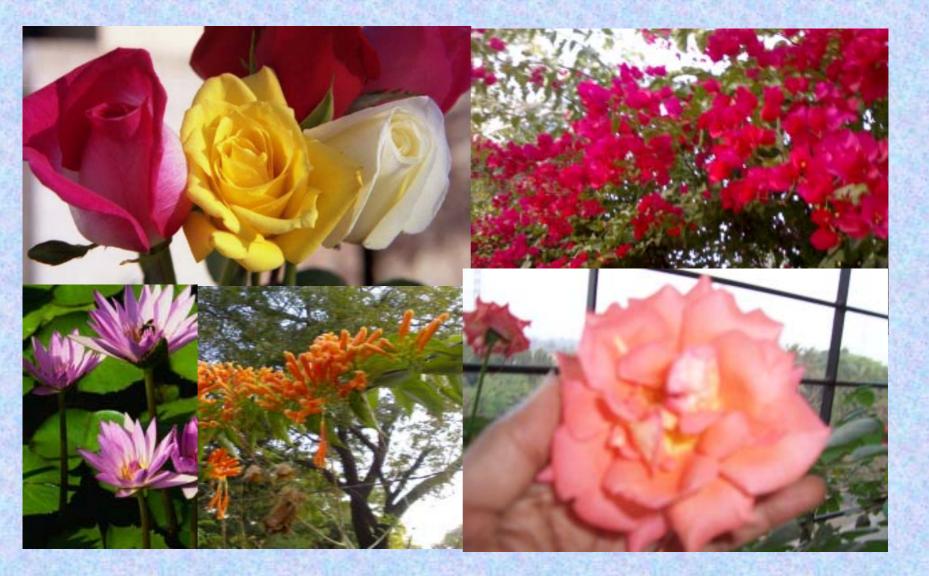
History of previous benchmarking tasks: For details, please visit the URL: http://icsbep.inl.gov/

2005: India contributed the KAMINI experimental benchmark (ICSBEP Reference: U233-MET-THERM-001)

2008: India contributed the PURNIMA-II experimental benchmark (ICSBEP Reference: U233-SOL-THERM-007)

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THANK YOU



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