Argonne NATIONAL LABORATORY

*Member of the US Nuclear Data Program*

# The Atomic Mass Evaluation & NUBASE

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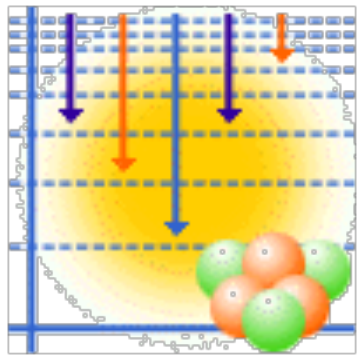
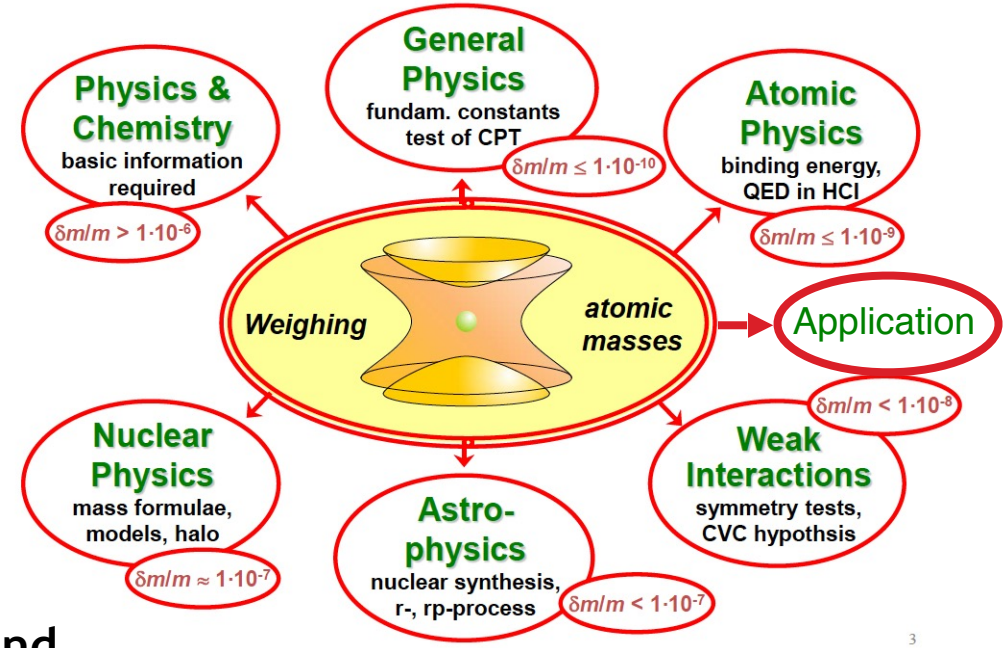


# Atomic Mass Evaluation & NuBase

- Correlations
  - ✓ pairing
  - ✓ p-n
- Binding energies
  - ✓ mass models
  - ✓ shell structure
- Reaction & decay phase space
  - ✓ Q values
  - ✓ decay & reaction probabilities
- The limits of existence
  - ✓ drip lines
  - ✓ specific configurations and topologies

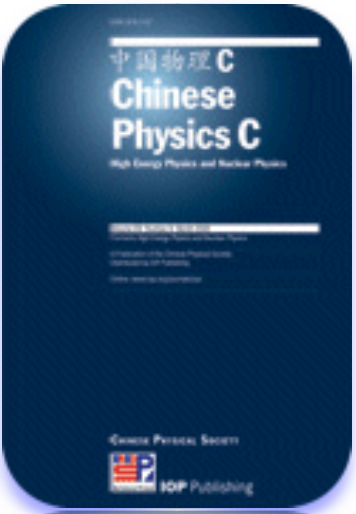



- **combines the experimental results from mass and energy measurements** produced in many nuclear physics laboratories using a procedure established by A.H. Wapstra in the early 1950's
  - ✓ recommended (best) values for the atomic masses and their uncertainties
  - ✓ extrapolation to the extremes using the smoothness of the mass surface

# AME & NuBase - historical perspective

- **long & rich history**

  **Ame1955, Ame1961, Ame1964, Ame1971, Ame1977**
  **Ame1983, Ame1993, Ame2003 -> A.H. Wapstra & G. Audi**




CPC(HEP & NP), 2012, **36**(12): 1603–2014 **Chinese Physics C** Vol. 36, No. 12, Dec., 2012

The AME2012 atomic mass evaluation *

(II). Tables, graphs and references

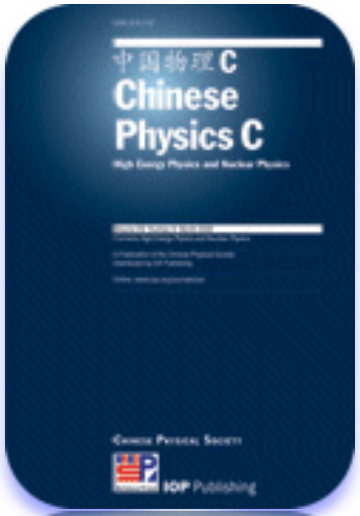
M. Wang[1,2,3], G. Audi[2,§], A.H. Wapstra[4,†], F.G. Kondev[5], M. MacCormick[6], X. Xu[1,7], and B. Pfeiffer[8,‡]

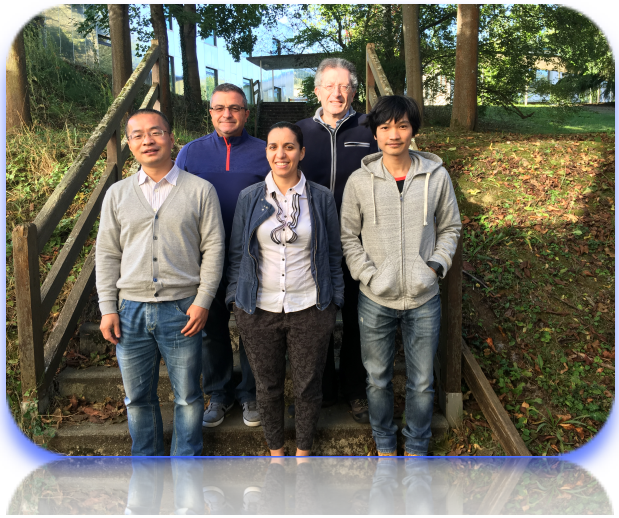
**Ame2012**

citations: >1800

**collaborative effort led by G. Audi (CSNSM)**

# AME2016 & NUBASE2016



Chinese Physics C Vol. 41, No. 3 (2017) 030003

## The AME2016 atomic mass evaluation *

Meng Wang (王猛)[1,2;1)] G. Audi (欧乔治)[3] F.G. Kondev[4] W.J. Huang(黄文嘉)[3] S. Naimi[5] Xing Xu(徐星)[1]

✓ **led by M. Wang (AME) and G. Audi (NuBase)**

- **AME2016**: continuing impact of direct mass spectrometry techniques using Penning Traps & Storage Rings spectrometers - high precision & far from stability … also new data in the region of heavy elements …

# NUBASE2016

Chinese Physics C Vol. 41, No. 3 (2017) 030001

## The NUBASE2016 evaluation of nuclear properties *

G. Audi (欧乔治)[1] F.G. Kondev[2] Meng Wang (王猛)[3,4;1)] W.J. Huang(黄文嘉)[1] S. Naimi[5]

- basic nuclear level properties of relevance to AME: **Ex**, Jπ, $T_{1/2}$, decay modes: β−n, β−2n, ECp, EC2p,…
- independently evaluated; based on ENSDF, but includes new data from the most recent references

| | ground state | | isomer ($T_{1/2}$>100 ns) | |
|---|---|---|---|---|
| | NUBASE12 | NUBASE16 | NUBASE12 | NUBASE16 |
| # of cases | 3379 | 3436 | 1769 | 1839 |
| stable | 286 | 286 | 1 | 1 |
| with Jπ | 3043 (92%) | 3138 (93%) | 1647 (93%) | 1724 (94%) |
| with firm Jπ | 1816 (55%) | 1866 (55%) | 724 (41%) | 747 (41%) |
| with T1/2 | 3288 (99%) | 3371 (100%) | | |
| with T1/2 (exp) | 2892 (87%) | 3027 (90%) | 1664 (94%) | 1734 (94%) |
| β− | 1343 | 1376 | 205 | 220 |
| β+ | 1236 | 1259 | 334 | 343 |
| α | 852 | 872 | 194 | 205 |
| p | 63 | 74 | 26 | 27 |
| SF | 192 | 203 | 40 | 45 |
| β-n | 583 | 609 | 20 | 27 |
| β+p | 243 | 265 | 28 | 29 |

# Dissemination

AMDC Atomic Mass Data Center

中国科学院近代物理研究所
Institute of Modern Physics, Chinese Academy of Sciences

http://amdc.impcas.ac.cn

Today is 2017/5/18, Thursday

About the AMDC
Introduction
NUBASE+AME2016
Evaluations
- AME
- NUBASE

Registration
Login
Logout

## The 2016 Atomic Mass Evaluation (AME2016)

**The evaluation has been published in Chinese Physics C 41 (2017) 030002 (PDF), 030003 (PDF).**

The four main ASCII files of AME2016 are

- mass16.txt - atomic masses
- mass16round.txt - atomic masses "Rounded" version
- rct1-16.txt - reaction energies, table 1, S(2n), S(2p), Q(a), Q(2B-), Q(ep), Q(B- n)
- rct2-16.txt - reaction energies, table 2, S(n), S(p), Q(4B-), Q(d,a), Q(p,a), Q(n,a)
- covariance.txt - Variances and Covariances of primary nuclides
-
- known_deficiencies.txt - list of corrections of the previous version

## AMDC Atomic Mass Data Center

AMDC Atomic Mass Data Center

This page contains data provided by the **Atomic Mass Data Center**, located at the Institute of Modern Physics, Chinese Academy of Sciences (IMP), Lanzhou, China. Please refer to that web-site for further information about AME and NUBASE.

https://www-nds.iaea.org/amdc/

**Atomic Mass Evaluation - AME2016**

**The evaluation has been published in Chinese Physics C 41 (2017) 030002 (PDF), 030003 (PDF).**

The four main ASCII files of AME2016 are

1. **mass16.txt** - atomic masses
2. **mass16round.txt** - atomic masses "rounded" version
3. **rct1-16.txt** - reaction energies, table 1
4. **rct2-16.txt** - reaction energies, table 2

## Q-value Calculator (QCalc)

QCalc calculates Q-values for nuclear reactions or decays. It uses mass values from the 2016 Atomic Mass Evaluation by M. Wang *et al*,

http://www.nndc.bnl.gov/qcalc/

**Target(s)**
*56fe, Fe56, 26056, cr50-fe56*
*use dash for range only*

**Projectile**
*4He, He-4, 2-he-4, a, alpha, 2004*

**Ejectile**
*g, n, n+p, 2n+a, 2a+12c (reaction)*
*b-, ec, 2b-, b-n, ecp, 18O (decay)*

$E_{lab}$ (MeV)

**Uncertainties**
- (•) Standard style
- ( ) Nuclear Data Sheets style

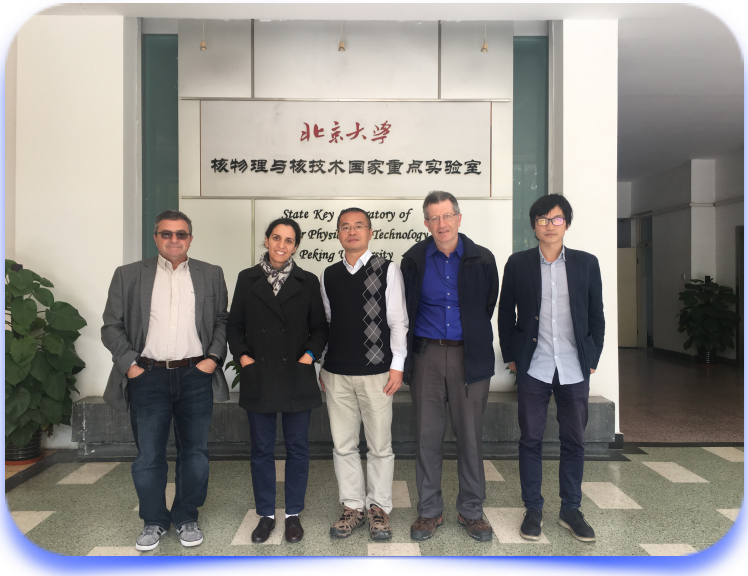
Submit Reset

- **the end users are recommended to use the data in the rct1-16.txt and rct2-16.txt files**
  - ✓ take into account correlations (explained in the 2nd AME paper)
  - ✓ uncertainties for the most precise values are listed as '0.00' - the end users need to calculate them using the correlation matrix (2nd AME paper) and non-rounded mass data (mass16.txt)

# AME collaboration meeting

- in conjunction with the US-China-RIB meeting (CUSTIPEN) - Oct. 16-18,2017
  - ✓ plenary talk on Nuclear Data Program & separate ND WG meeting

- next tables are planed for 2022 (tentative)
  - ✓ M.Wang (AME) & F. Kondev (NUBASE)
- fix known issues in the 2016 tables
  - ✓ format changes, typos. errors, etc.
- investigate discrepancies between Qα and direct Penning Trap measurements
- investigate the treatment of correlations in the storage-ring mass data




- explore FRIB - ChinaScholarshipCouncil Fellowship program for a post-doc at ANL (cost free to USNDP)