Cyclotron institute evaluation center report: US Nuclear Structure Data Program (USNDP)

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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-FG03-93ER40773, "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 2020, 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], and A=153 at the end of 2020 [17]. In Aug 2020 we submitted the A=141 mass chain to NNDC which was reviewed and now awaits final publication.

As mentioned in our previous reports, our community has been passing through two crises: a critical shortage of evaluators, followed by a similar shortage of reviewers, due mainly to the retirement of several experienced evaluators. Moreover, the publication pipeline became more demanding, with a prereview process, followed by the main technical review with a couple of iterations, and finally by an editorial review, which together propagated substantial delays of 2-3 years to the currency of the ENSDF database.

In the interval of this report, Apr 1, 2021 – March 31, 2022, we have completed the work for A=162 full mass-chain evaluation, which we successfully submitted to the NNDC before the promised Oct 1, 2021, due date. (It is currently under review.) In parallel with the mainstream work, we also completed a technical review of a 477 pages manuscript on the A=31 mass chain, in a timely manner, after having worked consistently on it for about two months. We also completed the after-review and editorial work on the A=160 chain, which was published in Aug 2021 [18]. We also addressed the most substantial part of after-review and editorial work on the A=147 chain (our second full evaluation of A=147 after that in 2009).

After Oct 2021 we did a substantial part of the work on this fiscal year's commitment, the A=154 full mass-chain evaluation. This mass chain was studied in about 1200 experimental publications of which about 150 have been added since its last full evaluation in May 2008. This work is currently in progress and is to be submitted to NNDC by Sept 30, 2022.

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