Progress Report on Nuclear Structure and Decay Data Activities at Argonne National Laboratory*

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I. Program overview

The Argonne Nuclear Data Program is involved in a number of scientific activities carried out within the broad framework of the U.S. Nuclear Data Program (USNDP) Coordinated Work Plan. The main emphasis is on nuclear structure and decay data, and their applications in nuclear physics research, and in applied nuclear technologies. Compiled and evaluated data are made available to the National Nuclear Data Center (NNDC) for inclusion in the Evaluated Nuclear Structure Data File (ENSDF) database or the results are published directly in peer-reviewed scientific journals. Contributions are also made to various specialized databases that serve specific needs in the fields of nuclear structure, nuclear astrophysics and applied nuclear physics. This effort includes evaluations of atomic masses and complementary nuclear structure data for the Atomic Mass Evaluation (AME) and NUBASE databases, and compilations of recently published nuclear structure data for the Unevaluated Nuclear Data List (XUNDL) database. Measurements aimed at providing answers to specific questions and at improving the quality of existing databases in specific areas are also performed. The experimental activities are carried out at the U.S. Department of Energy nuclear physics user facilities and/or at leading nuclear physics laboratories elsewhere through collaborative arrangements.

II. Nuclear Data Evaluations Activities for ENSDF and XUNDL

The main emphasis of the nuclear data evaluation activities at Argonne National Laboratory is on nuclear structure and decay data evaluations for the ENSDF database. The ANL nuclear data center has responsibilities for evaluating nuclei within the **A=106-112, 176-179** and **199-209** mass chains. The up-to-date status of these evaluations is presented in Table 1 and 2. During the period of time covered by this report, the **A=188**

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mass chain was completed and published in *Nuclear Data Sheets* (in collaboration with Prof. S. Juutinen, Jyvaskyla University and Prof. D. Hartley, US Naval Academy) and the evaluation of the **A=177** mass chain was completed, reviewed and it is being prepared for publication. The evaluation of **A=205** is currently ongoing. Compilations for the XUNDL database and ENSDF evaluations for nuclides where the first experimental results about their properties become available, as well as review of ENSDF mass chains, were also carried out, when requested.

Table 1. Status of mass chain evaluations assigned to the ANL nuclear data center

A Chain	NDS publication	Evaluator	Current Status
106	NDS **109** (2008) 943	D. De Frenne & A. Negret	completed
107	NDS **109** (2008) 1383	J. Blachot	completed
108	updated online 2008	J. Blachot	completed
109	NDS **137** (2016) 1	S.Kumar, J.Chen & F.G. Kondev	completed
110	NDS **113** (2012) 1315	G. Gurdal & F.G. Kondev	completed
111	NDS **110** (2009) 1239	J. Blachot	completed
112	NDS **124** (2015) 157	S. Lalkovski & F.G. Kondev	completed
176	NDS **107** (2006) 791	M.S. Basunia	completed/LBNL
177	NDS **98** (2003) 801	F.G. Kondev	**completed in 2018**
178	NDS **110** (2009) 1473	E. Achterberg *et al.*	completed/Argentina
179	NDS **110** (2009) 265	C.M. Baglin	completed/LBNL
199	NDS **108** (2007) 79	B. Singh	completed/McMaster
200	NDS **108** (2007) 1471	F.G. Kondev & S. Lalkovski	completed
201	NDS **108** (2007) 365	F.G. Kondev	completed
202	NDS **109** (2008) 699	S. Zhu & F.G. Kondev	completed
203	NDS **105** (2005) 1	F.G. Kondev	completed
204	NDS **111** (2010) 141	C.J. Chiara & F.G. Kondev	completed
205	NDS **101** (2004) 521	F.G. Kondev	**under revision**
206	NDS **109** (2008) 1527	F.G. Kondev	completed
207	NDS **112** (2011) 707	F.G. Kondev & S. Lalkovski	completed
208	NDS **108** (2007) 1583	M. Martin	completed/ORNL
209	NDS **126** (2015) 373	J. Chen & F.G. Kondev	completed

Table 2. Evaluated mass chains outside the ANL region of responsibilities

A Chain	NDS publication	Evaluator	Current Status
188	NDS **150** (2018) 1	S. Juutinen, D. Hartley & F.G. Kondev	completed

III. Other Activities

The Argonne nuclear data program continued contributing to ongoing evaluations of atomic masses in collaboration with scientists from CSNSM (Orsay, France), IMP (Lanzhou, China) and RIKEN (Japan).

The ANL staff participated in a number of IAEA-led activities, including the CRP on "Nuclear Data for Charged-particle Monitor Reactions and Medical Isotope Production", technical meetings on "Total Absorption Gamma-ray Spectroscopy for Decay Heat Calculations and Other Applications", "Nuclear Data for Anti-neutrino Spectra and Applications", "Improvements of analysis codes for Nuclear Structure and Decay Data Evaluations", and "Nuclear Moments", lecturer at the ICTP-IAEA organized Trieste workshop on "Nuclear Structure and Decay Data Evaluation: Theory and Experiment", and consultancies on the development of the LiveChart Web application.

Our program is also involved in complementary Nuclear Data related research activities. This effort complemented the main ANL evaluation activities by providing training experience to the evaluator on modern experimental techniques and instruments that are used in nuclear data production. Such activities also allow to maintain contacts with a broad range of nuclear data users and with the FRIB and GRETINA research communities, in particular. Contributions were made to collaborative nuclear structure and decay research activities at the ATLAS and CARIBU facilities at ANL aimed at improving the quality of existing databases. This effort also included measurements aimed at improving decay data in the actinide region, where the main emphasis was on properties of nuclei far from the line of stability and on nuclear isomers in heavy nuclei. There is a growing involvement of our program in dedicated decay studies of neutron-rich nuclei in the fission product region at the CARIBU facility.