

*Texas A&M University*  
*US Nuclear Data Program*

*TAMU ENSDF Report*  
*FY2017*

*N. Nica*

*J.C. Hardy*

# *Evaluation of Nuclear Structure and Decay Data*

## *OVERVIEW*

- *Scope:*

*Promote and accomplish mass-chain nuclear structure data evaluation at Texas A&M University - Cyclotron Institute as regular activity and foresee future developments.*

- *New Nuclear Data Evaluation Center at the Cyclotron Institute is continuing the effort we have invested in this respect since 2005 that was financed by a contract with the National Nuclear Data Center at Brookhaven National Laboratory.*
- *The actual status is based on the financing addressed directly at Cyclotron Institute by DOE Grant*

# *NSDD Evaluation Centers*

- *North America:*
  - *US – 7 centers -> Texas A&M the 7<sup>th</sup> center*
  - *Canada – 1 center*
- *Asia:*
  - *China – 2 centers*
  - *India – 1 center*
  - *Japan – 1 center*
- *Europe:*
  - *Russia – 1 center*
  - *Hungary – 1 center*
  - *Romania – 1 center*
- *Australia: 1 center*

***I. Overview:***  
***Texas A&M Nuclear Data Program***  
***under Contract with BNL/NNDC***

***Since 2005 to 2016***

- ***Intended to help the major crisis of evaluators (because of many retiring evaluators)***
- ***Initiated by J.C. Hardy, R.G. Helmer, J.K. Tuli***
- ***N. Nica (PI, evaluator) and J.C. Hardy (scientific adviser)***
- ***It placed Texas A&M from the very beginning as one of the productive evaluation centers although officially we were not counted as an autonomous center***
- ***67% FTE Mass Chain Evaluation***
- ***evaluated 210 nuclei, 16 mass chains, published 14 papers (NDS)***

*Texas A&M - Cyclotron Institute*  
*part of U.S. Nuclear Data Program*  
*under contract with NNDC-BNL (subcontract #100586):*  
*Period 2005 – 2016, 67% FTE Mass Chain Evaluation*

- *Initiated in 2005*
  - *At Texas A&M by J.C. Hardy based on his precision measurements and evaluations on the superallowed  $0^+$  to  $0^+$  beta decay, as well as on his network of collaborators, particularly R.G. Helmer, a distinguished experimentalist and mass-chain data evaluator*
  - *At BNL-NNDC by J.K. Tuli, A.A. Sonzogni, T.W. Burrows (mentor)*
  - *Basically as part of the effort to bring new ENSDF evaluators, as effect of “evaluation crisis”*
- *67% FTE, one major A-chain/FY*
- *Texas A&M precision measurements of ICC are a major contribution to NSDD/USNDP*
  - *9 major E3, M4 transitions, mostly  $\alpha_K$  ICC, and fewer  $\alpha_T$ :*
    - *$^{125}\text{Te}$ ,  $^{127}\text{Te}$ ,  $^{111}\text{Cd}$ ,  $^{119}\text{Sn}$ ,  $^{139}\text{La}$ ,  $^{134}\text{Cs}$ ,  $^{137}\text{Ba}$ ,  $^{197}\text{Pt}$ ,  $^{193}\text{Ir}$*
  - *1 fluorescence yield  $\omega_K$  of Iridium:  $^{191}\text{Os}(\beta^-)$*
  - *13 major publications*
  - *BrIcc adopted the “Frozen Orbitals” calculations based on Texas A&M ICC measurements*

# Mass Chain Evaluation: 200+ nuclei, 16 A-chains

- 1. [N.Nica](#), *Nuclear Data Sheets for A = 252*, Nucl.Data Sheets 106, 813 (2005)  
8 nuclei:  $^{252}\text{Cm}$ ,  $^{252}\text{Bk}$ ,  $^{252}\text{Cf}$ ,  $^{252}\text{Es}$ ,  $^{252}\text{Fm}$ ,  $^{252}\text{Md}$ ,  $^{252}\text{No}$ ,  $^{252}\text{Lr}$
- 2. [N.Nica](#), *Nuclear Data Sheets for A = 140*, Nucl.Data Sheets 108, 1287 (2007)  
16 nuclei:  $^{140}\text{Te}$ ,  $^{140}\text{I}$ ,  $^{140}\text{Xe}$ ,  $^{140}\text{Cs}$ ,  $^{140}\text{Ba}$ ,  $^{140}\text{La}$ ,  $^{140}\text{Ce}$ ,  $^{140}\text{Pr}$ ,  $^{140}\text{Nd}$ ,  $^{140}\text{Pm}$ ,  $^{140}\text{Sm}$ ,  $^{140}\text{Eu}$ ,  $^{140}\text{Gd}$ ,  $^{140}\text{Tb}$ ,  $^{140}\text{Dy}$ ,  $^{140}\text{Ho}$
- 3. [D.Abriola et al.](#), *Nuclear Data Sheets for A = 84*, Nucl.Data Sheets 110, 2815 (2009)  
1 nucleus:  $^{84}\text{Y}$
- 4. [N.Nica](#), *Nuclear Data Sheets for A = 147*, Nucl.Data Sheets 110, 749 (2009)  
16 nuclei:  $^{147}\text{Xe}$ ,  $^{147}\text{Cs}$ ,  $^{147}\text{Ba}$ ,  $^{147}\text{La}$ ,  $^{147}\text{Ce}$ ,  $^{147}\text{Pr}$ ,  $^{147}\text{Nd}$ ,  $^{147}\text{Pm}$ ,  $^{147}\text{Sm}$ ,  $^{147}\text{Eu}$ ,  $^{147}\text{Gd}$ ,  $^{147}\text{Tb}$ ,  $^{147}\text{Dy}$ ,  $^{147}\text{Ho}$ ,  $^{147}\text{Er}$ ,  $^{147}\text{Tm}$
- 5. [N.Nica](#), *Nuclear Data Sheets for A = 97*, Nucl.Data Sheets 111, 525 (2010)  
14 nuclei:  $^{97}\text{Br}$ ,  $^{97}\text{Kr}$ ,  $^{97}\text{Rb}$ ,  $^{97}\text{Sr}$ ,  $^{97}\text{Y}$ ,  $^{97}\text{Zr}$ ,  $^{97}\text{Nb}$ ,  $^{97}\text{Mo}$ ,  $^{97}\text{Tc}$ ,  $^{97}\text{Ru}$ ,  $^{97}\text{Rh}$ ,  $^{97}\text{Pd}$ ,  $^{97}\text{Ag}$ ,  $^{97}\text{Cd}$
- 6. [J.Cameron](#), [J.Chen](#), [B.Singh](#), [N.Nica](#), *Nuclear Data Sheets for A = 37*, Nucl.Data Sheets 113, 365 (2012)  
10 nuclei:  $^{37}\text{Na}$ ,  $^{37}\text{Mg}$ ,  $^{37}\text{Al}$ ,  $^{37}\text{Si}$ ,  $^{37}\text{P}$ ,  $^{37}\text{S}$ ,  $^{37}\text{Cl}$ ,  $^{37}\text{Ar}$ ,  $^{37}\text{K}$ ,  $^{37}\text{Ca}$
- 7. [N.Nica](#), [J.Cameron](#), [B.Singh](#), *Nuclear Data Sheets for A = 36*, Nucl.Data Sheets 113, 1 (2012)  
10 nuclei:  $^{36}\text{Na}$ ,  $^{36}\text{Mg}$ ,  $^{36}\text{Al}$ ,  $^{36}\text{Si}$ ,  $^{36}\text{P}$ ,  $^{36}\text{S}$ ,  $^{36}\text{Cl}$ ,  $^{36}\text{Ar}$ ,  $^{36}\text{K}$ ,  $^{36}\text{Ca}$
- 8. [N.Nica](#), [B.Singh](#), *Nuclear Data Sheets for A = 34*, Nucl.Data Sheets 113, 1563 (2012)  
11 nuclei:  $^{34}\text{Ne}$ ,  $^{34}\text{Na}$ ,  $^{34}\text{Mg}$ ,  $^{34}\text{Al}$ ,  $^{34}\text{Si}$ ,  $^{34}\text{P}$ ,  $^{34}\text{S}$ ,  $^{34}\text{Cl}$ ,  $^{34}\text{Ar}$ ,  $^{34}\text{K}$ ,  $^{34}\text{Ca}$
- 9. [B.Singh](#), [N.Nica](#), *Nuclear Data Sheets for A = 77*, Nucl.Data Sheets 113, 1115 (2012)  
12 nuclei:  $^{77}\text{Ni}$ ,  $^{77}\text{Cu}$ ,  $^{77}\text{Zn}$ ,  $^{77}\text{Ga}$ ,  $^{77}\text{Ge}$ ,  $^{77}\text{As}$ ,  $^{77}\text{Se}$ ,  $^{77}\text{Br}$ ,  $^{77}\text{Kr}$ ,  $^{77}\text{Rb}$ ,  $^{77}\text{Sr}$ ,  $^{77}\text{Y}$
- 10. [N.Nica](#), *Nuclear Data Sheets for A = 148*, Nucl.Data Sheets 117, 1 (2014)  
16 nuclei:  $^{148}\text{Xe}$ ,  $^{148}\text{Cs}$ ,  $^{148}\text{Ba}$ ,  $^{148}\text{La}$ ,  $^{148}\text{Ce}$ ,  $^{148}\text{Pr}$ ,  $^{148}\text{Nd}$ ,  $^{148}\text{Pm}$ ,  $^{148}\text{Sm}$ ,  $^{148}\text{Eu}$ ,  $^{148}\text{Gd}$ ,  $^{148}\text{Tb}$ ,  $^{148}\text{Dy}$ ,  $^{148}\text{Ho}$ ,  $^{148}\text{Er}$ ,  $^{148}\text{Tm}$
- 11. [N.Nica](#), *Nuclear Data Sheets for A = 141*, Nucl.Data Sheets 122, 1 (2014)  
16 nuclei:  $^{141}\text{Te}$ ,  $^{141}\text{I}$ ,  $^{141}\text{Xe}$ ,  $^{141}\text{Cs}$ ,  $^{141}\text{Ba}$ ,  $^{141}\text{La}$ ,  $^{141}\text{Ce}$ ,  $^{141}\text{Pr}$ ,  $^{141}\text{Nd}$ ,  $^{141}\text{Pm}$ ,  $^{141}\text{Sm}$ ,  $^{141}\text{Eu}$ ,  $^{141}\text{Gd}$ ,  $^{141}\text{Tb}$ ,  $^{141}\text{Dy}$ ,  $^{141}\text{Ho}$
- 12. [N.Nica](#), *Nuclear Data Sheets for A = 157*, Nucl.Data Sheets 132, 1 (2016)  
15 nuclei:  $^{157}\text{Nd}$ ,  $^{157}\text{Pm}$ ,  $^{157}\text{Sm}$ ,  $^{157}\text{Eu}$ ,  $^{157}\text{Gd}$ ,  $^{157}\text{Tb}$ ,  $^{157}\text{Dy}$ ,  $^{157}\text{Ho}$ ,  $^{157}\text{Er}$ ,  $^{157}\text{Tm}$ ,  $^{157}\text{Yb}$ ,  $^{157}\text{Lu}$ ,  $^{157}\text{Hf}$ ,  $^{157}\text{Ta}$ ,  $^{157}\text{W}$
- 13. [N.Nica](#), *Nuclear Data Sheets for A = 158*, Nucl.Data Sheets  
15 nuclei:  $^{158}\text{Nd}$ ,  $^{158}\text{Pm}$ ,  $^{158}\text{Sm}$ ,  $^{158}\text{Eu}$ ,  $^{158}\text{Gd}$ ,  $^{158}\text{Tb}$ ,  $^{158}\text{Dy}$ ,  $^{158}\text{Ho}$ ,  $^{158}\text{Er}$ ,  $^{158}\text{Tm}$ ,  $^{158}\text{Yb}$ ,  $^{158}\text{Lu}$ ,  $^{158}\text{Hf}$ ,  $^{158}\text{Ta}$ ,  $^{158}\text{W}$
- 14. [N.Nica](#), *Nuclear Data Sheets for A = 140*, Nucl.Data Sheets – *to be published*  
17 nuclei:  $^{140}\text{Sb}$ ,  $^{140}\text{Te}$ ,  $^{140}\text{I}$ ,  $^{140}\text{Xe}$ ,  $^{140}\text{Cs}$ ,  $^{140}\text{Ba}$ ,  $^{140}\text{La}$ ,  $^{140}\text{Ce}$ ,  $^{140}\text{Pr}$ ,  $^{140}\text{Nd}$ ,  $^{140}\text{Pm}$ ,  $^{140}\text{Sm}$ ,  $^{140}\text{Eu}$ ,  $^{140}\text{Gd}$ ,  $^{140}\text{Tb}$ ,  $^{140}\text{Dy}$ ,  $^{140}\text{Ho}$
- 15. [N.Nica](#), *A = 155, Nuclear Data Sheets for A = 155, Nucl.Data Sheets – to be published*  
16 nuclei:  $^{155}\text{Ce}$ ,  $^{155}\text{Pr}$ ,  $^{155}\text{Nd}$ ,  $^{155}\text{Pm}$ ,  $^{155}\text{Sm}$ ,  $^{155}\text{Eu}$ ,  $^{155}\text{Gd}$ ,  $^{155}\text{Tb}$ ,  $^{155}\text{Dy}$ ,  $^{155}\text{Ho}$ ,  $^{155}\text{Er}$ ,  $^{155}\text{Tm}$ ,  $^{155}\text{Yb}$ ,  $^{155}\text{Lu}$ ,  $^{155}\text{Hf}$ ,  $^{155}\text{Ta}$
- 16. [N.Nica](#), *A = 160, submitted to NNDC, to be published in Nucl.Data Sheets*  
17 nuclei:  $^{160}\text{Pr}$ ,  $^{160}\text{Nd}$ ,  $^{160}\text{Pm}$ ,  $^{160}\text{Sm}$ ,  $^{160}\text{Eu}$ ,  $^{160}\text{Gd}$ ,  $^{160}\text{Tb}$ ,  $^{160}\text{Dy}$ ,  $^{160}\text{Ho}$ ,  $^{160}\text{Er}$ ,  $^{160}\text{Tm}$ ,  $^{160}\text{Yb}$ ,  $^{160}\text{Lu}$ ,  $^{160}\text{Hf}$ ,  $^{160}\text{Ta}$ ,  $^{160}\text{W}$ ,  $^{160}\text{Re}$
- Work in Progress
- 17. [N.Nica](#), *A = 153*,  
16 nuclei:  $^{153}\text{La}$ ,  $^{153}\text{Ce}$ ,  $^{153}\text{Pr}$ ,  $^{153}\text{Nd}$ ,  $^{153}\text{Pm}$ ,  $^{153}\text{Sm}$ ,  $^{153}\text{Eu}$ ,  $^{153}\text{Gd}$ ,  $^{153}\text{Tb}$ ,  $^{153}\text{Dy}$ ,  $^{153}\text{Ho}$ ,  $^{153}\text{Er}$ ,  $^{153}\text{Tm}$ ,  $^{153}\text{Yb}$ ,  $^{153}\text{Lu}$ ,  $^{153}\text{Hf}$

***II. New Project:  
Texas A&M Nuclear Data Program  
under DOE Grant and new NSDD Evaluation Center***

***New Proposal with Cyclotron Institute Grant 2017-2019***

***Approved by 2017 NSDD meeting, Berkeley, CA***

- ***67% FTE Mass Chain Evaluation***
- ***N. Nica (PI, evaluator) and J.C. Hardy (scientific adviser)***
- ***Arguments for running as independent program:***
  - ***Texas A&M University operates at rather low overhead costs so cost-wise we are going to be among the efficient centers in the USNDP effort***
  - ***New Evaluation Center since May FY2017***

***II. New Project:  
Texas A&M Nuclear Data Program  
under DOE Grant and new NSDD Evaluation Center***

***New Proposal with Cyclotron Institute Grant 2017-2019***

***Approved by 2017 NSDD meeting, Berkeley, CA***

***Arguments for running as independent program:***

- Increasing gradually the FTE margin for the PI (Ninel Nica)***
- Hiring inexpensive undergraduate student workers***
- Adding (if possible) some post-doc FTE fraction to the ENSDF effort.***
- These are the main ways to add value to the whole NSDD effort.***



# ***A-Chain Evaluation Responsibility @Texas A&M University***

- *140, 141, 147, 148, 153, 155, 157, 158, 160,  
All but 153 were previously full-evaluated by  
N. Nica (140 twice)*

# *TAMU Commitment FY2018*

- *0.67 FTE*

- *One big mass chain:*

*A =153, 16 nuclei:  $^{153}\text{La}$ ,  $^{153}\text{Ce}$ ,  $^{153}\text{Pr}$ ,  $^{153}\text{Nd}$ ,  
 $^{153}\text{Pm}$ ,  $^{153}\text{Sm}$ ,  $^{153}\text{Eu}$ ,  $^{153}\text{Gd}$ ,  $^{153}\text{Tb}$ ,  $^{153}\text{Dy}$ ,  $^{153}\text{Ho}$ ,  
 $^{153}\text{Er}$ ,  $^{153}\text{Tm}$ ,  $^{153}\text{Yb}$ ,  $^{153}\text{Lu}$ ,  $^{153}\text{Hf}$*

*Actual size: about 20,000 ens lines*

*II. New Project:  
Texas A&M Nuclear Data Program  
under DOE Grant and NSDD Data Center*

*Promoting Scientific Research Programs  
related to data evaluation:*

- Continuing the Internal Conversion Coefficients precision measurements program*
- Promoting original research ideas from reevaluating existing data*

*III. Texas A&M University  
Nuclear Data Center*

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College Station, Texas 77843, USA

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