

United States Nuclear Structure Data Program (USNDP) and Evaluated Nuclear Structure Data File (ENSDF) at Texas A&M University ENSDF Data Evaluation Center

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Nuclear data evaluation fills a century-long chapter of nuclear science. A search in the *Nuclear Science Reference* (NSR) database maintained at the National Nuclear Data Center (<https://www.nndc.bnl.gov/nsr/>) on the author “M. Curie” produces a paper titled “*The Radioactive Constants as of 1930*” [1]. The introduction to this paper states that “*the need has arisen for the publication of special Tables of the Radioactive Constants*” and continues, “*This responsibility has been assumed by the International Radium Standards Commission chosen in Brussels in 1910 (...)*”. Here we have the origin of what today is known as nuclear data evaluation.

Starting with the first generation of nuclear chemists and physicists, when measurements were already producing diverse and sometimes conflicting data, it became evident that assembling and reconciling the data from all across the published literature was a tedious and difficult task. Nevertheless, only after such a systematic analysis could the community arrive at recommended “practical standards,” which could then be updated periodically to reflect the continuous improvements in knowledge and technology. Soon nuclear data evaluation became a specialized branch of research in its own right.

After the Second World War most of this activity was taken across the Atlantic and hosted by the United States Nuclear Structure Data Program (USNDP), which maintains the Evaluated Nuclear Structure Data File (ENSDF) database. While mostly undertaken by U.S. national laboratories, it has expanded to a relatively small number of university research labs, which has included the Texas A&M Cyclotron Institute since 2005. For more than a decade, the Texas A&M effort was financed by a contract with Brookhaven National Laboratory, but in 2017 it started to receive direct financing through the DOE Grant DE-FG03-93ER40773, “Cyclotron-based Nuclear Science”; and since May 2017 Texas A&M Cyclotron Institute has been recognized as an independent ENSDF Data Evaluation Center included within the Nuclear Structure and Decay Data international network.

Since 2005 we have completed and published the following full mass chain evaluations: the superheavy $A=252$ mass chain [2]; the very data-rich mid-mass chains, $A=140$ [3], $A=141$ [4], $A=147$ [5] and $A=148$ [6]; the relatively lighter chains, $A=97$ [7] and $A=84$ [8], the latter in a large international collaboration. In collaboration with B. Singh and a group of authors from McMaster University, Canada, we also published the $A=77$ [9], $A=37$ [10], $A=36$ [11], and $A=34$ [12] chains. At the beginning of 2016 another of our big mass chains, $A=157$, was published in Nuclear Data Sheets [13], followed by $A=158$ in the 2017 March-April issue of the same journal [14]. Three massive mass chains, $A=140$, $A=155$ and $A=160$ are also in the pipeline for publication.

In Oct 2017 we started a new full evaluation for the mass chain $A=153$, covering all publications since Jan 2006. The chain consists of the following isobars: Ba, La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, and Hf: in total, 17 nuclei. Our bibliographical search found that, since Jan 2006, 202 papers have been published relating to this mass chain, of which 182 are primary references (most important). In all, 94 are experimental. This work is in progress.

- [1] M. Curie, A. Debierne, A.S. Eve, H. Geiger, O. Hahn, S.C. Lind, S. Meyer, E. Rutherford, E. Schweidler, *Rev. Mod. Phys.* **3**, 427 (1931).
- [2] N. Nica, *Nucl. Data Sheets* **106**, 813 (2005).
- [3] N. Nica, *Nucl. Data Sheets* **108**, 1287 (2007).
- [4] N. Nica, *Nucl. Data Sheets* **122**, 1 (2014).
- [5] N. Nica, *Nucl. Data Sheets* **110**, 749 (2009).
- [6] N. Nica, *Nucl. Data Sheets* **117**, 1 (2014).
- [7] N. Nica, *Nucl. Data Sheets* **111**, 525 (2010).
- [8] D. Abriola *et al.*, *Nucl. Data Sheets* **110**, 2815 (2009).
- [9] B. Singh and N. Nica, *Nucl. Data Sheets* **113**, 1115 (2012).
- [10] J. Cameron, J. Chen, B. Singh, and N. Nica, *Nucl. Data Sheets* **113**, 365 (2012).
- [11] N. Nica, J. Cameron, and B. Singh, *Nucl. Data Sheets* **113**, 1 (2012).
- [12] N. Nica and B. Singh, *Nucl. Data Sheets* **113**, 1563 (2012).
- [13] N. Nica, *Nucl. Data Sheets* **132**, 1 (2016).
- [14] N. Nica, *Nucl. Data Sheets* **142**, 1 (2017).