

The Advanced Atomic Mass Evaluation Project at GSI

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The ground-state binding energy, and thus the mass of a nucleus, is one its characteristic properties, revealing deep insight into the nuclear structure. Total binding energies and derived quantities such as proton or neutron separation energies, Q -values, etc., are needed for a basic understanding of the strong force, reaction kinematics and also for applications in medicine, energy generation, nuclear-waste transmutation, and nuclear astrophysics.

Ever since the beginning of modern chemistry and physics, compilations of masses have been undertaken [1]. The modern evaluations of atomic masses were initiated about 50 years ago by Aaldert H. Wapstra [2], and the most recent evaluations of atomic masses and decay properties, AME-2003 and NUBASE [3, 4, 5], respectively, were prepared by Wapstra and Audi. However, and despite of this work, in Europe there was a general decline of data collection and evaluation activities in the last decades [6]. Also the future of AME was somewhat uncertain. Therefore, almost two years ago, after consultation and in an agreement with G. Audi, GSI took the initiative to start working on the continuation of the atomic mass data collection and its evaluation. The first goal is to maintain and to update the existing data base. The success of radioactive beam facilities has lead to a notable increase in quantity and quality of mass data for exotic nuclides. Since the latest evaluation in 2003, a lot of new mass measurements are available from direct and indirect (e.g. Q_β) measurements and reaction studies.

The scientific literature has been scanned for publications containing information on nuclear masses, lifetimes of ground and/or isomeric states. The Nuclear Science References (NSR) data base [7] of the National Nuclear Data Center at Brookhaven National Laboratory was browsed from the year 2000 until present. In addition, the recent volumes of relevant journals as Physical Review A, C, Physical Review Letters, Nuclear Physics A, European Physical Journal, International Journal of Mass Spectrometry, Physics Letters, Journal of Physics G (London), Nuclear Instruments and Methods, Physics of Atomic Nuclei (Yadernaya Fizika), Physica Scripta, Pramana, Metrologia, Chinese Physics, Chinese Physics Letters are being scanned regularly.

Also data from non-refereed sources are collected, such as laboratory reports, preprints, diploma and PhD-theses and similar sources. More than 1000 data have been collected. Data previously available in the data base are checked for correctness and present validity. In parallel, the NUBASE data are updated: new data on masses and decay properties such as half-lives, excitation energies of isomeric states are examined and entered into compilations

for further use in evaluations. References are stored and archived electronically, links to existing data are stored. The activities are carried out in close contact with ENSDF editors.

Presently, each new data point is included into the master file of the evaluation for masses, decay properties and references. The consistency with existing data and the influence on the surrounding mass surface are checked by a local evaluation. In case of discrepancies, the relevant data and publications are scrutinized for hints pointing to possible problems. If necessary, the authors are contacted for clarification. A new evaluation is presently in preparation.

Measured masses are included in the AME as single equations related to one reference nucleus. Thus, the *many* correlations between *all* nuclides measured in FRS-ESR experiments – which is a strength of the method – are lost. Therefore, it is proposed to merge the original data from the FRS-ESR (i.e., frequency ratios) with data from other measuring techniques already contained in the AME into the Advanced Atomic Mass Evaluation (AAME).

For the mid-term future it is planned to make all data available via electronic media for broad dissemination of the original and the evaluated data, respectively. The creation of a web-site with interactive tools to serve the community of experimentalists, theorists, and for users in applied sciences is under development.

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