Texas A&M University
Cyclotron Institute

TAMU NSDD EVALUATION CENTER
Report Oct 2022 - Apr 2024

N. Nica

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.***
  - ***Address gaps in data through targeted experiments***
  - ***Promote data-based research***
- ***2005-2017: under contract with BNL/NNDC***
  - ***67% FTE Mass Chain Evaluation***
  - ***N. Nica (PI, evaluator), J.C. Hardy (scientific adviser)***
- ***2018-2024: NSDD Data Center***
  - ***FY2018: 67% FTE Mass Chain Evaluation***
  - ***FY2019-2022: 100% FTE Mass Chain Evaluation***
  - ***N. Nica (PI, evaluator), J.C. Hardy (scientific adviser)***

Texas A&M - Cyclotron Institute NSDD Center Contributions

- ***Major Direct Contribution to USNDP/NSDD: Nuclear Data Evaluation***
  - *19 publications*
- ***Important Contribution to USNDP/NSDD: Precision ICC Measurements***
  - *BrIcc adopted the "Frozen Orbitals" calculations*
  - *^{93}Nb, ^{103}Rh, ^{125}Te, ^{127}Te, ^{111}Cd, ^{119}Sn, ^{134}Cs, ^{137}Ba, ^{191}Os, ^{193}Ir, ^{197}Pt*
  - *18 publications*
- ***Texas A&M Contribution to Precision Nuclear Data Production: Precision β-γ Measurements (Standard Model, CKM matrix)***
  - *$T_{1/2}$, Branching Ratios, Efficiency calibration*
  - *21 publications*
- ***Texas A&M Medical Radioisotopes***
  - *^{67}Cu, ^{99}Mo*
  - *4 publications*

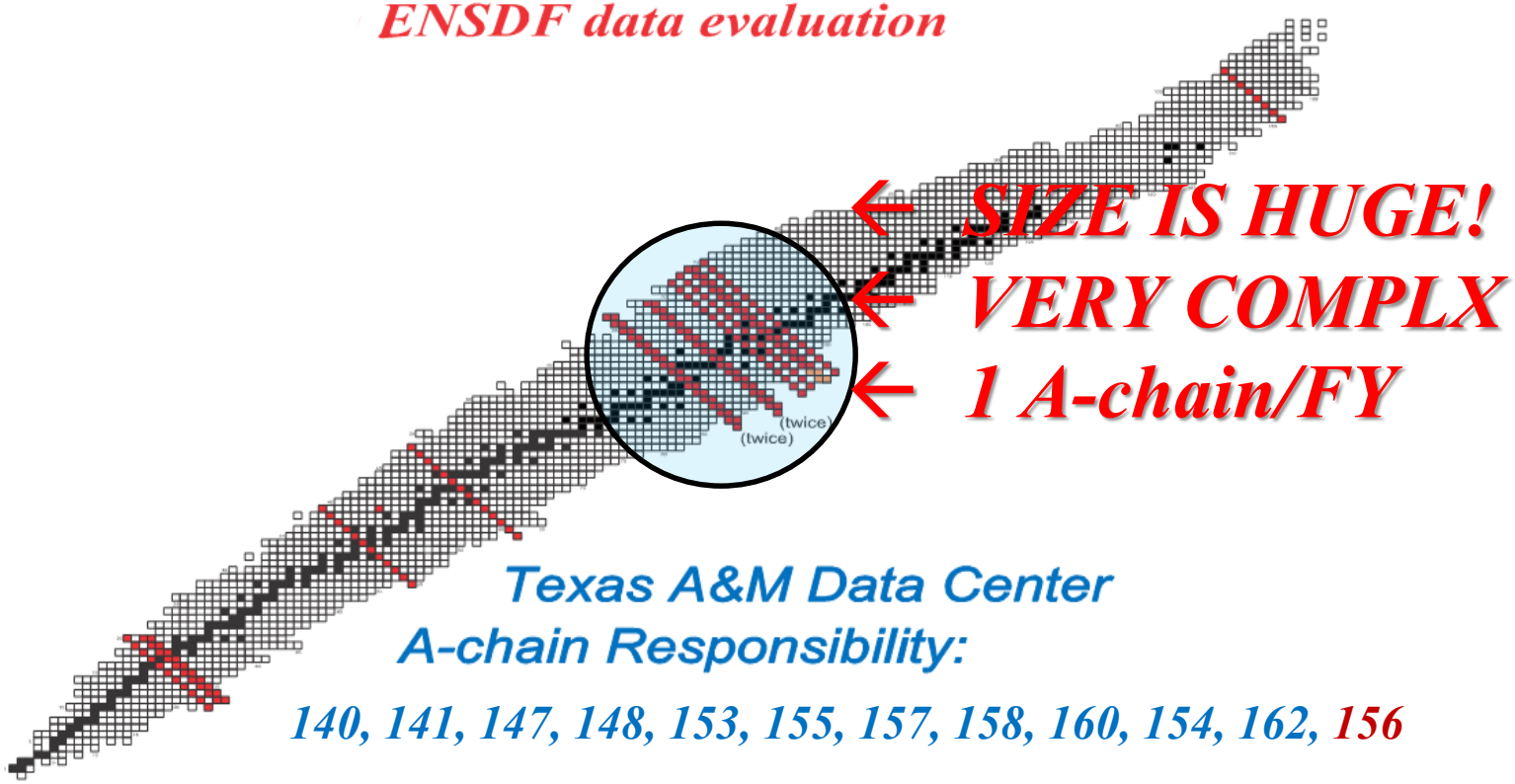
Mass Chain Evaluation: *310 nuclei, 22 A-chains*

- 1. N.Nica, *Nuclear Data Sheets for A = 252*, Nucl.Data Sheets 106, 813 (2005)
  8 nuclei: ^{252}Cm, ^{252}Bk, ^{252}Cf, ^{252}Es, ^{252}Fm, ^{252}Md, ^{252}No, ^{252}Lr
- 2. N.Nica, *Nuclear Data Sheets for A = 140*, Nucl.Data Sheets 108, 1287 (2007)
  16 nuclei: ^{140}Te, ^{140}I, ^{140}Xe, ^{140}Cs, ^{140}Ba, ^{140}La, ^{140}Ce, ^{140}Pr, ^{140}Nd, ^{140}Pm, ^{140}Sm, ^{140}Eu, ^{140}Gd, ^{140}Tb, ^{140}Dy, ^{140}Ho
- 3. D.Abriola *et al.*, *Nuclear Data Sheets for A = 84*, Nucl.Data Sheets 110, 2815 (2009)
  1 nucleus: ^{84}Y
- 4. N.Nica, *Nuclear Data Sheets for A = 147*, Nucl.Data Sheets 110, 749 (2009)
  16 nuclei: ^{147}Xe, ^{147}Cs, ^{147}Ba, ^{147}La, ^{147}Ce, ^{147}Pr, ^{147}Nd, ^{147}Pm, ^{147}Sm, ^{147}Eu, ^{147}Gd, ^{147}Tb, ^{147}Dy, ^{147}Ho, ^{147}Er, ^{147}Tm
- 5. N.Nica, *Nuclear Data Sheets for A = 97*, Nucl.Data Sheets 111, 525 (2010)
  14 nuclei: ^{97}Br, ^{97}Kr, ^{97}Rb, ^{97}Sr, ^{97}Y, ^{97}Zr, ^{97}Nb, ^{97}Mo, ^{97}Tc, ^{97}Ru, ^{97}Rh, ^{97}Pd, ^{97}Ag, ^{97}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}Na, ^{37}Mg, ^{37}Al, ^{37}Si, ^{37}P, ^{37}S, ^{37}Cl, ^{37}Ar, ^{37}K, ^{37}Ca
- 7. N.Nica, J.Cameron, B.Singh, *Nuclear Data Sheets for A = 36*, Nucl.Data Sheets 113, 1 (2012)
  10 nuclei: ^{36}Na, ^{36}Mg, ^{36}Al, ^{36}Si, ^{36}P, ^{36}S, ^{36}Cl, ^{36}Ar, ^{36}K, ^{36}Ca
- 8. N.Nica, B.Singh, *Nuclear Data Sheets for A = 34*, Nucl.Data Sheets 113, 1563 (2012)
  11 nuclei: ^{34}Ne, ^{34}Na, ^{34}Mg, ^{34}Al, ^{34}Si, ^{34}P, ^{34}S, ^{34}Cl, ^{34}Ar, ^{34}K, ^{34}Ca
- 9. B.Singh, N.Nica, *Nuclear Data Sheets for A = 77*, Nucl.Data Sheets 113, 1115 (2012)
  12 nuclei: ^{77}Ni, ^{77}Cu, ^{77}Zn, ^{77}Ga, ^{77}Ge, ^{77}As, ^{77}Se, ^{77}Br, ^{77}Kr, ^{77}Rb, ^{77}Sr, ^{77}Y
- 10. N.Nica, *Nuclear Data Sheets for A = 148*, Nucl.Data Sheets 117, 1 (2014)
  16 nuclei: ^{148}Xe, ^{148}Cs, ^{148}Ba, ^{148}La, ^{148}Ce, ^{148}Pr, ^{148}Nd, ^{148}Pm, ^{148}Sm, ^{148}Eu, ^{148}Gd, ^{148}Tb, ^{148}Dy, ^{148}Ho, ^{148}Er, ^{148}Tm
- 11. N.Nica, *Nuclear Data Sheets for A = 141*, Nucl.Data Sheets 122, 1 (2014)
  16 nuclei: ^{141}Te, ^{141}I, ^{141}Xe, ^{141}Cs, ^{141}Ba, ^{141}La, ^{141}Ce, ^{141}Pr, ^{141}Nd, ^{141}Pm, ^{141}Sm, ^{141}Eu, ^{141}Gd, ^{141}Tb, ^{141}Dy, ^{141}Ho
- 12. N.Nica, *Nuclear Data Sheets for A = 157*, Nucl.Data Sheets 132, 1 (2016)
  15 nuclei: ^{157}Nd, ^{157}Pm, ^{157}Sm, ^{157}Eu, ^{157}Gd, ^{157}Tb, ^{157}Dy, ^{157}Ho, ^{157}Er, ^{157}Tm, ^{157}Yb, ^{157}Lu, ^{157}Hf, ^{157}Ta, ^{157}W
- 13. N.Nica, *Nuclear Data Sheets for A = 158*, Nucl.Data Sheets 141, 1 (2017)
  15 nuclei: ^{158}Nd, ^{158}Pm, ^{158}Sm, ^{158}Eu, ^{158}Gd, ^{158}Tb, ^{158}Dy, ^{158}Ho, ^{158}Er, ^{158}Tm, ^{158}Yb, ^{158}Lu, ^{158}Hf, ^{158}Ta, ^{158}W
- 14. N.Nica, *Nuclear Data Sheets for A = 140*, Nucl.Data Sheets 154, 1 (2018)
  17 nuclei: ^{140}Sb, ^{140}Te, ^{140}I, ^{140}Xe, ^{140}Cs, ^{140}Ba, ^{140}La, ^{140}Ce, ^{140}Pr, ^{140}Nd, ^{140}Pm, ^{140}Sm, ^{140}Eu, ^{140}Gd, ^{140}Tb, ^{140}Dy, ^{140}Ho
- 15. N.Nica, A =155, *Nuclear Data Sheets for A = 155,* Nucl.Data Sheets 160, 1 (2019)
  16 nuclei: ^{155}Ce, ^{155}Pr, ^{155}Nd, ^{155}Pm, ^{155}Sm, ^{155}Eu, ^{155}Gd, ^{155}Tb, ^{155}Dy, ^{155}Ho, ^{155}Er, ^{155}Tm, ^{155}Yb, ^{155}Lu, ^{155}Hf, ^{155}Ta
- 16. N.Nica, A =153, *Nuclear Data Sheets for A = 153*, Nucl.Data Sheets 170, 1 (2020)
  16 nuclei: ^{153}La, ^{153}Ce, ^{153}Pr, ^{153}Nd, ^{153}Pm, ^{153}Sm, ^{153}Eu, ^{153}Gd, ^{153}Tb, ^{153}Dy, ^{153}Ho, ^{153}Er, ^{153}Tm, ^{153}Yb, ^{153}Lu, ^{153}Hf
- 17. N.Nica, A =160, *Nuclear Data Sheets for A = 160,* Nucl.Data Sheets 176, 1 (2021)
  17 nuclei: ^{160}Pr, ^{160}Nd, ^{160}Pm, ^{160}Sm, ^{160}Eu, ^{160}Gd, ^{160}Tb, ^{160}Dy, ^{160}Ho, ^{160}Er, ^{160}Tm, ^{160}Yb, ^{160}Lu, ^{160}Hf, ^{160}Ta, ^{160}W, ^{160}Re
- 18. N.Nica , B.Singh, *Nuclear Data Sheets for A = 147,* Nucl.Data Sheets 181, 1 (2022)
  16 nuclei: ^{147}Xe, ^{147}Cs, ^{147}Ba, ^{147}La, ^{147}Ce, ^{147}Pr, ^{147}Nd, (*^{147}Pm Balraj Singh*), ^{147}Sm, ^{147}Eu, ^{147}Gd, ^{147}Tb, ^{147}Dy, ^{147}Ho, ^{147}Er, ^{147}Tm

Mass Chain Evaluation: *310 nuclei, 22 A-chains*

- 19. N.Nica, *Nuclear Data Sheets for A = 141,* Nucl.Data Sheets 187, 1 (2023)
  17 nuclei : ^{141}Sb, ^{141}Te, ^{141}I, ^{141}Xe, ^{141}Cs, ^{141}Ba, ^{141}La, ^{141}Ce, ^{141}Pr, ^{141}Nd, ^{141}Pm, ^{141}Sm, ^{141}Eu, ^{141}Gd, ^{141}Tb, ^{141}Dy, ^{141}Ho
- 20. N.Nica, *Nuclear Data Sheets for A = 162,* Nucl.Data Sheets 195, 1 (2024)
  17 nuclei: ^{162}Nd, ^{162}Pm, ^{162}Sm, ^{162}Eu, ^{162}Gd, ^{162}Tb, ^{162}Dy, ^{162}Ho, ^{162}Er, ^{162}Tm, ^{162}Yb, ^{162}Lu, ^{162}Hf, ^{162}Ta, ^{162}W, ^{162}Re, ^{162}Os
- 21. N.Nica, *Nuclear Data Sheets for A = 154 – Post-review*
  17 nuclei: , ^{154}Ba, ^{154}La, ^{154}Ce, ^{154}Pr, ^{154}Nd, ^{154}Pm, ^{154}Sm, ^{154}Eu, ^{154}Gd, ^{154}Tb, ^{154}Dy, ^{154}Ho, ^{154}Er, ^{154}Tm, ^{154}Yb, ^{154}Lu, ^{154}Hf
- 22. N.Nica, *Nuclear Data Sheets for A = 148 – Review*
  17 nuclei: , ^{148}Xe, ^{148}Cs, ^{148}Ba, ^{148}La, ^{148}Ce, ^{148}Pr, ^{148}Nd, ^{148}Pm, ^{148}Sm, ^{148}Eu, ^{148}Gd, ^{148}Tb, ^{148}Dy, ^{148}Ho, ^{148}Er, ^{148}Tm, ^{148}Yb

Our accomplishments
ENSDF data evaluation



← SIZE IS HUGE!
← VERY COMPLX
← 1 A-chain/FY

Texas A&M Data Center
A-chain Responsibility:

140, 141, 147, 148, 153, 155, 157, 158, 160, 154, 162, 156

TEXAS A&M UNIVERSITY

Texas A&M - Cyclotron Institute NSDD Center Oct 2022 - Apr 2024

- 19. N.Nica, *Nuclear Data Sheets for A = 141,* Nucl.Data Sheets 187, 1 (2023), ***FY2020***

  17 nuclei : ^{141}Sb, ^{141}Te, ^{141}I, ^{141}Xe, ^{141}Cs, ^{141}Ba, ^{141}La, ^{141}Ce, ^{141}Pr, ^{141}Nd, ^{141}Pm, ^{141}Sm, ^{141}Eu, ^{141}Gd, ^{141}Tb, ^{141}Dy, ^{141}Ho

- 20. N.Nica, *Nuclear Data Sheets for A = 162,* Nucl.Data Sheets 195, 1 (2024), ***FY2021***

  17 nuclei: ^{162}Nd, ^{162}Pm, ^{162}Sm, ^{162}Eu, ^{162}Gd, ^{162}Tb, ^{162}Dy, ^{162}Ho, ^{162}Er, ^{162}Tm, ^{162}Yb, ^{162}Lu, ^{162}Hf, ^{162}Ta, ^{162}W, ^{162}Re, ^{162}Os

- 21. N.Nica, *Nuclear Data Sheets for A = 154, – Post-review,* ***FY2022***

  17 nuclei: ^{154}Ba, ^{154}La, ^{154}Ce, ^{154}Pr, ^{154}Nd, ^{154}Pm, ^{154}Sm, ^{154}Eu, ^{154}Gd, ^{154}Tb, ^{154}Dy, ^{154}Ho, ^{154}Er, ^{154}Tm, ^{154}Yb, ^{154}Lu, ^{154}Hf

- 22. N.Nica, *Nuclear Data Sheets for A = 148 – Review,* ***FY2023***

  17 nuclei: ^{148}Xe, ^{148}Cs, ^{148}Ba, ^{148}La, ^{148}Ce, ^{148}Pr, ^{148}Nd, ^{148}Pm, ^{148}Sm, ^{148}Eu, ^{148}Gd, ^{148}Tb, ^{148}Dy, ^{148}Ho, ^{148}Er, ^{148}Tm, ^{148}Yb

- 23. N.Nica, *Nuclear Data Sheets for A = 156 – In progress,* ***FY2024***

  17 nuclei: ^{154}La, ^{154}Ce, ^{154}Pr, ^{154}Nd, ^{154}Pm, ^{154}Sm, ^{154}Eu, ^{154}Gd, ^{154}Tb, ^{154}Dy, ^{154}Ho, ^{154}Er, ^{154}Tm, ^{154}Yb, ^{154}Lu, ^{154}Hf, ^{154}Ta

- 1. Review, A = 200, Review of full mass chain evaluation, ***FY2023***

  12 nuclei: ^{200}Os, ^{200}Ir, ^{200}Pt, ^{200}Au, ^{200}Hg, ^{200}Tl, ^{200}Pb, ^{200}Bi, ^{200}Po, ^{200}At, ^{200}Rn, ^{200}Fr

- 2. Review: A = 63, Review of full mass chain evaluation, ***FY2024***

  13 nuclei: ^{63}Ti, ^{63}V, ^{63}Cr, ^{63}Mn, ^{63}Fe, ^{63}Co, ^{63}Ni, ^{63}Cu, ^{63}Zn, ^{63}Ga, ^{63}Ge, ^{63}As, ^{63}Se

Texas A&M - Cyclotron Institute NSDD Center
Mass chain evaluations: Statistics

	A=141 Evaluation	A=162 Evaluation	A=154 Evaluation	A=148 Evaluation	A=156 Evaluation	A=200 Review	A=63 Review
Number of Adopted Levels	1084	1120	1256	1269	1157	518	1032
Number of Adopted Gammas	1953	1787	2604	2049	2018	899	1500
Number of nuclides	17	17	17	17	17	12	13
Number of datasets	98	86	86	97	85	67	108
Number of .ens lines	18635	21138	25401	19971	21547	11912	17280
NG/NL	1.80	1.60	2.07	1.61	1.74	1.73	1.45

Texas A&M - Cyclotron Institute NSDD Center, Oct 2022 - Apr 2024 Publications

- **2024NIAA Nucl.Data Sheets 195, 1 (2024)**

  N.Nica

  Nuclear Data Sheets for A=162

- **2023NI01 Nucl.Data Sheets 187, 1 (2023)**

  N.Nica

  Nuclear Data Sheets for A=141

- **2023DIAA Radiation Physics and Chemistry 212, 111162 (2023)**

  M.R.Dias Rodrigues, J.Mabiala, V.E.Iacob, N.Nica, B.Roeder, G.Tabacaru, K.Wang, J.Romo, D. Scriven, N. Tempas, G.A. Souliotis, A. Bonasera

  Production of ^{99}Mo in inverse kinematics heavy ion reactions

Texas A&M - Cyclotron Institute, NSDD Center, Oct 2022 - Apr 2024
Conferences

- **N. Nica**, "*TAMU NSDD EVALUATION CENTER Report 2021-2022*," 24th Technical Meeting of the Nuclear Structure and Decay Data Network, Oct 2022, Australia National University , Canberra, Australia
- **N. Nica**, "*Evaluation Issues*," 24th Technical Meeting of the Nuclear Structure and Decay Data Network, Oct 2022, Australia National University, Canberra, Australia
- **N. Nica**, "*Texas A&M University US Nuclear Data Program Texas A&M Evaluation Center Report 2022*," Nov 2022, National Nuclear Data Center, Brookhaven National Laboratory , Upton, NY, USA
- **N. Nica**, "*Precision Internal Conversion Coefficients Measurements for US Nuclear Data Program*," Nov 2022, NSAC Long Range Plan Town Hall Meeting on Nuclear Structure, Reactions and Astrophysics, Argonne National Laboratory, Lemont, IL, USA
- **N. Nica**, "*Data-Based Physics Research: Level Scheme Re-Concept*," Jan 2023, Brown Bag Luncheon presentation, Cyclotron Institute, College Station, TX, USA
- **N. Nica**, "*Evaluation of Nuclear Structure and Decay Data for U.S. Nuclear Data Program 2023-2026*," Jan 2023, Cyclotron Institute, College Station, TX, USA
- **N. Nica**, "*Status of Texas A&M - Cyclotron Institute USNDP Evaluation Center*," Sep 2023, Nuclear Data Advisory Committee Meeting, National Nuclear Data Center, Brookhaven National Laboratory, Upton, NY, USA

A-Chain Evaluation Currency @Texas A&M University

- **Responsibility:**

  140, 141, 147, 148, 153, 155, 157, 158, 160, 154, 162

- **Status:**

✓ 162 (Sep 2023, since Mar 2007)
✓ 141 (Oct 2022)
✓ 147 (Mar 2022)
✓ 160 (May 2021)
✓ 153 (Aug 2020)
✓ 155 (Oct 2019)
✓ 140 (Nov 2018)
✓ 158 (Feb 2017)
✓ 157 (Dec 2015)
➢ 154 (Aug 2022, post-review, since May 2008)
➢ 148 (Feb 2023, review)
➢ 156 (Mar 2024, in progress FY24, since Mar 2012)

Good Standing@Texas A&M University CI

HELP ENSDF CURRENCY

A-Chain Evaluation 2022-2023 @Texas A&M University

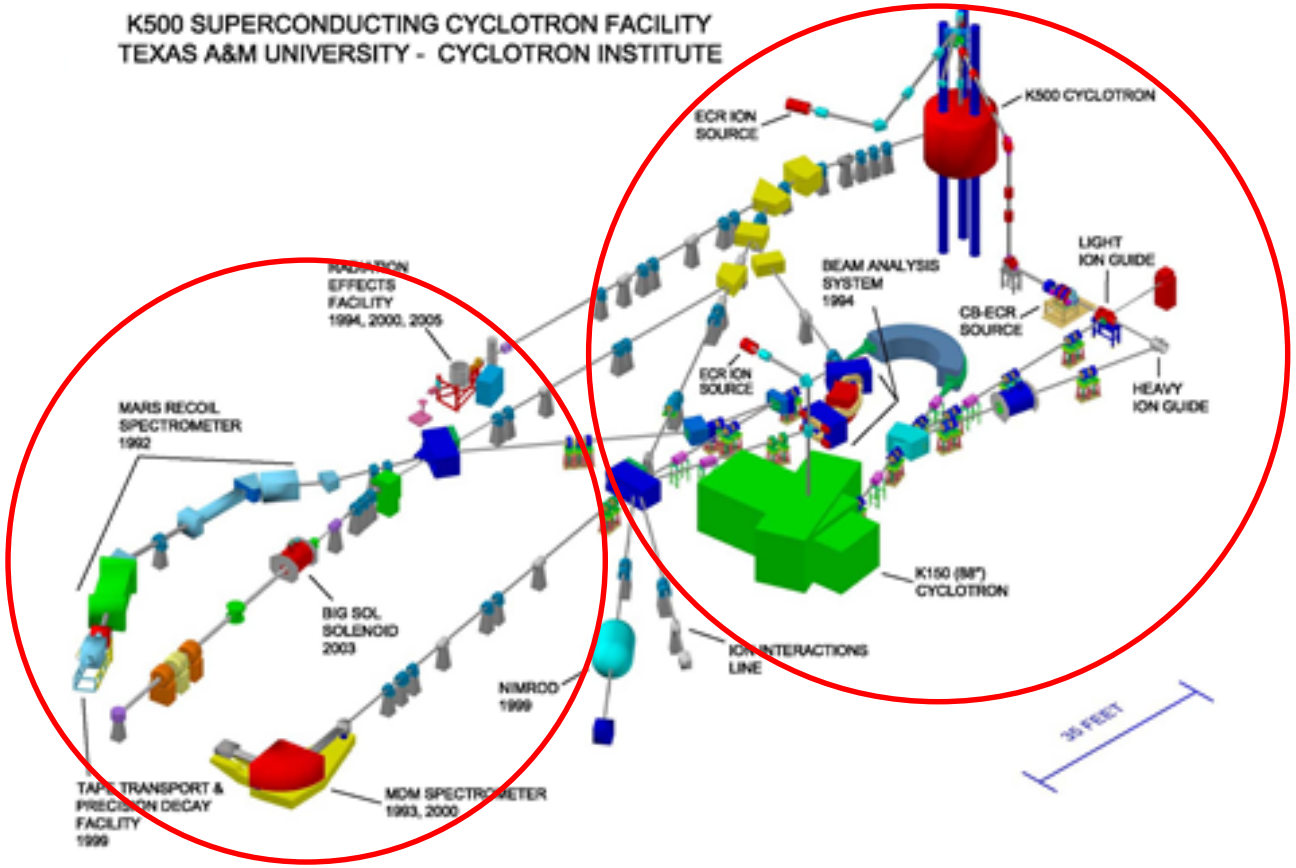
- ***FY2024:*** ***A156 (1-Mar-2012)***
- ***For next year:***
  - ***Solve backlog:***
    - ***-A154***
    - ***-A148***
  - ***Review A-chain evaluations***
  - ***XUNDL (limited)***

OBS.: 156 Demanding future TAMU RESPONSIBILITY

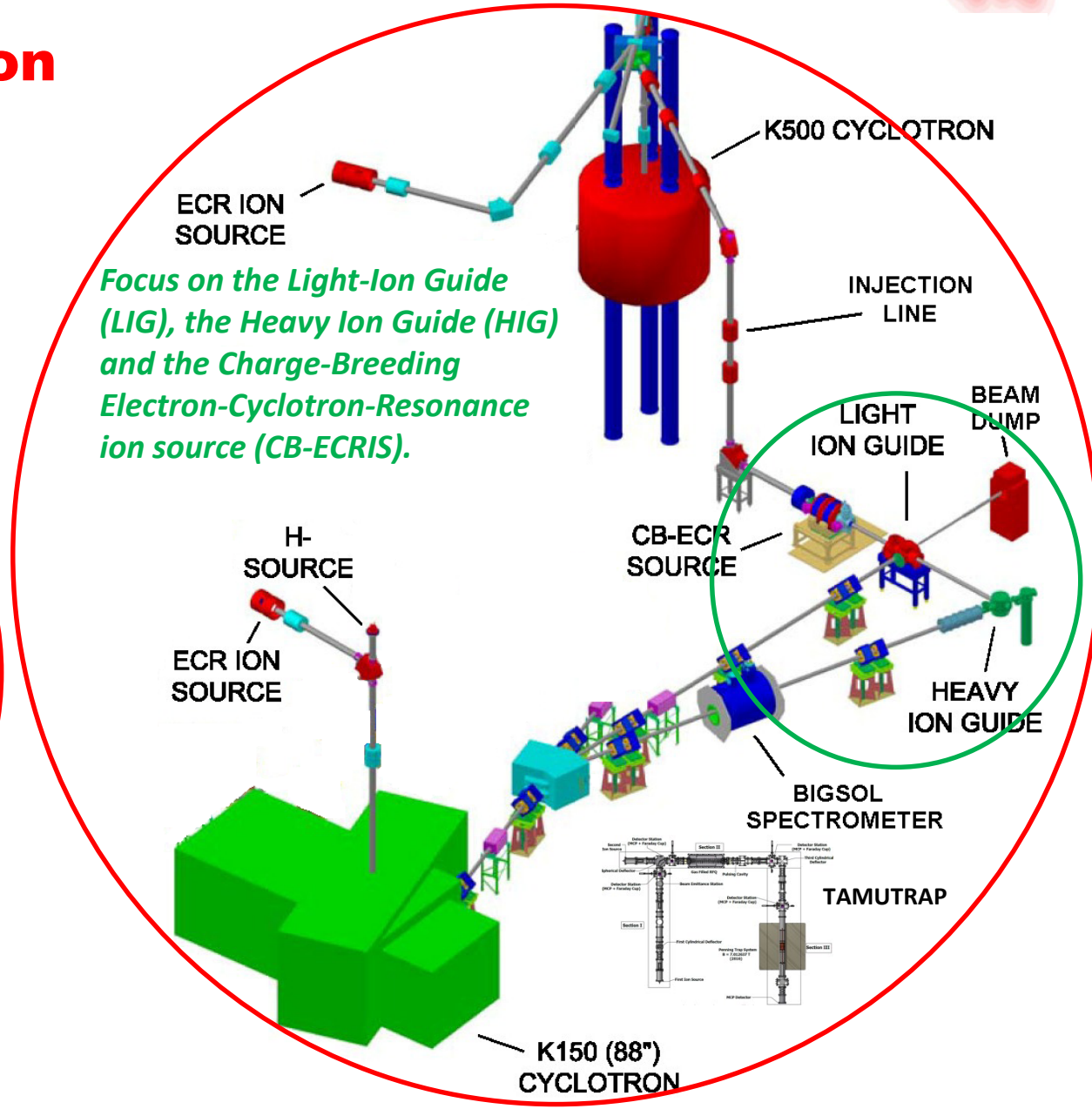
- ***Personnel changes***
  - ***Not foreseeable***
  - ***However highly desirable for developing TAMU Center***
  - ***Pending on future financing/perspectives***

Texas A&M Evaluation Center:
Data Evaluation Station at Cyclotron Radioactive Ion Beam Facility to assist experiments and pre-evaluate data

CYCLOTRON INSTITUTE
Texas A&M University



Focus on the Light-Ion Guide (LIG), the Heavy Ion Guide (HIG) and the Charge-Breeding Electron-Cyclotron-Resonance ion source (CB-ECRIS).



Texas A&M NSDD Evaluation Center
Strategic Priorities

- **Continuing ENSDF Mass Chain Evaluation**
  - **First Strategic Priority according to the Mission Statement.**
  - **All other priorities will be strictly subordinated to this purpose**
- **Produce experimental nuclear data to aid data evaluation**
  - **Precision βγ Spectroscopy for $T_{1/2}$ and BR for Standard Model**
- **Experimental studies of Medical Isotopes**
  - **Invers kinematics methodology, Cyclotron Institute, Texas A&M University**
- **Reevaluation of data procedures for basic science and data evaluation**
  - **Level scheme re-concept based on Repeatability, a newly revealed experimental data evidence**