Cyclotron institute evaluation center report: US nuclear structure data program

N. Nica and J.C. Hardy

Nuclear data evaluation is the main activity designed to capitalize the results of nuclear science research. From its beginnings more than a century ago, it became evident that nuclear science evolves over the years in such a way that establishing the "best" parameters at any given time is an important and challenging task. Thus, very early in its development the scientific community became aware, as Marie Curie wrote [1], that "*the need has arisen for the publication of special Tables of the Radioactive Constants*", which she, together with a prestigious group of contemporary scientists, co-authored the first major international nuclear data evaluation paper, titled "*The Radioactive Constants as of 1930*". Moreover, as she continues, "*This responsibility has been assumed by the International Radium Standards Commission chosen in Brussels in 1910 (...)*", which means that, due to its practical importance, this type of activity got institutionalized from its beginnings. Therefore, the origins of what today is known as nuclear data evaluation dates to the dawn of nuclear science itself.

In more recent times, it was recognized that the diversity of published data, not to mention their occasional inconsistencies, demanded that all published results should be assembled and reconciled by a specialized group of experienced scientists. Even collecting the relevant information from all the world's publications, was a nontrivial task, but documented databases were gradually established. This culminated with today's *Nuclear Science Reference* (NSR) database, which is maintained at the National Nuclear Data Center (https://www.nndc.bnl.gov/nsr/). Gradually after several cycles of systematic data analyses the community arrived at "practical standards" of data, which are then revisited periodically to include the continuous updates of newly published data. In this way, nuclear data evaluation has become a new research domain with its own specificity.

A new turning point emerged after the Second World War when the United States got the leading position in the nuclear research field, and consequently the transatlantic nuclear data evaluation changed shores, with the US becoming its main contributor. The United States Nuclear Structure Data Program (USNDP) was started (with its two main subcomponents, one for nuclear reactions and one for nuclear structure), being designed to maintain the so-called Evaluated Nuclear Structure Data File (ENSDF) database, the most extensive nuclear structure data repository in the world. This effort was shared initially among several national institutes and was extended to gradually include a few universities, of which Texas A&M Cyclotron Institute has been one since 2005. It was first funded by a contract with Brookhaven National Laboratory, but in 2017 we started to receive direct funding through the DOE Grant DE-FG02-93ER40773, "Cyclotron-based Nuclear Science". At that time, we became the Texas A&M Cyclotron Institute independent ENSDF Data Evaluation Center, one of the important contributors to the USNDP, as well as to the Nuclear Structure and Decay Data international network hosted by the IAEA Vienna

Between 2005 and 2022, we 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]; and 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] mass chains. At the beginning of 2016, we published another large mass chain, A=157, in Nuclear Data Sheets [13]; followed by A=158 in 2017 [14]; the renewed full evaluation of A=140 in 2018 [15]; A=155 in 2019 [16]; A=153 in 2020 [17]; and A=160 in 2021 [18]. We also published the renewed evaluations of A=147 in 2022 [19] (also with Balraj Singh), as well as A=141 in 2023 [20].

In the interval April-September 2023 we worked on the A=148 mass chain, submitted for peer review before the due date of Oct 1, 2023. It is still under review at the time this report is being written.

We also completed the technical review of the A=63 mass chain as assigned by NNDC, in a timely manner, returning the reviewed manuscript of over 400 pages by the end of Feb 2024. It required two months of concentrated effort.

Before the end of 2023, we also completed post-review work for the A=162 mass chain. Following the final editorial review and final preparations for publication, it appeared in Nuclear Data Sheets 195, 1 (2024) (May issue).

After Oct 2023 we started to work on this fiscal year's principal commitment, the A=156 mass chain. This mass chain involves about 1000 experimental publications, of which 136 have been added since our last evaluation. This work is currently in progress and is to be submitted to NNDC by Sept 30, 2024.

In recent years we initiated a process to evaluate several mass chains that are not the official responsibility of our center, but which for different reasons had remained unevaluated for many years: A=162 (since Mar 2007), A=154 (since May 2008), and A=156 (since Mar 2012), in order to improve the currency of the ENSDF database. This initiative is appreciated by the ENSDF community.

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