

Technical Aspects of Compilation and Dissemination of the U.S. and Canadian Experimental Nuclear Reaction Data

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BROOKHAVEN
NATIONAL LABORATORY

a passion for discovery

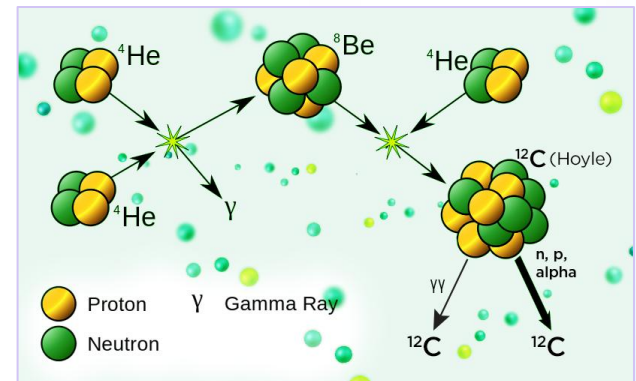


U.S. DEPARTMENT OF
ENERGY

Office of
Science

Value of Compilations

- Compilations create a basis for nuclear data evaluations and support research.
- Compilations are driven by
 - New results and discoveries in science
 - New rules and element names
 - Need for up-to-date databases
- NSR compilation of Notre Dame/MSU work on “Enhancement of the Triple Alpha Rate in a Hot Dense Medium”.



ND/MSU, PRL 119, 112701 (2017)

2017BE18 Phys.Rev.Lett. 119, 1127501 (2017)

M.Beard, S.M.Austin, R.Cyburt

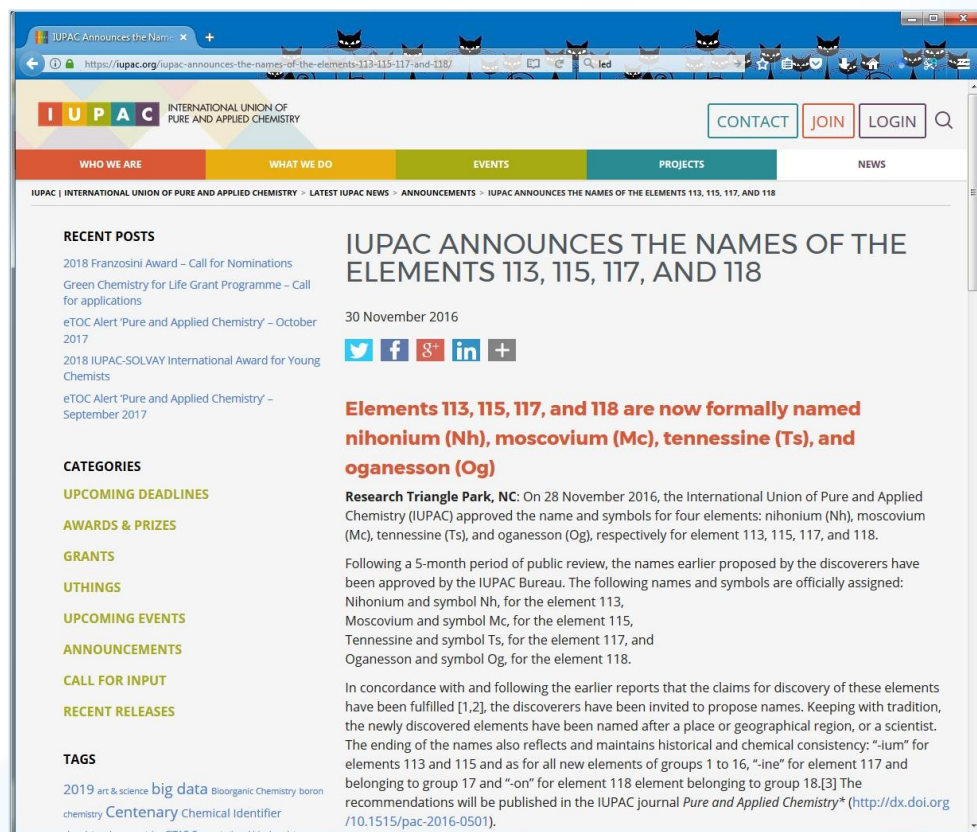
Enhancement of the Triple Alpha Rate in a Hot Dense Medium

NUCLEAR REACTIONS $^4\text{He}(\alpha, X)^8\text{Be}$, $^8\text{Be}(\alpha, X)^{12}\text{C}$, $E < 30$ MeV; calculated 3α σ , reaction rates; deduced that in hot and dense astrophysical environment the rate of the triple-alpha reaction can increase greatly over the value appropriate for helium burning stars owing to hadronically induced deexcitation of the Hoyle state.

doi: 10.1103/PhysRevLett.119.112701

Speed of Compilations

- Compilations should be performed in a timely fashion.
- International Union of Pure and Applied Chemistry (IUPAC) assigned names to Z=113, 115, 117 and 118 as Nh, Mc, Ts and Og, respectively, on November 30, 2016.
- As of January 5, 2017 these changes were implemented in NSR.
- 594 entries/keywords were identified and modified to reflect the latest naming convention.



The screenshot shows the IUPAC website with the following content:

IUPAC INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY

CONTACT JOIN LOGIN

WHO WE ARE WHAT WE DO EVENTS PROJECTS NEWS

IUPAC | INTERNATIONAL UNION OF PURE AND APPLIED CHEMISTRY > LATEST IUPAC NEWS > ANNOUNCEMENTS > IUPAC ANNOUNCES THE NAMES OF THE ELEMENTS 113, 115, 117, AND 118

RECENT POSTS

- 2018 Franzosini Award – Call for Nominations
- Green Chemistry for Life Grant Programme – Call for applications
- eTOC Alert 'Pure and Applied Chemistry' – October 2017
- 2018 IUPAC-SOLVAY International Award for Young Chemists
- eTOC Alert 'Pure and Applied Chemistry' – September 2017

CATEGORIES

- UPCOMING DEADLINES
- AWARDS & PRIZES
- GRANTS
- UTHINGS
- UPCOMING EVENTS
- ANNOUNCEMENTS
- CALL FOR INPUT
- RECENT RELEASES

TAGS

- 2019 art & science big data Bioorganic Chemistry boron chemistry Centenary Chemical Identifier

IUPAC ANNOUNCES THE NAMES OF THE ELEMENTS 113, 115, 117, AND 118

30 November 2016

[Twitter](#) [Facebook](#) [Google+](#) [LinkedIn](#) [+](#)

Elements 113, 115, 117, and 118 are now formally named nihonium (Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og)

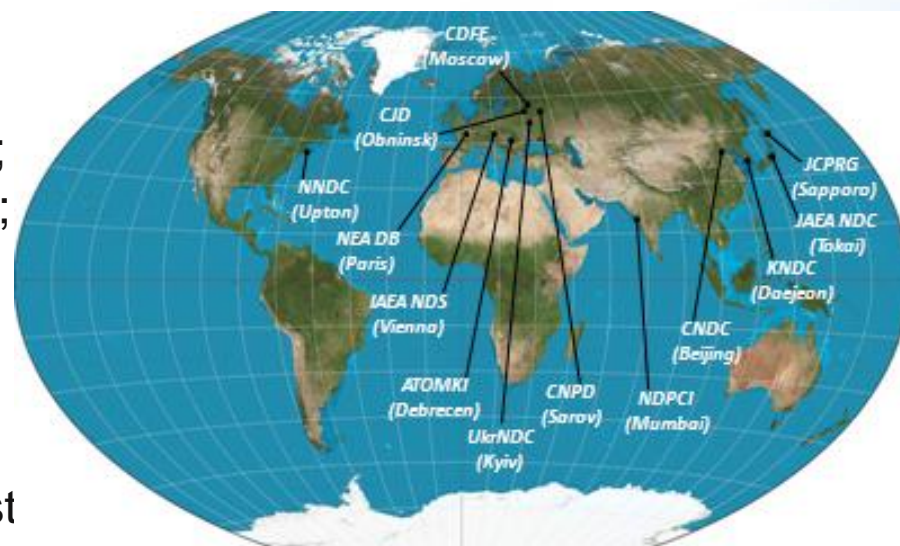
Research Triangle Park, NC: On 28 November 2016, the International Union of Pure and Applied Chemistry (IUPAC) approved the name and symbols for four elements: nihonium (Nh), moscovium (Mc), tennessine (Ts), and oganesson (Og), respectively for element 113, 115, 117, and 118.

Following a 5-month period of public review, the names earlier proposed by the discoverers have been approved by the IUPAC Bureau. The following names and symbols are officially assigned: Nihonium and symbol Nh, for the element 113, Moscovium and symbol Mc, for the element 115, Tennessine and symbol Ts, for the element 117, and Oganesson and symbol Og, for the element 118.

In concordance with and following the earlier reports that the claims for discovery of these elements have been fulfilled [1,2], the discoverers have been invited to propose names. Keeping with tradition, the newly discovered elements have been named after a place or geographical region, or a scientist. The ending of the names also reflects and maintains historical and chemical consistency: “-ium” for elements 113 and 115 and as for all new elements of groups 1 to 16, “-ine” for element 117 and belonging to group 17 and “-on” for element 118 element belonging to group 18.[3] The recommendations will be published in the IUPAC journal *Pure and Applied Chemistry** (<http://dx.doi.org/10.1515/pac-2016-0501>).

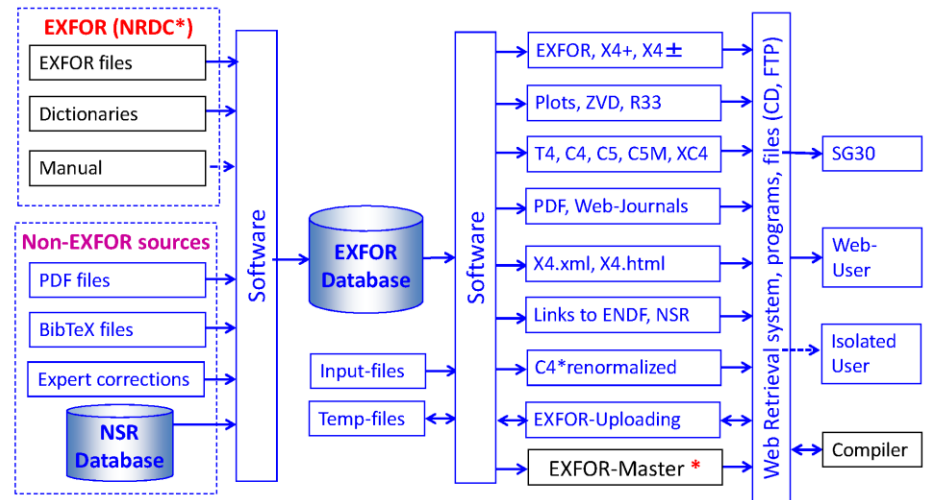
EXFOR Compilations in FY2017

- Nuclear reaction data sets are stored in EXFOR library.
- NNDC is a member of Nuclear Reaction Data Centers (NRDC) network: Area #1: U.S. and Canada; Area #2 is Western Europe + Japan; Area #3 is Eastern Europe, Africa, Asia, Australia, Latin America; Area #4 Former USSR.
- NNDC has produced ~36% of EXFOR compilations; it is the largest contributor worldwide.
- FY 2017: 98 new and 95 corrected entries (experiments).



EXFOR Workflow

- Collaboration with scientists: Authors asked to submit original data sets and approve compilations for EXFOR.
- Combined international compilation and Quality Assurance (QA) efforts.
- Use of multiple data sources, computer technologies and Web dissemination.
- NNDC EXFOR Team:
B. Pritychenko +
2 contractors (S. Hlavac,
O. Schwerer) and 1 IAEA
Web developer (V. Zerkin).



EXFOR Compilation Updates

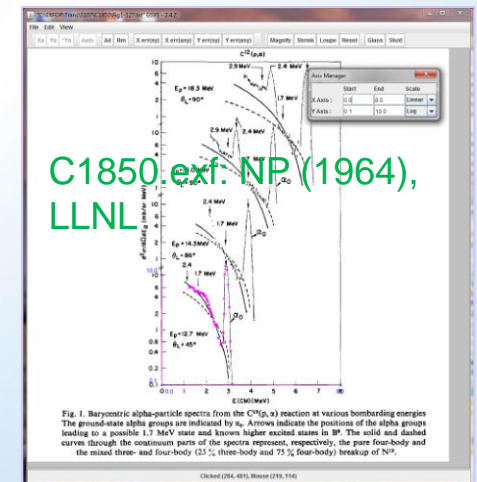
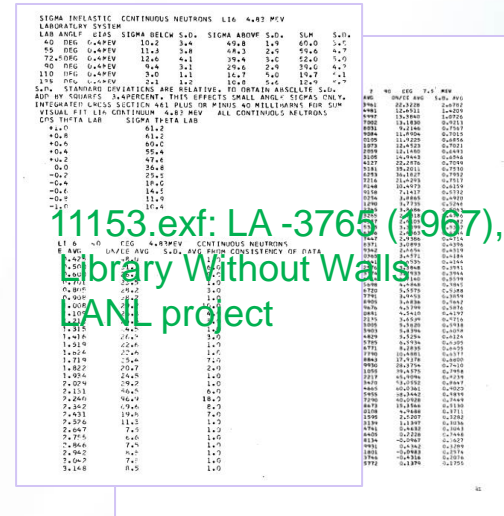
- Updates should not diminish the original compilations. Please be extremely careful with the updates.
- Work on updates conservatively, good intentions may result in new deficiencies.
- Erroneous SF8=SPA addition that confused CIELO evaluators, reaction strings are not easy to code and interpret.
- EN-MIN in keV, EN-MAX in MeV for tabulated data.
- Always verify DECAY-DATA, i.e. for ground and isomeric states.

ENTRY	20743	20160725	20170203	20170124	2252
SUBENT	20743001	20160725	20170203	20170124	2252
BIB	17	46			
REFERENCE	(W.CIERJACKS,19780222) Text was included. Data were given on attached tape, called FENNEV.				
REL-REF	(I..I.Schouky+,C.75WASH,1,277,19750303) Details on method and apparatus. (O.20856001,S.Cierjacks+,C.78HARWELL,1,187,1978) - part of data presented on fig. 1 at 1.5 - 3. MeV range (O.20856001,S.Cierjacks+,P.NEANDC(E)-192,(5),9,1978) - part of data presented on figs 5,6 at 0.4-0.9 MeV range (S.W.Cierjacks,I.Schouky,F.Voss)				
AUTHOR	(2GERKFK) Institute fur Angewandte Kernphysik.				
INSTITUTE					
TITLE	Investigation of S-wave resonances and a possible doorway state in Fe below 850 keV				
ENTRY	22356	20160512	20160912	20160829	2250
SUBENT	22356001	20160512	20160912	20160829	2250
BIB	14	31			
TITLE	Measurement of the 160(n,g)170 reaction cross section at stellar energy and the critical role of nonresonant p-wave neutron capture				
AUTHOR	(M.Igashira, Y.Nagai, K.Masuda, T.Ohsaki, H.Kitazawa)				
INSTITUTE	(2JPNTIT)				
REFERENCE	(J.AJ,441,L89,1995) (C.94AQI,201,1994) (n,g0) and (n,g1) at 280 keV+MACS. The contents of p202 and p203 must be swapped.				
FACILITY	(VDG,2JPNTIT) 3.2 MV Pelletron Accelerator				
MONITOR	(79-AU-197(N,G)79-AU-198, SIG)				
MONIT-REF	(.P.G.Young,3,ENDF/B-VI,7925,1984) (11679023,R.L.Macklin+,J.PR,159,1007,1967)				
INC-SOURCE	(P-LI7)				
SAMPLE	7Li20 (63.7 mm diam., 18.8 mm thick) and standard Au				
METHOD	(TOF)				

COMMENT	Compiler comment: According to the ENSDF database 137Ce ground state T1/2=9.0 HR and isomeric state T1/2=34.4 HR. Perhaps we have a typo in the article, otherwise the results could be wrongly calculated.
DECAY-DATA	(58-CE-137-G,34.4HR,EC) (58-CE-137-M,9.0HR,DG)

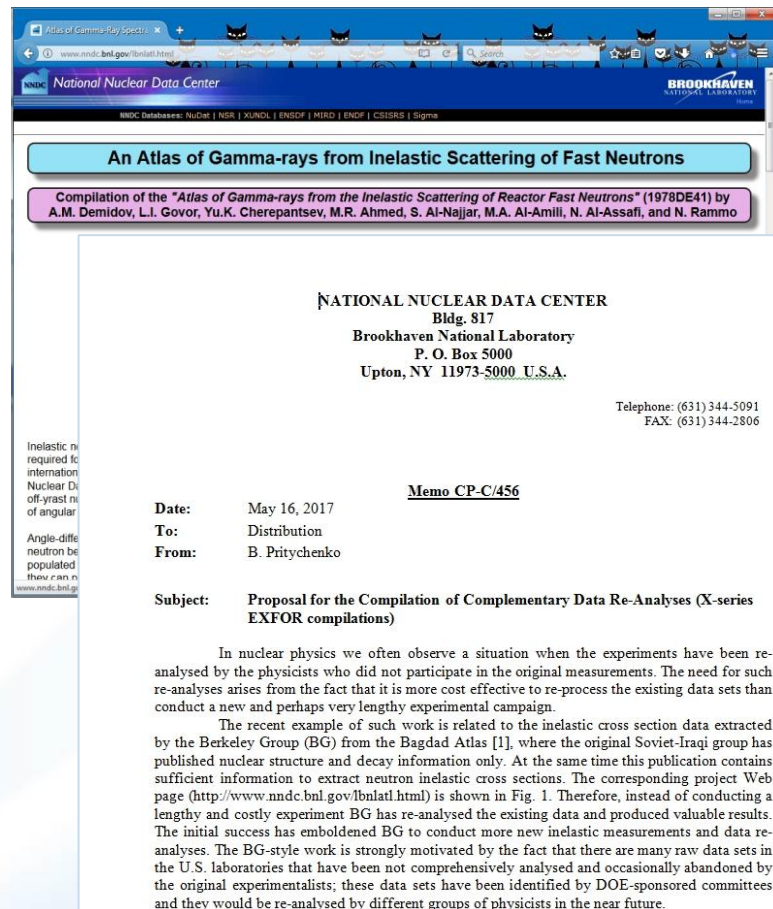
Missing Data

- Due to many historical and technical reasons not all nuclear physics papers and data sets were compiled.
- We address these issues by adding missing references in NSR while in EXFOR we work on data recovery (e.g. nuclear archeology).
- New measurements would require lengthy delays, contingent on a program advisory committee approval process, and may result in many dollars of additional expenses.
- Data recovery includes optical character recognition and data points digitization. Both technologies work well with high quality images and become challenging otherwise.
- Finally, we work with scientists/evaluators on obtaining the missing publications and data sets, if available.



Status of Baghdad Atlas

- Berkeley groups works on Baghdad Atlas data recovery.
- The compilation is ready and it is calibrated against CIELO ^{56}Fe evaluation.
- Atlas work is published as an LBNL report.
- EXFOR memo Memo CP-C/456 and discussions at NRDC 2017.
- We will submit it in the next 1-2 months, as an Area #1 neutron contribution.



The screenshot shows a web browser window displaying the National Nuclear Data Center (NNDC) website. The page title is "An Atlas of Gamma-rays from Inelastic Scattering of Fast Neutrons". Below the title, it mentions the compilation of the "Atlas of Gamma-rays from the Inelastic Scattering of Reactor Fast Neutrons" (1978DE41) by A.M. Demidov, L.I. Govor, Yu.K. Cherepantsev, M.R. Ahmed, S. Al-Najjar, M.A. Al-Amili, N. Al-Assafi, and N. Rammo. The page includes contact information for the NNDC and a memo reference: Memo CP-C/456. The memo is dated May 16, 2017, and is from B. Pritychenko. The subject is "Proposal for the Compilation of Complementary Data Re-Analyses (X-series EXFOR compilations)".

NATIONAL NUCLEAR DATA CENTER
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Brookhaven National Laboratory
P. O. Box 5000
Upton, NY 11973-5000 U.S.A.

Telephone: (631) 344-5091
FAX: (631) 344-2806

Memo CP-C/456

Date: May 16, 2017
To: Distribution
From: B. Pritychenko

Subject: **Proposal for the Compilation of Complementary Data Re-Analyses (X-series EXFOR compilations)**

In nuclear physics we often observe a situation when the experiments have been re-analysed by the physicists who did not participate in the original measurements. The need for such re-analyses arises from the fact that it is more cost effective to re-process the existing data sets than conduct a new and perhaps very lengthy experimental campaign.

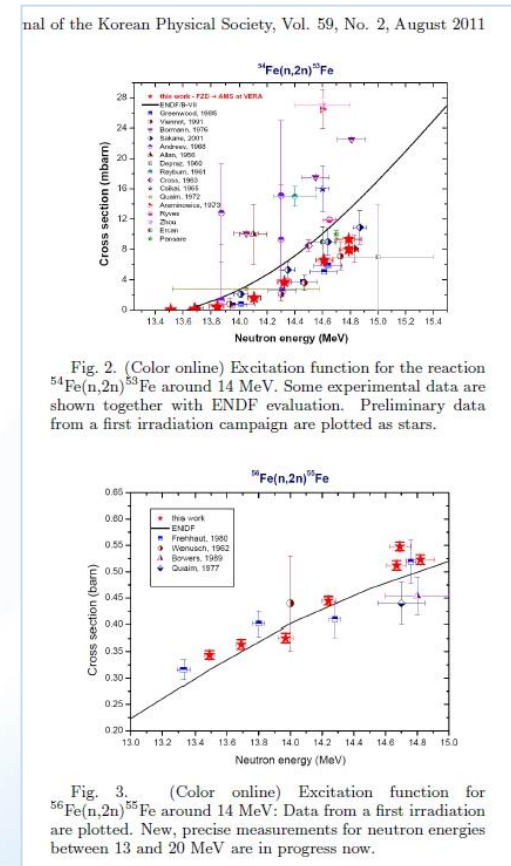
The recent example of such work is related to the inelastic cross section data extracted by the Berkeley Group (BG) from the Bagdad Atlas [1], where the original Soviet-Iraqi group has published nuclear structure and decay information only. At the same time this publication contains sufficient information to extract neutron inelastic cross sections. The corresponding project Web page (<http://www.nndc.bnl.gov/bnlatl.html>) is shown in Fig. 1. Therefore, instead of conducting a lengthy and costly experiment BG has re-analysed the existing data and produced valuable results. The initial success has emboldened BG to conduct more new inelastic measurements and data re-analyses. The BG-style work is strongly motivated by the fact that there are many raw data sets in the U.S. laboratories that have been not comprehensively analysed and occasionally abandoned by the original experimentalists; these data sets have been identified by DOE-sponsored committees and they would be re-analysed by different groups of physicists in the near future.

EXFOR Database Updates

- Previously, we had 10-11 updates per year with long interruptions during the summer and X-Mas.
- Physics does not go on vacation, work never stops and the update frequency was a problem for our users.
- The IAEA has changed the procedures, and now Viktor Zerkin is running the EXFOR updates.
- Since October 2018 we had 18 EXFOR and 6 CINDA updates.
- It is a recent database operation success story.
- It is a good idea to revise some existing procedures and improve the EXFOR project workflow.

5 Years Moratorium on Proceedings?

- It was originally introduced per complain of S. Harissopulos; his submission to PRC was rejected because of an EXFOR compilation.
- ENDF/B-VIII.0 release required all the latest data.
- A. Wallner et al., “Production of Long-lived Radionuclides ^{10}Be , ^{14}C , ^{53}Mn , ^{55}Fe , ^{59}Ni and ^{202}gPb in a Fusion Environment,” J. Korean Phys. Soc., Vol. 59, No. 2, August 2011, pp. 1378.
- ^{56}Fe CIELO evaluation required the data that were not in EXFOR.
- 5 year moratorium should be abolished per CSEWG and DNP APS Pittsburgh requests.



Communicate, Communicate, Communicate,

- We need better relations between compilers, EXFOR users and authors, and smooth operation and communication strategies.
- EXFOR is not an IAEA project, it is an international project and users should know about their countries contributions and contact people.
- Finally, we all should follow the rules and communicate when we need changes
 - M0923 -2016; M0928, M0929, M0930 -2017 were compiled without any consultation with the NNDC.
 - Deficiencies in C0030 and C0119 were discussed with users without any consultation with the NNDC.
 - NNDC is responsible for all Area #1 data. These infringements should stop, the responsible centers should be contacted.
- These examples are completely avoidable situations, we just have to communicate better.



Analysis of EXFOR History Field: 2012-2017

- In ENSDF world we know top performers.
- Incomplete, model-dependent analysis based on a two-letter record in the EXFOR HISTORY field, all areas.
- Lower limit because compilers sometimes would not write or miss their initials.
- EXFOR data can be used in unpredictable ways.
- Part-time people are on top.
- Wide range of individual contributions even amongst the top performers.

Initials	New Compilations	Remark
SB	419	Gold Star
SH	373	Silver Star
BP	284	Bronze Star
ON	167	Copper Star
MM	139	Runner Up: Honorable mention
VV	120	Runner Up: Honorable mention
VS	91	Runner Up: Honorable mention
TS	84	Runner Up: Honorable mention

Conclusions

- EXFOR operation in the Area #1 is in good shape; we always explore new ways to increase its efficiency.
- It is always good to re-examine the existing EXFOR rules and bring new people.
- We should listen to the suggestions of the CSEWG and DNP APS members.
- Personal stakes of participating centers have to be raised, project communication and coordination have to be improved.
- We need work together and share all our successes and failures. We should not be in a situation when we feel ignored, treated unfair or disrespected.

The IAEA Mission Statement

The International Atomic Energy Agency:

- is an independent intergovernmental, science and technology-based organization, in the United Nations family, that serves as the global focal point for nuclear cooperation;
- assists its Member States, in the context of social and economic goals, in planning for and using nuclear science and technology for various peaceful purposes, including the generation of electricity, and facilitates the transfer of such technology and knowledge in a sustainable manner to developing Member States;
- develops nuclear safety standards and, based on these standards, promotes the achievement and maintenance of high levels of safety in applications of nuclear energy, as well as the protection of human health and the environment against ionizing radiation;
- verifies through its inspection system that States comply with their commitments, under the Non-Proliferation Treaty and other non-proliferation agreements, to use nuclear material and facilities only for peaceful purposes.