Brookhaven
National Laboratory
U.S. DEPARTMENT OF
ENERGY
BNL Report
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NNDC Vision & Mission

The National Nuclear Data Center (NNDC) vision is to be the premier global resource for nuclear data and plan to:

- ❑ Implement AI/ML algorithms to reduce the time from data publication to integration in a recommended library to less than two years.
- ❑ Establish an open data repository for low-energy nuclear physics.
- ❑ Advance dissemination efforts with modern and efficient software tools.
- ❑ Sustain a robust nuclear physics research portfolio, including the development of an experimental program to accelerate isotope production science.

The NNDC is the lead and largest unit of the U.S. Nuclear Data Program (USNDP), whose mission is to provide current, accurate, authoritative data for workers in pure and applied areas of nuclear science and engineering. This is accomplished primarily through the compilation, evaluation, dissemination, and archiving of extensive nuclear datasets. USNDP also addresses gaps in the data, through targeted experimental studies and the use of theoretical models.

Shaofei

It is with infinite sadness that we must inform you about Shaofei Zhu's passing on Monday November 1st, 2021. At the time of his death, Shaofei was a physicist working at the National Nuclear Data Center in Brookhaven Laboratory, specializing in nuclear structure and decay, and in particular gamma-ray spectroscopy and evaluation of nuclear data.

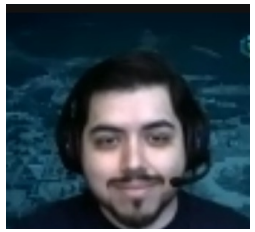
Shaofei was born in China, obtained his BS degree from the University of Science and Technology of China in 1992. He came to the US for graduate school, obtaining a Ph.D. in physics from the University of Notre Dame in 2004. During the 2004-2019 period Shaofei worked at Argonne National Laboratory, first as a post-doc and then as staff. Shaofei joined Brookhaven National Laboratory in May of 2019.

Shaofei was dedicated professional and a fantastic team player who always found time to help and mentor colleagues. His upbeat and friendly personality was cherished by all who were lucky to have known him at the professional and social level. We will be collecting notes of condolences to be sent to his family, please email us at nndc@bnl.gov if you'd like to contribute. A formal obituary will be published in Nuclear Data Sheets.

Other personnel changes at the NNDC

Ryan Lorek left the NNDC August 6th and is now a post-doc at NASA doing data science work.

Amber Lauer-Coles joined the NNDC July 1st as a post-doc working on the Intentional Forensics NA-22 Venture project.



Donnie Mason was converted from SULI student to staff mere two months ago! He is working on improving web services.

Alejandro Sonzogni promoted to Nuclear Science and Technology chair January 1, 2021

Andrea Mattera promoted from post-doc to scientific staff October 2021

Chris Morse joined the NNDC March 2021 as scientific staff working on ENSDF

David Brown promoted to become NNDC group leader June 2021

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This is in addition to our usual large number of student interns!

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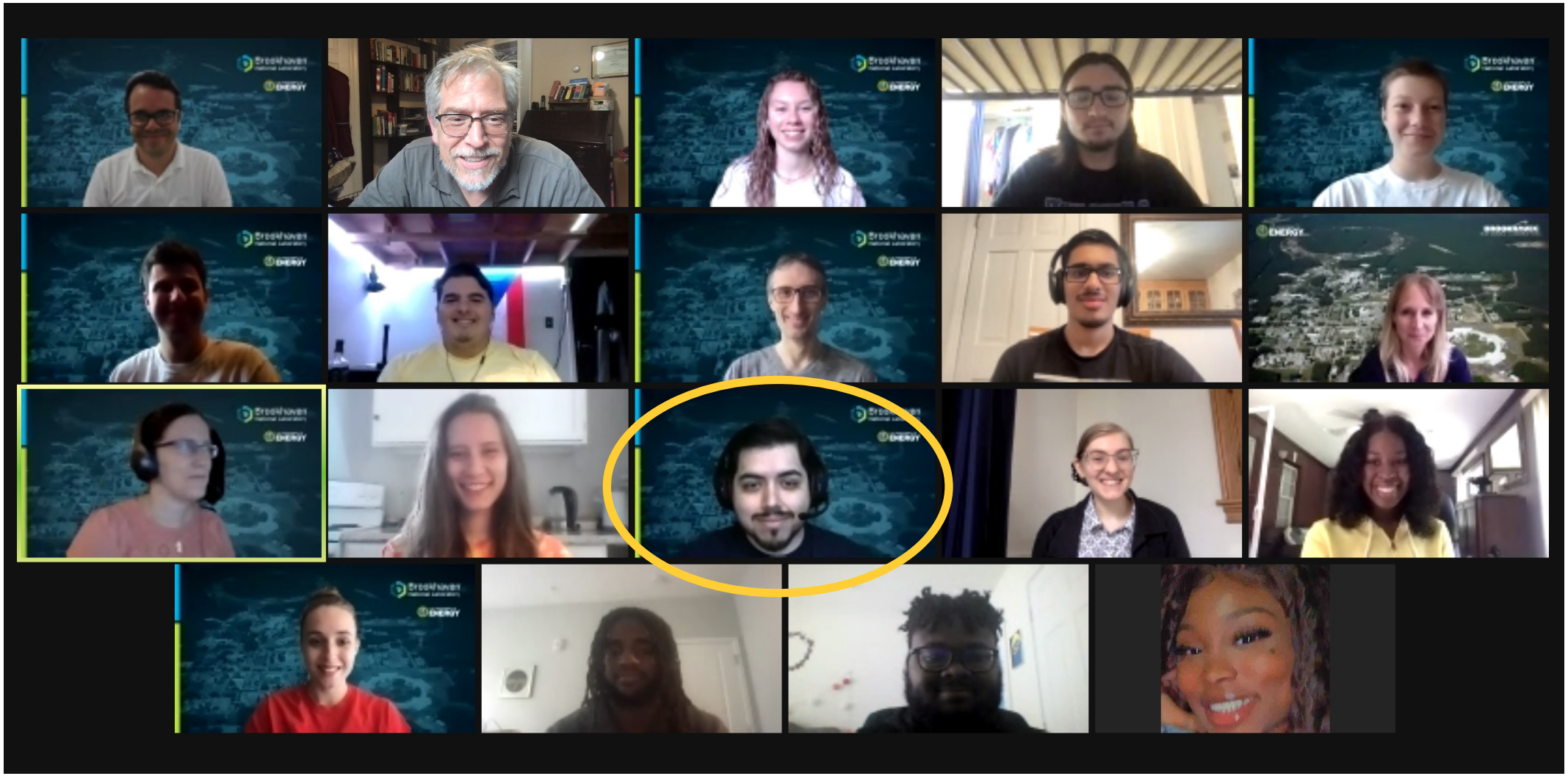


Postings postings postings

Apply Now

Postdoc in Nuclear Data

Job ID: 2797
Date posted: 09/10/2021

Brookhaven National Laboratory (www.bnl.gov) delivers discovery science and transformative technology to power and secure the nation's future. Brookhaven Lab is a multidisciplinary laboratory with seven Nobel Prize-winning discoveries, 37 R&D 100 Awards, and more than 70 years of pioneering research. The Lab is primarily supported by the U.S. Department of Energy's (DOE) Office of Science. Brookhaven Science Associates (BSA) operates and manages the Laboratory for DOE. BSA is a partnership between Battelle and The Research Foundation for the State University of New York on behalf of Stony Brook University.

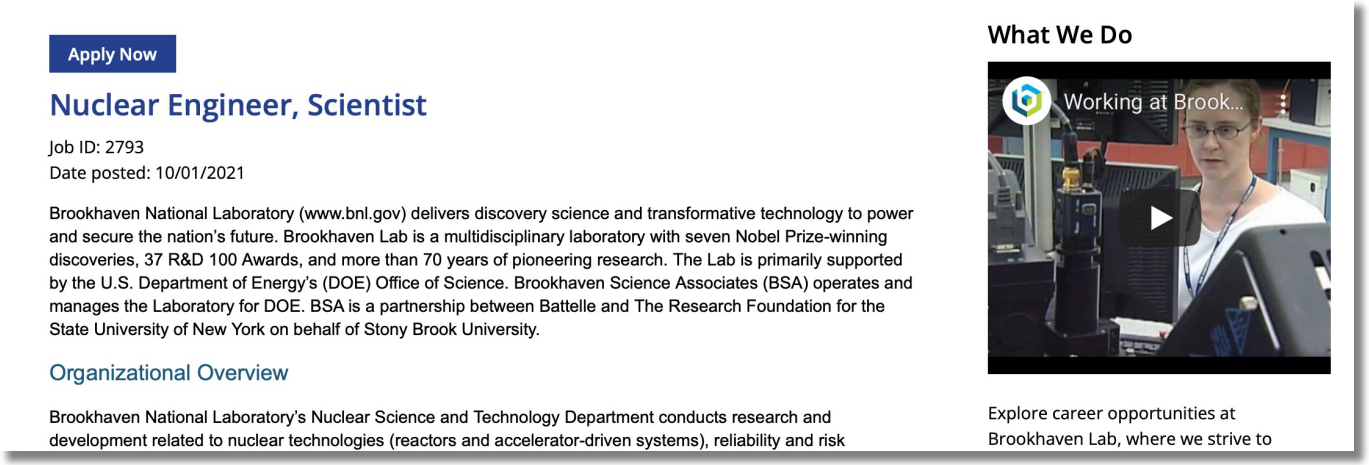
Organizational Overview

Brookhaven National Laboratory's Nuclear Science and Technology Department conducts research and development related to nuclear technologies (reactors and accelerator-driven systems), reliability and risk

What We Do

Explore career opportunities at Brookhaven Lab, where we strive to

https://jobs.bnl.gov/job/upton/postdoc-in-nuclear-data/3437/14140612576



Apply Now

Nuclear Engineer, Scientist

Job ID: 2793
Date posted: 10/01/2021

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https://jobs.bnl.gov/job/upton/nuclear-engineer-scientist/3437/15485467440

x3

ENSDF posting coming and an additional ENDF later

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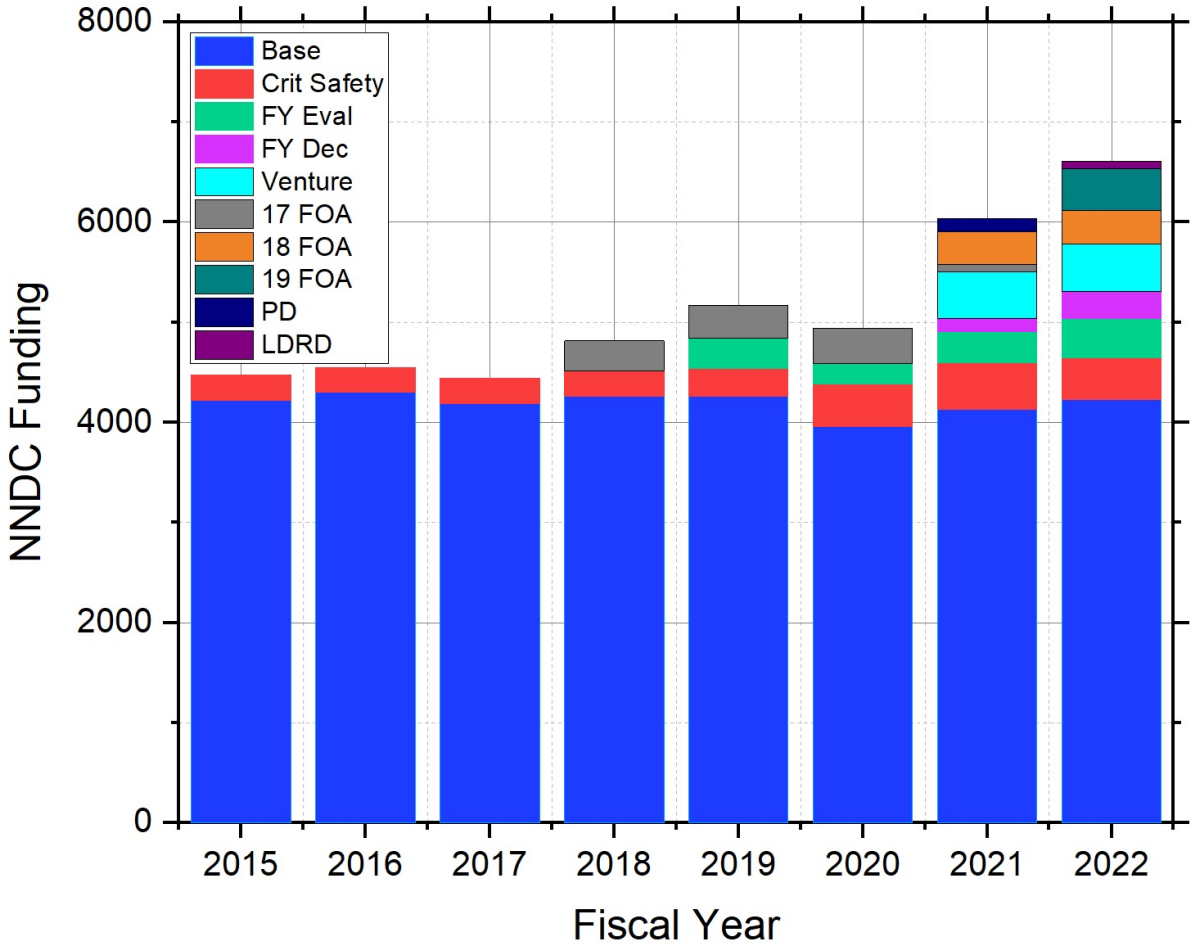
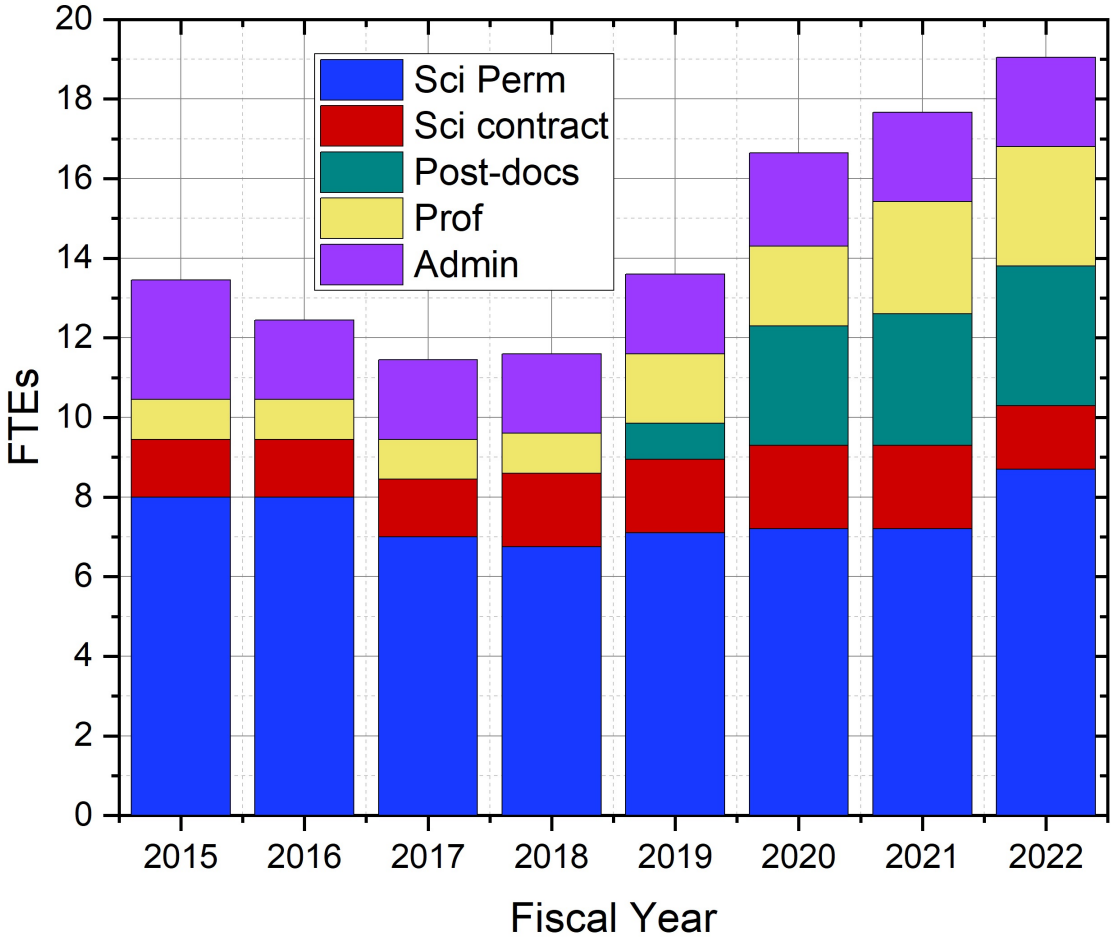
NNDC Funding and FTE evolution in the last 7 years





- We currently have a post-doc ad, looking to hire **2-3 postdocs** later in the year.
- Additionally, we are working on an **assistant scientist** personnel requisition for FY23.

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U.S. DEPARTMENT OF ENERGY

Highlights

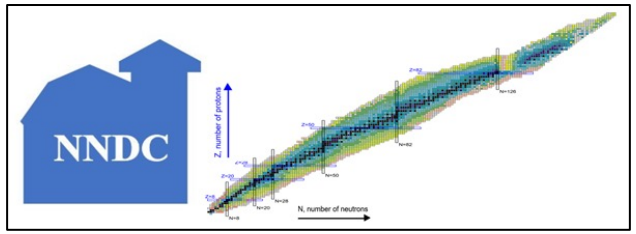
(some expected, some not!)

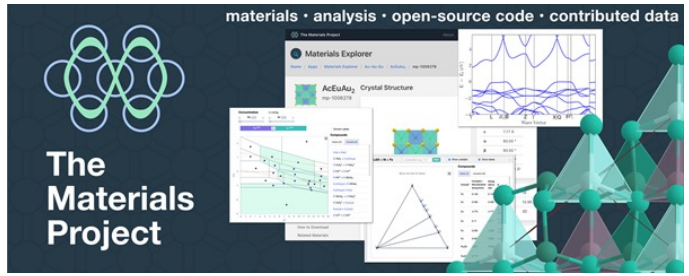
Public Reusable Research (PuRe) Data

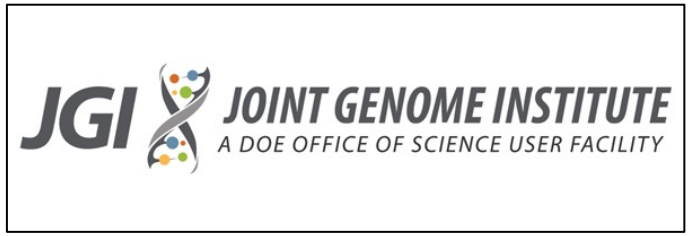
Public Reusable Research (PuRe) Data is a designation for key data repositories, knowledge bases, analysis platforms, and other activities that strive to make data publicly available to advance scientific or technical knowledge. Spanning the range of the DOE Office of Science (SC) mission, these data resources include a data center for atmospheric data and model products, data repositories and knowledge bases for biological and environmental research, and a materials database for physical sciences. Each resource is an authoritative provider of data or capabilities in their respective subject area. Together, these high-quality public resources play a strategic role in advancing the SC mission while making data easier to find, access, and reuse across the broader scientific community.

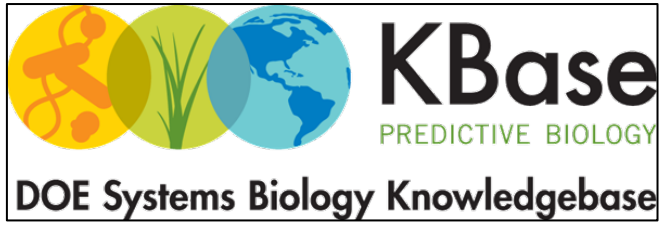
Designation as a PuRe Data Resource does more than simply recognize the importance of these investments -- it carries the weight of SC stewardship. SC manages these resources under an oversight model with high standards for data management, resource operations, and scientific impact. The designated PuRe Data Resources go above and beyond the standard SC requirements for data management plans and act as community leaders in data stewardship.

https://science.osti.gov/Initiatives/PuRe-Data









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- **Backup strategy working!**
- **DOI assignment in progress**

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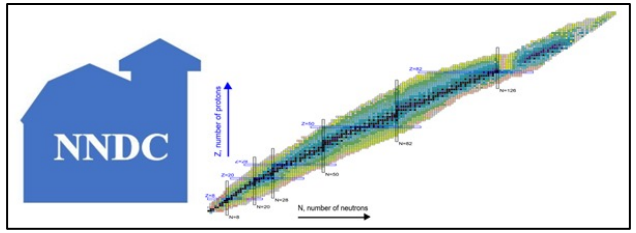

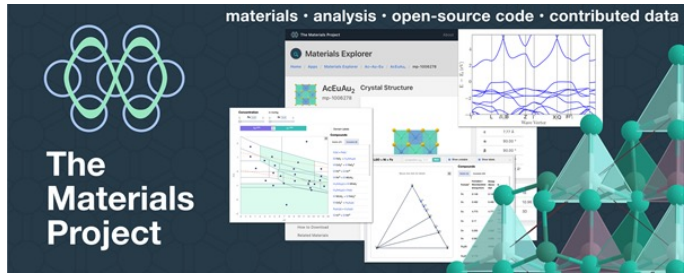

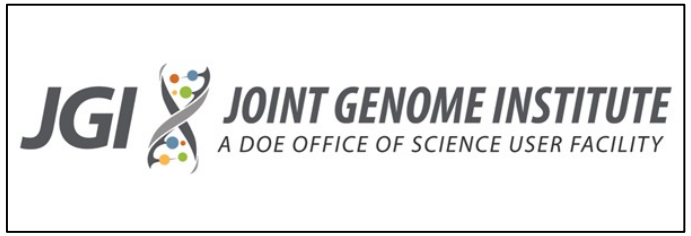

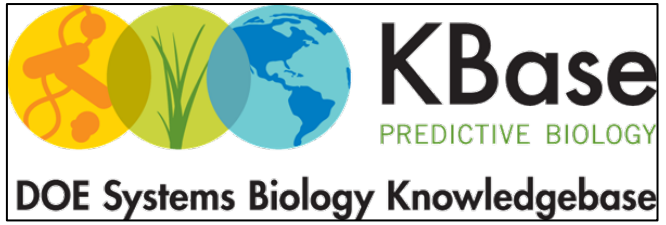

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Modernizing formats, tools and services

Data is from 40-Calcium

DSID given as non-unique text

```
40CA     ADOPTED LEVELS, GAMMAS                                        17NDS    201702
40CA  H TYP=FUL$AUT=JUN CHEN$CIT=NDS 140, 1 (2017)$CUT=30-Sep-2015$
40CA  Q -14323.0  2815635.0 6 8328.17 2 -7039.76 3     2012WA38
40CA cQ $S(2n)=28930.52 {I20}, S(2p)=14709.51 {I20} (2012Wa38)
```

Record type written here

Lines stop at/before 8(

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{
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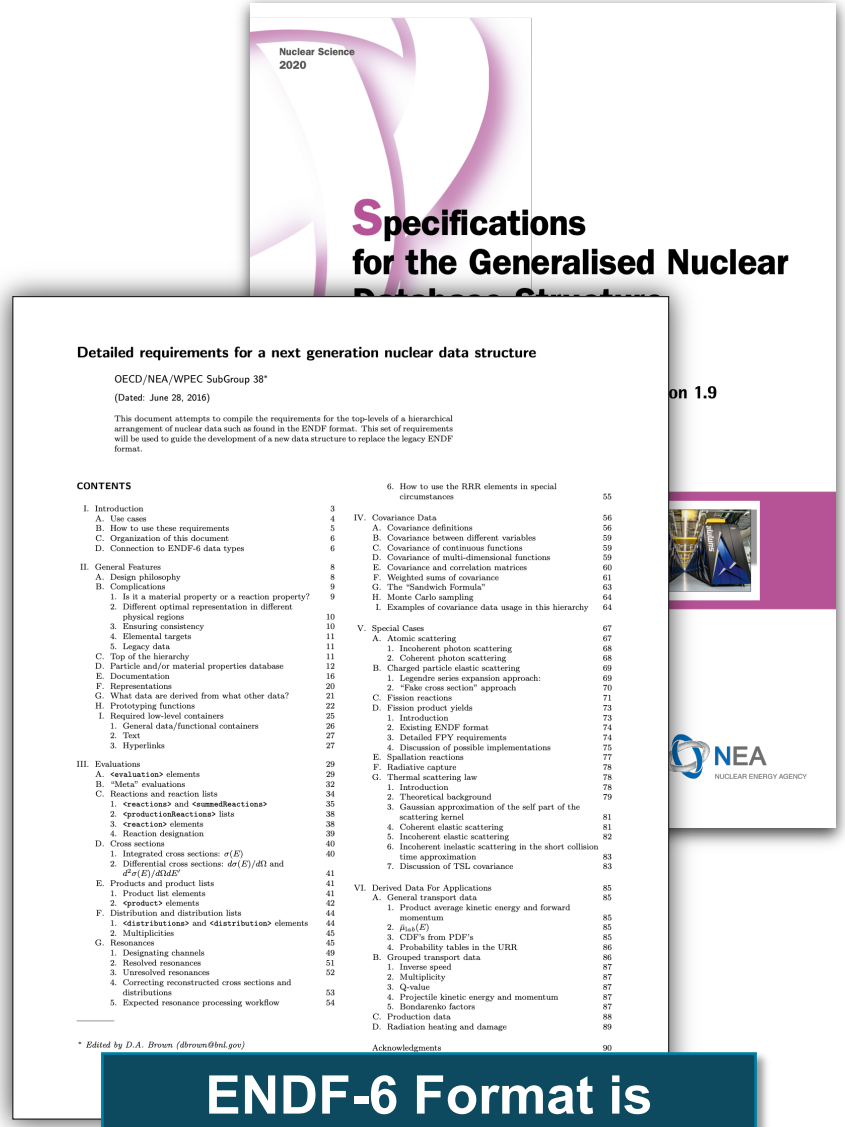
  "history": { ... },
  "qValues": { ... },
  "levels": {
    "0": {
      "gammas": {}
    },
    ...
  }
}
```

CouchDB relax

ENSDF modernization project well under way

NSR & EXFOR next



ENDF-6 Format is transitioning to GNDS, GNDS-2.0 almost ready

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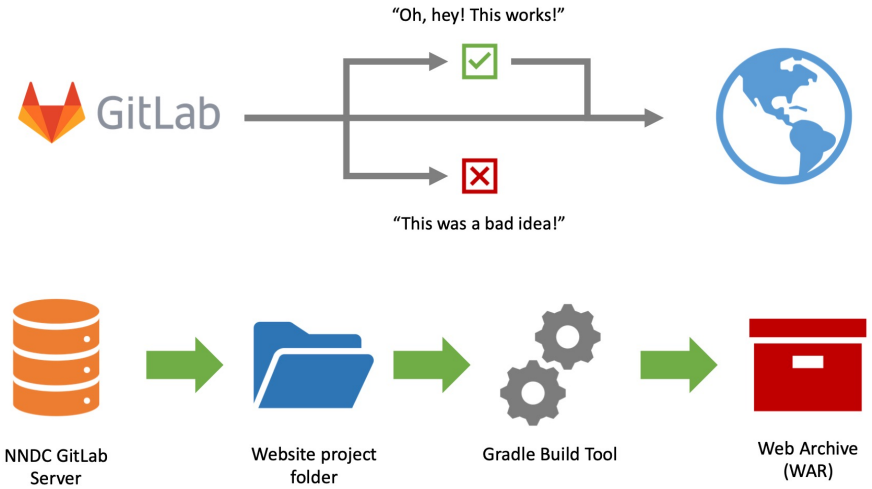
Modernizing formats, tools and services

NUDAT3 now, Sigma next

Streamlined web development



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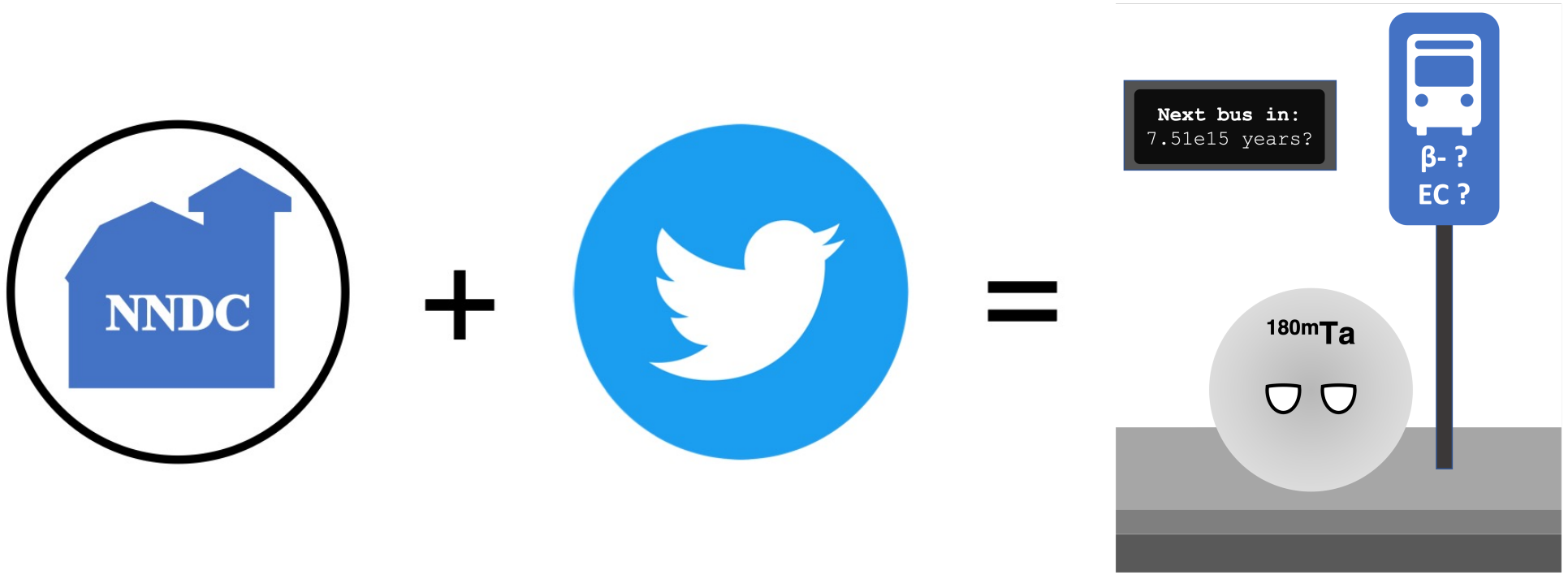
Modernizing formats, tools and services

Modernizing formats, tools and services



Publications 1/4

2021No03 Nucl.Data Sheets 173, 1 (2021) G.P.A.Nobre, M.T.Pigni, D.A.Brown, R.Capote, A.Trkov, K.H.Guber, R.Arcilla, J.Gutierrez, A.Cuadra, G.Arbanas, B.Kos, D.Bernard, P.Leconte Newly Evaluated Neutron Reaction Data on Chromium Isotopes NUCLEAR REACTIONS 50,52,53Cr(n,n),(n,gamma),(n,X), E<20 MeV; analyzed available data; deduced recommended sigma using EMPIRE code within the Hauser-Feshbach framework.

2021Se08 Nucl.Data Sheets 173, 118 (2021) C.J.Sears, A.Mattera, E.A.McCutchan, A.A.Sonzogni, D.A.Brown, D.Potemkin Compilation and Evaluation of Isomeric Fission Yield Ratios NUCLEAR REACTIONS 238U(n,F), E<20 MeV; analyzed available fission yields data.79,81Ge,82As,82Se,84Br,90Rb,95,97,99Nb,96,97,98Y,102Tc, 102,108Rh,111Pd,116,118,120Ag,116,118,120In,117,119,121Cd,121,122, 123,124,125,126,127,128,129,130,131In,123,125,127Cd,126,128,129,130, 132Sb,132,134,136I,131,133Te,135Xe,138Cs,146La,148Pr,148Pm; deduced isomeric fission yields ratios.

2021Ho15 Phys.Lett. B 822, 136710 (2021) M.Holl, R.Kanungo, Z.H.Sun, G.Hagen, J.A.Lay, A.M.Moro, P.Navratil, T.Papenbrock, M.Alcorta, D.Connolly, B.Davids, A.Diaz Varela, M.Gennari, G.Hackman, J.Henderson, S.Ishimoto, A.I.Kilic, R.Krucken, A.Lennarz, J.Liang, J.Measures, W.Mittig, O.Paetkau, A.Psaltis, S.Quaglioni, J.S.Randhawa, J.Smallcombe, I.J.Thompson, M.Vorabbi, M.Williams Proton inelastic scattering reveals deformation in 8He NUCLEAR REACTIONS 1H(8He,p), E=8.25 MeV/nucleon; measured reaction products, Ep,Ip. 8He; deduced sigma(theta), resonance parameters, first 2+ state, quadrupole deformation parameter. Comparison with no-core shell model predictions. Charged particle spectroscopy station IRIS at TRIUMF in Canada.

2021Vo03 Phys.Rev. C 103, 024604 (2021) M.Vorabbi, M.Gennari, P.Finelli, C.Giusti, P.Navratil, R.Machleidt Impact of three-body forces on elastic nucleon-nucleus scattering observables NUCLEAR REACTIONS 12C(polarized p,p),E=122,160,200,300 MeV; 16O(p,p), (polarized p,p),E=100,135,200,318 MeV; 12C(n,n),E=108,128,155,185, 225 MeV; calculated differential sigma(E,theta), and analyzing power A-y(EPSILON,theta) using nonrelativistic optical model potentials obtained from the no-core shell model densities using two- and three-nucleon chiral interactions; deduced that contribution of the 3N force in the t-NN matrix is small for the differential cross section and sizable for the spin observables such as analyzing power. Comparison with experimental data.

2021Pr08 J.Phys.(London) G48, 08LT01 (2021) B.Pritychenko Capitalizing on nuclear data libraries' comprehensiveness to obtain solar system r-process abundances NUCLEAR REACTIONS 56,57,58Fe,59Co,60,61,62,63,64Ni,65Cu,66,67,68Zn, 69,71Ga,70,72,73,74Ge,75As,76,77,78,79,80Se,81Br,82,83,84Kr,85Rb,86, 87,88Sr,89Y,90,91,92,93,94Zr,95,96,97,98Mo,99Tc,100,101,102Ru,103Rh, 104,105,106,107,108Pd,109Ag,110,111,112,113,114Cd,115In,116,117,118, 119,120Sn,121Sb,122,123,124,125,126Te,127I,128,129,130,131,132Xe, 133Cs,134,135,136,137,138Ba,139La,140Ce,141Pr,142,143,144,145,146Nd, 147,148,149,150,151,152Sm,153Eu,154,155,156,157,158Gd,159Tb,160,161, 162,163,164Dy,165Ho,166,167,168Er,168,169Tm,168,170,171,172,173, 174Yb,175,176Lu,177,178,179,180Hf,181Ta,182,183,184W,185Re,186,187, 188,189,190Os,191,193Ir,192,194,195,196Pt,197Au,196,198,199,200,201, 202Hg,203Tl,204,205,206,207,208Pb,209Bi,210Po(n,gamma), E ~ 30 keV; calculated Maxwellian-averaged sigma and uncertainties. 69Ga,70,72, 73,74,76Ge,73As,76,77,78,79,80,81,82Se,79,81Br,82,83,84,85Kr,85Rb,86, 87,88Sr,89Y,90,91,92,93,94,95,96Zr,93,95Nb,92,95,96,97,98,99,100Mo, 99Tc,99,100,101,104Ru,103Rh,104,105,106,107,108Pd,107,109Ag,110,111, 112,113,114,116Cd,115In,116,117,118,119,120Sn,121,123Sb,122,123,124, 125,126,128Te,127,128I,128,129,130,131,132,134,136Xe,133Cs,134,135, 136,137,138Ba,139La,140,142Ce,141Pr,142,143,144,145,146,147,148, 150Nd,147Pm,147,148,149,150,151,152,154Sm,151,153Eu,154,155,156,157, 158,160Gd,159Tb,160,161,162,163,164Dy,165Ho,166,167,168,170Er,169Tm, 170,171,172,173,174,176Yb,175,176Lu,176,177,178,179,180Hf,181Ta,182, 183,184,186W,185Re,186,187,188,189,190,192Os,191,193Ir,192,193,194, 195,196,198Pt,197Au,198,199,200,201,202,203,204Hg,203,205Tl,204,205, 206,207,208Pb,209Bi; deduced s- and r-process abundances using ENDF/B-VIII.0 evaluated nuclear data library. Comparison with available data.

Publications 2/4

2021PrZZ INDC(NDS)-0817 (2021) B.Pritychenko, S.Oberstedt, O.Cabellos, R.Vogt, R.Capote Noy, S.Okumura, T.Kawano Summary Report of the 1st RCM of the CRP on the Updating Fission Yield Data for Applications COMPILATION Z=1-100; compiled, evaluated neutron-induced and spontaneous fission yields data.

2021Di04 Nucl.Data Sheets 173, 144 (2021) P.Dimitriou, I.Dillmann, B.Singh, V.Piksaikin, K.P.Rykaczewski, J.L.Tain, A.Algora, K.Banerjee, I.N.Borzov, D.Cano-Ott, S.Chiba, M.Fallot, D.Foligno, R.Grzywacz, X.Huang, T.Marketin, F.Minato, G.Mukherjee, B.C.Rasco, A.Sonzogni, M.Verpelli, A.Egorov, M.Estienne, L.Giot, D.Gremyachkin, M.Madurga, E.A.McCutchan, E.Mendoza, K.V.Mitrofanov, M.Narbonne, P.Romojaro, A.Sanchez-Caballero, N.D.Scielzo Development of a Reference Database for Beta-Delayed Neutron Emission COMPILATION Z=2-87; compiled beta-delayed neutron emission data; deduced total delayed neutron yields, time-dependent group parameters in 6- and 8-group representation, and aggregate delayed neutron spectra.

2021Ma19 Nucl.Data Sheets 172, 543 (2021) A.M.Mattera, S.Zhu, A.B.Hayes, E.A.Mccutchan Nuclear Data Sheets for A=252 COMPILATION 252U,252Np,252Pu,252Am,252Cm,252Bk,252Cf,252Es,252Fm, 252Md,252No,252Lr; compiled, evaluated nuclear structure data.

2021Zh35 Nucl.Data Sheets 175, 1 (2021) S.Zhu, E.A.McCutchan Nuclear Data Sheets for A=214 COMPILATION 214Hg,214Tl,214Pb,214Bi,214Po,214At,214Rn,214Fr,214Ac, 214Th,214Pa,214U; compiled, evaluated nuclear structure data.

2021Ma21 Phys.Rev. C 103, 034307 (2021) A.O.Macchiavelli, H.L.Crawford, R.M.Clark, P.Fallon, I.Y.Lee, C.Morse, C.M.Campbell, M.Cromaz, C.Santamaria, J.Chen, C.R.Hoffman, B.P.Kay Coriolis coupling effects in proton-pickup spectroscopic factors from 12B NUCLEAR REACTIONS 2H(12B,3He)11Be,E=12 MeV/nucleon; analyzed Coriolis coupling effects in proton-pickup spectroscopic factors extracted from experimental data in 2019Ch51. 11B; calculated levels, J, pi, Coriolis mixing amplitudes of the proton Nilsson states using the particle rotor model (PRM) and compared with the experimental data. 11Be,11B; calculated L=1 proton-removal spectroscopic factors from 1- 11B and 0+ 12C ground states using PRM, and compared with experimental data. 12B; deduced evidence of Coriolis coupling in the ground state.

2021Pr11 Phys.Rev. C 104, 044318 (2021) V.S.Prasher, A.J.Mitchell, C.J.Lister, P.Chowdhury, L.Afanasieva, M.Albers, C.J.Chiara, M.P.Carpenter, D.Cline, N.D'Olympia, C.J.Guess, A.B.Hayes, C.R.Hoffman, R.V.F.Janssens, B.P.Kay, T.L.Khoo, A.Korichi, T.Lauritsen, E.Merchan, Y.Qiu, D.Seweryniak, R.Shearman, S.K.Tandel, A.Verras, C.Y.Wu, S.Zhu Shapes, softness, and nonyrast collectivity in 186W

2021Ba03 Phys.Rev. C 103, 014301 (2021) A.Basu, A.K.Singh, I.Ragnarsson, B.G.Carlsson, A.Kardan, G.B.Hagemann, G.Sletten, B.Herskind, H.Hubel, S.Chmel, A.N.Wilson, J.Rogers, R.V.F.Janssens, M.P.Carpenter, T.L.Khoo, F.G.Kondev, T.Lauritsen, S.Zhu, A.Korichi, P.Fallon, B.M.Nyako, J.Timar Highly deformed band structures due to core excitations in 123Xe NUCLEAR REACTIONS 80Se(48Ca,5n)123Xe,E=207 MeV; measured E gamma, I gamma, two to four-fold gamma gamma-coin, angular-distribution ratios for eight transitions using the Gammasphere array at ATLAS-ANL facility. 123Xe; deduced high-spin levels, J, pi, multipolarities, highly-deformed rotational bands, alignments, band crossings, configurations; calculated total energy surfaces. Comparison with cranked Nilsson-Strutinsky (CNS) and cranked Nilsson-Strutinsky-Bogoliubov (CNSB) models.

Publications 3/4

2021Ca19 Phys.Rev. C 104, L022802 (2021) L.Canete, G.Lotay, G.Christian, D.T.Doherty, W.N.Catford, S.Hallam, D.Seweryniak, H.M.Albers, S.Almaraz-Calderon, E.A.Bennett, M.P.Carpenter, C.J.Chiara, J.P.Greene, C.R.Hoffman, R.V.F.Janssens, J.Jose, A.Kankainen, T.Lauritsen, A.Matta, M.Moukaddam, S.Ota, A.Saastamoinen, R.Wilkinson, S.Zhu New constraints on the 25Al (p,gamma) reaction and its influence on the flux of cosmic gamma rays from classical nova explosions NUCLEAR REACTIONS 11B(16O,p)26Mg,E=19 MeV from Argonne ATLAS accelerator; measured E gamma, I gamma, gamma gamma-coin, gamma(theta) and level half-lives by DSAM using Gammasphere array of 99 HPGe detectors. 2H(25Mg,p)26Mg,E=10 MeV/nucleon from Texas A and M cyclotron; measured outgoing protons and scattered deuterons using the TIARA Si array, and 26Mg recoils by the MDM-2 magnetic spectrometer with Oxford ionization chamber, angular distributions of scattered deuterons and protons. 26Mg; deduced levels, J, pi, resonances, spectroscopic factors. 26Si; deduced levels, resonances, J, pi, GAMMA-p, GAMMA-gamma, resonance strengths by comparing with the level structures of mirror nucleus 26Mg. 25Al(p,gamma)26Si,T=0.2-0.4 GK; deduced stellar reaction rate by considering the contribution of resonant states in 26Si, galactic abundance of 26Al from classical novae; performed nova outburst simulations using the hydrodynamic Lagrangian time-implicit code SHIVA.

2021Cr01 Phys.Lett. B 816, 136210 (2021) F.C.L.Crespi, A.Bracco, E.G.Lanza, A.Tamii, N.Blasi, F.Camera, O.Wieland, N.Aoi, D.L.Balabanski, S.Bassauer, A.S.Brown, M.P.Carpenter, J.J.Carroll, M.Ciemala, A.Czeszumska, P.J.Davies, V.Derya, L.M.Donaldson, Y.D.Fang, H.Fujita, G.Gey, H.T.Ha, M.N.Harakeh, T.Hashimoto, N.Ichige, E.Ideguchi, A.Inoue, J.Isaak, C.Iwamoto, D.G.Jenkins, T.Klaus, N.Kobayashi, T.Koike, M.Krzysiek, M.K.Raju, M.Liu, A.Maj, L.Morris, P.von Neumann-Cosel, S.Noji, H.J.Ong, S.G.Pickstone, N.Pietralla, D.Savran, J.M.Schmitt, M.Spieker, G.Steinhilber, C.Sullivan, B.Wasilewska, M.Weinert, V.Werner, Y.Yamamoto, T.Yamamoto, R.G.T.Zegers, X.Zhou, S.Zhu, A.Zilges The structure of low-lying 1- states in 90,94Zr from (alpha,alpha'gamma) and (p,p'gamma) reactions NUCLEAR REACTIONS 90,94Zr(p,p'gamma), E=80 MeV; 90, 94Zr(alpha,alpha'gamma), E=130 MeV; measured reaction products, E gamma,I gamma; deduced ratio of the measured yields, dipole states sigma, transition densities, low-lying dipole strength. The array CAGRA with HPGe detectors.

2021Ha14 Phys.Rev. C 103, 034322 (2021) D.J.Hartley, K.Villafana, F.G.Kondev, M.A.Riley, R.V.F.Janssens, K.Auranen, A.D.Ayangeakaa, J.S.Baron, A.J.Boston, M.P.Carpenter, J.A.Clark, J.P.Greene, J.Heery, C.R.Hoffman, P.Jackson, T.Lauritsen, J.Li, D.Little, E.S.Paul, G.Savard, D.Seweryniak, J.Simpson, S.Stolze, G.L.Wilson, J.Wu, S.Zhu, S.Frauendorf Possible quenching of static neutron pairing near the N=98 deformed shell gap: Rotational structures in 160,161Gd NUCLEAR REACTIONS 154Sm,164Dy(160Gd,X)160Gd/161Gd,E=1000 MeV; measured E gamma, I gamma, gamma gamma-coin using the Gammasphere array with 73 detectors at ATLAS-ANL facility. 160,161Gd; deduced high-spin levels, J, pi, rotational bands, branching ratios, B(M1)/B(E2), Nilsson configurations, alignments, neutron pairing strength. Comparison with structure of nu5/2[523] band in N=97 isotone 159Sm.

2021Ka05 Phys.Lett. B 813, 136033 (2021) A.Kankainen, P.J.Woods, D.T.Doherty, H.M.Albers, M.Albers, A.D.Ayangeakaa, M.P.Carpenter, C.J.Chiara, J.L.Harker, R.V.F.Janssens, C.Lederer-Woods, D.Seweryniak, F.Strieder, S.Zhu Decay of the key 92-keV resonance in the 25Mg(p,gamma) reaction to the ground and isomeric states of the cosmic gamma-ray emitter 26Al NUCLEAR REACTIONS 24Mg(3He,p), E=10 MeV; measured reaction products, E gamma,I gamma,gamma-gamma-coin.; deduced gamma-ray energies and intensities, gamma-ray branches, J,pi.

2021Ke04 Phys.Rev. C 103, 035805 (2021) A.R.L.Kennington, G.Lotay, D.T.Doherty, D.Seweryniak, C.Andreoiu, K.Auranen, M.P.Carpenter, W.N.Catford, C.M.Deibel, K.Hadynska-Klek, S.Hallam, D.Hoff, T.Huang, R.V.F.Janssens, S.Jazrawi, J.Jose, F.G.Kondev, T.Lauritsen, J.Li, A.M.Rogers, J.Saiz, G.Savard, S.Stolze, G.L.Wilson, S.Zhu Level structure of the T-z = -1 nucleus 34Ar and its relevance for nucleosynthesis in ONe novae NUCLEAR REACTIONS 12C(24Mg,2n)34Ar,(24Mg,2p)34S,E=95 MeV; measured reaction products, E gamma, I gamma, (34Ar)gamma- and (34S)gamma-coin, gamma gamma-coin, gamma(theta) using GRETINA array for detection of high-energy gamma rays, and Fragment mass analyzer (FMA) for recoils at ATLAS-ANL facility. 34Ar,34S; deduced levels, proton-unbound levels of astrophysical significance, J, pi, mirror symmetry, 33S/32S and 34S/32S ratios to search for nova presolar grains, and compared with previous experimental data. 34Cl(p,gamma),T=0.1-0.8 GK; calculated stellar reaction rate. Comparison of levels structures in 34Ar and 34S with data from the ENSDF database, and with shell-model calculations using USDA Hamiltonian, within the sd shell-model space for even-parity states, and using WBP Hamiltonian, within the sd-pf space for odd-parity levels.

Publications 4/4

2021Ko09 Nucl.Instrum.Methods Phys.Res. A1000, 165240 (2021) K.Kolos, A.M.Hennessy, N.D.Scielzo, V.E.Iacob, J.C.Hardy, M.A.Stoyer, A.P.Tonchev, W.-J.Ong, M.T.Burkey, B.Champine, J.A.Clark, P.Copp, A.Gallant, E.B.Norman, R.Orford, H.I.Park, J.Rohrer, D.Santiago-Gonzalez, G.Savard, A.J.Shaka, B.S.Wang, S.Zhu New approach to precisely measure gamma-ray intensities for long-lived fission products, with results for the decay of 95Zr RADIOACTIVITY 95Zr,95Nb,95Sr,95Y(beta-); measured decay products, E gamma,I gamma,E beta,I beta, beta-gamma-coin.; deduced gamma-ray energies and intensities, beta-branching ratios. Comparison with a Monte Carlo decay code simulations. CARIBU facility, the reactor facility at TAMU.

2021Mi07 Phys.Rev. C 103, 024323 (2021) A.J.Mitchell, R.Orford, G.J.Lane, C.J.Lister, P.Copp, J.A.Clark, G.Savard, J.M.Allmond, A.D.Ayangeakaa, S.Bottoni, M.P.Carpenter, P.Chowdhury, D.A.Gorelov, R.V.F.Janssens, F.G.Kondev, U.Patel, D.Seweryniak, M.L.Smith, Y.Y.Zhong, S.Zhu Ground-state and decay properties of neutron-rich 106Nb RADIOACTIVITY 106Nb(beta-)[from 252Cf(SF), CARIBU radioactive-ion-beam facility at ANL, followed by mass separation and measurement using Multi-Reflection Time-of-Flight (MR-TOF) mass separator and Canadian Penning Trap (CPT)]; measured CPT spectra, E gamma, I gamma, beta gamma gamma-coin, half-life of 106Nb decay using five HPGe clover detectors, and a plastic scintillator at the X-Array and SATURN decay-spectroscopy station. 106Mo; deduced levels, J, pi, apparent beta feedings, range of logft values, configurations. 106Nb; discussed spin, parity and configurations of the ground state. Comparison with earlier experimental results. ATOMIC MASSES 106Nb; measured cyclotron frequency using the Phase-Imaging Ion-Cyclotron-Resonance (PI-ICR) technique, CPT spectra; deduced mass excess. Comparison with previous measurement, and with AME 2016 evaluation.

2021Su02 Phys.Rev. C 103, 014319 (2021) S.Suman, S.K.Tandel, A.Kumawat, S.G.Wahid, M.Hemalatha, P.Chowdhury, R.V.F.Janssens, M.P.Carpenter, T.L.Khoo, F.G.Kondev, T.Lauritsen, C.J.Lister, D.Seweryniak, S.Zhu Nanosecond isomers and the evolution of collectivity in stable, even-A Hg isotopes NUCLEAR REACTIONS 197Au(209Bi,X),E=1450 MeV; 197Au(207Pb,X),E=1430 MeV; measured E gamma, I gamma, three- and higher fold gamma gamma-coin, gamma gamma(theta)(DCO), half-lives of nanosecond isomers by gamma gamma(t) using pulsed beams from ATLAS-ANL accelerator, and Gammasphere array of 100 Compton-suppressed HPGe detectors. 198,200,202Hg; deduced levels, J, pi, multipolarities, B(E2), configurations, band crossings, and collectivity; calculated total energy surface plots, neutron and proton quasiparticle energy levels using the Ultimate Cranker code. Systematics of nanosecond isomers, half-lives and B(E2) in 192,194,196,198,200,202,204Hg.

2021Za06 Phys.Rev. C 104, 014607 (2021) J.C.Zamora, C.Sullivan, R.G.T.Zegers, N.Aoi, L.Batail, D.Bazin, M.Carpenter, J.J.Carroll, Y.D.Fang, H.Fujita, U.Garg, G.Gey, C.J.Guess, M.N.Harakeh, T.H.Hoang, E.Hudson, N.Ichige, E.Ideguchi, A.Inoue, J.Isaak, C.Iwamoto, C.Kacir, N.Kobayashi, T.Koike, M.Kumar Raju, S.Lipschutz, M.Liu, P.von Neumann-Cosel, S.Noji, H.J.Ong, S.Peru, J.Pereira, J.Schmitt, A.Tamii, R.Titus, V.Werner, Y.Yamamoto, X.Zhou, S.Zhu Investigation of the isoscalar response of 24Mg to 6Li scattering NUCLEAR REACTIONS 24Mg(6Li,6Li'),E=100 MeV/nucleon; measured scattered 6Li particles, sigma(theta) using Grand Raiden spectrometer and two position-sensitive multiwire drift chambers (MWDCs) and three plastic scintillators for particle identification and reconstructing their trajectories at RCNP-Osaka University; deduced differential sigma(E,Q), angular momentum transfers by fitting with multipole-decomposition analysis (MDA) using DWBA calculations for angular-momentum transfers. 24Mg; deduced energies, widths, EWSR, isoscaler giant monopole resonance (ISGMR), isoscaler giant monopole resonance (ISGDR), isoscaler giant quadrupole resonance (ISGQR) strength functions from Lorentzian fits to data. Comparison with antisymmetrized molecular dynamics (AMD) calculations, and with previous experimental data.

2021MaZZ BNL-220804-2021-INRE (2021) A.Mattera, A.A.Sonzogni Revision of Fission Yields Uncertainties in ENDF/B-VIII.0 NUCLEAR REACTIONS 227,229Th(n,F), E thermal; 232Th(n,F), E=0.5,14 MeV; 231Pa(n,F), E=0.5 MeV; 232,233,235U(n,F), E thermal; 233,234, 235,236,238U(n,F), E=0.5,14 MeV; 237U(n,F), E=0.5 MeV; 237Np(n,F), E thermal; 237Np(n,F), E=0.5,14 MeV; 238Np,238,241Pu(n,F), E=0.5 MeV; 239,240,241,242Pu(n,F), E thermal; 239Pu(n,F), E=0.5,2,14 MeV; 240, 242Pu(n,F), E=0.5,14 MeV; 241,242Am(n,F), E thermal; 241Am(n,F), E=0.5,14 MeV; 243Am,242,243,244,246,248Cm(n,F), E=0.5 MeV; 243,245, 249Cm,251Cf,254Es,255Fm(n,F), E thermal; analyzed available dat; deduced neutron fission yields corrections. ENDF/B-VIII.0 library. RADIOACTIVITY 238U,244,246,248Cm,250,252Cf,253Es,254,256Fm(SF); analyzed available dat; deduced spontaneous fission yields corrections. ENDF/B-VIII.0 library

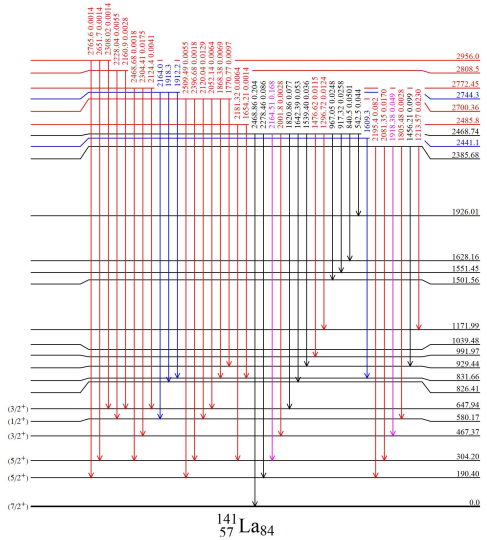
Brookhaven National Laboratory

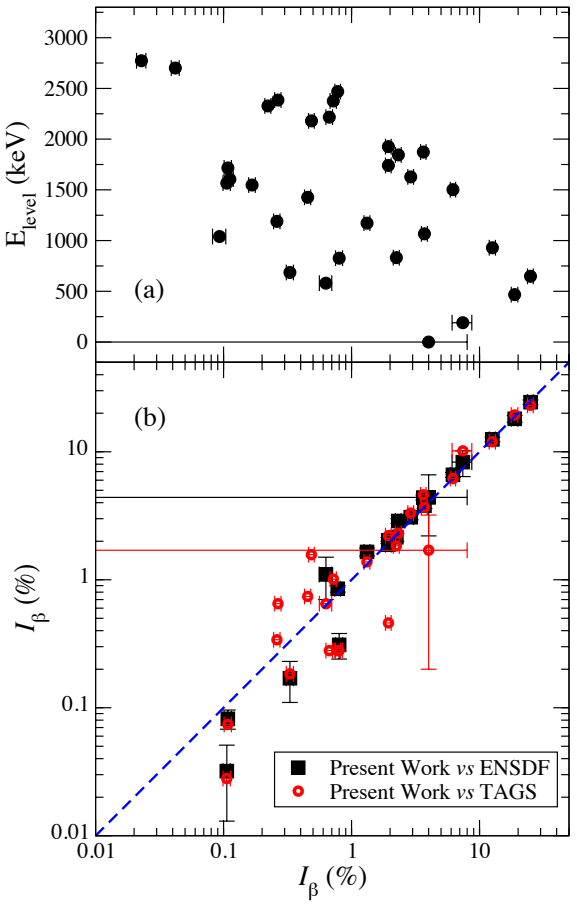
Structure Measurements Highlights

Gamma-ray spectroscopy of the β-decay of ^{141}Ba for a beta-feeding benchmark comparison of HPGe spectroscopy to TAGS

Javier Rufino Jr[1,2], E. A. McCutchan[2], S. Zhu[2,3], A. A. Sonzogni[2], M. Alcorta[3], P. F. Bertone[3], M. P. Carpenter[3], J. Clark[3], C. R. Hoffman[3], R. V. F. Janssens[3], F. G. Kondev[3], T. Lauritsen[3], C. J. Lister[3], , R. Pardo[3], A. Rogers[3], G. Savard[3], D. Seweryniak[3], R. Vondrasek[3]

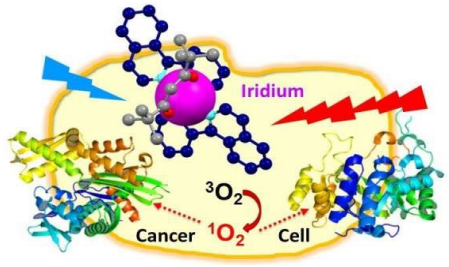
Submitted to Physical Review C





- >70 additions to the level scheme
- Excellent agreement with TAGS
- New measurement of absolute Ig
- >20 new spin determinations
- **Javier now PhD student in Nuclear Physics at Notre Dame!**

Improving Decay Data on Promising Medical Isotope ^{186}Ir

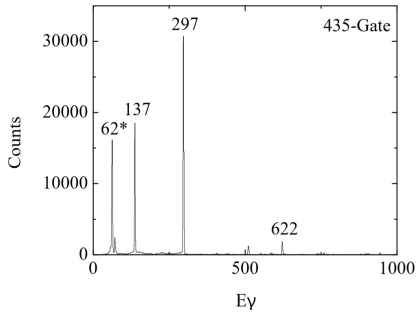


- Ir used in chemotherapy treatment
- ^{186}Ir both Auger emitter and potential SPECT
- Perform therapy and imaging simultaneously
- Last measurement nearly 50 years ago

PHYSICAL REVIEW C VOLUME 8, NUMBER 6 DECEMBER 1973

Levels in ^{186}Os as Populated from Decay of 15.8-h ^{186}Ir†

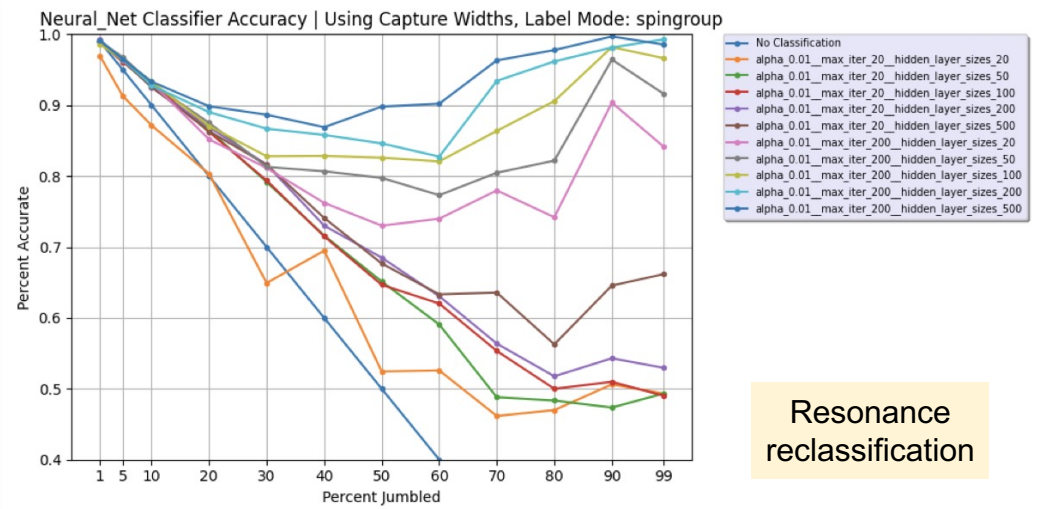
K. J. Hofstetter*
Cyclotron Institute and Department of Chemistry, Texas A & M University, College Station, Texas 77843,



- Significant level scheme revision
- > 100 new transitions
- Substantial revision to existing placements
- **Sophia will start PhD in Nuclear Physics at University of Montana next Fall !**

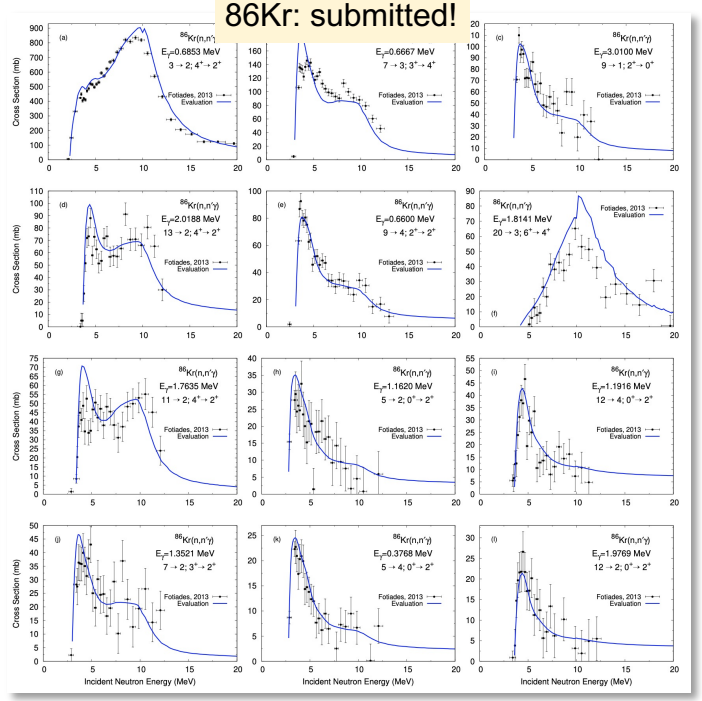
Reaction Highlights

- **CSEWG news:**
  - Mini-CSEWG August 2021
  - ENDF/B-VIII.1 delayed until Feb. 2024
  - Developing review system for library
- **NNDC reaction work:**
  - Published: INDEN Cr evaluations
  - Submitted: ^{86}Kr evaluation
  - In prep.: Resonance reclassification (6 interns: S. Hollick, P. Rodriguez, S. Scoville, M. Fucci, S. Ruiz, R. Crawford)
  - In prep.: URR PT development (1 intern: M. Mclaurin)



Resonance reclassification

86Kr: submitted!



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Nuclear Data Sheets

Nuclear Data Sheets 173 (2021) 1–41

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Newly Evaluated Neutron Reaction Data on Chromium Isotopes

G.P.A. Nobre,[1,*] M.T. Pigni,[2] D.A. Brown,[1] R. Capote,[3] A. Trkov,[4] K.H. Guber,[2] R. Arcilla,[1] J. Gutierrez,[5] A. Cuadra,[1,6] G. Arbanas,[2] B. Kos,[4] D. Bernard,[7] and P. Leconte[7]

[1]*National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY 11973, USA*
[2]*Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA*
[3]*NAPC–Nuclear Data Section, International Atomic Energy Agency, A-1400 Vienna, Austria*
[4]*Jozef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia*
[5]*Gonzaga University, Spokane, WA, USA*
[6]*Nuclear Systems & Structural Analysis Group, Brookhaven National Laboratory, Upton, NY 11973, USA*
[7]*CEA/DEN/CAD/DER/SPRC/Laboratoire d'Études de Physique Centre de Cadarache, Bâtiment 230, F-13108 Saint-Paul-Lez-Durance, France*

(Received December 13, 2020; accepted January 15, 2021)

Neutron reaction data for the set of major chromium isotopes were reevaluated from the thermal energy range up to 20 MeV. In the low energy region, updates to the thermal values together with an improved *R*-matrix analysis of the resonance parameters characterizing the cluster of large *s*-wave resonances for ^{50,53}Cr isotopes were performed. In the intermediate and high energy range up to 20 MeV, the evaluation methodology used statistical nuclear reaction models implemented in the EMPIRE code within the Hauser-Feshbach framework to evaluate the reaction cross sections and angular distributions. Exceptionally, experimental data were used to evaluate relevant cross sections above the resonance region up to 5 MeV in the major ^{52}Cr isotope. Evaluations were benchmarked with Monte Carlo simulations of a small suite of critical assemblies highly sensitive to Chromium data, and with the Oktavian shielding benchmark to judge deep penetration performance with a 14-MeV D-T neutron source. A significant improvement in performance is demonstrated compared to existing evaluations.

CONTENTS

I. Introduction 2
II. Resolved Resonance Region 4
A. Background 4
B. Estimation of Multiple-Scattering Corrections 5
1. Finite size and infinite-slab approximation 5
2. Experimental corrections estimated by the MCNP 6
C. Results 7
D. Direct-Semidirect (DSD) neutron capture cross sections 10
E. Angular distributions in the RRR 12
III. Experimental Constraints on Fast-region Fluctuations 14
IV. Evaluated Results in the Fast Range 18
A. Cross Sections 19
1. Total Cross Sections 20
2. Elastic Cross Sections 21
3. Inelastic Cross Sections 21
4. Capture Cross Sections 22
5. (*n*, 2*n*) Cross Sections 22
6. (*n*, *p*) Cross Sections 22
B. Elastic and Inelastic Angular Distributions 24
C. Energy Spectra 25
D. Double Differential Cross Sections 25
1. Neutron Double-Differential Spectra 27
2. γ Spectra 28
V. Validation 29
A. Criticality Benchmarks 29
B. D-T Neutron Leakage Experiments 30
C. CEA Pile-oscillation Experiments in MINERVE Reactor 31
VI. Conclusions and Recommendations 34
Acknowledgments 35
References 35

* Corresponding author: gnobre@bnl.gov

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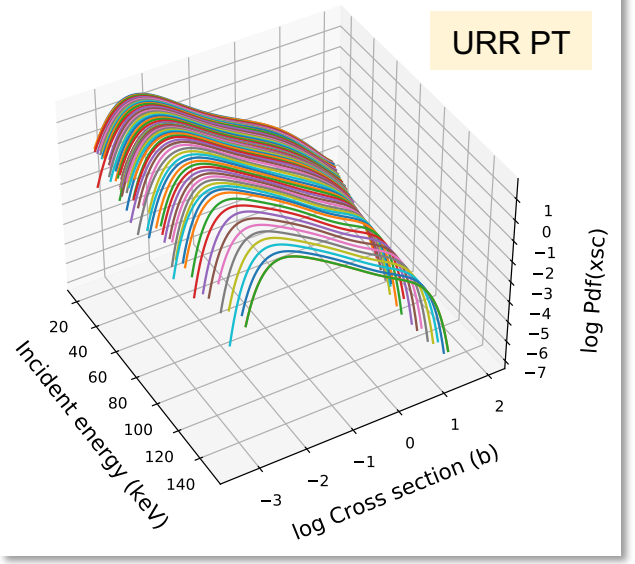
INDEN Cr: published!

Capture PDF for ^{238}U+n at 0K

URR PT



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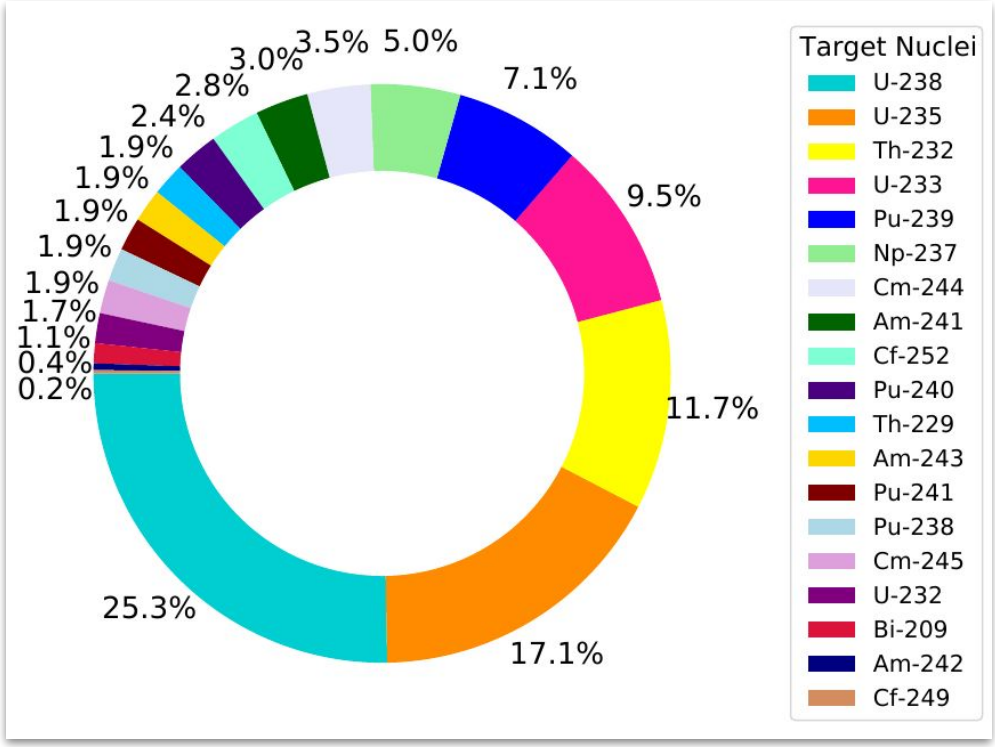
Fission Yield Highlight

- Retrieval, and compilation of over 538 independent **isomeric yield ratios**, from 39 compound nuclei, and 62 unique fission products.

- Identification of outliers (decay data, isomeric state assignments, trends vs IYR in other measured systems)

- New recommended experimental yields ratios for low-energy neutron induced fission and SF



C. Sears, *et al.* "Compilation and Evaluation of Isomeric Fission Yield Ratios." *Nucl Data Sheets* 173 (2021): 118.

Work on Fission Yields retrieval, compilation and update continues to include ^{241,239}Pu...

C. Sears
(Smith College)

D. Potemkin
(SUNY Stonybrook)

Brookhaven National Laboratory

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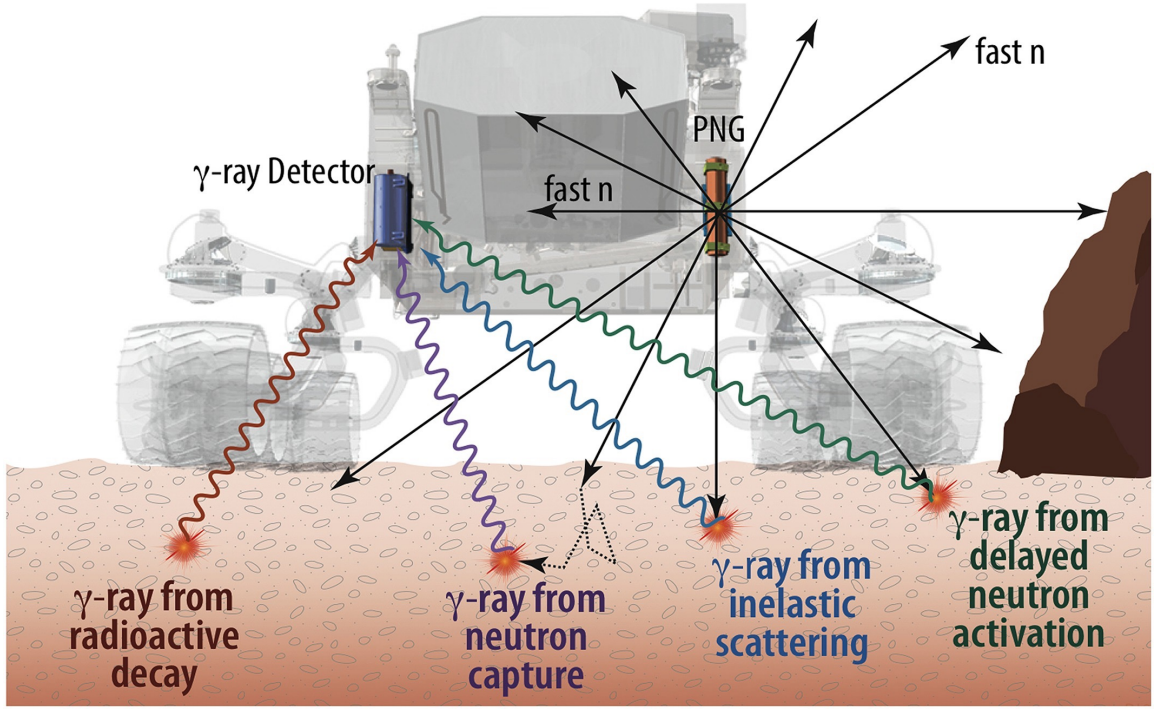
U.S. DEPARTMENT OF ENERGY

New directions

(some expected, some not!)

Gamma-Rays Induced by Neutrons (GRIN) – NA-22 Multilab project

- Oct. 28th kickoff
- Led by BNL, with LLNL & LBNL
- Aimed at improving inelastic and capture reaction gamma production simulations
- Serves both non-proliferation & space science
- An opportunity to bridge ENSDF & ENDF workflows



This project & RHIC fixed target experiments as way to engage NASA

National Laboratory

Nowicki, S. F., et al, (2017), Modeled Martian subsurface elemental composition measurements with the Probing In situ with Neutron and Gamma ray instrument, Earth and Space Science, 4, 76– 90, doi:10.1002/2016EA000162.

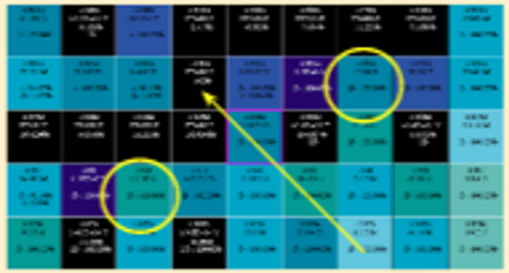
Accurate Decay Data for Forensics

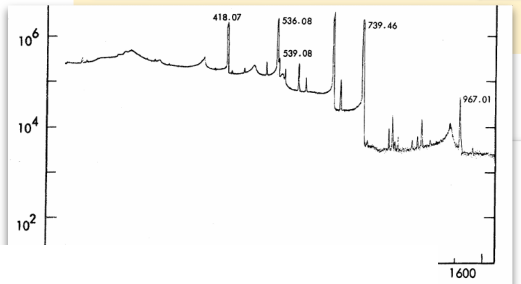
- The **International Monitoring System** of the CTBT is a worldwide network of radiation detectors, continuously monitoring for the **presence of radionuclides** that can provide **evidence of a nuclear event**
- The most common way to identify fission products and determine their yield, is to **measure the characteristic γ-rays** emitted in their decay ("activation technique")
- Proposed new measurement campaign to improve **knowledge of** nuclear decay data (*i.e.,* **γ-ray energy** and **intensities**)

FY21 Measurements

Iodine-130

- "blocked" fragment, highly-sensitive to fuel/n-energy changes
- ENSDF based on a 1973 measurement, with more recent experiments reporting intensities disagreeing by as much as 10%

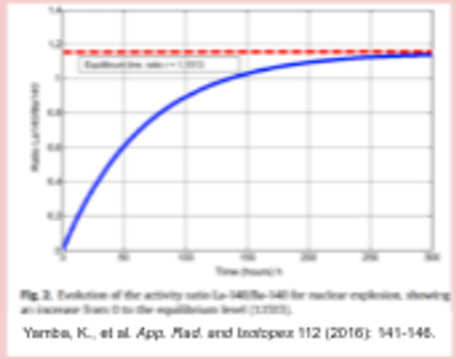




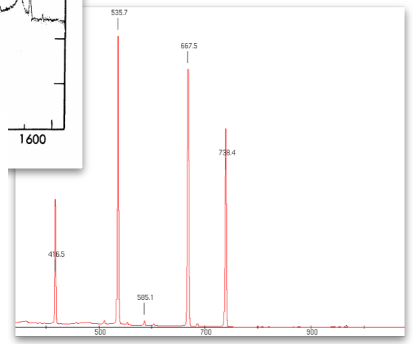
dramatic improvement in sensitivity wrt previously available data

Lanthanum-140

- along with Ba-140, is a well-known chronometer used to date a nuclear event
- evaluated intensities originate from a single publication from 1991



Yamba, K., et al. *App. Rad. and Isotopes* 112 (2016): 141-146.



data currently being analyzed and readied for publication...

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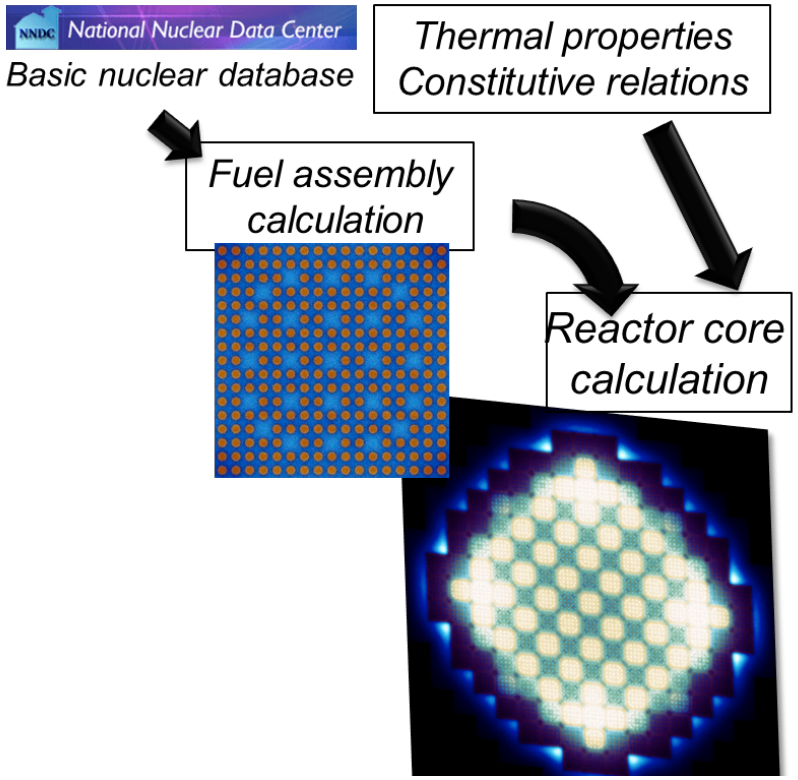
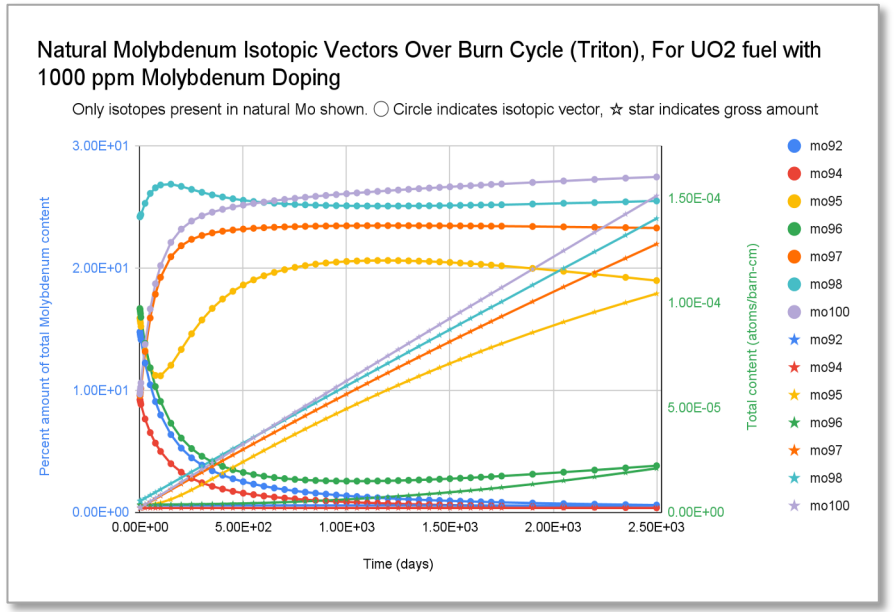
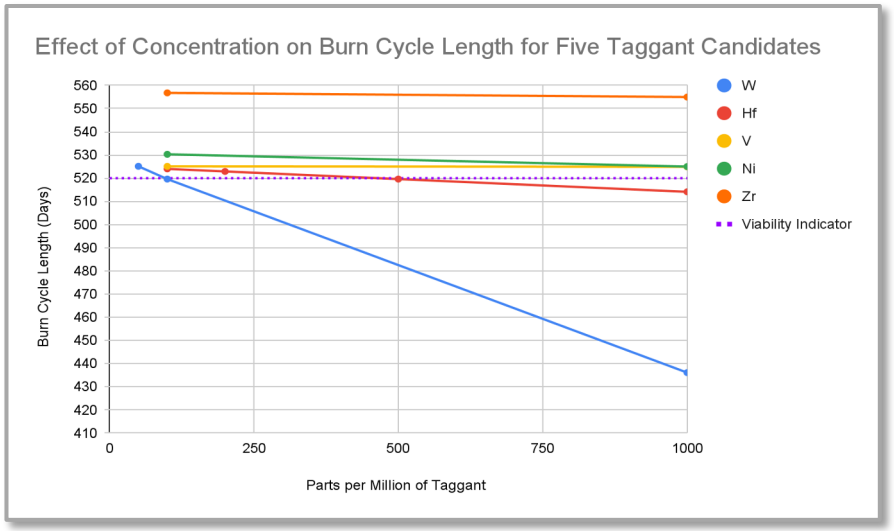
Intentional Forensics

NA-22 Venture



- Neutronics modeling of taggant performance
- ENDF/B-VIII.0 being used to model taggant effects & performance
- We are developing nuclear data “quality” metric to guide AI/ML optimizations (“feature engineering”)





Plots from A. Cuadra & summer interns C. Sears, S. Jones, E. Schess

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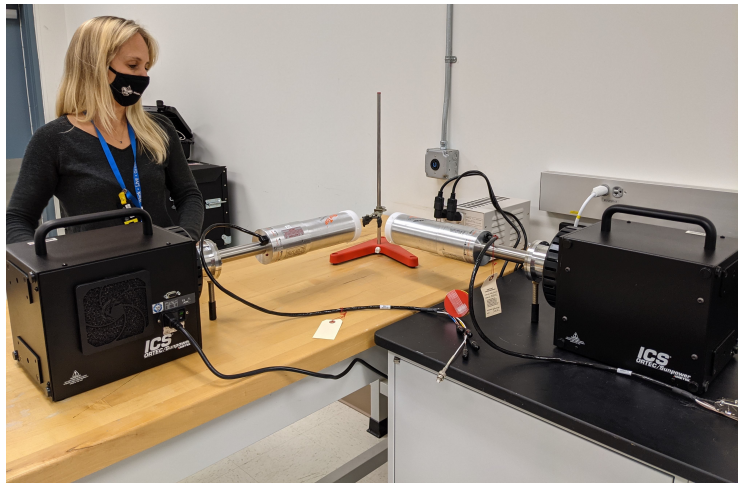
BNL making significant investment in Nuclear Data and Related Infrastructure

Program Development funds for $\alpha\beta\gamma$ spectrometer

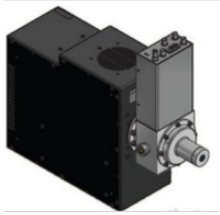
Precision decay studies
Complements in-house production capabilities (BLIP and tandem)

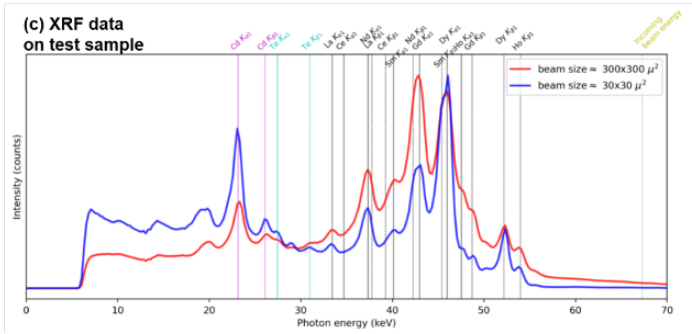


PD funds for fission yield measurements at NSLSII

(a) MIRION XRF detector
(ordered, fabricated in EU, will arrive BNL in September 2021)

(b) HEXITEC XRF detector
(loaned, tested at NSLS-II)

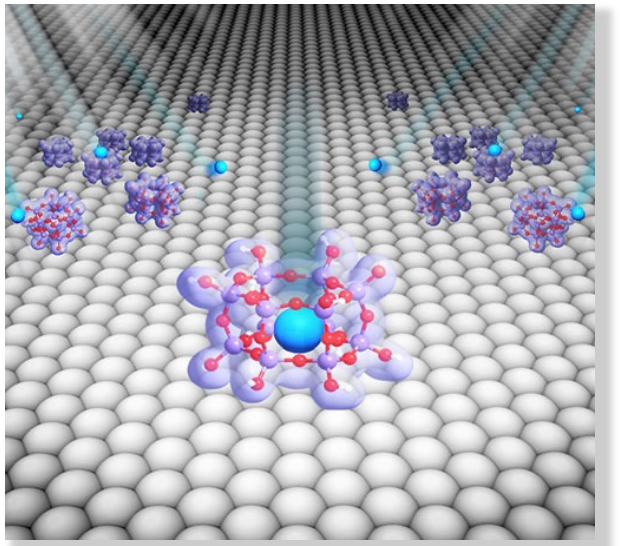




LDRD funding for Silica NanoCages

Trapping noble gases for medical isotopes, energy and nonproliferation

BLIP, CFN, NNDC Collaboration



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