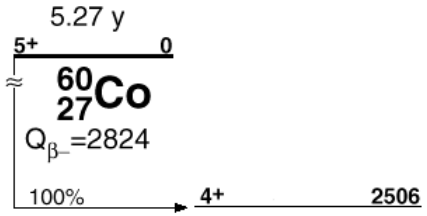
USNDP Berkeley Isotopes Project

Richard B. Firestone
Isotopes Project, Lawrence Berkeley National Laboratory,
Berkeley, CA 94720



Isotopes Project Group Members

Richard B. Firestone – Group Leader* (USNDP, ANS&T)
Shamsu Basunia – Group Leader† (ARRA, USNDP)
Aaron Hurst – Staff scientist (ANS&T, USNDP)
Lee Bernstein – Visiting scientist (LLNL, UC Berkeley)
Edgardo Browne – Emeritus staff scientist (NNDC)
Coral Baglin – Emeritus staff scientist
Andrew Rogers – Postdoc (ANS&T, USNDP)
Graduate Students –

Christoph Genreith (Forschungszentrum Jülich GmbH)
Andrew Lerch (U.S. Army Advanced Civil Schooling)
Danyal Turkoghu (Ohio State University)

Undergraduate student - Adriana Ureche (UC Berkeley,)
Funding sources FY2013:

USNDP – 1.9 FTE	ARRA – 1 FTE
ANS&T – 2 FTE	NNDC – 0.4 FTE

* Retired 10/1/2013, †Interim, 10/2/2013 to present

Isotope Project Collaborators

LLNL/LBNL ENDF γ-ray Library – B. Sleaford, N. Summers, J. Escher

LLNL National Ignition Facility – L. Bernstein

UC Berkeley Nuclear Engineering – K. van Bibber, K.-N. Leung, B. Goldblum

Budapest Reactor – T. Belgya, L. Szentmiklosi

Garching FRM-II Reactor – Zs. Revay, P. Kudejova

Charles University, Prague – M. Krticka, F. Becvar

Evaluation of Reaction γ-ray Data – S. Siem, M. Guttormsen (Oslo Cyclotron)

TransActinide Nuclear Data Evaluation and Measurement (TANDEM) – M. Rossbach, C. Genreith (Jülich Forschungszentrum)

Berkeley Geochronology Center – P. Renne

Seoul National University, Korea – H. Choi

U.S. Army Research Laboratory – J. Carroll

Mass Chain Evaluations

Mass Chain Evaluations

A=28, M.S. Basunia, Nuclear Data Sheets **114**, 1189 (2013)

A=91, C.M. Baglin, Nuclear Data Sheets **114**, 1293 (2013)

A=92, C.M. Baglin, Nuclear Data Sheets **113**, 2187 (2013)

A=211, B. Singh, D. Abriola, C. Baglin, V. Demetriou, T. Johnson, E. McCutchan, G. Mukherjee, S. Singh, A. Sonzogni, and J. Tuli, Nuclear Data Sheets 114, 661 (2013)†

A=231, E. Browne and J.K. Tuli, Nuclear Data Sheets **114**, 751 (2013)*

A=251-259 (odd), E. Browne and J.K. Tuli, Nuclear Data Sheets **114**, 1041 (2013)*

Nuclide Evaluations - ***^{167}Ta, ^{186}Po:*** C.M. Baglin

XUNDL Evaluations – ***^{169,170}Re:*** C.M. Baglin

† Work produced in IAEA/ICTP training session

* Work funded by the NNDC

EGAF Evaluation Status

Publications (47 isotopes)

Z=1-17 (25 isotopes) – Proceedings of ND2013

^{23}Na(n,γ) – submitted to Phys. Rev. C.

^{39,40,41}K(n,γ) – Phys. Rev. C **87**, 024605 (2013).

^{102,104,105,106,108,110}Pd(n,γ) – Phys. Rev. C **77**, 054615 (2008).

^{152,154}Eu(n,γ) – Proceedings of ND2013

^{155,157}Gd(n,γ) – Nucl. Sci. Eng. In press.

^{182,183,184,186}W(n,γ) – submitted to Phys. Rev. C.

Evaluations in progress (13 isotopes)

^{54,56,57,58}Fe(n,γ) – Firestone, Krticka

^{89}Y(n,γ) – Abusaleem, Hurst

^{93}Nb,^{103}Rh(n,γ) – Turkoghu, Basunia

^{139}La(n,γ) – Ureche, Hurst

^{180}W(n,γ) – Hurst

^{185}Re(n,γ) – Lerch, Hurst, Carroll

^{237}Np,^{241}Am,^{242}Pu(n,γ) – Genreith, Hurst

^{238}U(n,γ) – Basunia, Genreith, Sleaford

Recent Measurements (Garchin FRM-II)

^{70,72,74,76}Ge, ^{90,91,92,94}Zr, ^{192,196,198}Pt(n,γ) – Firestone, Oslo Group

Research Highlights – W EGAF Evaluation

A.M. Hurst, et al, *A structural evaluation of the tungsten isotopes via thermal neutron capture,* submitted to Phys. Rev. C.

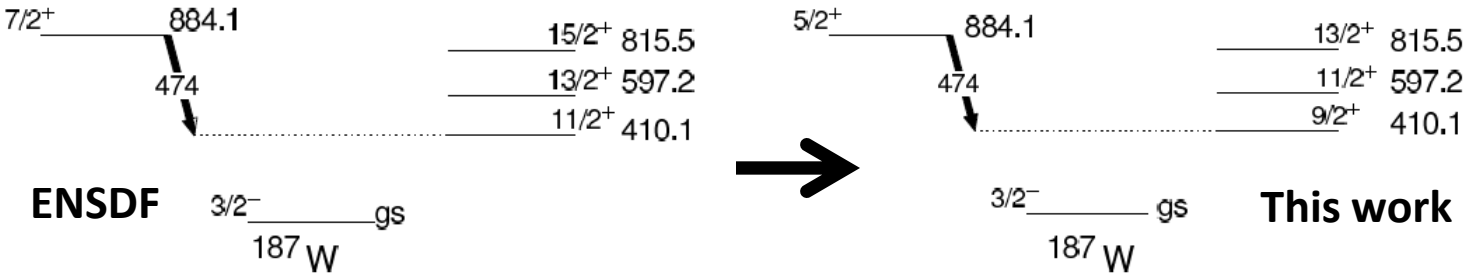
Tungsten Thermal (n,γ) Cross Sections		
Isotope	**Cross section (b)**	
	This work	**Atlas**
$^{182}W(n,\gamma)^{183}W$	20.5(14)	19.9(3)
$^{182}W(n,\gamma)^{183}W^{m}$	0.177(18)	---
$^{183}W(n,\gamma)^{184}W$	9.4(4)	10.4(2)
$^{183}W(n,\gamma)^{184}W^{m}$	0.025(6)	---
$^{184}W(n,\gamma)^{185}W$	1.43(10)	1.7(1)
$^{184}W(n,\gamma)^{185}W^{m}$	0.0062(16)	---
$^{186}W(n,\gamma)^{187}W$	33.3(6)	38.1(5)
$^{186}W(n,\gamma)^{187}W^{m}$	0.400(16)	---

^{187}W β– decay P_{γ}(686 keV)	
This work	0.352(9)
ENSDF	0.332(5)

Tungsten Neutron Separation Energy		
Isotope	**S_n (keV)**	
	This Work	**AME**
^{183}W	6190.88(6)	6190.81(5)
^{184}W	7411.11(13)	7411.66(25)
^{185}W	5753.74(5)	5753.71(30)
^{187}W	5466.62(7)	5466.79(5)

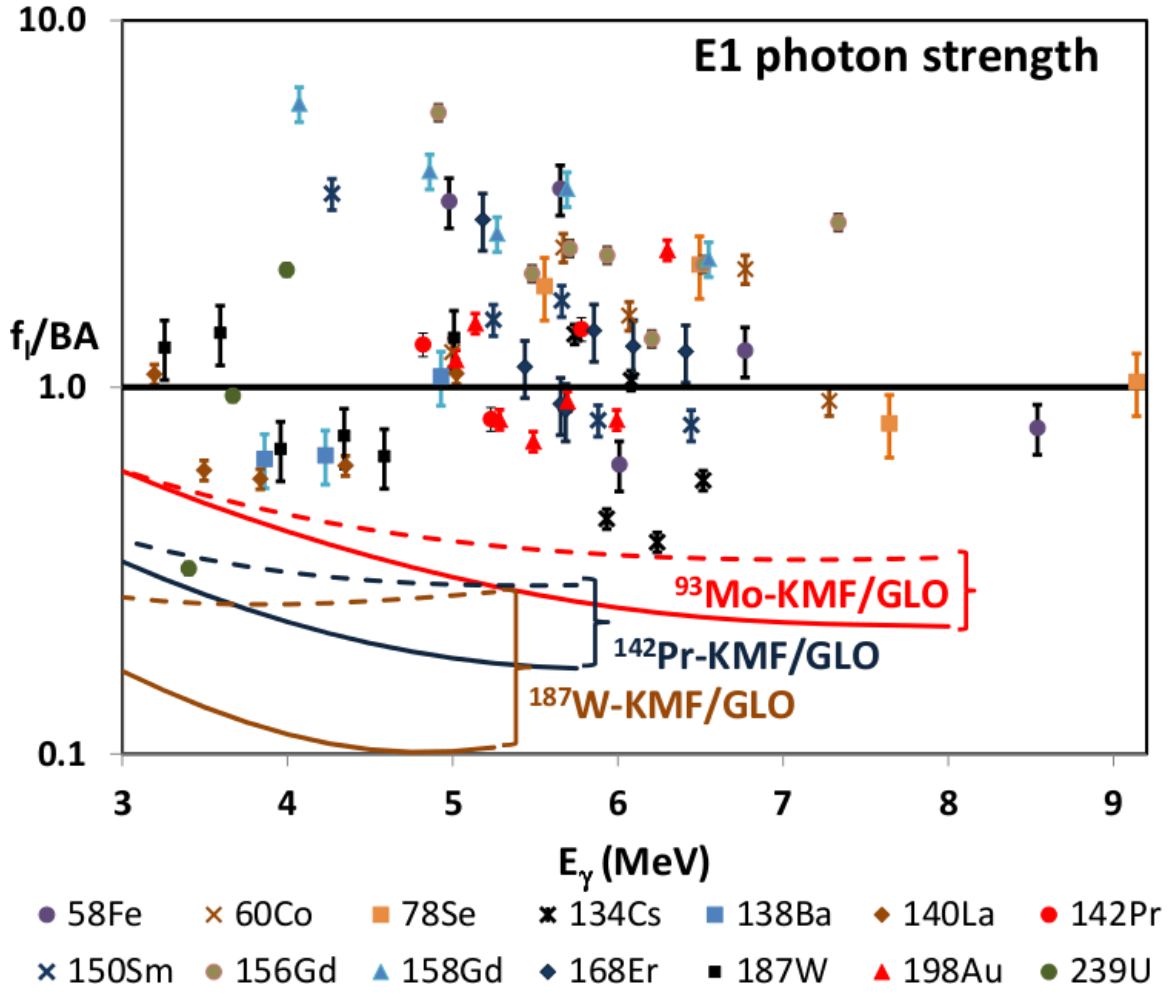
Improved Tungsten Adopted Level, Gamma Data

New Tungsten Nuclear Structure Data				
Isotope	**^{183}W**	**^{184}W**	**^{185}W**	**^{187}W**
# levels below E_{crit} (RIPL)	11	12	8	3
# levels below E_{crit} (This work)	12	18	11	40
New J^{π} assignments	1	1	3	16
New levels placed	0	0	0	1
Previous levels removed	1	1	0	0
New γ-rays placed	1	2	2	5

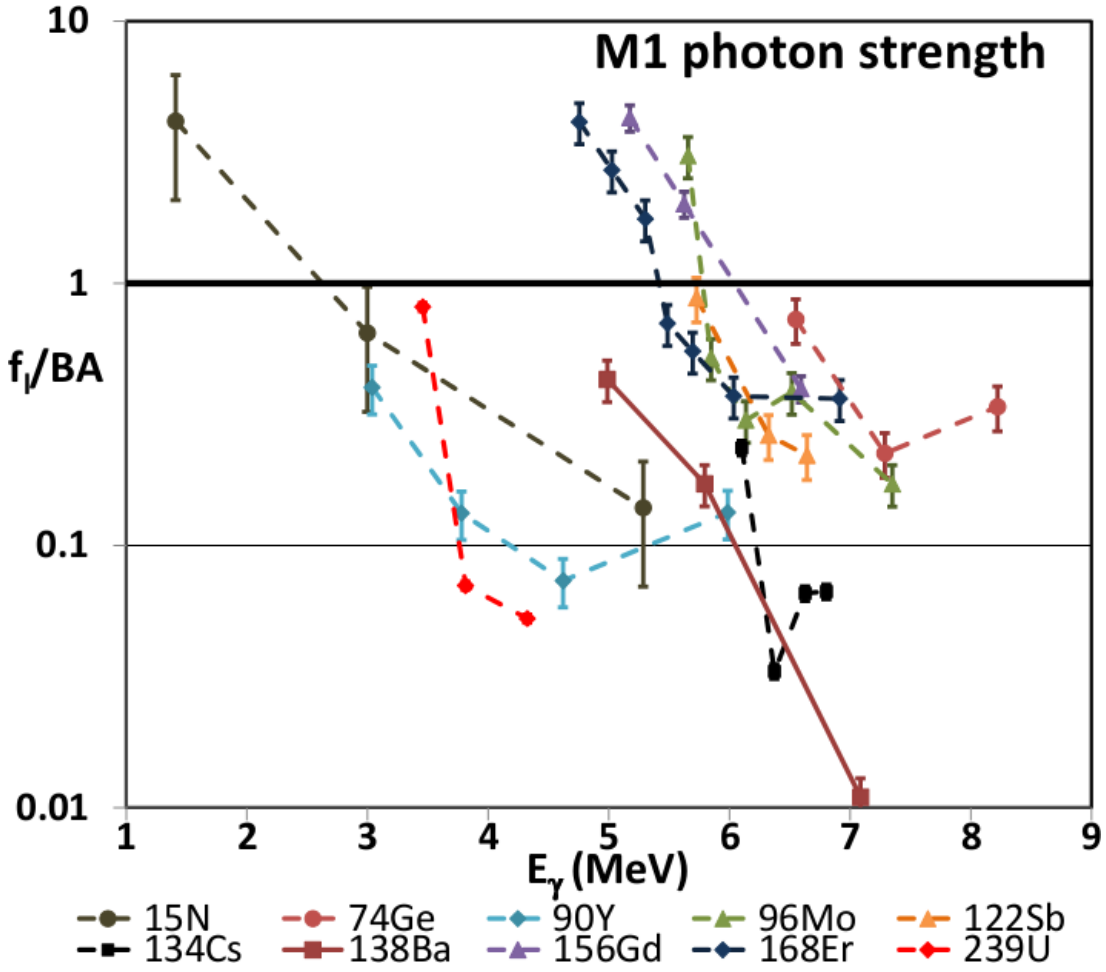


J^{π} of -26.6 eV bound resonance	
ENSDF	$(0,1)^-$
This work	1^-

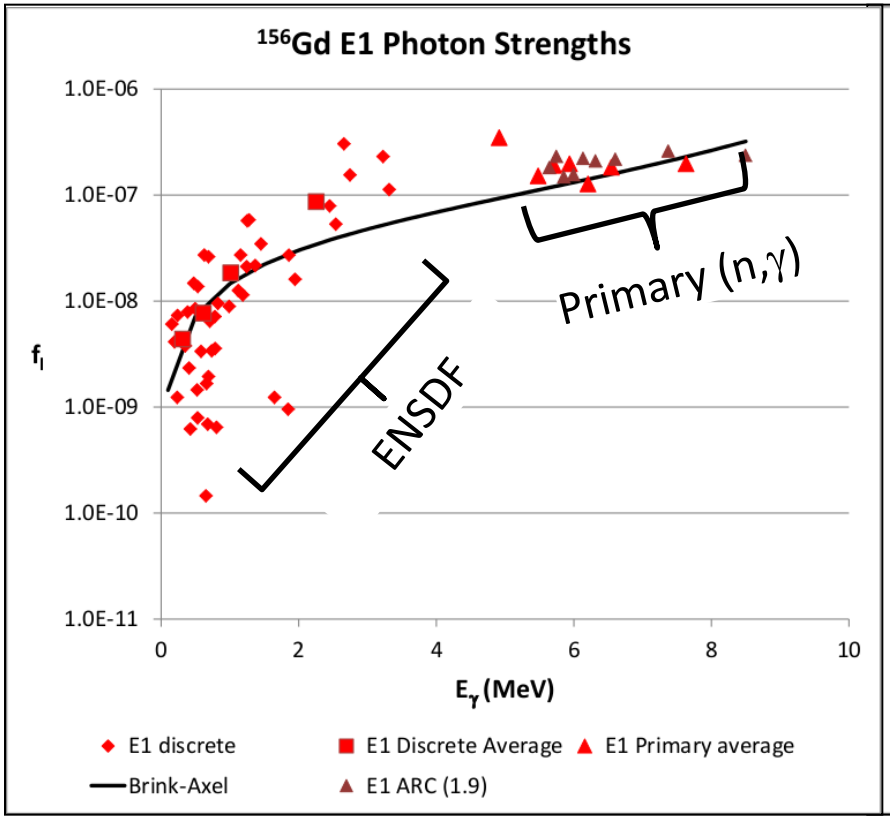
E1 Photon Strengths from Primary Thermal Neutron Capture γ-rays

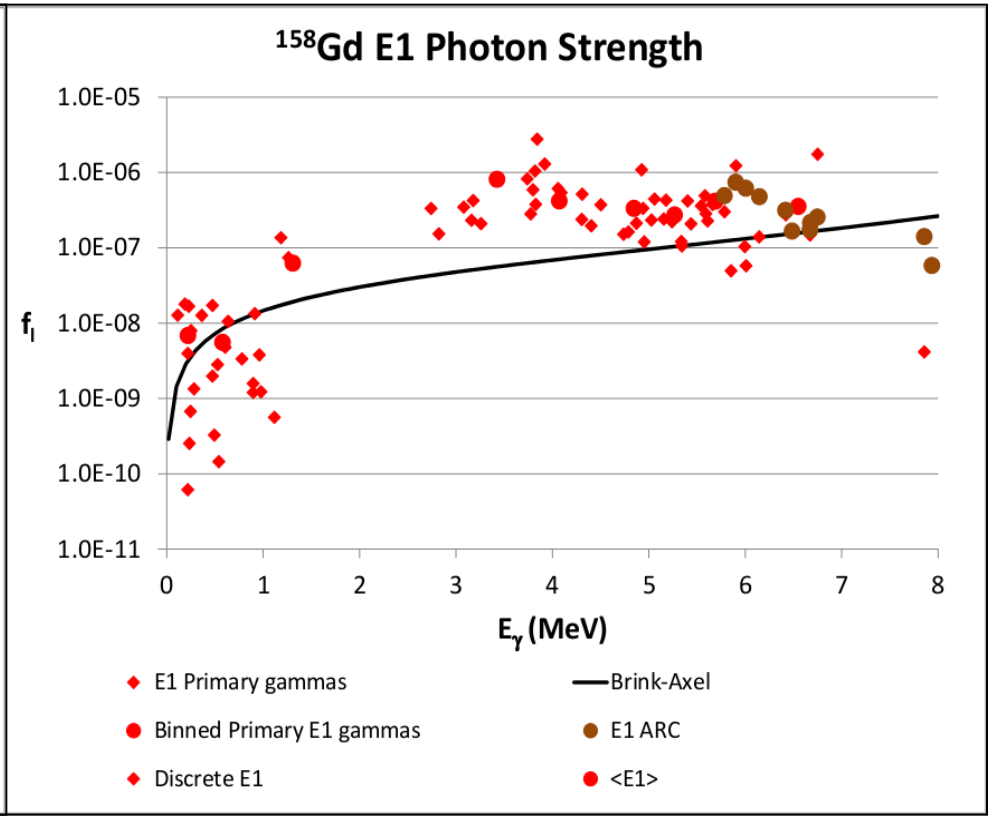


M1 Photon Strengths from Primary Thermal Neutron Capture γ-rays



^{156,158}Gd E1 Photon Strengths





LBNL Isotopes Project Future Plans

ENSDF Evaluation (A=21-30…)

- Recent retirements of 2 senior staff, retention of ARRA evaluator
- Hire/retain/train new evaluators
- Evaluate Adopted Levels, Gammas for (n,γ) nuclides
- Evaluate (n,γ) activation decay data

EGAF

- Participation of international collaborators and students
- Evaluate Actinide/transactinide data
- New IAEA initiative to create a database of photonuclear and reaction γ-ray data for photon strength studies.

AME

- Evaluate (n,γ) neutron separation energies

Nuclear Cross Section Measurements

- Thermal neutrons – FRM-II (Garchiing) and Budapest Reactor
- 2.5 MeV neutrons – UC Berkeley D+D Neutron generator
- High energy neutrons – LBNL 88” cyclotron
- Photon strength studies with primary (n,γ) γ-rays.


I'm
Retired
Not Expired