The future of the nuclear moments database (*a personal point of view*)

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What kind of database do we want to have ?

1. How a database should be structured in the "era of GenZ"?

1.1. What should be the database structure/content

1.1.1. Compilation *vs* evaluation — **both are needed**

1.1.2. Data presentation: observables vs final values — **both are needed**

1.2. Machine oriented, easy digital access and retrievals — **which format?**

1.3. Comparability with related databases — **absolutely necessary**

1.4. Instant updates — **no cutoff**

1.4.1. What needs to be updated? — **compilation and evaluation**

1.4.2. How to organize updates? — **working group**

1.4.3. How to obtain the relevant information?

2. Who are the users of the nuclear moment database and what they need?

2.1. The broad scientific community — **evaluated data**

2.2. The educated nuclear physics community — **evaluated data, comments**

2.2. The expert nuclear moment community — **rough and evaluated data, corrections and comments**

What are evaluated nuclear moments

1. We do not measure nuclear moments:

Experiments yield interaction between a moment and a field

1.1. Is it enough to indicate the experimental technique in the data compilation?

1.1.1. Experimental observable — **absolutely needed**

1.1.2. Data from different measurements — **all need to be available**

1.2. What do we want to see in the compilation?

1.3. What is the meaning of a recommended value? — **clear evaluation procedure**

1.4. When a recommended value should be changed? — **clear track of changes**

1.4.1. What needs to be tracked?

1.4.2. How to organize the updates?

1.4.3. What different users should know?

2. Different measurements

2.1. How different measurements should be considered? — **evaluated data**

2.2. What can be a reason to neglect a measurement? — **confidence level**

2.2. Low level statistics: χ^2 vs Bayesian fitting

Only one example




Nuclear electromagnetic moments in the new millennium

The sunset of high-spin physics and the sunrise of exotic nuclear studies

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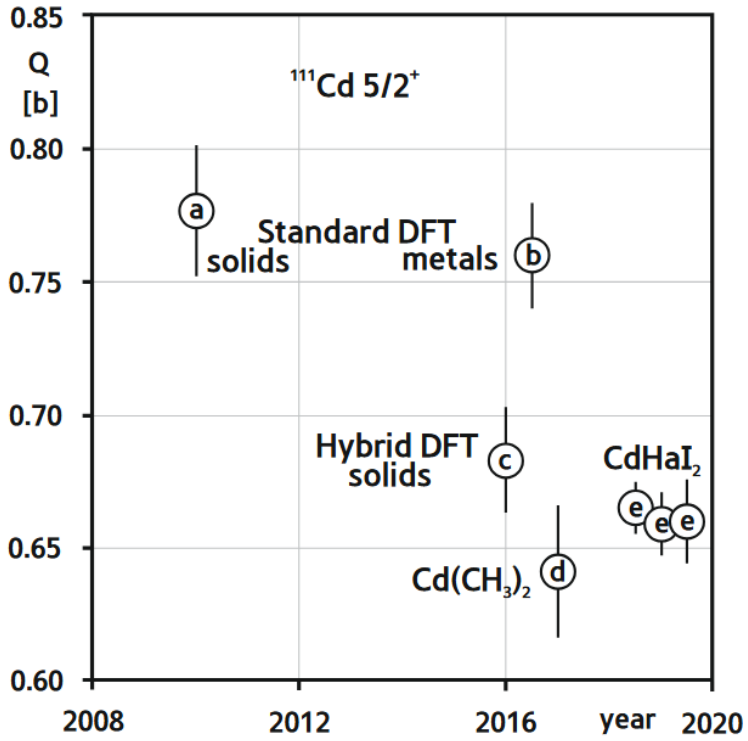
A compilation of the nuclear moment data is provided under the auspices of the Nuclear Data Section of the International Atomic Energy Agency (IAEA) [911]. It is based on several earlier compilations [91, 912]. Over the last several years N.J. Stone put considerable effort into keeping the compilation updated and determining recommended values [91, 92, 913]. As noted in this review filed calibrations are a key factor in determining nuclear moments and the raw data in many cases require the application of particular corrections. Although some guiding materials were published [914, 915], it is not always clear how the different corrections have been applied to the compiled data.

The situation with the choice of recommended values is also complicated. Several sets of recommended nuclear magnetic dipole and electric quadrupole moments have been published [95, 363, 916]. In some cases it is not clear how the recommended values have been derived. Moreover, this database needs to be further maintained and enlarged, and occasional misprints should be corrected.



pages: 317, figures: 68, tables 10, formulae: 167, cited papers: 919

Uncertainties and corrections

1. Experimental uncertainties and corrections

- **1.1. Are the uncertainties given in all papers correct?** — **most probably NOT**
  - 1.1.1. How to obtain correct estimates?
  - 1.1.2. How to treat error propagation? — **procedure can be defined**
- **1.2. Are corrections given in papers correct?** — **case-by-case judgement**
  - 1.2.1. How to treat corrections in the database? — **comments needed**
  - 1.2.2. How to address field calibrations? — **comments needed**
  - 1.2.3. Which are the open problems in field calibrations?

2. Statistical methods

- **2.1. How averages should be taken** — **procedures needed**
- **2.2. Are new approaches needed?**
- **2.3. Where are the limits of statistics?**

What new data is expected

1. Which are the applicable methods in the "era of exotic nuclei"

1.1. Laser-based methods

1.1.1. Limitations and need for improvement

1.1.2. Expected data flow — **can be estimated**

1.1.3. Data production — **well structured community**

1.2. Short-lived states (atomic and ferromagnetic fields)

1.2.1. Limitations and need of improvement — **calibrations needed**

1.2.2. Expected data flow — **difficult to say**

1.2.3. Data production — **limited community**

1.3. Other methods (and excited states)

1.4.1. Few examples were given — **growth can be expected**

1.4.2. Data production — **limited community**

2. Communication with data producers

2.1. How to make them contribute to the database — **compilation update**

2.2. Discussion of assumptions and corrections — **active communication**

What are the open problems of the existing database

1. How to improve the existing nuclear moment database

- **1.1. How to correct typos and obvious errors?** — seems trivial but NOT
  - 1.1.1. How to obtain updated moment estimates? — procedure can be defined
  - 1.1.2. Who should update recommended values?
- **1.2. How to cross-check thousands of entries?**
- **1.3. How to treat other moment databases?**
  - 1.2.1. Darmstadt laser spectroscopy database — interaction needed
- **1.4. Shall we treat higher order moments?**

2. Other relevant databases

- **2.1. ENSDEF**
- **2.2. Charge radii**
- **2.3. Electric field gradients**
- **2.4. Atomic data**

Other communities to be involved/consulted

1. Interaction/input from other communities

1.1. Which communities?

1.1.1. Nuclear theory

1.1.2. Atomic/molecular physics

1.1.3. Solid state physics

1.2. Who are the partners?

1.3. How to establish communication channels?

2. Other relevant communities

2.1. NNDC — **close contact absolutely needed**

2.2. Charge radii — **need to synchronize the input and database format**

How to organize the work

1. Clearly voluntary work on expert level

- **1.1. Working group on evaluations**
  - 1.1.1. Laser spectroscopy — **expected largest data flow**
  - 1.1.2. Short-lived states — **clarifications/adjustments needed**
  - 1.1.3. Two-level evaluation — **evaluation and review**
- **1.2. Compilation work** — **need to be organized**
- **1.3. Database support/reformatting** — **need professional support**

2. Who should/wants to join?

3. What should be the timeline?

4. Which instruments of IAEA can be used? ***maybe a push be provided***