

Update of activities of Nuclear Data Physics Centre of India 2014-2015

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India

- ❖ To cater to various needs of department, the Nuclear Data Physics Centre of India (NDPCI) was formed in 2010-11 under BRNS to provide a platform for coordinated efforts in all aspects of nuclear data, viz., measurements, analysis, compilation and evaluation involving national laboratories and universities in India

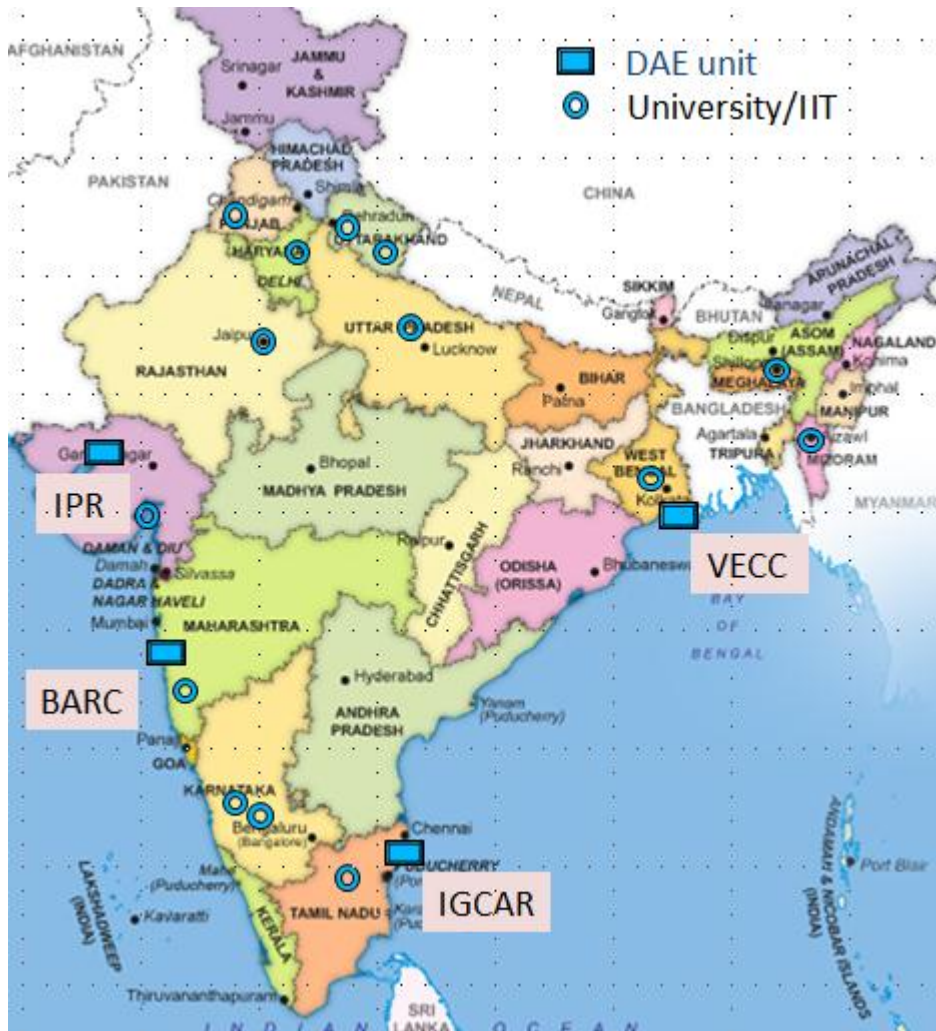
- **The Composition of the Programme Implementation Committee (PIC) :**

- P.D. Krishnani, Head, RPDD, BARC Chairman
- D. Raj ,RPDD,BARC Member
- Rajeev Kumar,RPDD, BARC Member
- H. Naik, RCD, BARC Member
- Rahul Tripathy, RCD, BARC Member
- Amar Sinha, Head, NAXPD Member
- B.K.Nayak, NPD, BARC Member
- E. Radha, RPD, IGCAR Member
- G. Pandikumar, NDS, RPD, IGCAR Member
- CSR Murthy, Computer Division Member
- Gopal Mukherjee, VECC Member
- D. Roy, Programme Officer, (BRNS) Member
- S. Ganesan, RR Fellow, DAE Permanent Invitee Member
- R. Srivenkatesan,MCNS, Manipal University Member
- C. Sunil, HPD Member
- SV Suryanarayana, NPD Member
- Abhijeet Bhattacharya, NPD Member
- U. Kannan, RPDD Member
- Alok Saxena, NPD, BARC Member-Secretary, NDPCI

- **The Composition of the Programme Review Committee (PRC) :**

- | | |
|---|-------------------------|
| • S. Kailas, Ex-Dir. Physics Group, BARC | Chairman |
| • Sangeeta, Scientific Secretary (BRNS) | Member |
| • V.M. Datar, Head, NPD, BARC | Member |
| • A. Goswami,Head RCD, BARC | Member |
| • R.M. Tripathi, Head, HPD, BARC | Member |
| • D. K.Srivastava, Director, VECC, Kolkatta | Member |
| • A.K.Jain, Dept. of Physics, IIT, Roorkee | Member |
| • P. D. Krishnani, Head, RPDD, BARC | Member |
| • K. Devan, Head, RPD, IGCAR | Member |
| • R.S. Mundada, Head, Computer Div. BARC | Member |
| • A.Saxena, NPD BARC | Member-Secretary, NDPCI |

Linkages of NDPCI with DAE Units and Univ./IIT



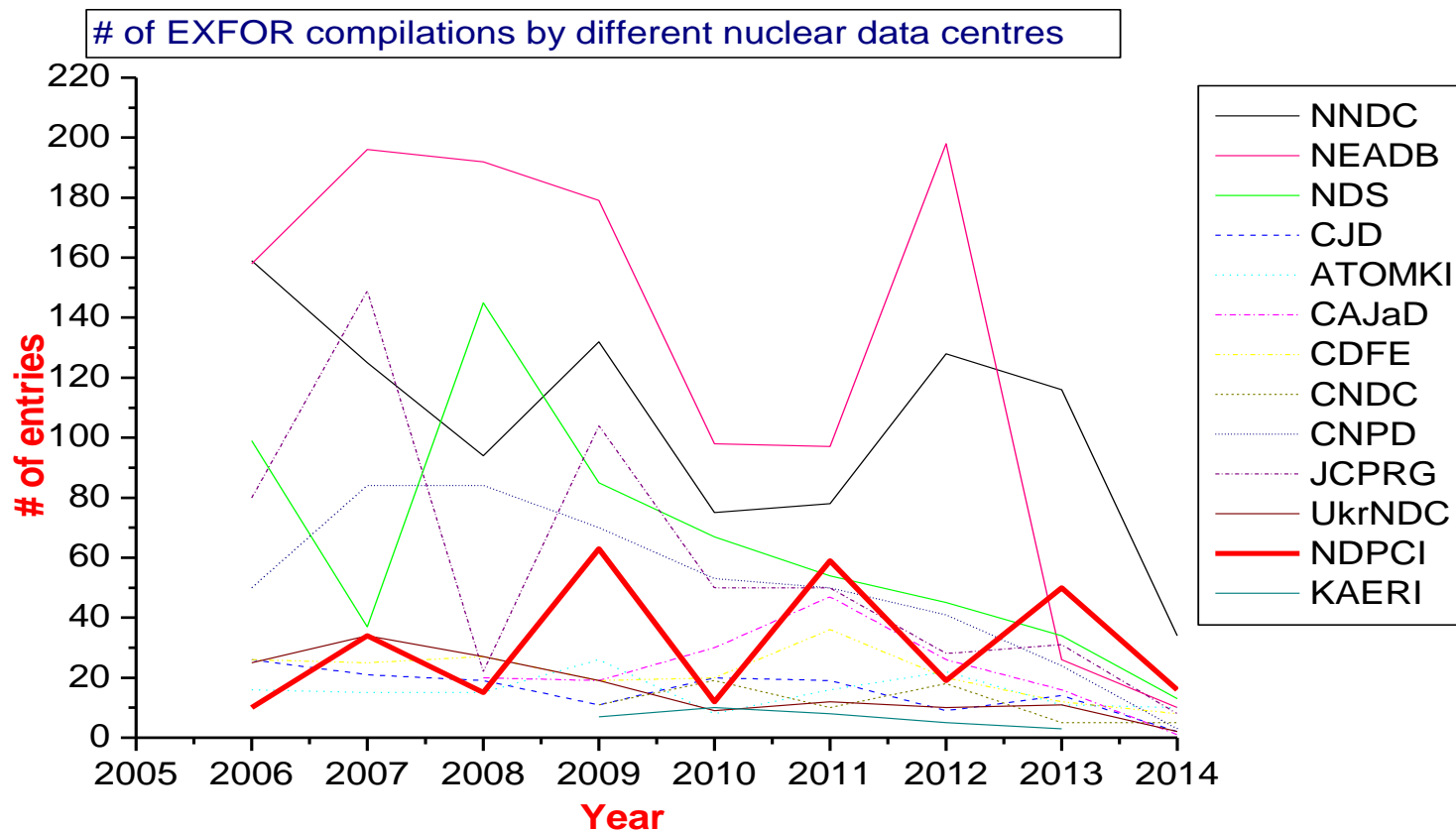
NDPCI has projects / collaborations with universities/DAE units across India.

Domestic EXFOR Compilation Workshop

- No such an attempt of domestic compilation workshop before India.
- The Department of Atomic Energy(DAE) conducted Six domestic EXFOR workshops (2006, 2007, 2009, 2011, 2013, 2015).
- We have successfully collected and sensitized many young and senior participants from Indian universities and institutes.
- Participation of NDPCI as full member to NRDC (International Network of Nuclear Reaction Data Centres) was officially approved in 2008 NRDC Meeting (Obninsk, Russia) and accepted by DAE.

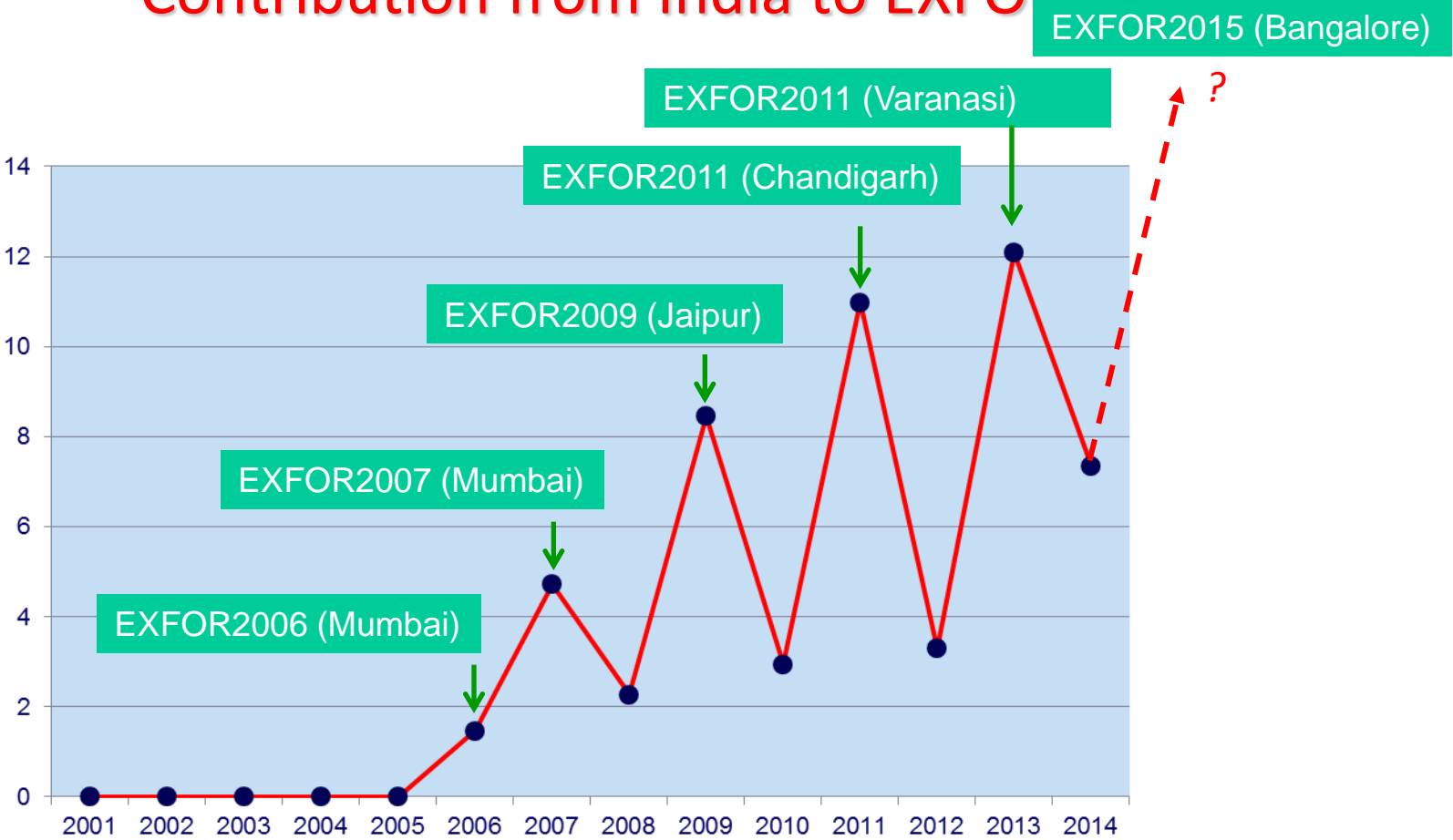
We are evolving a mechanism to coordinate the EXFOR compilation activities with IAEA-NDS

Over 285 entries compiled so far



Thus, approximately 11.8 million nuclear data points have been measured and compiled into computerized form as per IAEA website.

Contribution from India to EXFOR



Indian EXFOR CoCoS - Compilation Control System (Last updated:2015-02-17)

1. All [ZCHEX](#) and [JANIS Trans Checker](#) error messages must be discussed with the coordinator before submission.
2. Entries must be submitted within 1 month since reservation. **Reservation is cancelled if the entry is not submitted within 1 month.**

Status

- Compile!: The entry must be compiled.
- Accepted: The entry was compiled.
- PRELIM: The entry was transmitted to other centres for comments.
- EXFOR: The entry was entered into the database.

Source

- Curve: Digitized data exist. Ask authors numerical data if the article is not old.
- Table: All data are from authors.

ZCHEX and JANIS Trans Checker are developed and maintained by IAEA Nuclear Data Section and NEA Data Bank, respectively. Thanks.

Entry	Compiler	Reference	Lab	Status	Source	Booked	Finalized	Remark
33044	A.Chakraborty	J.PRM,79,249,2012	TRM	EXFOR	Table	2013-02-18	2013-05-09	
33045	V.K.Mulik	J.JRN,296,1321,2013	TRM	EXFOR	Table	2013-05-22	2013-06-12	
33046	S.Badwar+R.Ghosh	J.EPJ/A,16,495,2003	TRM	EXFOR	Table	2013-06-12	2013-09-03	
33047	P.M.Prajapati	J.NSE,176,106,2014	TRM	Accepted	Table	2014-02-25	2014-07-04	
33048	R.Ghosh	J.JRN,82,263,1984	TRM	Accepted	Table	2014-04-17	2014-06-18	Memo CP-D/839
33049	R.Ghosh	J.JRN,91,291,1985	TRM	Accepted	Table	2014-04-17	2014-06-17	Memo CP-D/839
33050	B.Lalremruata	J.JRN,125,85,1988	TRM	Accepted	Table	2014-04-17	2014-04-22	Memo CP-D/839
33061	B.Lalremruata	J.NP,83,407,1966	TRM	Accepted	Curve	2014-04-22	2014-04-25	Memo CP-D/839
33062	B.Lalremruata	J.NP/A,502,307,1989	TRM	Accepted	Table	2014-06-04	2014-06-12	Memo CP-D/839
33063	S.Chachara	J.IJP,30,80,1956	DLH	Accepted	Table	2014-06-19	2014-08-26	Memo CP-D/839
33064	B.Lalremruata	J.PHY,28,1011,1962	DLH	Accepted	Curve	2014-06-19	2014-06-20	Memo CP-D/839
33065	B.Lalremruata	J.NP,55,127,1964	IND	Accepted	Curve	2014-06-20	2014-06-23	Memo CP-D/839
33066	S.Badwar	J.RCA,31,65,1982	TRM	Accepted	Table	2014-07-14	2014-08-15	Memo CP-D/839
33067	R.Ghosh	J.RCA,46,177,1989	TRM	Accepted	Table	2014-07-14	2014-08-15	Memo CP-D/839
33068	R.Ghosh	J.RCA,35,15,1984	TRM	Accepted	Table	2014-08-15	2014-09-09	Memo CP-D/839
33069	S.Badwar	J.PR/C,21,1411,1980	TRM	Accepted	Table	2014-08-15	2014-09-04	Memo CP-D/839
33070	S.Chachara	J.NP/A,235,307,1974	TRM	Accepted	Table	2014-10-01	2014-11-15	
33071	R.Ghosh	J.PR,166,1190,1968	TRM	Accepted	Table	2014-09-30	2014-12-16	Memo CP-D/839
33072	S.Badwar	J.PR,177,1776,1969	TRM	Accepted	Table	2014-09-30	2014-12-16	Memo CP-D/839
33073	B.Lalremruata	J.NP,29,522,1962	SAH	Accepted	Curve	2014-10-13	2014-11-05	found by Rema

All papers published in 2013 and 2014 were taken up for compilation the last workshop on EXFOR compilation in Jan., 2015, numerical data collected in advance, allocation of articles before workshop

6th Workshop in Bangalore (Jan 20-24 2015)



Faculty and resource persons

N. Otsuka, B. Remruata,
Vidya thakur, R. Ghosh
S. Badwar

Organizers

B. Rudraswamy
And his team,
A. Saxena

About 40 entries were compiled in this workshop
very good web based support from organizers

NDPCI Projects on EXFOR:

Sl.No	Title of the Project	PI/CI	PCs	Amount (Rupees)	Period	Staff	Institute
1	EXFOR compilation of nuclear Data	B.Jyrwa	S.Ganesan, A.Saxena, H.Naik (BARC)	8.15 lakhs	2011- 2013	R. Ghosh S.Badwar (Project Assistant)	NEHU
2	EXFOR Compilation of Nuclear Reaction Data	S.N.Roy	G.Mukherje e (VECC), A.Saxena (BARC)	9.11 lakhs	2012- 2014	U.S.Ghosh K.Mondal (Project Assistant)	Vishva-Bha rati University
3	Measurements, EXFOR compilation and theoretical study of nuclear data	B.Lalremruata H.H.Thanga	S.V.Suryanar ayana, A.Saxena, H.Naik (BARC)	22.69 Lakhs	2012- 2015	L.Punte(JRF) Rebbeca(JRF)	Mizoram University

One more is approved by NDPCI for Prof. Rudraswamy, Bangalore University another one by Vidya Thakur has been submitted .

EXFOR Web Site in Vienna and India

www.nds.iaea.org/exfor/

EXFOR: Experimental Nuclear Reaction Data

Help » EXFOR-Manual | Output | Plot+ | R33 | Databases » ENDF | CINDA | IBANDL | CD-ROM » EXFOR-CINDA | CD-C

Experimental Nuclear Reaction Data (EXFOR)
Database Version of September 27, 2013
Software Version of 2013.05.27

News

- 2013/05 EXFOR Milestone: 20,000 experimental works are now in the database!
- 2013/01 Collection of video-guides to EXFOR-ENDF database Web retrieval system: [page]
- 2012/11 Searching data compiled: [digitizing] plots, [not digitized], given [in tables]
- 2012/10 New plotting regime: switch display of data to display of ratios on the fly [video]

The EXFOR library contains an extensive compilation of experimental nuclear reaction data. Neutron reactions have been compiled systematically since the the neutron, while charged particle and photon reactions have been covered less extensively.
The library contains data from 20108 experiments (see statistics and recent updates).

Request Examples: 1|2|3|4|5|6|7|...
Submit Reset Help

Options

- Tip of the day: video-guide
- Ranges (Z,A)
- Reaction Sub-Fields
- Feedback and User's Input
- Clone Request: CINDA | ENDF

Target

Reaction

Quantity

Product

Energy from to eV

Author(s)

Publication year

Accession #

Extended Keywords Expert

Submit Reset

Notes:

- all criteria are optional (selected by checking)
- selected criteria are combined for search with logical AND
- criteria separated in a field by ";" are combined with logical OR
- criteria starting with "*" will be used as logical NOT
- wildcards (*) and intervals (..) are available

Vienna

www.nds.indcentre.org.in/exfor/

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Request Examples: 1|2|3|4|5|6|7|...
Submit Reset Help

Options

- Tip of the day: video-guide
- Exclude superseded data
- No reaction combinations (ratios...)
- Enhanced search of Products
- Retrieve listing only
- Disable Prompt-Help
- Sort by: reaction publication
- View: basic extended
- Ranges (Z,A)
- Reaction Sub-Fields
- Feedback and User's Input
- Clone Request: CINDA | ENDF

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India

The Indian mirror of the EXFOR database is well synchronized with the primary database in Vienna!!

The NDPCI website has been developed by EMBITEL Bangalore in consultation with Computer Division and coordinated by us. Security Audit is completed

The screenshot displays the NDPCI website interface. At the top, the browser address bar shows the URL oces.hbni.ac.in/ndpci/. The website header includes the Government of India logo, the Department of Atomic Energy (DAE), Board of Research in Nuclear Sciences (BRNS), and the NDPCI logo. A navigation menu contains links for Home, About Us, Our Work, Publications, Contact Us, and User Registration. The main content area is divided into several sections:

- NDPCI EVENTS**: Lists two events: "DAE-BRNS Theme Meeting on EXFOR Compilation of Nuclear Data" and "DAE-BRNS Workshop on Covariance in Nuclear Data".
- ANNOUNCEMENT/DOCUMENTS**: A section for updates and documents.
- NDPCI ACTIVITIES**: A central section with a search bar and a list of activities:
 - Provide support for joint experiments and development of computer programs interfacing with nuclear databases.
 - Provide support to advanced reactor applications to enable use of updated nuclear data.
 - Provide fellowships to visiting research students and internships to summer students of Post Graduate and Undergraduate level.
 - Organize theme meetings and national conferences on nuclear data physics.
 - Coordinate experimental and theoretical programs on nuclear data physics involving IAEA Nuclear data Section and be a single window from India for all its nuclear data physics activities as required by the IAEA.
- IMAGE BANK/GALLERY**: A section for images and photos.
- NUCLEAR DATA PHYSICS SERVICES**: A section for user services, including a registration link and a discussion forum. It states: "Do you want to send your query to expert group in NDPCI? Register." and "Already registered? Post your query". It also mentions: "This is discussion forum. You can post your query to a concerned expert group in NDPCI. Expert group will answer your posted query to your registered email address. Keep posting."
- EXFOR/ENSDF**: A section for EXFOR and ENSDF data, including links for "EXFOR Procedure (2012)", "EXFOR Compilation", and "International Network of Nuclear Reaction Data Centres (NRDC)".
- LINK TO OTHER SITES**: A section with a link to "IAEA Nuclear Data Service".

The Windows taskbar at the bottom shows the system clock at 20:01 on 28-09-2013.

5th AASPP Workshop on Asian Nuclear Reaction Database Development Bhabha Atomic Research Centre, Mumbai, India 22-24 Sept, 2014



Facilities, Experiments, EXFOR compilations, Theoretical simulations, benchmarks

<https://www-nds.iaea.org/publications/indc/indc-ind-0048/>

Feb., 2015

Organizers

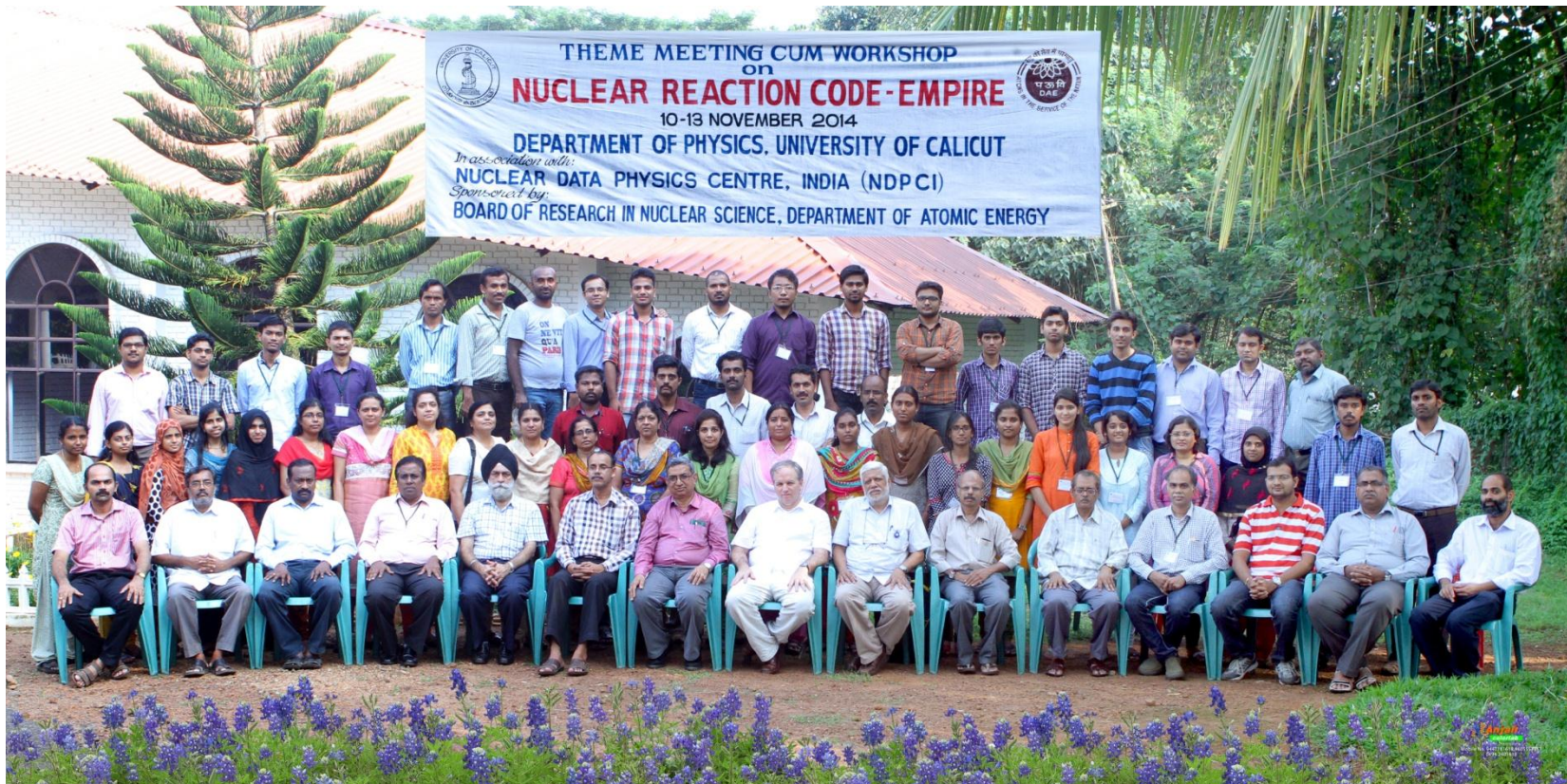
A. Saxena, D. Raj, P.D. Krishnani

Next in Japan

*2nd Theme meeting cum on
Nuclear Reaction Code-EMPIRE during
10 - 13 November 2014*
**DEPARTMENT OF PHYSICS
UNIVERSITY OF CALICUT**

Faculty and resource persons
R. Capote from IAEA, B Pandey,
P. Prajapati,
Organizers
M. Musthafa, S.V. Suryanaryana,
A. Saxena

- Total Number of registered participants : 55**



- The NDPCI project by **Prof. A.K. Jain (IIT-R)** “Improved Nuclear Structure and Decay Data for Nuclear Models in the Heavy Nuclides Region” is complete. (Rs 25 lakhs) is **completed**

A=224,222, 150,112,95

- Development of a modern computer code with up-to-date databases to estimate the inventory and radioactivity of actinides and fission products during various stages of nuclear fuel cycle is **ongoing**.

R. Srivenkatesan, Manipal University (Rs 25 Lakhs)

- Continuing EXFOR compilations and participation in the Measurement of High Energy Photon and Neutron induced reaction cross-sections of structural materials (e. g. Fe, Co, Ni, Cr, Zr etc.) and materials related to medical isotopes (e.g. Mo) is **ongoing**

B Jyrwa, NEHU (Rs 24.7 Lakhs)

Capture cross section measurements for Sodium, Iron and Data Compilation

- Ajay Tygai, BHU for 15.52 lakhs.
- PI was Postdoctoral Fellow July 2010 – June 2012
University of Kentucky, USA
- Referee reports received and now **recommendation finalized**
- BK Nayak, is PC

Nuclear Reaction Experiments in India

There are many experimental activities in India performed at

BARC (Mumbai, Navi Mumbai)

TIFR Pelletron (14 MV), FOTIA at BARC (6 MV)

Research Reactor “APSARA” , “CIRUS” and “DHRUVA”

Electron linacs (3 MeV/30 kW and 10 MeV/10 kW) at Khargarh

14 MeV neutron generator at BARC, PUNE

VECC (Kolkata) cyclotron

IUAC (New Delhi)

15 MV Pelletron

KSKRA is expected to join Mid-May 2015 in NPD

Mangalore Univ. (Mangalagangothri)

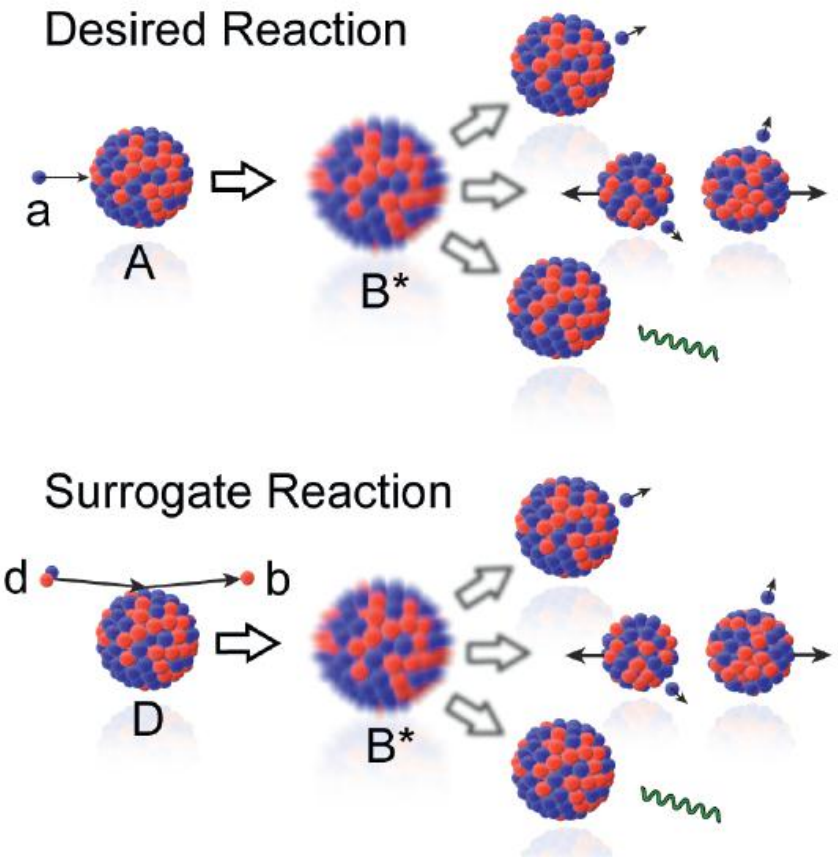
Microtron

About 65 papers published in various journals in three years

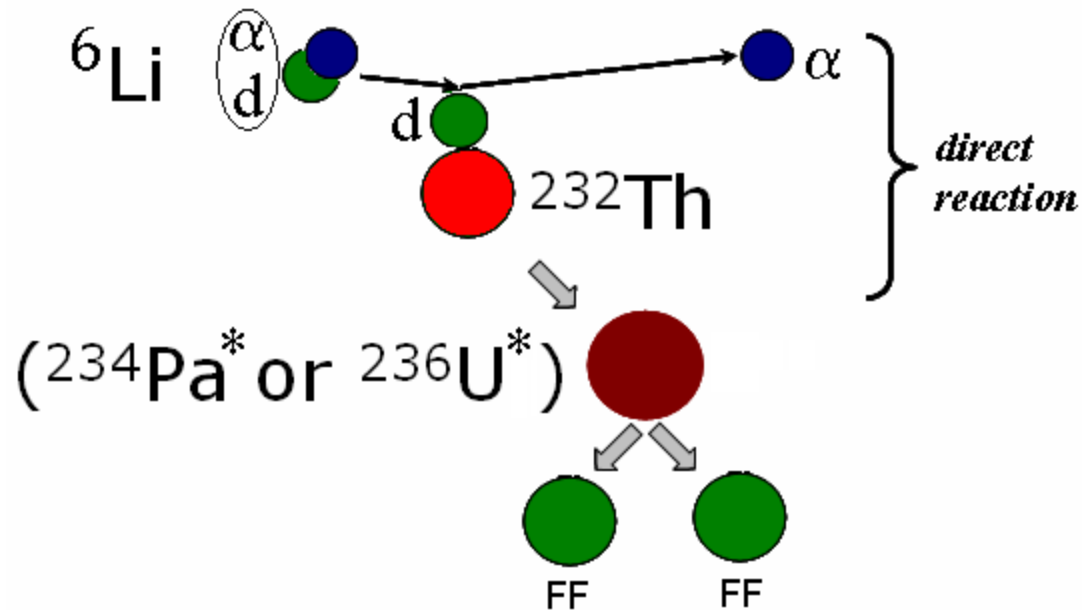
<http://sympnp.org/>

You do not have neutron beam.
You do not have a target of an unstable nuclei. How do you get the cross section data for interaction of neutrons with unstable target nuclide?

Use of **surrogate nuclear reactions**



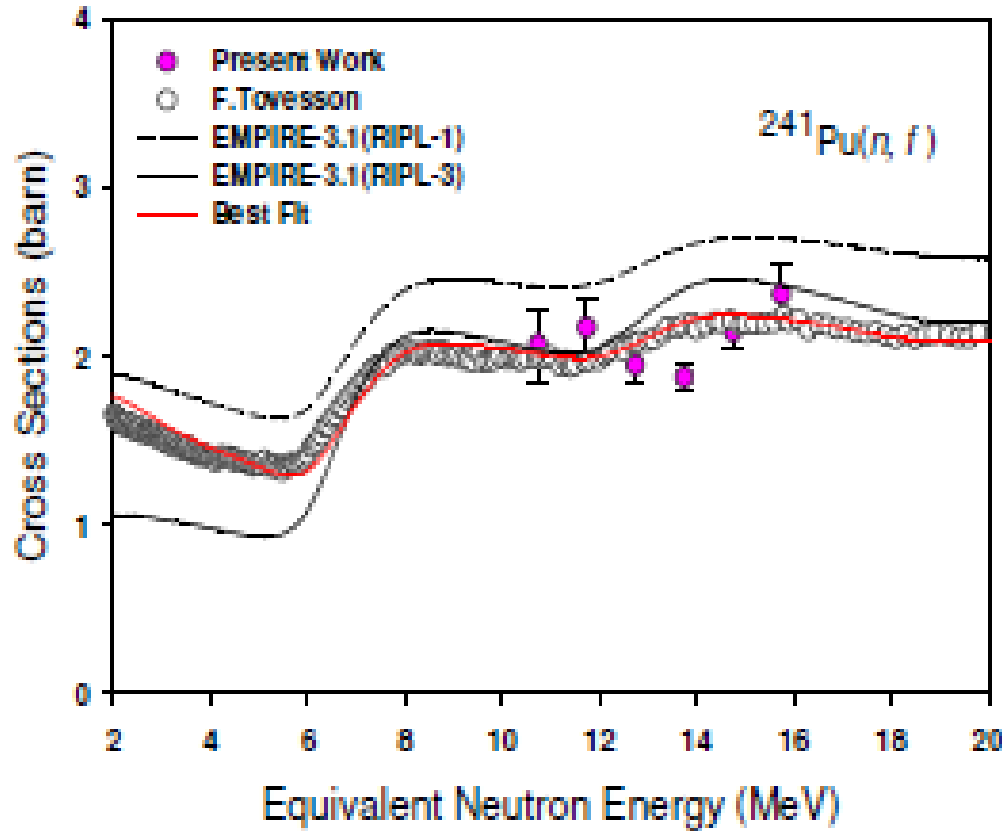
${}^6\text{Li} + {}^{232}\text{Th}$ transfer reaction (as the Surrogate reaction)



By carrying out PLF-FF coincidence measurement, we can determine the decay probability of the compound residues.



Phys. Rev. C 87, 034604 (2013)



Inner barrier

Outer barrier

System	RIPL-3	Best Fit	RIPL-3	Best Fit
${}^{242}\text{Pu}$	6.02	5.35	5.61	5.40
${}^{241}\text{Pu}$	5.85	6.22	5.81	5.85
${}^{240}\text{Pu}$	5.89	6.30	5.73	5.82
${}^{239}\text{Pu}$	5.96	6.30	5.86	5.96

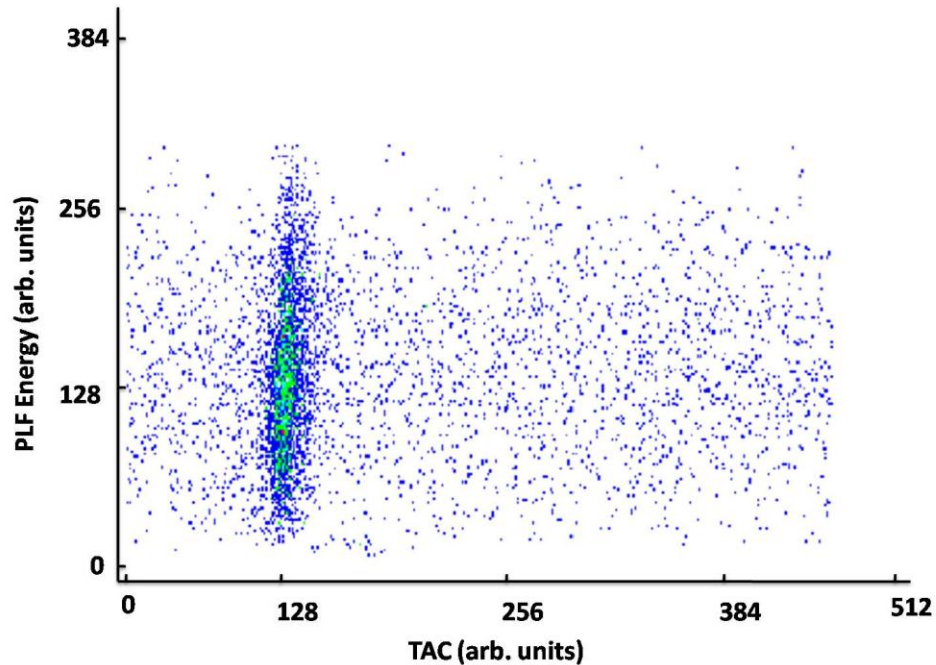
National Workshop on Surrogate Reactions and its Applications (Surrogate-2013), MSU, Vadodara (24-25 January 2013)

Experiments to measure cross-section for ${}^{55}\text{Fe}(n,p)$ reaction using surrogate ratio method was performed

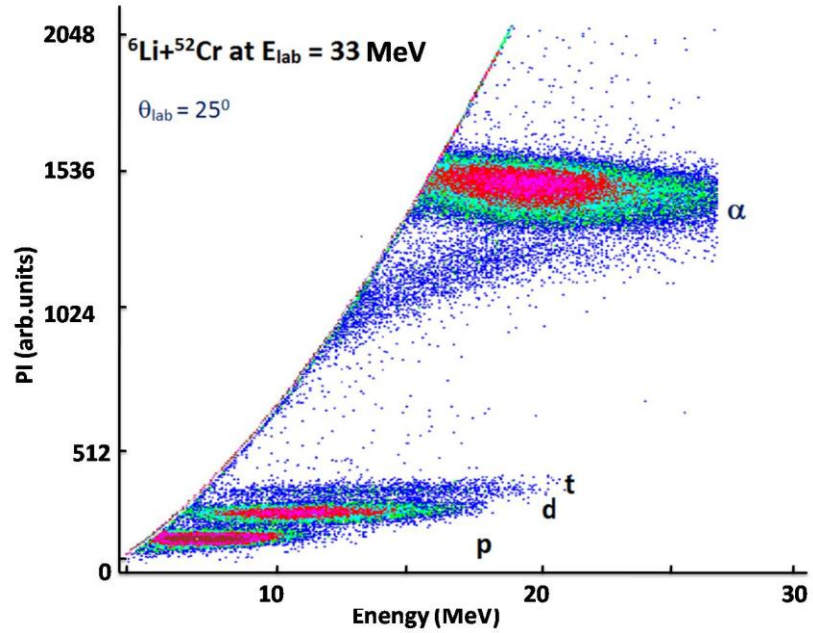
$^{55}\text{Fe}(n,p)$ cross-sections by surrogate ratio method
 $^6\text{Li}+^{52}\text{Cr} \rightarrow ^2\text{H}+^{56}\text{Fe}^*$ and $^6\text{Li}+^{45}\text{Sc} \rightarrow ^4\text{He}+^{47}\text{Ti}^*$



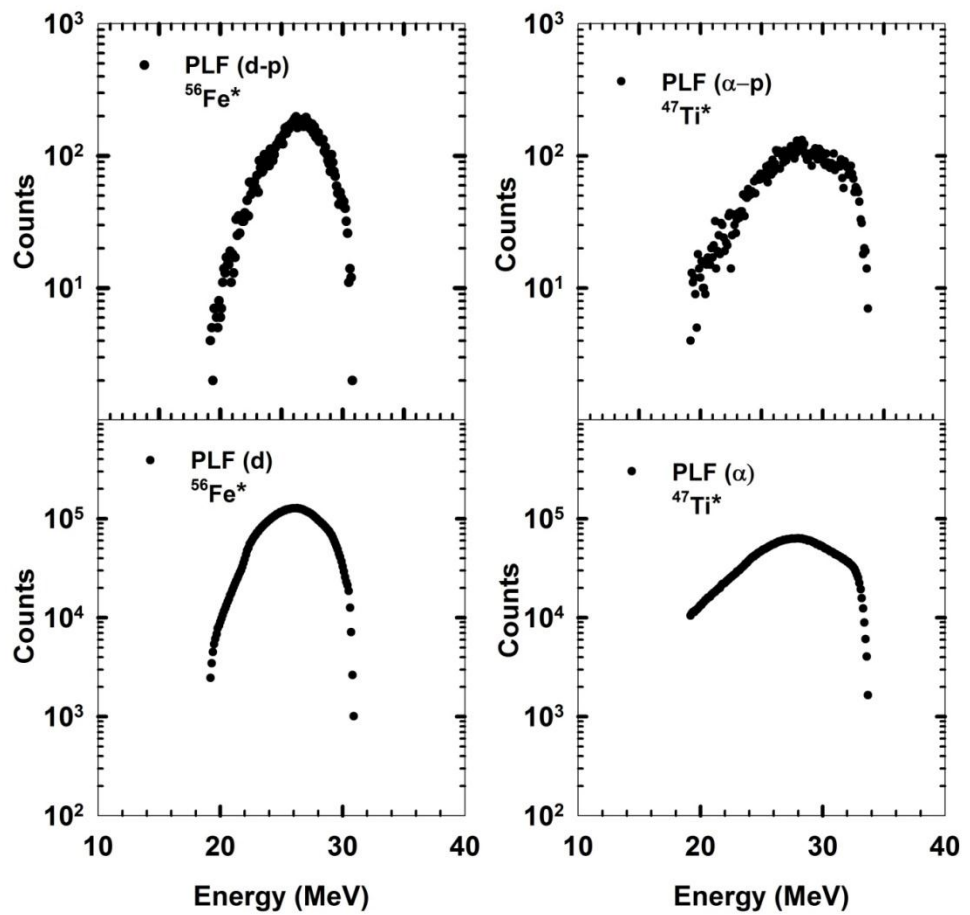
Typical PLF-proton TAC versus PLF deuteron energy plot in ${}^6\text{Li}+{}^{52}\text{Cr}$ reaction at $E_{\text{lab}}=33.0$ MeV



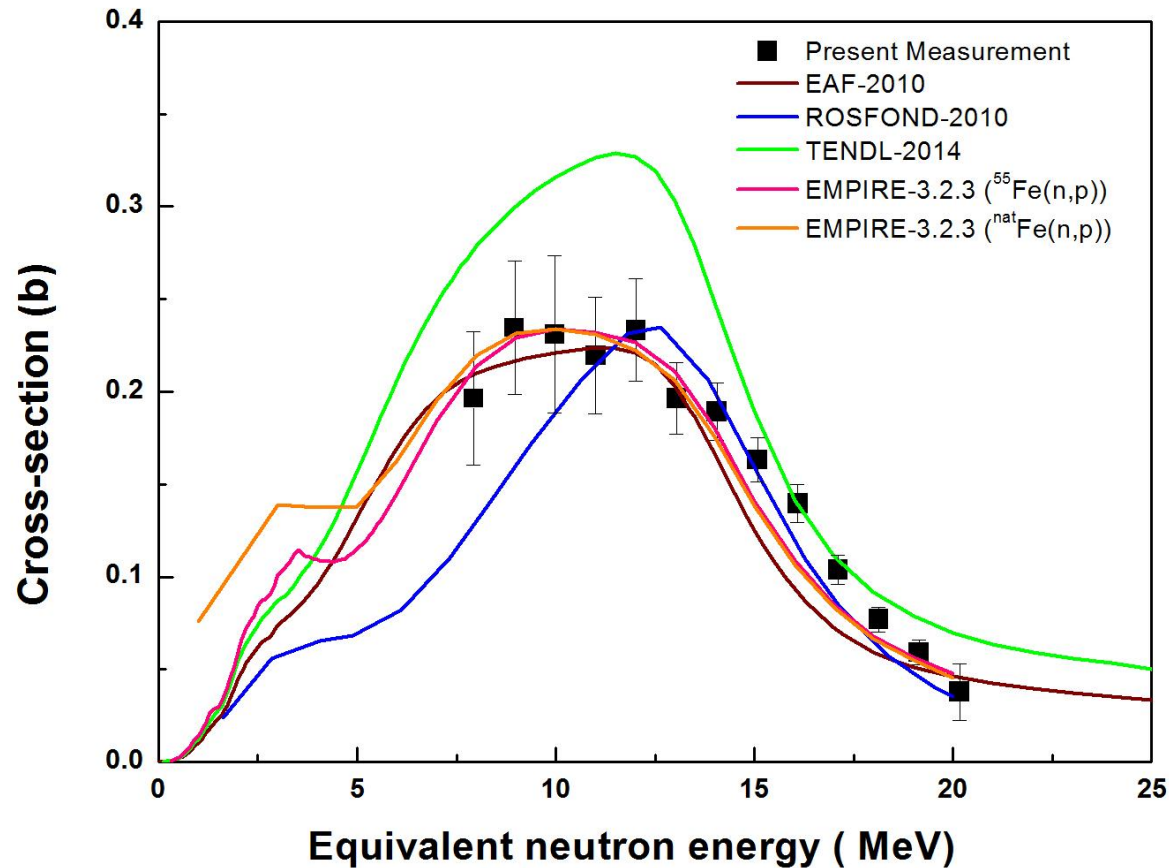
Particle Identification plot of PLF



Excitation energy spectra of TLF produced in ${}^6\text{Li}+{}^{52}\text{Cr}$ and ${}^6\text{Li}+{}^{45}\text{Sc}$ reactions corresponding to PLF deuteron and alpha with (upper) and without (bottom) coincidence with evaporated proton.



The $^{55}\text{Fe}(n,p)$ cross-section as a function of neutron energy as obtained from surrogate measurement along with various evaluation results and EMPIRE-3.2.3 code predictions



Study of Prompt Neutron energy spectra in fast neutron induced fission of ^{238}U , ^{232}Th

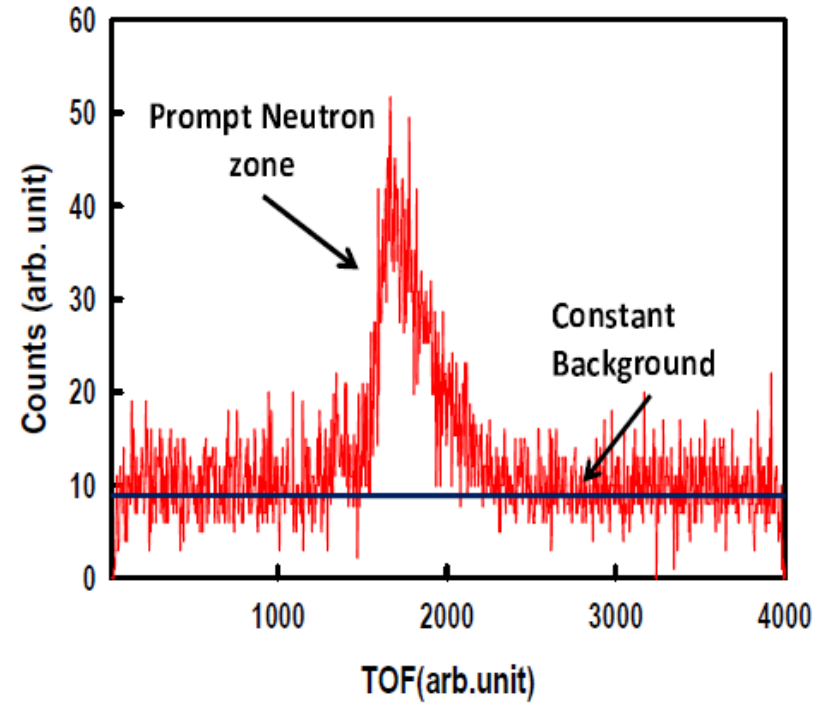
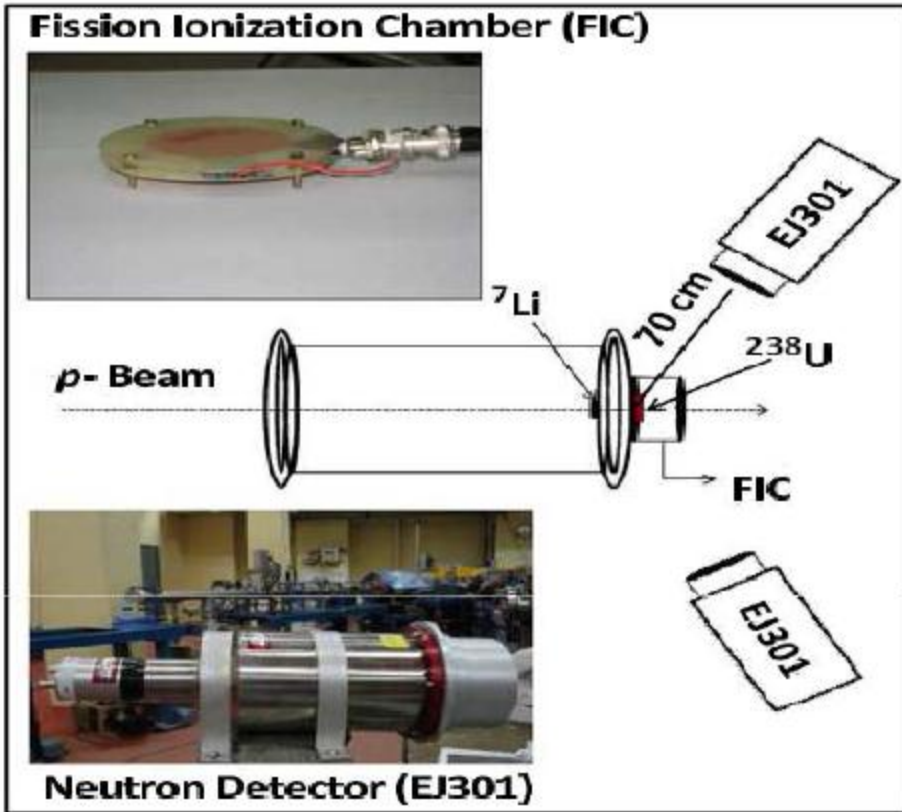
- 1 Study of prompt neutron emission spectra in fast neutron induced fission reaction is of topical interest because of its importance in engineering and design of new reactors for nuclear energy production, based on fast neutron induced fission .
- 2 The uncertainties affect the design parameters of thermal, fast, fusion-fission hybrids and accelerator driven systems reactor designs.

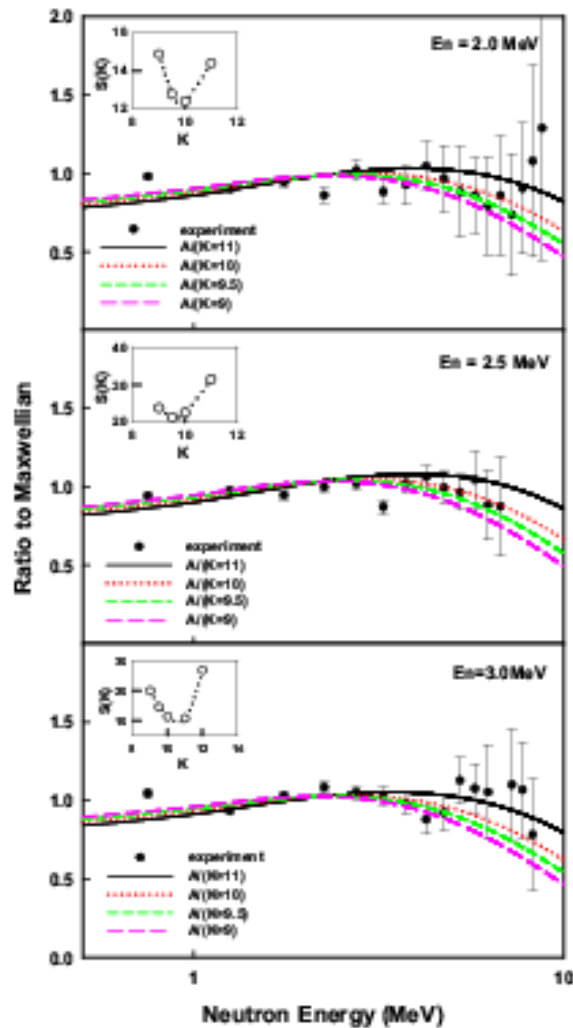
S. S. Kapoor, R. Ramanna and P. N. Rama Rao,
Emission of prompt neutrons in the thermal
neutron fission of U235, Physical Review, Vol. 131,
283-296 (1963).

M.S. Samant, R.P. Anand, R.K. Choudhury, S.S. Kapoor, K.
Kumar, D.M. Nadkarni and A. Saxena,
“Determination of nuclear level densities of neutron rich
fragment nuclei from measurement of prompt neutron
emission spectra,” pp.94-103 (1991)
in "Nuclear Data for Neutron Emission in the Fission
Process, Proceedings of a Consultants Meeting,"
INDC(NDS)-251, 1991; IAEA Nuclear Data Section, 252
pages. Compiled by S. Ganesan, Document available at

[See report at IAEA website `indc-nds-0251.pdf`](#)

Schematic of Experimental Setup at FOTIA





EMPIRE 3.2.3 code with Los Alamos parameterization

Level density parameter $a=A/k \text{ MeV}^{-1}$, $k=10.5 \pm 0.5$

Submitted to Phys. Rev. C

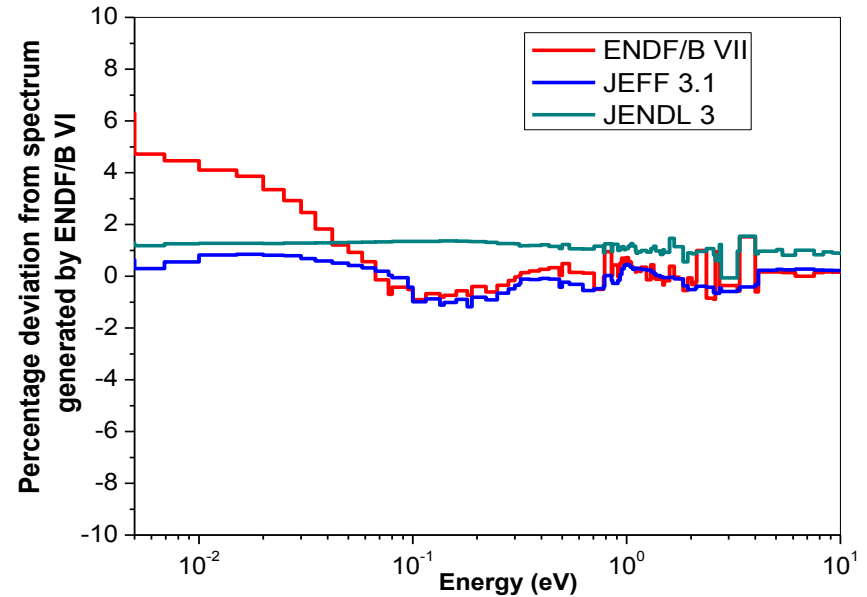
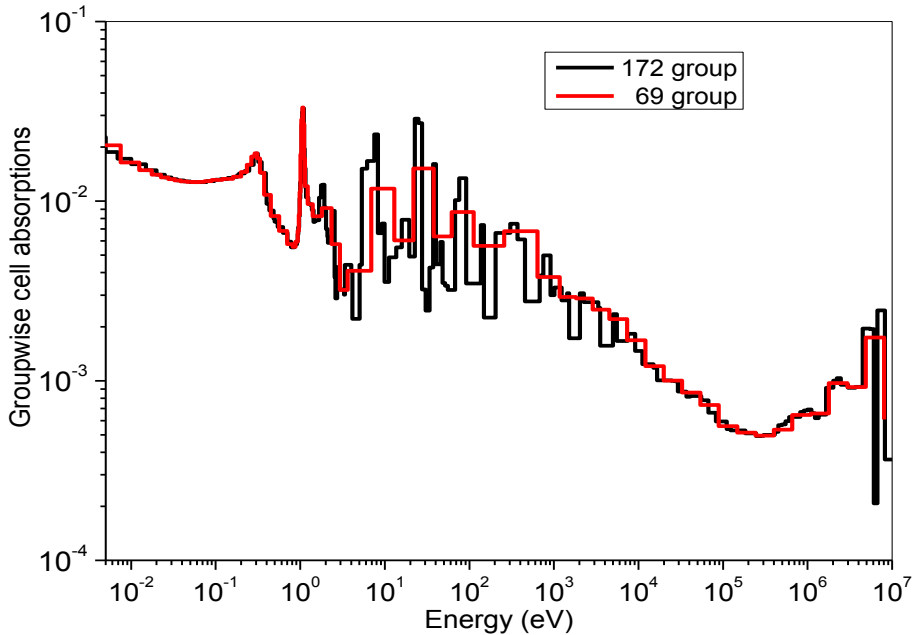
Referee report received within one week of submission

**IAEA CRP on beta delayed
neutron emission evaluation and
Nuclear Data for Charged-particle
Monitor Reactions and Medical
Isotope Production**

CERN n_TOF collaboration (Geneva)

- MOU was signed in Nov., 2008 for Indian participation n_tof experiments in phase II
- The annual O & M fee (CHF4264) being paid from the NDPCI funds
- Mr. Devesh Raj of RPDD participated in the n_tof experiments in 2010 and Mr. Pandikumar of IGCAR participated in 2011.
- Dr. Alok Saxena, NPD and Mr. AK Mallick, RPDD have participated in experiments on September 1-15, 2012
- Dr. Suryanarayana, NPD and Mr. Kapil Dev , RPDD participated in Dec., 2014
- **Main Objectives:**
- (1) neutron cross section measurements for nuclear astrophysics, (2) nuclear data measurements for advanced nuclear technologies and nuclear waste transmutation, and (3) neutron cross section measurements for basic nuclear physics.

Sensitivity to the neutron spectrum



Comparison of cell absorptions in AHWR-LEU fuel assembly for 69 and 172 energy groups using ENDF/B VI data library

Percentage deviation of neutron spectrum from different libraries from that of ENDF/B VI

-2 to +6% variations in the neutron spectrum is observed. The differences in the cell absorptions affect the relative reaction rates

Coolant void reactivity show a deviation as large as 2.8 mk. An increase in thermal absorptions and reduction resonance absorptions both lead to a reduction in the void reactivity .

A more detailed energy group modelling in the thermal and resonance groups of the 172 group structure results in a more accurate estimation of the reaction rates

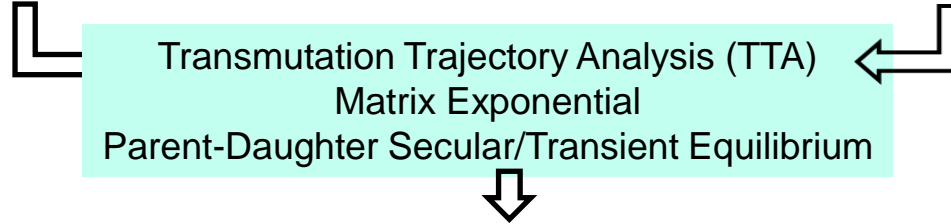
Development of Fuel Cycle Analysis Code

Activation, Decay, Waste Incineration and Transmutation Analysis

Specific XS /FP Data Library

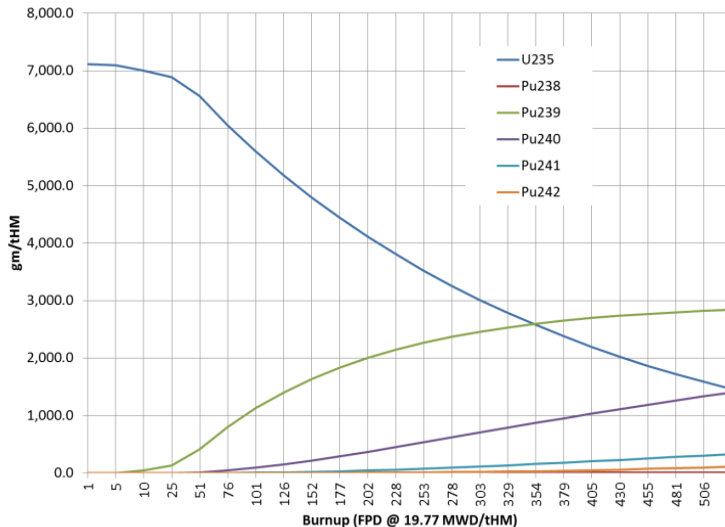
General Purpose Decay Data Library

PHWR-220



Capabilities of ADWITA

- **Inventory generation** based on power/irradiation history
- **Decay Follow up** of the generated inventory
- **Mass, Activity, Decay heat rate** during all time steps



Some Benchmark Results from IAEA-TECDOC-887, "In-core fuel management benchmarks for PHWRs", June 1996

<i>²³⁵U and ²³⁹Pu content (IAEA-TECDOC-887, P 26-27)</i>			
Burnup	0.0 GWD/t	4.0 GWD/t	8.0 GWD/t
<i>²³⁵U (g/kg)</i>			
PPV-Canada	7.1138	3.7859	1.9957
WIMS-Romana	7.1137	3.7465	1.9606
CLU B-India	7.1138	3.7962	2.0195
ADWITA	7.1138	3.829	2.052
<i>²³⁹Pu (g/kg)</i>			
PPV-Canada	0.0	1.9412	2.4136
WIMS-Romania	0.0	2.0949	2.7282
CLU B-India	0.0	1.9309	2.4895
ADWITA	0.0	2.0811	2.6486

<i>Radioactivity (Curies/T) of Fission Products (IAEA-TECDOC-887, P 102)</i>											
Time (s)	0.0E00	5.0E00	1.0E01	1.0E02	1.0E03	1.0E04	1.0E05	1.0E06	1.0E07	1.0E08	1.0E10
Argentina	1.50E+08	1.39E+08	1.34E+08	1.08E+08	7.43E+07	4.75E+07	2.86E+07	1.38E+07	3.48E+06	2.38E+05	8.13E+01
Pakistan	1.51E+08	1.39E+08	1.34E+08	1.09E+08	7.54E+07	4.85E+07	2.84E+07	1.37E+07	3.49E+06	2.47E+05	1.20E+02
ADWITA	1.49E+08	1.33E+08	1.27E+08	9.77E+07	6.96E+07	4.54E+07	2.80E+07	1.34E+07	3.32E+06	2.24E+05	5.66E+01

<i>Thermal Power (Watt/T) of fission products (IAEA-TECDOC-887, P 103)</i>											
Time (s)	0.0E00	5.0E00	1.0E01	1.0E02	1.0E03	1.0E04	1.0E05	1.0E06	1.0E07	1.0E08	1.0E10
Argentina	1.68E+06	1.49E+06	1.40E+06	1.06E+06	6.08E+05	2.82E+05	1.40E+05	6.26E+04	1.44E+04	9.16E+02	1.97E-01
Pakistan	1.69E+06	1.49E+06	1.40E+06	1.06E+06	6.10E+05	2.83E+05	1.37E+05	6.16E+04	1.42E+04	8.46E+02	2.63E-01
ADWITA	1.78E+06	1.46E+06	1.35E+06	8.98E+05	5.36E+05	2.55E+05	1.25E+05	5.66E+04	1.31E+04	7.97E+02	1.41E-01

Summary and NDPCI future plans:

- Scientists from NPD, RPDD, VECC, IPR, RCD, IGCAR and NPCIL associated with NDPCI are involved in measurements, EXFOR compilations, organizing workshops, awarding projects related to nuclear data, ENSDF evaluations, theoretical simulations, reactor sensitivity studies for many reactors of different fuel cycles **about 25 publications in 2014-2015**
- KSKRA is expected to join Mid-May 2015 in NPD
- To identify and nurture potential young researchers for our future ventures of various activities of NDPCI.
- To continue supporting researchers through funds giving mechanisms to generate basic nuclear data for various applications (Measurements, evaluation and compilation of nuclear data and sensitivity studies for various reactor systems etc) through outreach programmes.
- Upgrading the existing detector facilities, buying enriched foils
- Website for NDPCI is almost ready to go online.
- Proposed n_TOF facility at IGCAR using electron accelerator, GGU Bilaspur using bunched proton beam
- Workshops on ENSDF is planned this year another one on n_TOF and photo-nuclear reactions are in discussion stage
- School on nuclear data is being proposed