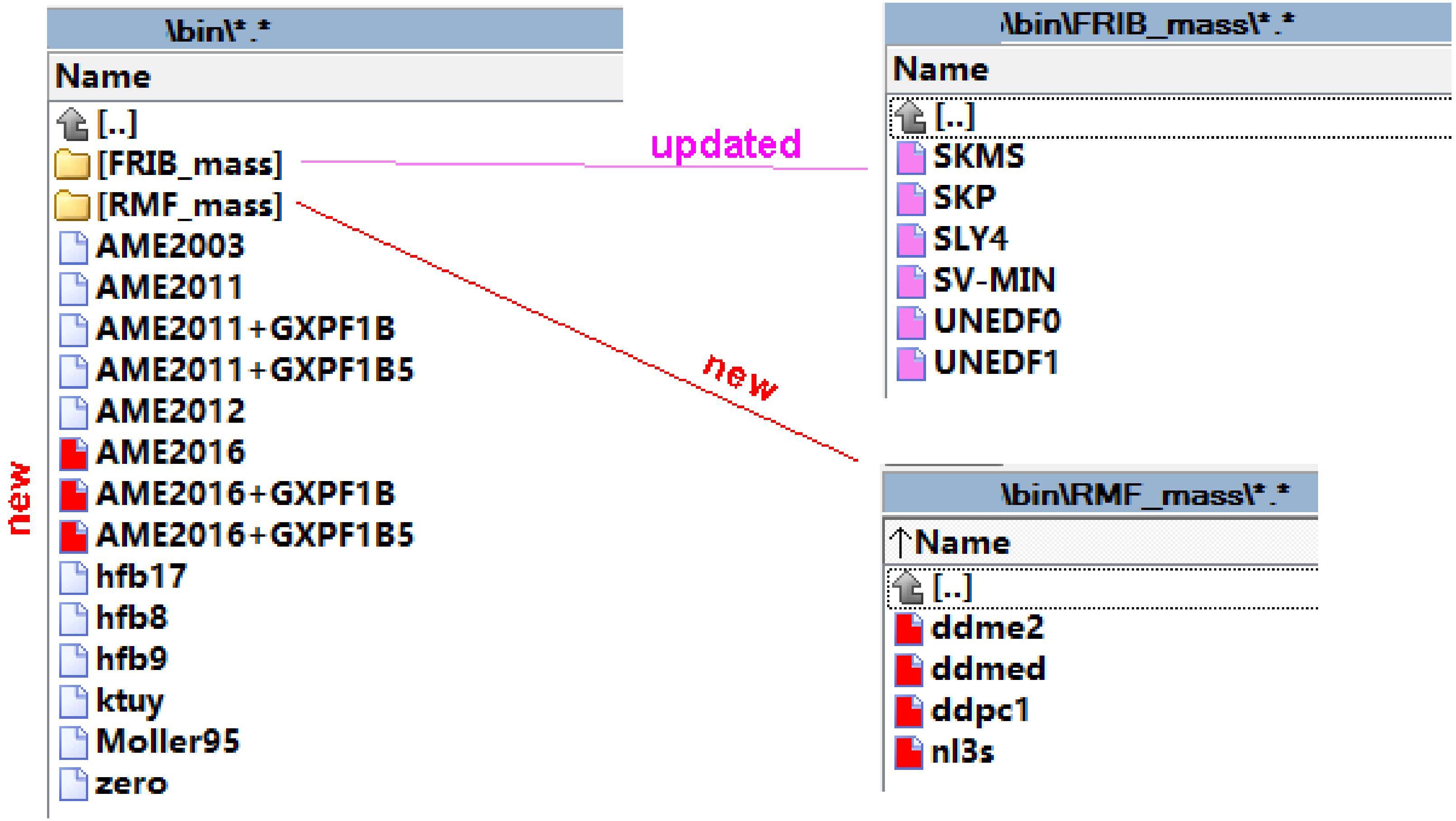
2018 : status of mass tables in LISE^{++}

Version 10.1.71

RF kicker

F11

2018 : New mass tables in LISE^{++}



\bin*.*

Name
- [..]
- [FRIB_mass]
- [RMF_mass]
- AME2003
- AME2011
- AME2011+GXPF1B
- AME2011+GXPF1B5
- AME2012
- AME2016
- AME2016+GXPF1B
- AME2016+GXPF1B5
- hfb17
- hfb8
- hfb9
- ktuy
- Moller95
- zero

\bin\FRIB_mass*.*

Name
- [..]
- SKMS
- SKP
- SLY4
- SV-MIN
- UNEDF0
- UNEDF1

\bin\RMF_mass*.*

↑Name
- [..]
- ddme2
- ddmed
- ddpc1
- nl3s

You can use own mass tables. LISE mass file extension is “lme”.

Line Format : Index *<separator>* ME (+ optional → *<separator>* dME),

Where “Index” is Z*1000+N, *<separator>* can be space, comma, or tab, “ME” is Mass Excess in MeV, “dME” is Mass Excess Error in MeV.

Information about RMF mass tables, and LISE^{++} LDM

“Mass tables" calculated with the DDPC1, DD-ME2, DD-MEδ, and NL3* covariant energy density functionals.
It represent a part of the study of the global performance of covariant energy density functionals and assesment of related systematic theoretical uncertainties. The major results of this study are presented in the following publication:

S. E. Agbemava, A. V. Afanasjev, D. Ray and P. Ring,
"Global performance of covariant energy density functionals: Ground state observables of even-even nuclei and the estimate of theoretical uncertainties", Physical Review C 89, 054320 (2014)

with additional analysis provided in two follow-up publications

A.V.Afanasjev and S.E.Agbemava,
"Covariant energy density functionals: Nuclear matter constraints and global ground state properties"
Phys. Rev. C 93, 054310 (2016)

A.V. Afanasjev, S.E. Agbemava, D. Ray and P.Ring,
"Neutron drip line: Single-particle degrees of freedom and pairing properties as sources of theoretical uncertainties"
Phys. Rev. C 91, 014324 (2015).

If you have questions, please, contact Anatoli Afanasjev at Anatoli.Afanasjev@gmail.com

RF kicker

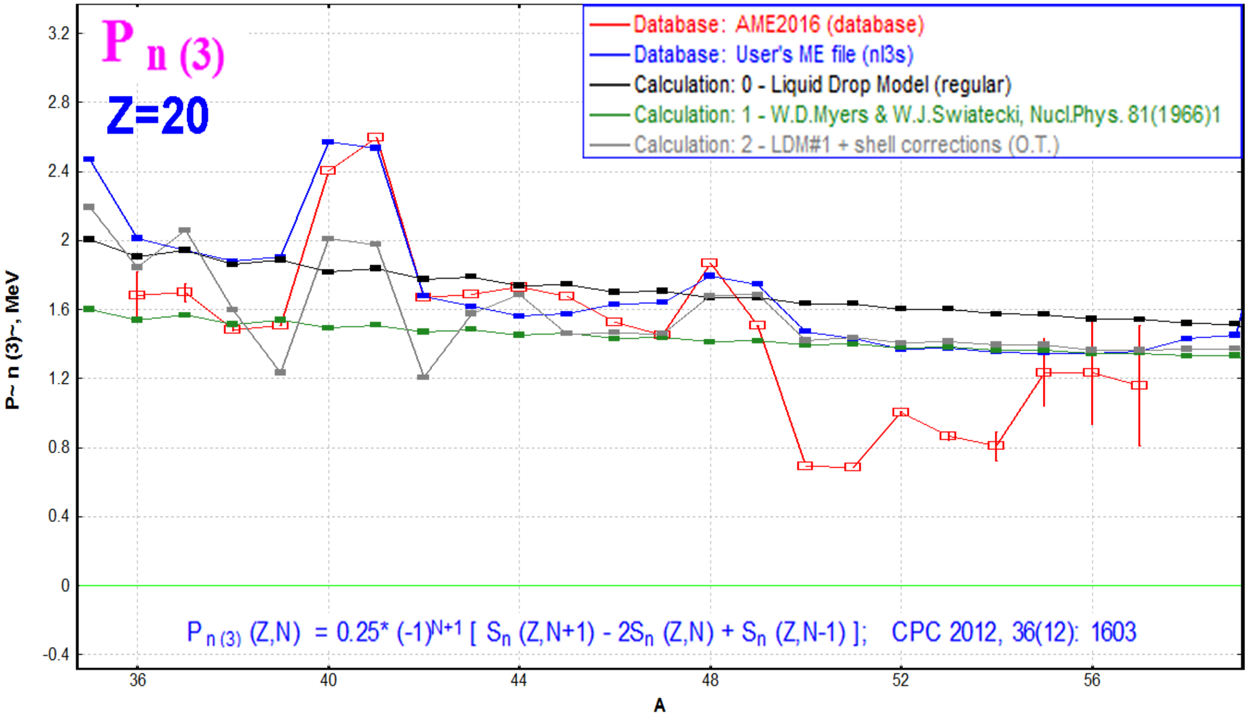
F11

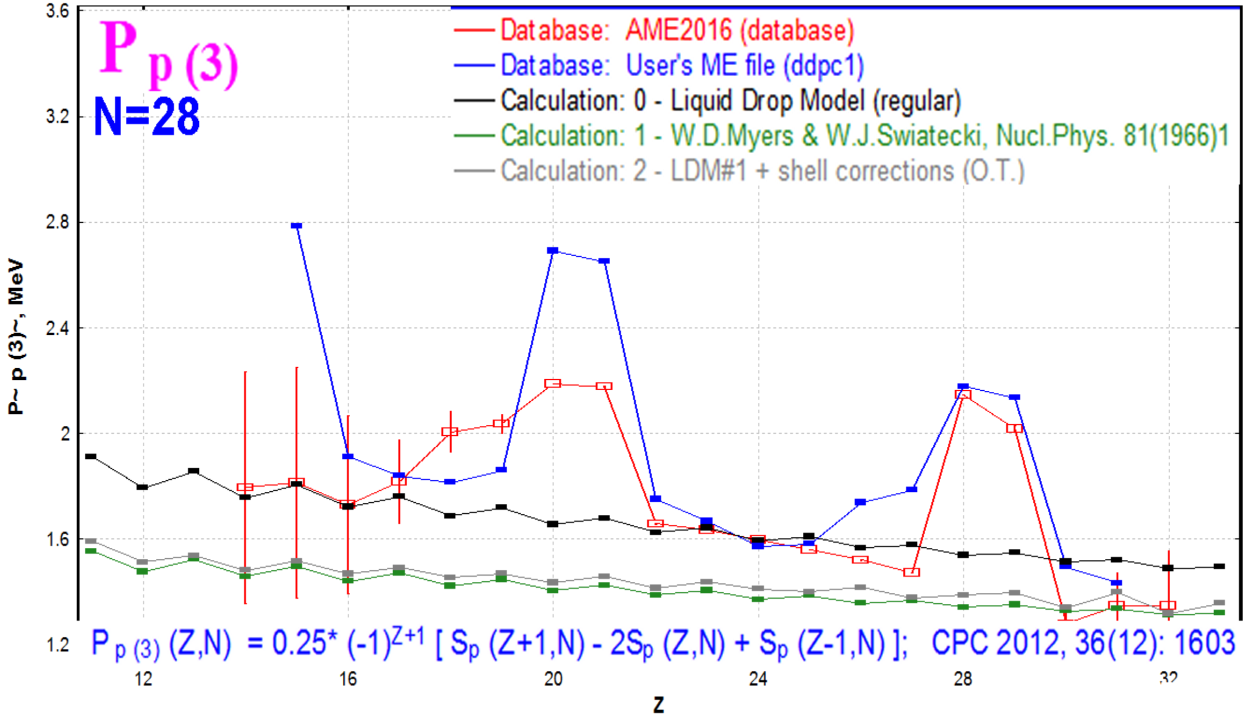
LDM #0,1,2 on the next plots are [Liquid Droplet Models in LISE^{++}](http://lise.nscl.msu.edu/6_1/lise++_6.htm#_Toc26162476)

http://lise.nscl.msu.edu/6_1/lise++_6.htm#_Toc26162476

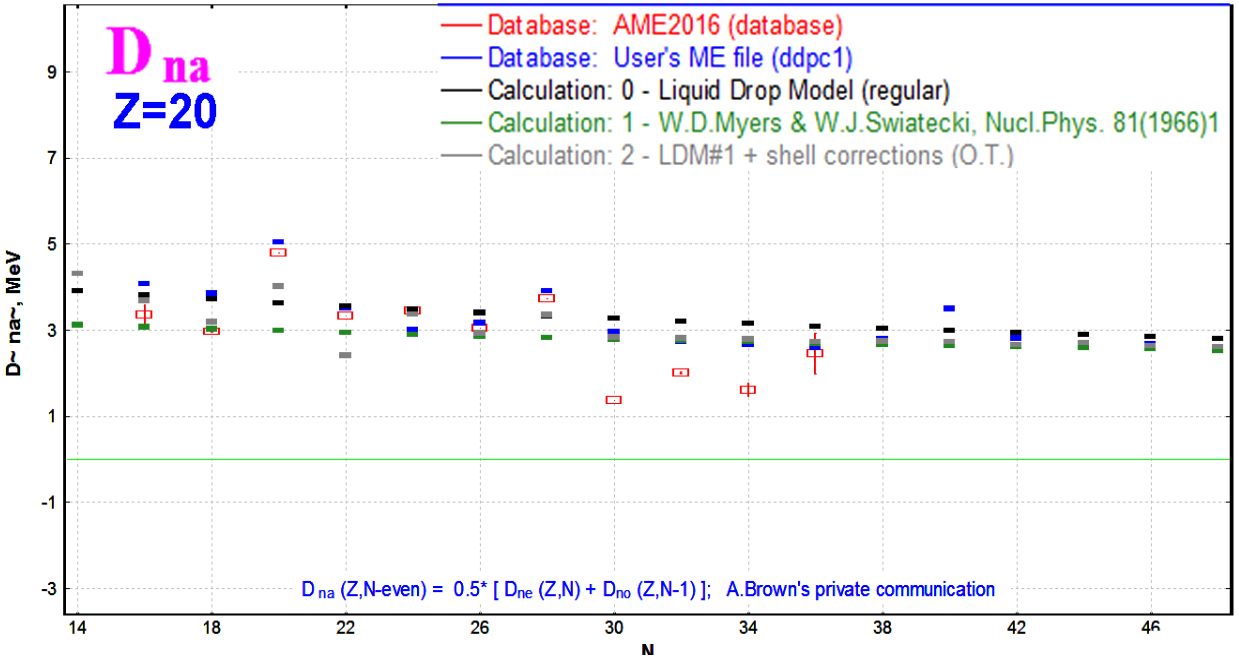
Creation of the RMF mass tables in LISE^{++}

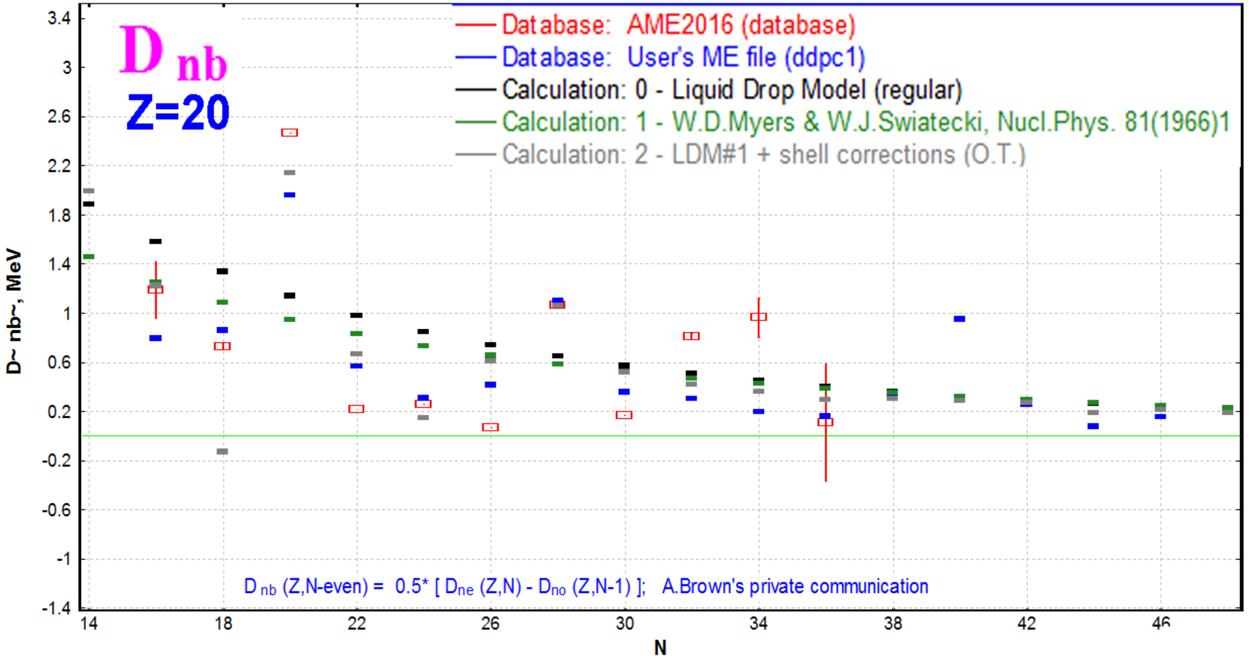
- Original RMF mass tables contains only information on even-even isotopes, and did not contain Proton and Neutron pairing energy information;
- To create a regular LISE++ mass excess file, in order to use for cross section calculations and provide separation energy information, pairing energy tables should be applied to get information for odd isotopes;
- Average Proton and Neutron pairing energies (PE) from the FRIB mass explorer DTF tables have been used to create RMF mass tables in LISE^{++} ;
- link on the pairing energies http://lise.nscl.msu.edu/10_1/FRIB_OnlyGaps.xlsx;
- Median StdDev(PE)=131 keV (StdDev/Mean=16.4%) for neutrons,
  Median StdDev(PE)= 77 keV (StdDev/Mean=12.7%) for protons.

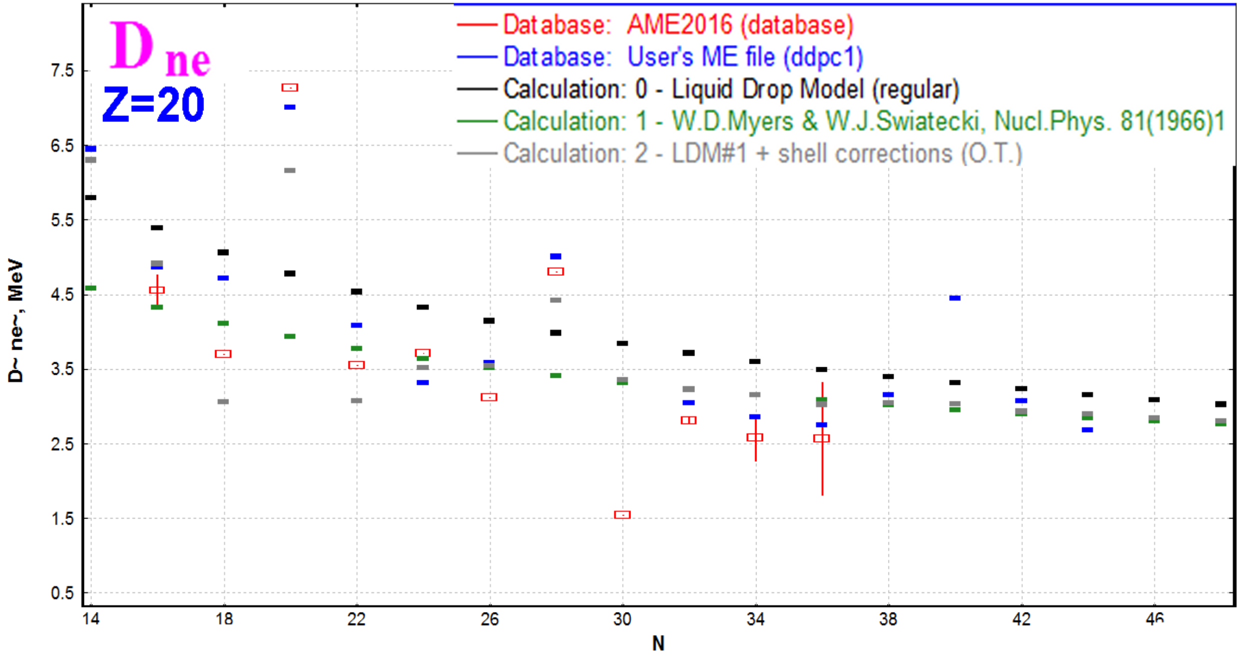


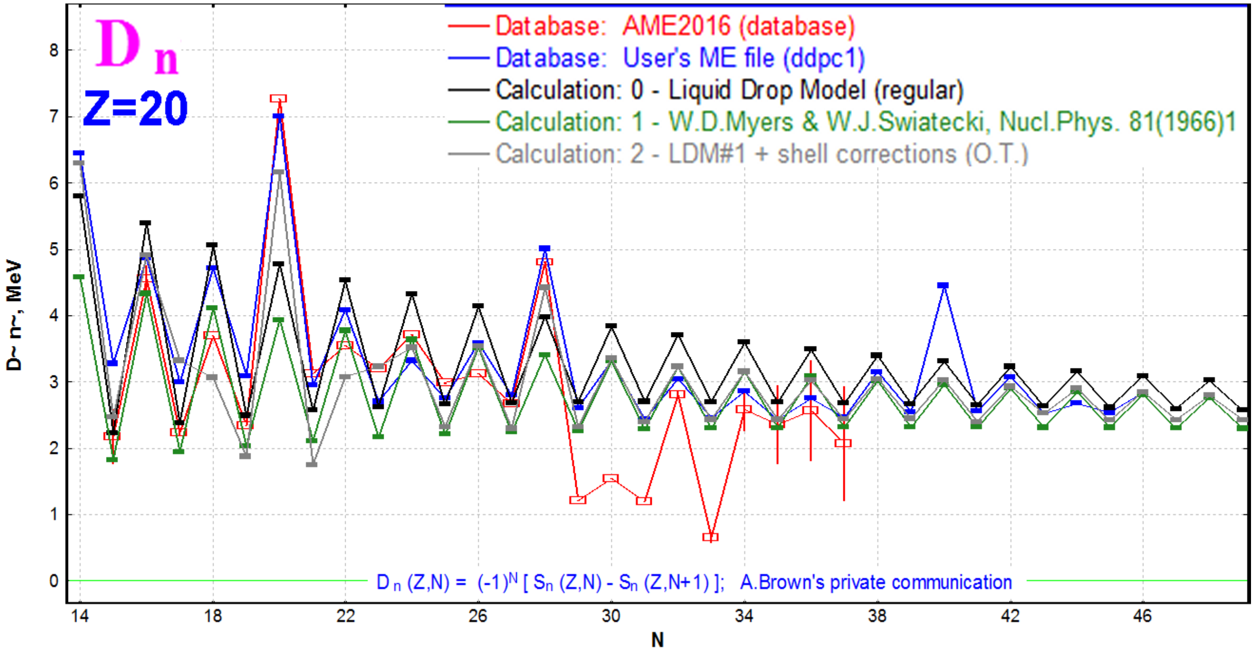


Deduced D_n energies with the RMF mass table (ddpc1) in LISE^{++}

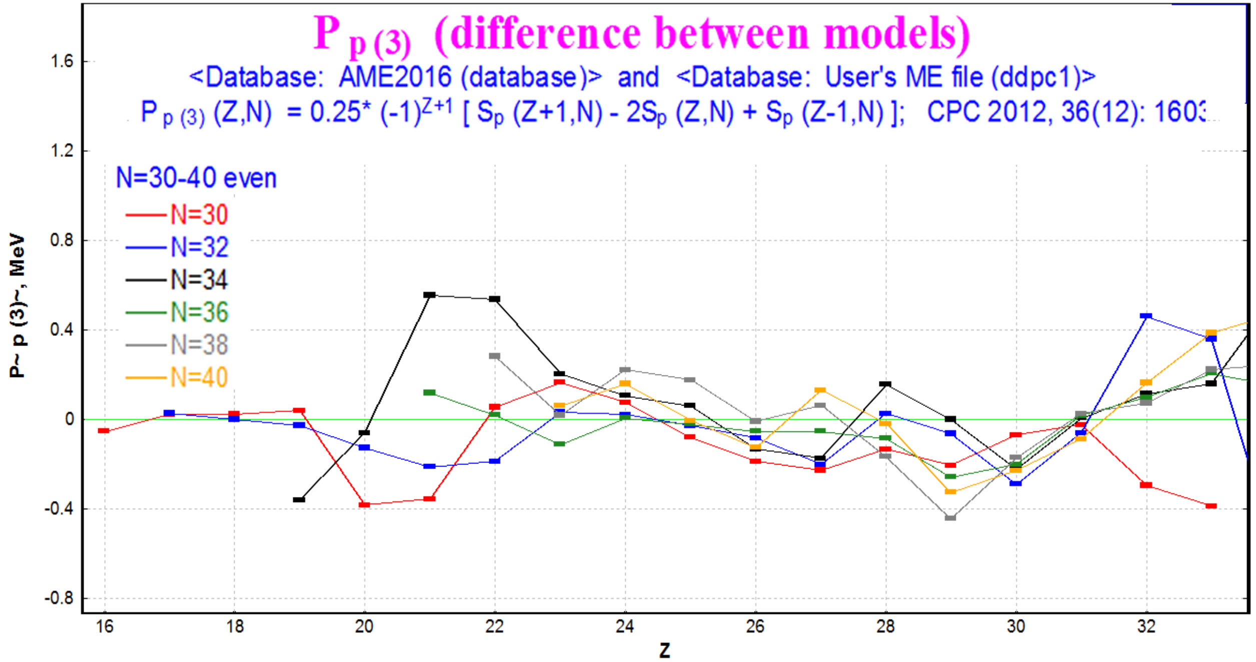


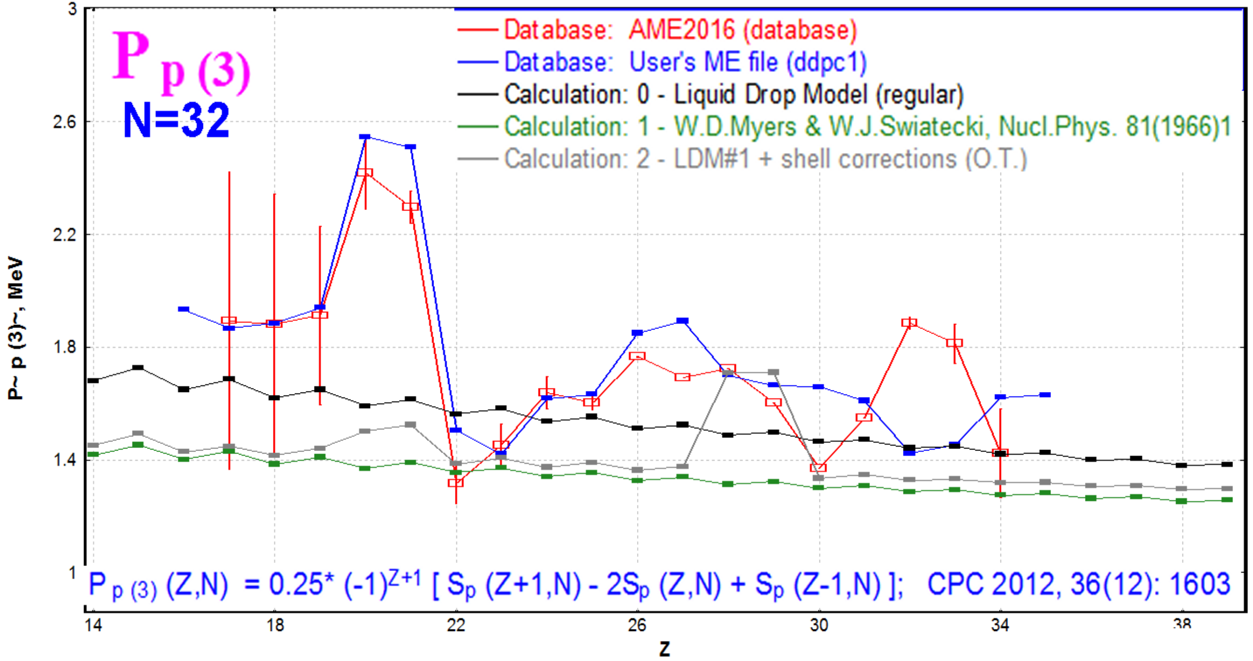


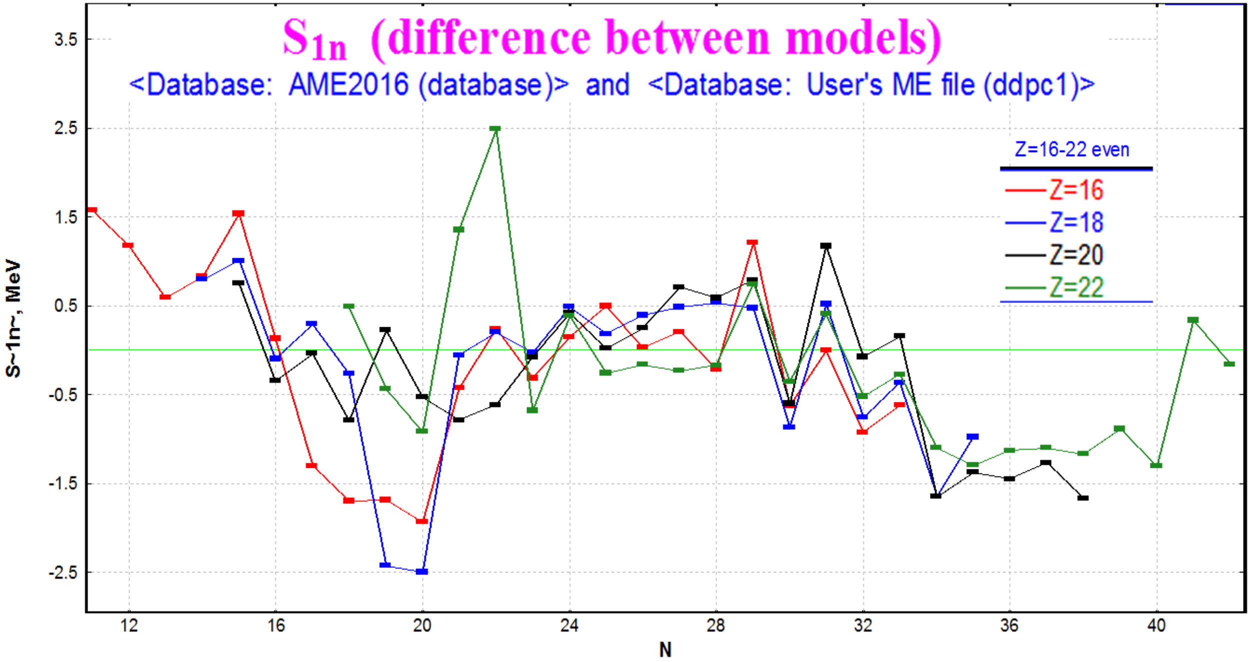


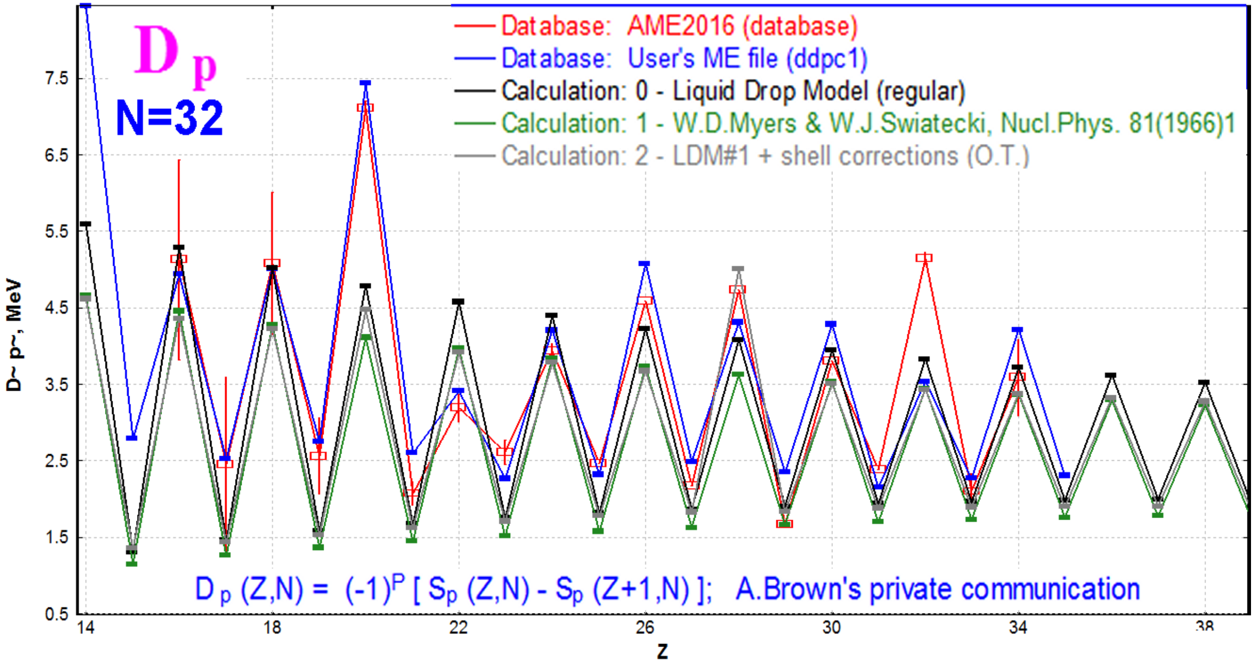


Deduced values using the RMF mass table (ddpc1) in LISE^{++}







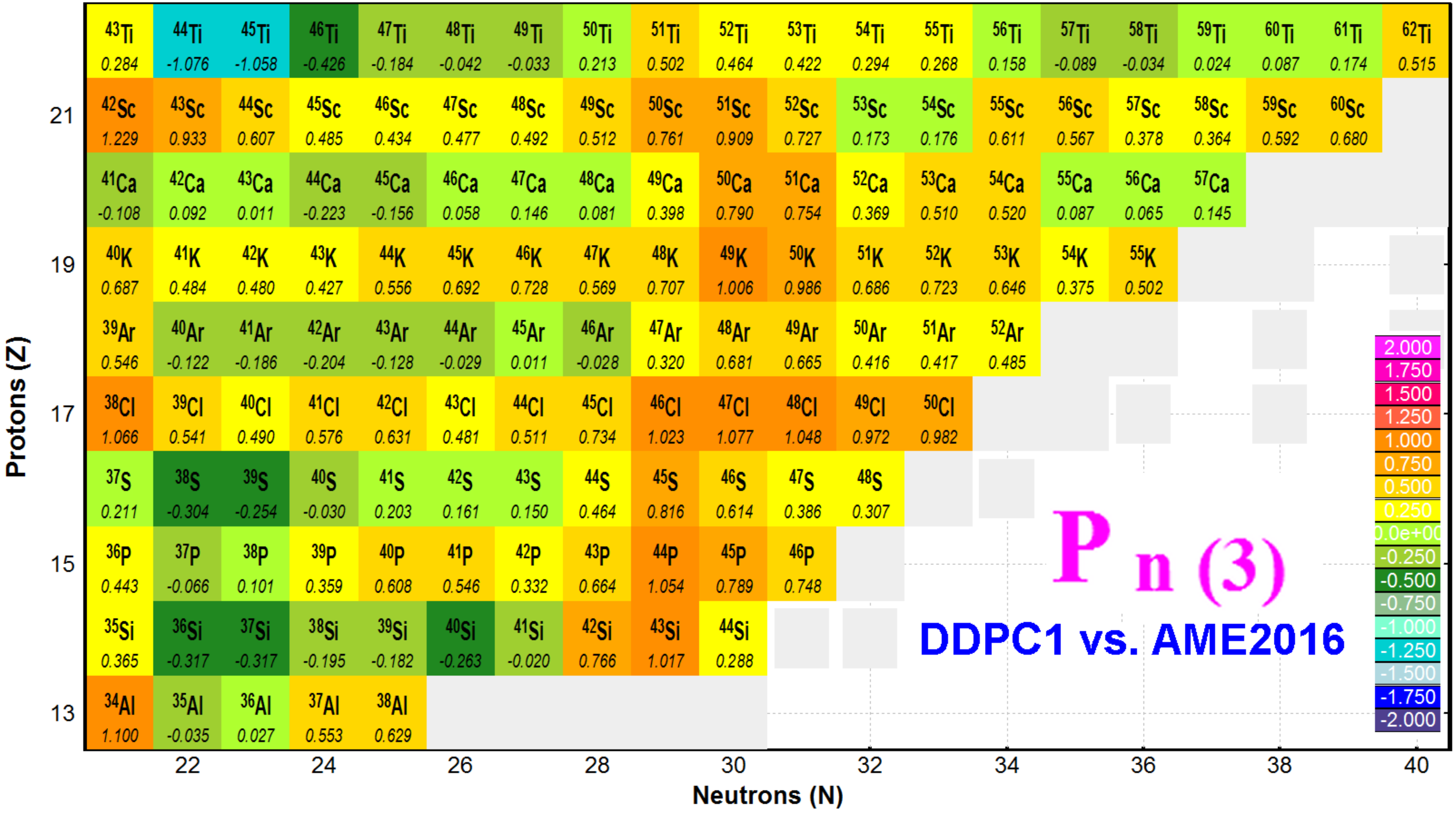


$P_{n(3)}$ difference between RMF mass table (ddpc1) vs. AME2016

$P_{n\ (3)}$ (difference between models)

<Database: User's ME file (ddpc1)> and <Database: AME2016 (database)>

$P_{n\ (3)}$ (Z,N) = 0.25* $(-1)^{N+1}$ [S_n (Z,N+1) - 2S_n (Z,N) + S_n (Z,N-1)]; CPC 2012, 36(12): 1603



^{43}Ti 0.284	^{44}Ti -1.076	^{45}Ti -1.058	^{46}Ti -0.426	^{47}Ti -0.184	^{48}Ti -0.042	^{49}Ti -0.033	^{50}Ti 0.213	^{51}Ti 0.502	^{52}Ti 0.464	^{53}Ti 0.422	^{54}Ti 0.294	^{55}Ti 0.268	^{56}Ti 0.158	^{57}Ti -0.089	^{58}Ti -0.034	^{59}Ti 0.024	^{60}Ti 0.087	^{61}Ti 0.174	^{62}Ti 0.515
^{42}Sc 1.229	^{43}Sc 0.933	^{44}Sc 0.607	^{45}Sc 0.485	^{46}Sc 0.434	^{47}Sc 0.477	^{48}Sc 0.492	^{49}Sc 0.512	^{50}Sc 0.761	^{51}Sc 0.909	^{52}Sc 0.727	^{53}Sc 0.173	^{54}Sc 0.176	^{55}Sc 0.611	^{56}Sc 0.567	^{57}Sc 0.378	^{58}Sc 0.364	^{59}Sc 0.592	^{60}Sc 0.680	
^{41}Ca -0.108	^{42}Ca 0.092	^{43}Ca 0.011	^{44}Ca -0.223	^{45}Ca -0.156	^{46}Ca 0.058	^{47}Ca 0.146	^{48}Ca 0.081	^{49}Ca 0.398	^{50}Ca 0.790	^{51}Ca 0.754	^{52}Ca 0.369	^{53}Ca 0.510	^{54}Ca 0.520	^{55}Ca 0.087	^{56}Ca 0.065	^{57}Ca 0.145			
^{40}K 0.687	^{41}K 0.484	^{42}K 0.480	^{43}K 0.427	^{44}K 0.556	^{45}K 0.692	^{46}K 0.728	^{47}K 0.569	^{48}K 0.707	^{49}K 1.006	^{50}K 0.986	^{51}K 0.686	^{52}K 0.723	^{53}K 0.646	^{54}K 0.375	^{55}K 0.502				
^{39}Ar 0.546	^{40}Ar -0.122	^{41}Ar -0.186	^{42}Ar -0.204	^{43}Ar -0.128	^{44}Ar -0.029	^{45}Ar 0.011	^{46}Ar -0.028	^{47}Ar 0.320	^{48}Ar 0.681	^{49}Ar 0.665	^{50}Ar 0.416	^{51}Ar 0.417	^{52}Ar 0.485						
^{38}Cl 1.066	^{39}Cl 0.541	^{40}Cl 0.490	^{41}Cl 0.576	^{42}Cl 0.631	^{43}Cl 0.481	^{44}Cl 0.511	^{45}Cl 0.734	^{46}Cl 1.023	^{47}Cl 1.077	^{48}Cl 1.048	^{49}Cl 0.972	^{50}Cl 0.982							
^{37}S 0.211	^{38}S -0.304	^{39}S -0.254	^{40}S -0.030	^{41}S 0.203	^{42}S 0.161	^{43}S 0.150	^{44}S 0.464	^{45}S 0.816	^{46}S 0.614	^{47}S 0.386	^{48}S 0.307								
^{36}P 0.443	^{37}P -0.066	^{38}P 0.101	^{39}P 0.359	^{40}P 0.608	^{41}P 0.546	^{42}P 0.332	^{43}P 0.664	^{44}P 1.054	^{45}P 0.789	^{46}P 0.748									
^{35}Si 0.365	^{36}Si -0.317	^{37}Si -0.317	^{38}Si -0.195	^{39}Si -0.182	^{40}Si -0.263	^{41}Si -0.020	^{42}Si 0.766	^{43}Si 1.017	^{44}Si 0.288										
^{34}Al 1.100	^{35}Al -0.035	^{36}Al 0.027	^{37}Al 0.553	^{38}Al 0.629															

2.000
1.750
1.500
1.250
1.000
0.750
0.500
0.250
0.0e+00
-0.250
-0.500
-0.750
-1.000
-1.250
-1.500
-1.750
-2.000

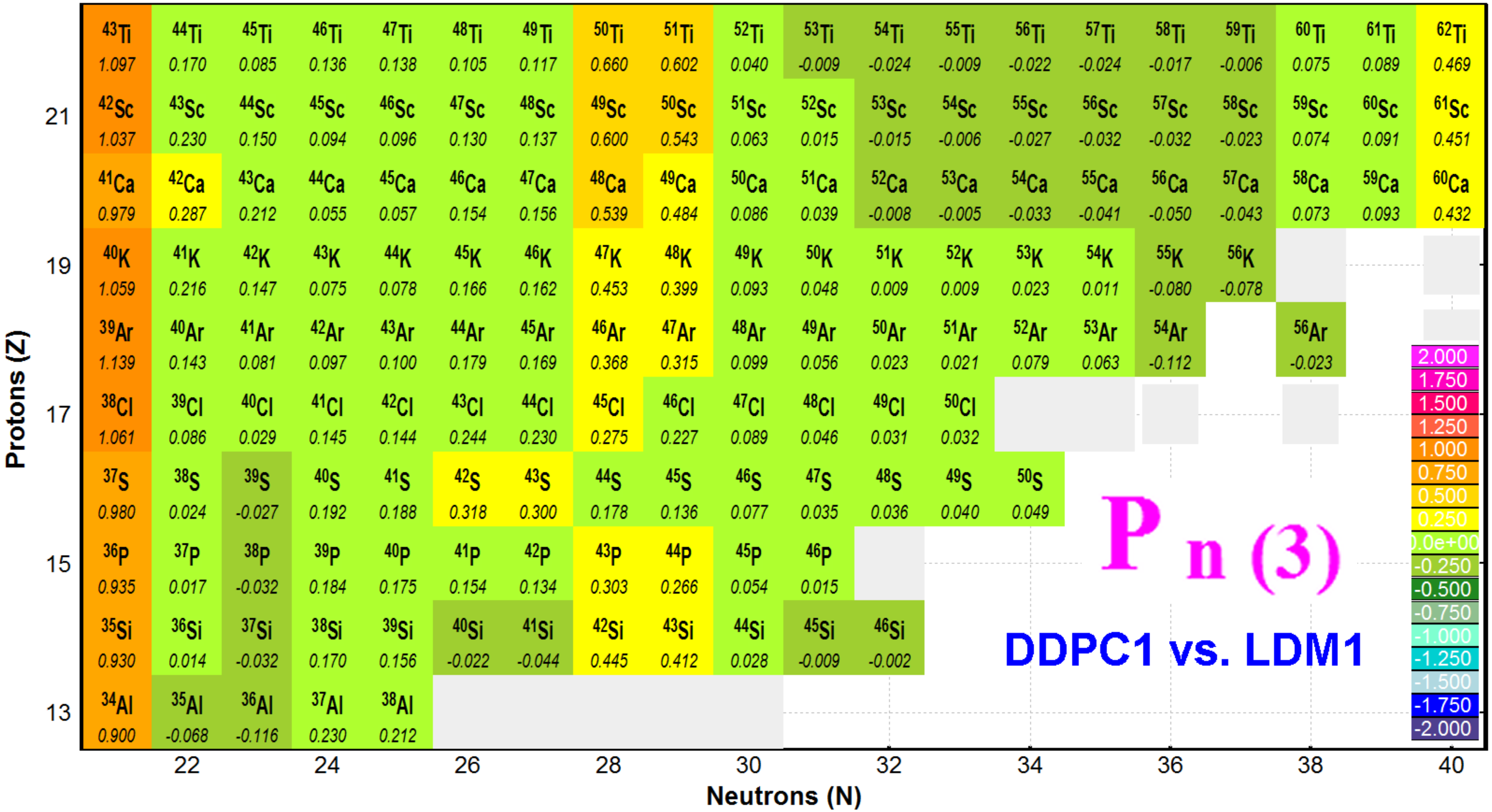
count	137
StDeV	0.894
median	0.816
median	0.689

$P_{n(3)}$ difference between RMF mass table (ddpc1) vs. LDM1

$P_{n\,(3)}$ (difference between models)

<Database: User's ME file (ddpc1)> and <Calculation: 1 - W.D.Myers & W.J.Swiatecki, Nucl.Phys. 81(1966)1>

$P_{n\,(3)}(Z,N) = 0.25^{*}(-1)^{N+1}[S_n(Z,N+1) - 2S_n(Z,N) + S_n(Z,N-1)]$; CPC 2012, 36(12): 1603



^{43}Ti 1.097	^{44}Ti 0.170	^{45}Ti 0.085	^{46}Ti 0.136	^{47}Ti 0.138	^{48}Ti 0.105	^{49}Ti 0.117	^{50}Ti 0.660	^{51}Ti 0.602	^{52}Ti 0.040	^{53}Ti -0.009	^{54}Ti -0.024	^{55}Ti -0.009	^{56}Ti -0.022	^{57}Ti -0.024	^{58}Ti -0.017	^{59}Ti -0.006	^{60}Ti 0.075	^{61}Ti 0.089	^{62}Ti 0.469
^{42}Sc 1.037	^{43}Sc 0.230	^{44}Sc 0.150	^{45}Sc 0.094	^{46}Sc 0.096	^{47}Sc 0.130	^{48}Sc 0.137	^{49}Sc 0.600	^{50}Sc 0.543	^{51}Sc 0.063	^{52}Sc 0.015	^{53}Sc -0.015	^{54}Sc -0.006	^{55}Sc -0.027	^{56}Sc -0.032	^{57}Sc -0.032	^{58}Sc -0.023	^{59}Sc 0.074	^{60}Sc 0.091	^{61}Sc 0.451
^{41}Ca 0.979	^{42}Ca 0.287	^{43}Ca 0.212	^{44}Ca 0.055	^{45}Ca 0.057	^{46}Ca 0.154	^{47}Ca 0.156	^{48}Ca 0.539	^{49}Ca 0.484	^{50}Ca 0.086	^{51}Ca 0.039	^{52}Ca -0.008	^{53}Ca -0.005	^{54}Ca -0.033	^{55}Ca -0.041	^{56}Ca -0.050	^{57}Ca -0.043	^{58}Ca 0.073	^{59}Ca 0.093	^{60}Ca 0.432
^{40}K 1.059	^{41}K 0.216	^{42}K 0.147	^{43}K 0.075	^{44}K 0.078	^{45}K 0.166	^{46}K 0.162	^{47}K 0.453	^{48}K 0.399	^{49}K 0.093	^{50}K 0.048	^{51}K 0.009	^{52}K 0.009	^{53}K 0.023	^{54}K 0.011	^{55}K -0.080	^{56}K -0.078			
^{39}Ar 1.139	^{40}Ar 0.143	^{41}Ar 0.081	^{42}Ar 0.097	^{43}Ar 0.100	^{44}Ar 0.179	^{45}Ar 0.169	^{46}Ar 0.368	^{47}Ar 0.315	^{48}Ar 0.099	^{49}Ar 0.056	^{50}Ar 0.023	^{51}Ar 0.021	^{52}Ar 0.079	^{53}Ar 0.063	^{54}Ar -0.112		^{56}Ar -0.023		
^{38}Cl 1.061	^{39}Cl 0.086	^{40}Cl 0.029	^{41}Cl 0.145	^{42}Cl 0.144	^{43}Cl 0.244	^{44}Cl 0.230	^{45}Cl 0.275	^{46}Cl 0.227	^{47}Cl 0.089	^{48}Cl 0.046	^{49}Cl 0.031	^{50}Cl 0.032							
^{37}S 0.980	^{38}S 0.024	^{39}S -0.027	^{40}S 0.192	^{41}S 0.188	^{42}S 0.318	^{43}S 0.300	^{44}S 0.178	^{45}S 0.136	^{46}S 0.077	^{47}S 0.035	^{48}S 0.036	^{49}S 0.040	^{50}S 0.049						
^{36}P 0.935	^{37}P 0.017	^{38}P -0.032	^{39}P 0.184	^{40}P 0.175	^{41}P 0.154	^{42}P 0.134	^{43}P 0.303	^{44}P 0.266	^{45}P 0.054	^{46}P 0.015									
^{35}Si 0.930	^{36}Si 0.014	^{37}Si -0.032	^{38}Si 0.170	^{39}Si 0.156	^{40}Si -0.022	^{41}Si -0.044	^{42}Si 0.445	^{43}Si 0.412	^{44}Si 0.028	^{45}Si -0.009	^{46}Si -0.002								
^{34}Al 0.900	^{35}Al -0.068	^{36}Al -0.116	^{37}Al 0.230	^{38}Al 0.212															

For

$13 \le Z \le 22$

$21 \le N \le 40$

count	149
StDeV	0.271
median	0.091
average	0.180

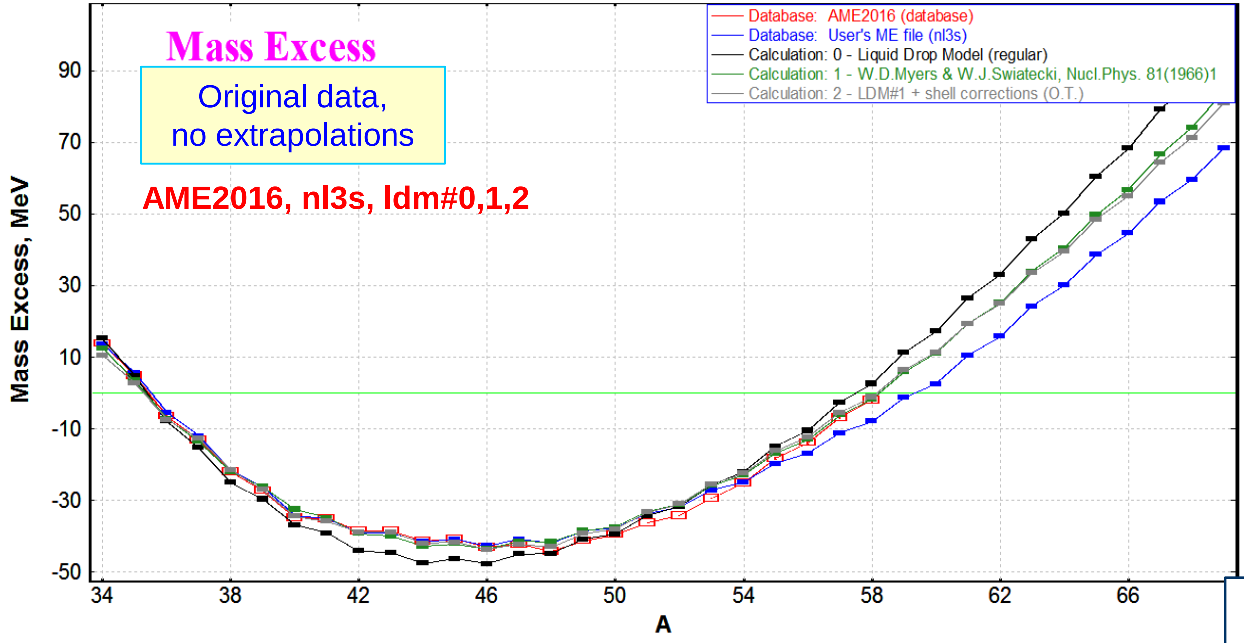
For

$13 \le Z \le 22$

$\mathbf{22} \le N \le 40$

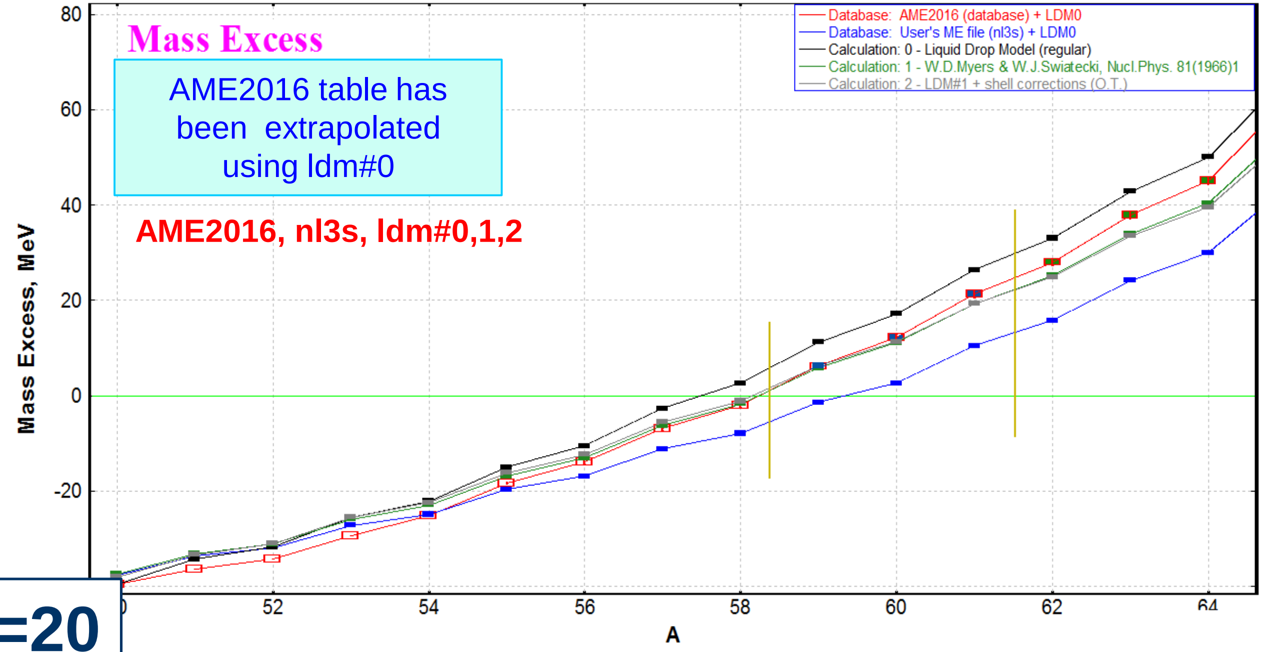
count	139
StDeV	0.157
median	0.085
average	0.121

Modification of the mass excess extrapolation in LISE^{++}


Mass Excess

Original data,
no extrapolations

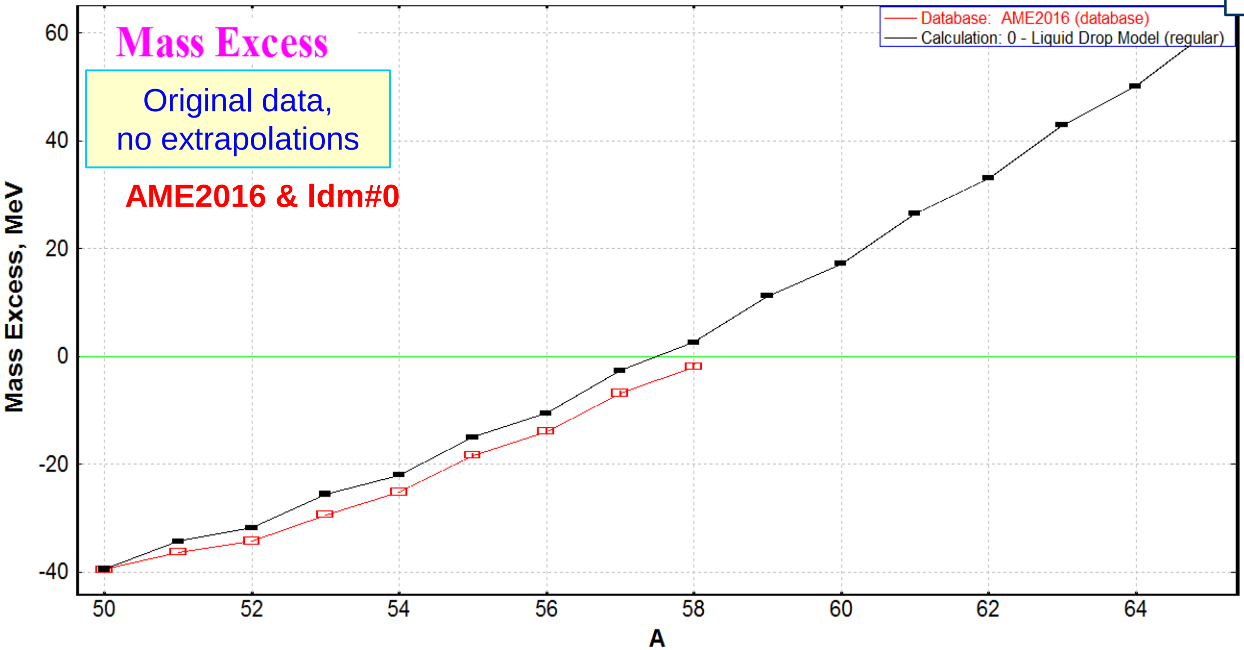
AME2016, nl3s, ldm#0,1,2


Mass Excess

AME2016 table has
been extrapolated
using ldm#0

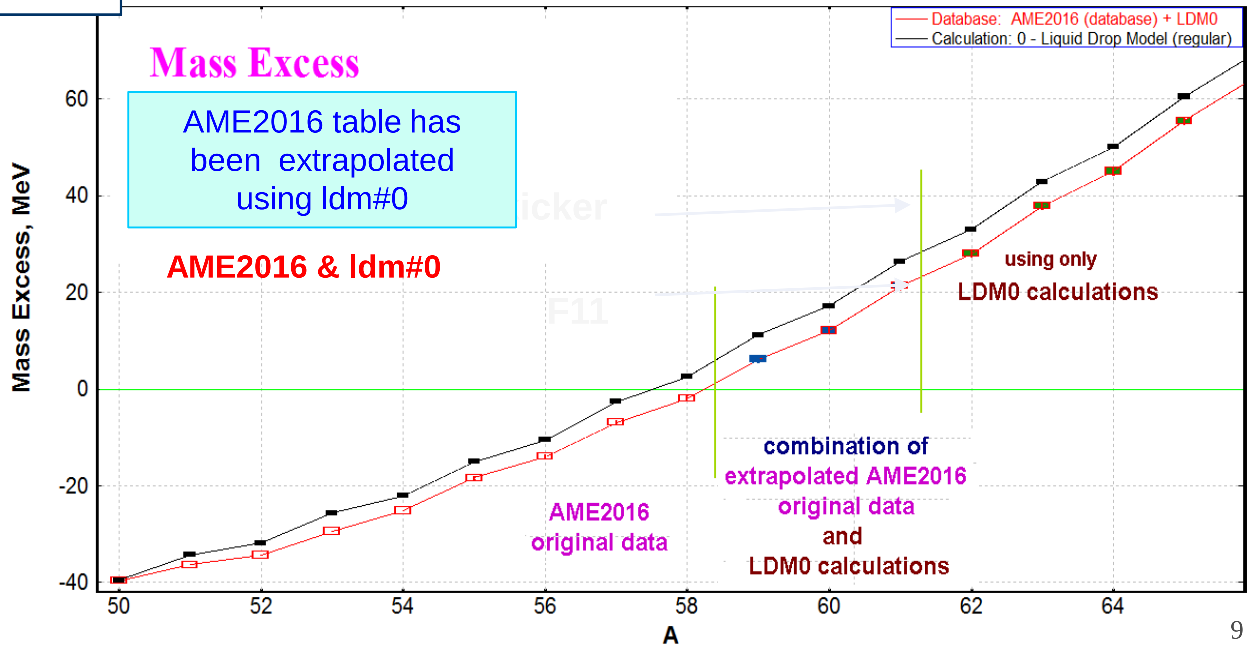
AME2016, nl3s, ldm#0,1,2

Z=20


Mass Excess

Original data,
no extrapolations

AME2016 & ldm#0


Mass Excess

AME2016 table has
been extrapolated
using ldm#0

AME2016 & ldm#0

using only
LDM0 calculations

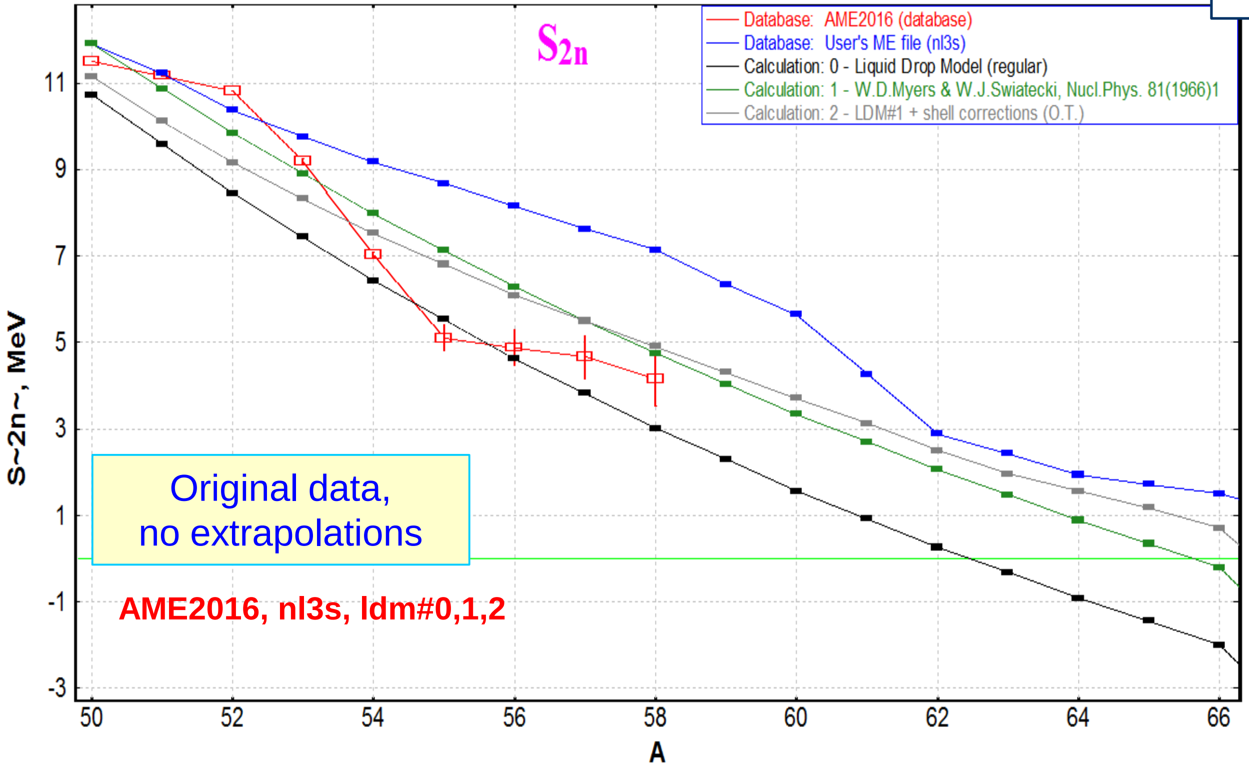
combination of
extrapolated AME2016
original data
and
LDM0 calculations

AME2016
original data

Modification of the mass excess extrapolation in LISE^{++}

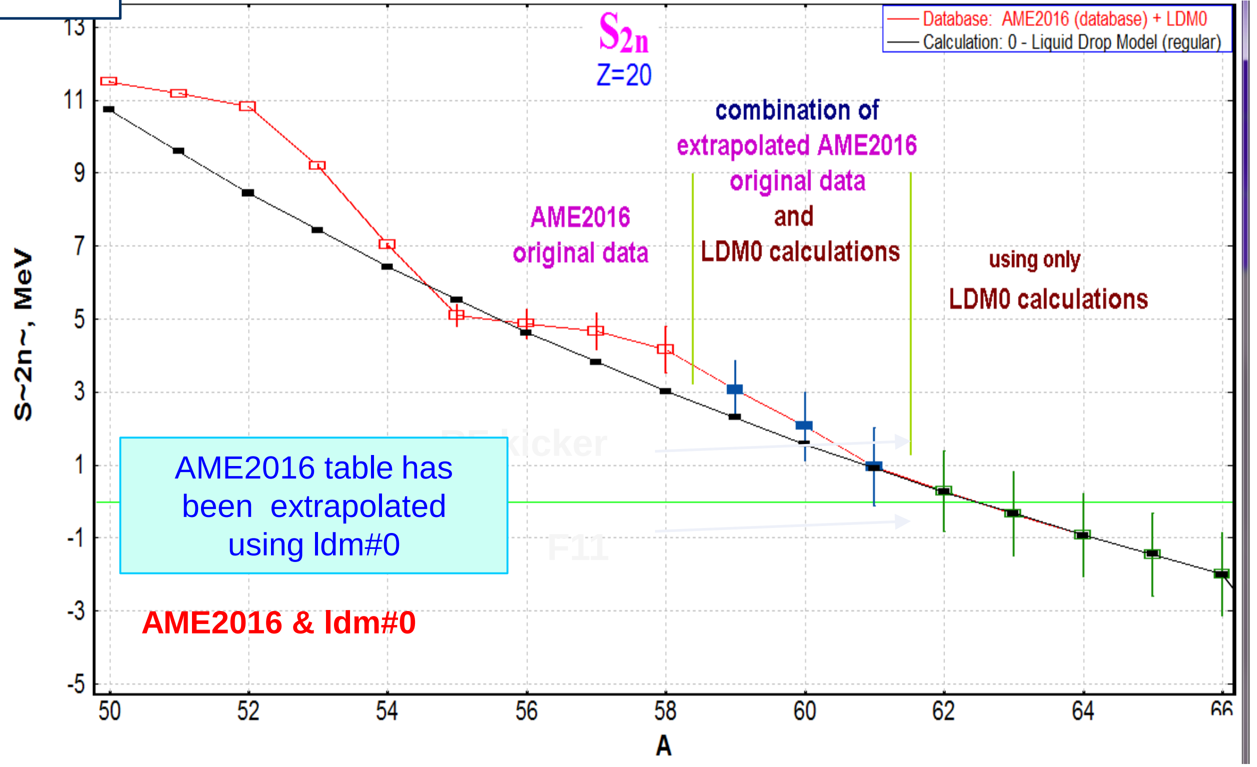
S_{2n} plots for *Z*=20 (corresponds to the previous Mass Excess page)

Z=20



Original data,
no extrapolations

AME2016, nl3s, ldm#0,1,2



AME2016
original data

combination of
extrapolated AME2016
original data
and
LDM0 calculations

using only
LDM0 calculations

AME2016 table has
been extrapolated
using ldm#0

AME2016 & ldm#0

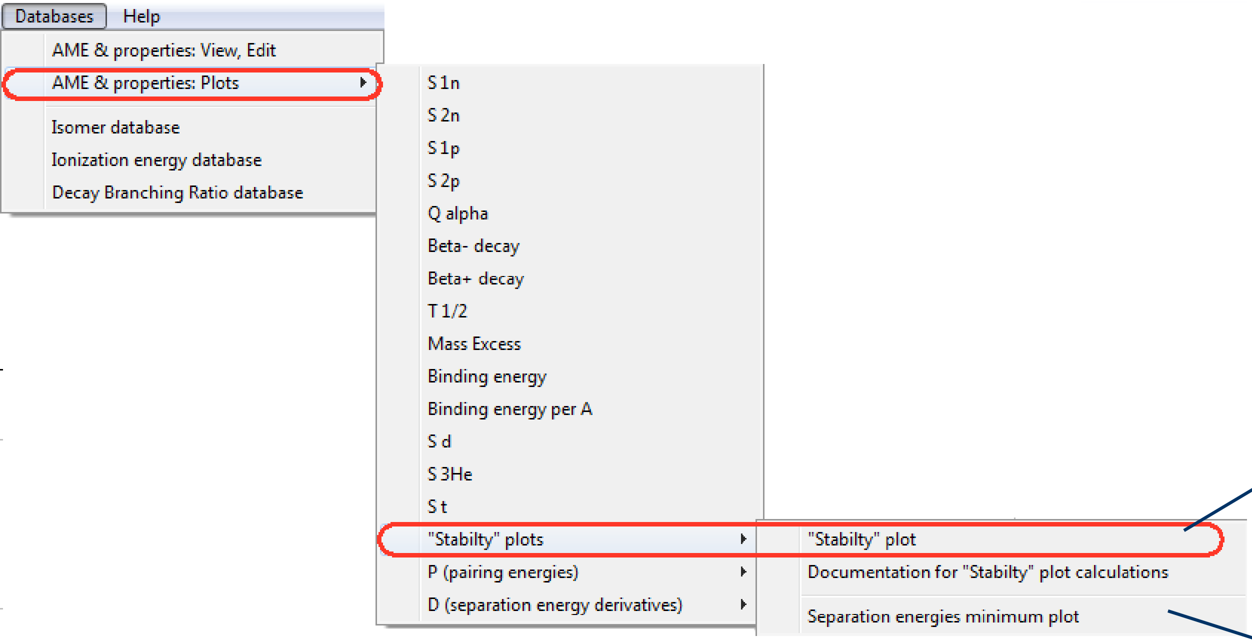
Where LDM #0,1,2 are [Liquid Droplet Models in LISE^{++}](http://lise.nscl.msu.edu/6_1/lise++_6.htm#_Toc26162476)

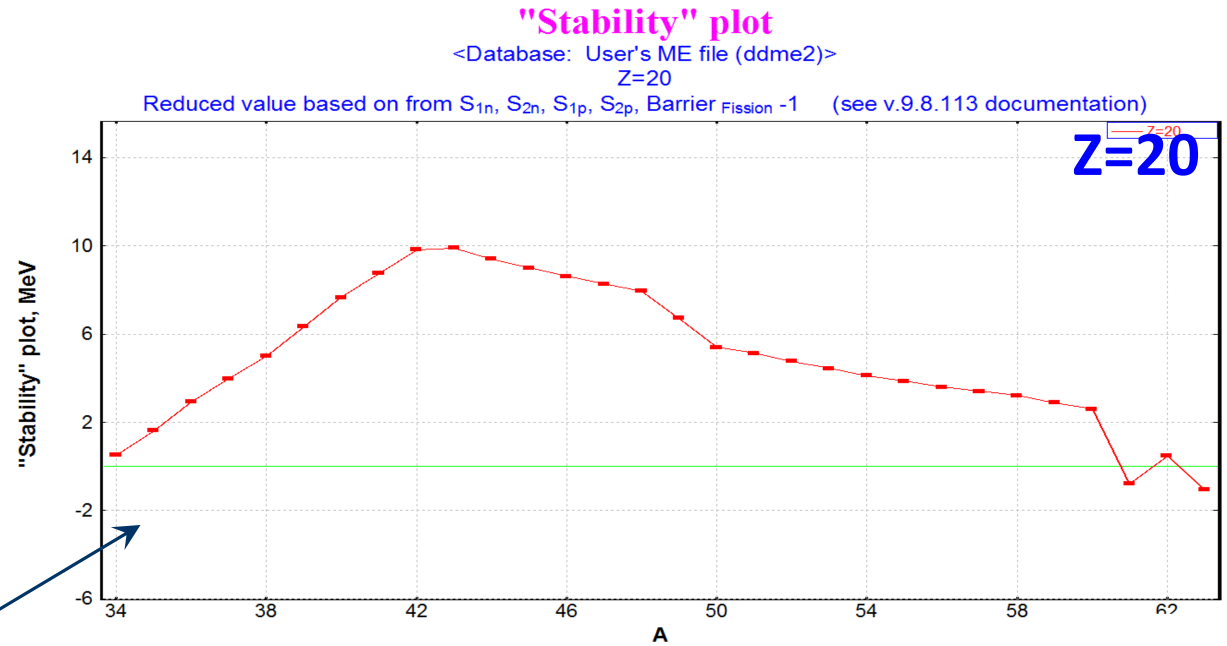
http://lise.nscl.msu.edu/6_1/lise++_6.htm#_Toc26162476

“Stability” plots

More information can be find at

http://lise.nscl.msu.edu/9_8/LISE_stability_plot.pdf



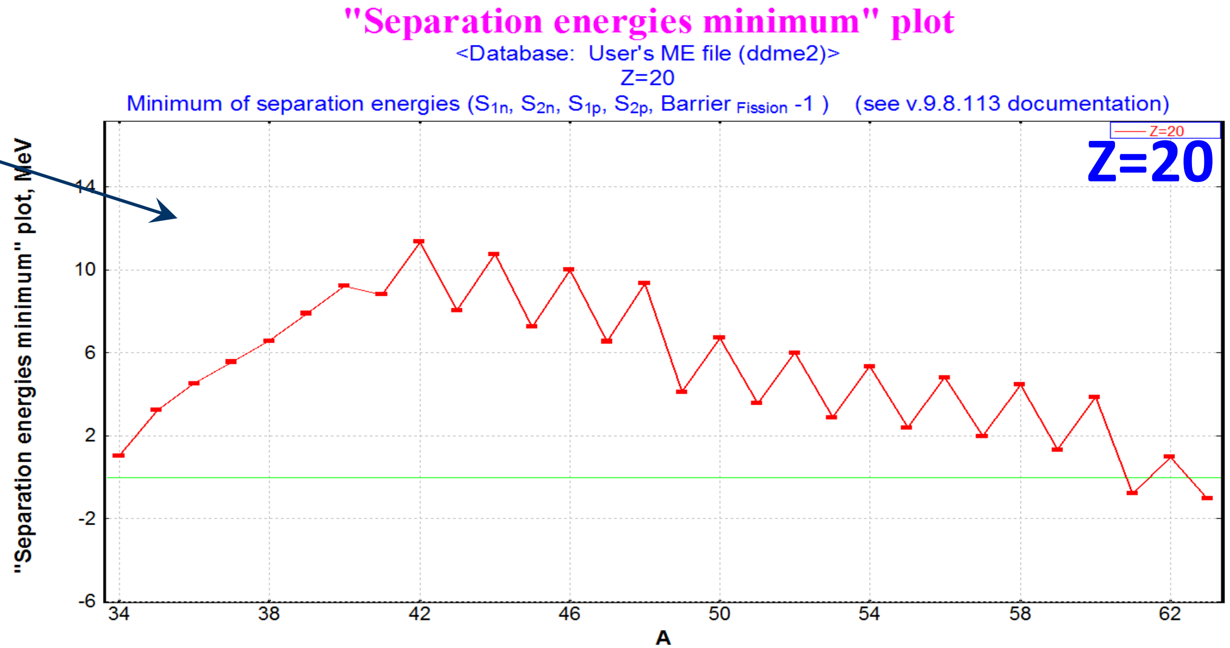


"Stability" plot

<Database: User's ME file (ddme2)>

Z=20

Reduced value based on from S_{1n}, S_{2n}, S_{1p}, S_{2p}, Barrier $_{Fission}$ -1 (see v.9.8.113 documentation)



"Separation energies minimum" plot

<Database: User's ME file (ddme2)>

Z=20

Minimum of separation energies (S_{1n}, S_{2n}, S_{1p}, S_{2p}, Barrier $_{Fission}$ -1) (see v.9.8.113 documentation)

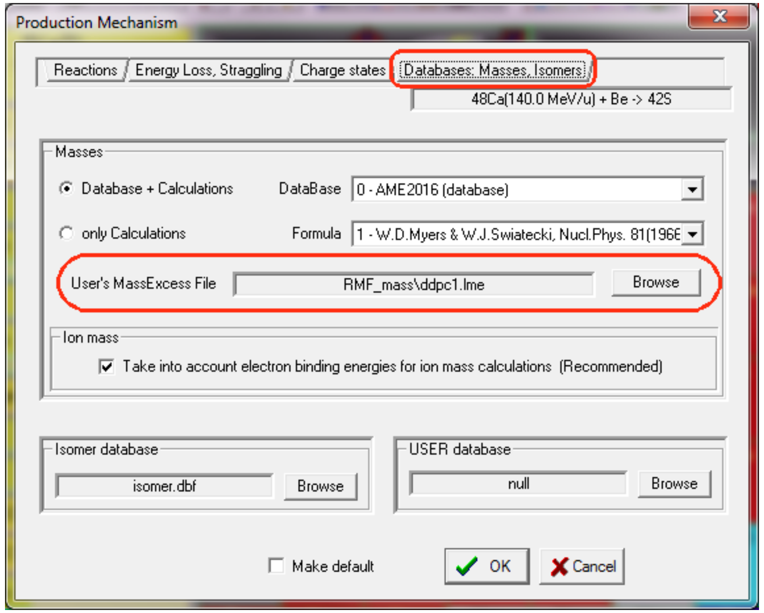
The Purpose is to deduce and plot a minimum value from the set of S1n, S2n, S1p, S2p, Fission Barrier in order to

- Show particle bound isotopes
- Avoid “saw” structure due to odd-even corrections in separation energy

Fission barrier is a maximum value obtained from Fission barrier models in LISE^{++}, including experimental information. BarFac=1, L=0. Fission barrier is decrease by 1.0,roughly assuming that at Fission Barrier =1 a nucleus is not particle bound against fission

Working with mass tables in LISE^{++}

- First of all, download the latest version of the LISE^{++} package from the LISE^{++} site http://lise.nscl.msu.edu/download/, and install the code;
- Select a mass model to use from the dialog using the menu “Physics models” → “Production mechanism” → tab “Databases: Masses, Isomers”. “LISE\bin\” is the default directory for mass excess files;
- If you are planning to apply the user mass excess files for cross sections and transmission calculations, then select “1 – User’s ME file” in the “DataBase” combox;

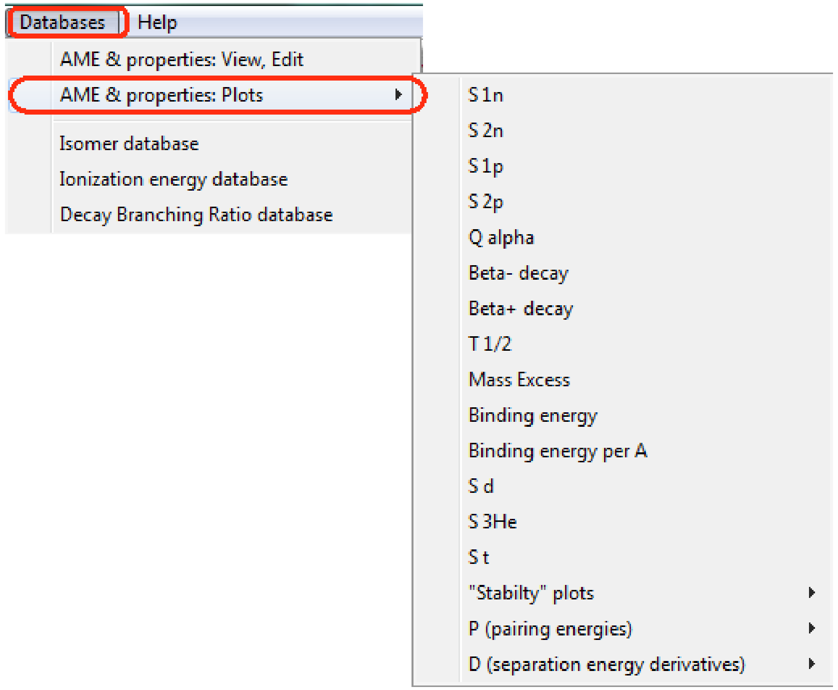


48Ca(140.0 MeV/u) + Be -> 42S

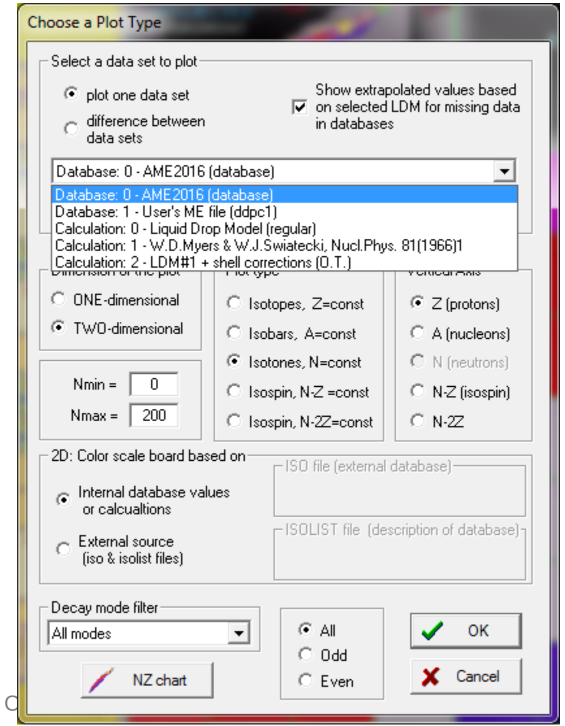
Masses
● Database + Calculations   DataBase: 0 - AME2016 (database)
○ only Calculations   Formula: 1 - W.D.Myers & W.J.Swiatecki, Nucl.Phys. 81(1966
User's MassExcess File: RMF_mass\ddpc1.lme

Ion mass
☑ Take into account electron binding energies for ion mass calculations (Recommended)

Isomer database: isomer.dbf
USER database: null
☐ Make default



- To plot nuclei values deduced from AME2016 database, mass user files, or LDM calculations use the menu “Databases” → “AME & properties: Plots”



● plot one data set
○ difference between data sets
☑ Show extrapolated values based on selected LDM for missing data in databases

Database: 0 - AME2016 (database)
Database: 0 - AME2016 (database)
Database: 1 - User's ME file (ddpc1)
Calculation: 0 - Liquid Drop Model (regular)
Calculation: 1 - W.D.Myers & W.J.Swiatecki, Nucl.Phys. 81(1966)1
Calculation: 2 - LDM#1 + shell corrections (O.T.)

○ ONE-dimensional
● TWO-dimensional
Nmin = 0
Nmax = 200

○ Isotopes, Z=const
○ Isobars, A=const
● Isotones, N=const
○ Isospin, N-Z =const
○ Isospin, N-2Z=const

● Z (protons)
○ A (nucleons)
○ N (neutrons)
○ N-Z (isospin)
○ N-2Z

● Internal database values or calcualtions
○ External source (iso & isolist files)

All modes
● All
○ Odd
○ Even

- Select a data set to plot, dimension of the plot, plot type, and vertical axis value using the “Choose a Plot type” dialog