# New mass-table parameters for nuclei $Z \leq 16$

C. Thibault and R. Klapisch

*Laboratoire René-Bernas du Centre de Spectrométrie, Nucléaire et de Spectrométrie de Masse, 91-Orsay, France*

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Recent measurements of the masses of $^{11}Li$ and $^{14}B$ and a better fitting procedure result in a new set of parameters for the Garvey *et al.* mass table. A better agreement is obtained for the limit of stability as $^{14}Be$ and $^{19}C$ are now predicted to be bound.

NUCLEAR STRUCTURE Calculated mass excesses of nuclei $Z \leq 16$, $N \geq Z$. Garvey-Kelson transverse relations.

## I. INTRODUCTION

We have recently[1] recalculated the parameters of the mass table that had been derived by Garvey *et al.*[2] on the basis of local relations between masses.[3] One of the conclusions of our work was the prediction that $^{17}B$ should be particle stable and the suggestion that it seemed possible to observe it experimentally. The experimental particle stability of $^{17}B$ has since been reported by Bowman *et al.*[4] who also report evidence for the stability of $^{14}Be$.

We had already pointed out[1] the special importance of the $T_z = 2$, odd-odd nuclei as input data for this table. The basic reason for this is that one cannot calculate these using the local relations, because one would then have to use the $T_z = 0$ odd-odd nuclei and this is forbidden.[3] At the time of our last calculation,[1] $^{10}Li$ and $^{14}B$ were still unknown in that series and we had to make assumptions. Since then, new experimental developments have occurred allowing us to make a final readjustment of parameters.

## II. RECALCULATION OF PARAMETERS

We start from the "transverse relation" (t):

$$M(N+2, Z-2) - M(N,Z) + M(N, Z-1) - M(N+1, Z-2) + M(N+1, Z) - M(N+2, Z-1) = 0,$$

which Garvey *et al.*[2] have shown to be equivalent to

$$M(N, Z) = g_1(N) + g_2(Z) + g_3(A) .$$

$g_1, g_2, g_3$ are the parameters that we calculate using known masses of $T_z \leq 2$. Table I shows the result of our new calculation using the following changes:

(1) The experimental mass of $^{11}Li$[5] is used in-

TABLE I. New parameters used to calculate the binding energies $B(N,Z) = 110.7824 + g_1(N) + g_2(Z) + g_3(A)$ MeV. Only the values which are different from the original ones (Ref. 2) are given.

| $N, Z$, or $A$ | $g_1(N)$ | $g_2(Z)$ | $g_3(A)$ |
|---|---|---|---|
| 1 | ... | ... | ... |
| 2 | ... | −98.279 | ... |
| 3 | ... | −71.813 | ... |
| 4 | −61.368 | −42.432 | ... |
| 5 | −45.322 | −22.229 | ... |
| 6 | −28.777 | −0.173 | 78.133 |
| 7 | −19.301 | 11.016 | 61.614 |
| 8 | −9.900 | 22.855 | 47.632 |
| 9 | −7.700 | 25.564 | 35.139 |
| 10 | −3.748 | 30.320 | 25.406 |
| 11 | −5.182 | 28.530 | 16.432 |
| 12 | −5.443 | 27.981 | 10.326 |
| 13 | −10.757 | 20.792 | 5.804 |
| 14 | −14.279 | 15.545 | 4.579 |
| 15 | −23.355 | 3.307 | 3.598 |
| 16 | −31.564 | | 3.888 |
| 17 | −44.570 | | 5.829 |
| 18 | −56.203 | | 9.923 |
| 19 | | | 15.260 |
| 20 | | | 23.243 |
| 21 | | | 31.544 |
| 22 | | | 42.118 |
| 23 | | | 52.666 |
| 24 | | | 64.975 |
| 25 | | | 77.552 |
| 26 | | | 92.203 |
| 27 | | | 107.693 |
| 28 | | | 124.465 |
| 29 | | | 142.075 |
| 30 | | | 160.864 |
| 31 | | | 180.429 |
| 32 | | | 201.342 |
| 33 | | | 223.049 |
| 34 | | | 246.068 |
| 35 | | | 269.729 |

TABLE II. Mass excesses, neutron, and two-neutron binding energies calculated for nuclei $Z \leq 16$, $N \leq 2Z+6$.

| | | | | Mass excess | | Binding energy | |
|---|---|---|---|---|---|---|---|
| | $N$ | $Z$ | $A$ | Calc (MeV) | Exp-calc (MeV) | Neutron (MeV) | 2 neutron (MeV) |
| He | 4 | 2 | 6 | 17.60 | 0.00 | 0.00 | 0.00 |
| | 5 | 2 | 7 | 26.11 | −0.00 | −0.44 | 0.00 |
| | 6 | 2 | 8 | 31.65 | −0.00 | 2.53 | 2.09 |
| | 7 | 2 | 9 | 42.74 | | −3.02 | −0.48 |
| | 8 | 2 | 10 | 51.14 | | −0.33 | −3.35 |
| | 9 | 2 | 11 | 65.99 | | −6.77 | −7.11 |
| | 10 | 2 | 12 | 76.21 | | −2.15 | −8.93 |
| Li | 4 | 3 | 7 | 14.91 | −0.00 | 0.00 | 0.00 |
| | 5 | 3 | 8 | 20.95 | 0.00 | 2.03 | 0.00 |
| | 6 | 3 | 9 | 24.97 | −0.00 | 4.05 | 6.09 |
| | 7 | 3 | 10 | 33.30 | | −0.26 | 3.79 |
| | 8 | 3 | 11 | 40.94 | 0.00 | 0.43 | 0.17 |
| | 9 | 3 | 12 | 52.92 | | −3.91 | −3.48 |
| | 10 | 3 | 13 | 61.56 | | −0.57 | −4.48 |
| | 11 | 3 | 14 | 72.29 | | −2.66 | −3.23 |
| | 12 | 3 | 15 | 81.60 | | −1.24 | −3.90 |
| Be | 4 | 4 | 8 | 6.83 | −1.89 | 0.00 | 0.00 |
| | 5 | 4 | 9 | 11.35 | 0.00 | 3.55 | 0.00 |
| | 6 | 4 | 10 | 12.61 | 0.00 | 6.81 | 10.37 |
| | 7 | 4 | 11 | 20.18 | −0.00 | 0.50 | 7.31 |
| | 8 | 4 | 12 | 24.95 | −0.00 | 3.30 | 3.80 |
| | 9 | 4 | 13 | 35.35 | | −2.32 | 0.97 |
| | 10 | 4 | 14 | 40.69 | | 2.73 | 0.41 |
| | 11 | 4 | 15 | 51.18 | | −2.42 | 0.31 |
| | 12 | 4 | 16 | 59.22 | | 0.03 | −2.39 |
| | 13 | 4 | 17 | 70.67 | | −3.37 | −3.34 |
| | 14 | 4 | 18 | 78.17 | | 0.57 | −2.80 |
| B | 6 | 5 | 11 | 8.67 | 0.00 | 0.00 | 0.00 |
| | 7 | 5 | 12 | 13.37 | 0.00 | 3.37 | 0.00 |
| | 8 | 5 | 13 | 16.56 | −0.00 | 4.88 | 8.25 |
| | 9 | 5 | 14 | 23.66 | 0.00 | 0.98 | 5.85 |
| | 10 | 5 | 15 | 28.76 | | 2.97 | 3.95 |
| | 11 | 5 | 16 | 37.98 | | −1.14 | 1.83 |
| | 12 | 5 | 17 | 44.37 | | 1.68 | 0.54 |
| | 13 | 5 | 18 | 53.66 | | −1.22 | 0.46 |
| | 14 | 5 | 19 | 59.92 | | 1.81 | 0.59 |
| | 15 | 5 | 20 | 69.08 | | −1.09 | 0.72 |
| | 16 | 5 | 21 | 77.06 | | 0.09 | −1.00 |
| C | 6 | 6 | 12 | 0.01 | −0.01 | 0.00 | 0.00 |
| | 7 | 6 | 13 | 3.12 | 0.00 | 4.95 | 0.00 |
| | 8 | 6 | 14 | 3.02 | −0.00 | 8.18 | 13.13 |
| | 9 | 6 | 15 | 9.87 | −0.00 | 1.22 | 9.40 |
| | 10 | 6 | 16 | 13.70 | −0.01 | 4.24 | 5.46 |
| | 11 | 6 | 17 | 21.27 | | 0.51 | 4.75 |
| | 12 | 6 | 18 | 25.51 | | 3.83 | 4.34 |
| | 13 | 6 | 19 | 33.55 | | 0.02 | 3.86 |
| | 14 | 6 | 20 | 37.17 | | 4.46 | 4.48 |
| | 15 | 6 | 21 | 46.01 | | −0.77 | 3.69 |
| | 16 | 6 | 22 | 51.72 | | 2.36 | 1.59 |
| | 17 | 6 | 23 | 62.25 | | −2.46 | −0.09 |
| | 18 | 6 | 24 | 69.64 | | 0.68 | −1.78 |
| N | 8 | 7 | 15 | 0.10 | 0.00 | 0.00 | 0.00 |
| | 9 | 7 | 16 | 5.68 | −0.00 | 2.49 | 0.00 |
| | 10 | 7 | 17 | 7.86 | 0.01 | 5.89 | 8.38 |
| N | 11 | 7 | 18 | 13.27 | 0.00 | 2.66 | 8.55 |
| | 12 | 7 | 19 | 16.27 | | 5.08 | 7.74 |
| | 13 | 7 | 20 | 21.67 | | 2.67 | 7.75 |
| | 14 | 7 | 21 | 24.96 | | 4.78 | 7.45 |
| | 15 | 7 | 22 | 31.54 | | 1.50 | 6.28 |
| | 16 | 7 | 23 | 37.27 | | 2.34 | 3.84 |
| | 17 | 7 | 24 | 46.04 | | −0.70 | 1.64 |
| | 18 | 7 | 25 | 53.17 | | 0.94 | 0.25 |
| | 19 | 7 | 26 | 63.30 | | −2.06 | −1.11 |
| | 20 | 7 | 27 | 71.22 | | 0.14 | −1.91 |
| O | 8 | 8 | 16 | −4.74 | 0.00 | 0.00 | 0.00 |
| | 9 | 8 | 17 | −0.81 | 0.00 | 4.14 | 0.00 |
| | 10 | 8 | 18 | −0.78 | −0.00 | 8.05 | 12.19 |
| | 11 | 8 | 19 | 3.39 | −0.05 | 3.90 | 11.95 |
| | 12 | 8 | 20 | 3.74 | 0.06 | 7.72 | 11.63 |
| | 13 | 8 | 21 | 8.82 | 0.48 | 2.99 | 10.71 |
| | 14 | 8 | 22 | 9.84 | 1.66 | 7.05 | 10.04 |
| | 15 | 8 | 23 | 16.44 | | 1.47 | 8.52 |
| | 16 | 8 | 24 | 20.41 | | 4.10 | 5.57 |
| | 17 | 8 | 25 | 28.91 | | −0.43 | 3.67 |
| | 18 | 8 | 26 | 33.97 | | 3.02 | 2.59 |
| | 19 | 8 | 27 | 43.26 | | −1.22 | 1.80 |
| | 20 | 8 | 28 | 49.90 | | 1.43 | 0.21 |
| | 21 | 8 | 29 | 61.59 | | −3.61 | −2.19 |
| | 22 | 8 | 30 | 70.36 | | −0.70 | −4.31 |
| F | 10 | 9 | 19 | −1.54 | 0.05 | 0.00 | 0.00 |
| | 11 | 9 | 20 | −0.02 | −0.00 | 6.55 | 0.00 |
| | 12 | 9 | 21 | 0.02 | −0.06 | 8.04 | 14.59 |
| | 13 | 9 | 22 | 2.83 | 0.00 | 5.26 | 13.30 |
| | 14 | 9 | 23 | 3.87 | | 7.03 | 12.29 |
| | 15 | 9 | 24 | 8.71 | | 3.23 | 10.26 |
| | 16 | 9 | 25 | 12.42 | | 4.37 | 7.60 |
| | 17 | 9 | 26 | 18.84 | | 1.65 | 6.01 |
| | 18 | 9 | 27 | 23.06 | | 3.86 | 5.50 |
| | 19 | 9 | 28 | 31.06 | | 0.06 | 3.92 |
| | 20 | 9 | 29 | 36.87 | | 2.26 | 2.33 |
| | 21 | 9 | 30 | 47.38 | | −2.43 | −0.17 |
| | 22 | 9 | 31 | 55.37 | | 0.08 | −2.36 |
| | 23 | 9 | 32 | 65.96 | | −2.52 | −2.44 |
| | 24 | 9 | 33 | 73.98 | | 0.05 | −2.47 |
| Ne | 10 | 10 | 20 | −6.99 | −0.05 | 0.00 | 0.00 |
| | 11 | 10 | 21 | −5.78 | 0.05 | 6.87 | 0.00 |
| | 12 | 10 | 22 | −8.02 | −0.00 | 10.31 | 17.18 |
| | 13 | 10 | 23 | −5.19 | 0.04 | 5.23 | 15.55 |
| | 14 | 10 | 24 | −5.90 | −0.05 | 8.79 | 14.02 |
| | 15 | 10 | 25 | −1.33 | −0.84 | 3.50 | 12.29 |
| | 16 | 10 | 26 | 0.30 | | 6.44 | 9.94 |
| | 17 | 10 | 27 | 5.89 | | 2.48 | 8.93 |
| | 18 | 10 | 28 | 8.82 | | 5.14 | 7.62 |
| | 19 | 10 | 29 | 15.99 | | 0.90 | 6.04 |
| | 20 | 10 | 30 | 20.62 | | 3.44 | 4.35 |
| | 21 | 10 | 31 | 30.35 | | −1.66 | 1.79 |
| | 22 | 10 | 32 | 36.99 | | 1.42 | −0.23 |

TABLE II *(Continued)*

| | *N* | *Z* | *A* | Mass excess (MeV) | Mass excess Exp-calc (MeV) | Binding energy Neutron (MeV) | Binding energy 2 neutron (MeV) |
|---|---|---|---|---|---|---|---|
| Ne | 23 | 10 | 33 | 46.78 | | −1.72 | −0.30 |
| | 24 | 10 | 34 | 53.50 | | 1.36 | −0.36 |
| | 25 | 10 | 35 | 63.47 | | −1.90 | −0.54 |
| | 26 | 10 | 36 | 70.40 | | 1.14 | −0.76 |
| Na | 12 | 11 | 23 | −9.49 | −0.04 | 0.00 | 0.00 |
| | 13 | 11 | 24 | −8.42 | 0.00 | 7.00 | 0.00 |
| | 14 | 11 | 25 | −9.40 | 0.04 | 9.05 | 16.05 |
| | 15 | 11 | 26 | −6.90 | −0.00 | 5.58 | 14.63 |
| | 16 | 11 | 27 | −6.11 | 0.32 | 7.28 | 12.86 |
| | 17 | 11 | 28 | −1.81 | 0.55 | 3.77 | 11.05 |
| | 18 | 11 | 29 | 0.29 | 2.44 | 5.98 | 9.74 |
| | 19 | 11 | 30 | 6.28 | 2.12 | 2.08 | 8.06 |
| | 20 | 11 | 31 | 10.13 | 1.77 | 4.22 | 6.30 |
| | 21 | 11 | 32 | 18.51 | −1.31 | −0.31 | 3.91 |
| | 22 | 11 | 33 | 24.36 | | 2.22 | 1.91 |
| | 23 | 11 | 34 | 32.84 | | −0.41 | 1.81 |
| | 24 | 11 | 35 | 38.91 | | 2.00 | 1.59 |
| | 25 | 11 | 36 | 47.24 | | −0.25 | 1.75 |
| | 26 | 11 | 37 | 53.89 | | 1.42 | 1.17 |
| | 27 | 11 | 38 | 62.33 | | −0.37 | 1.05 |
| | 28 | 11 | 39 | 68.56 | | 1.84 | 1.48 |
| Mg | 12 | 12 | 24 | −13.96 | 0.03 | 0.00 | 0.00 |
| | 13 | 12 | 25 | −13.16 | −0.04 | 7.26 | 0.00 |
| | 14 | 12 | 26 | −16.21 | 0.00 | 11.13 | 18.39 |
| | 15 | 12 | 27 | −14.56 | −0.03 | 6.41 | 17.54 |
| | 16 | 12 | 28 | −15.05 | 0.03 | 8.56 | 14.98 |
| | 17 | 12 | 29 | −11.58 | 0.99 | 4.60 | 13.17 |
| | 18 | 12 | 30 | −10.66 | | 7.16 | 11.76 |
| | 19 | 12 | 31 | −5.45 | | 2.86 | 10.01 |
| | 20 | 12 | 32 | −2.94 | | 5.57 | 8.42 |
| | 21 | 12 | 33 | 4.64 | | 0.48 | 6.05 |
| | 22 | 12 | 34 | 9.18 | | 3.53 | 4.02 |
| | 23 | 12 | 35 | 17.02 | | 0.23 | 3.76 |
| | 24 | 12 | 36 | 21.44 | | 3.65 | 3.88 |
| | 25 | 12 | 37 | 29.49 | | 0.03 | 3.68 |
| | 26 | 12 | 38 | 34.44 | | 3.12 | 3.15 |
| | 27 | 12 | 39 | 42.44 | | 0.07 | 3.19 |
| | 28 | 12 | 40 | 47.20 | | 3.31 | 3.38 |
| | 29 | 12 | 41 | 56.33 | | −1.06 | 2.25 |
| | 30 | 12 | 42 | 63.28 | | 1.12 | 0.06 |
| Al | 14 | 13 | 27 | −17.22 | 0.03 | 0.00 | 0.00 |
| | 15 | 13 | 28 | −16.85 | 0.00 | 7.70 | 0.00 |
| | 16 | 13 | 29 | −18.18 | −0.03 | 9.40 | 17.10 |
| | 17 | 13 | 30 | −15.89 | −0.00 | 5.78 | 15.18 |
| | 18 | 13 | 31 | −15.75 | 0.74 | 7.93 | 13.71 |
| | 19 | 13 | 32 | −11.88 | | 4.20 | 12.14 |
| | 20 | 13 | 33 | −10.17 | | 6.36 | 10.57 |
| | 21 | 13 | 34 | −3.90 | | 1.80 | 8.16 |
| | 22 | 13 | 35 | 0.00 | | 4.17 | 5.97 |
| | 23 | 13 | 36 | 6.19 | | 1.88 | 6.05 |
| | 24 | 13 | 37 | 10.33 | | 3.93 | 5.81 |
| | 25 | 13 | 38 | 16.68 | | 1.73 | 5.66 |
| | 26 | 13 | 39 | 21.19 | | 3.56 | 5.29 |
| | 27 | 13 | 40 | 27.72 | | 1.54 | 5.10 |
| | 28 | 13 | 41 | 32.09 | | 3.70 | 5.24 |
| | 29 | 13 | 42 | 39.81 | | 0.35 | 4.06 |
| | 30 | 13 | 43 | 46.54 | | 1.34 | 1.70 |

| | *N* | *Z* | *A* | Mass excess Calc (MeV) | Mass excess Exp-calc (MeV) | Binding energy Neutron (MeV) | Binding energy 2 neutron (MeV) |
|---|---|---|---|---|---|---|---|
| Al | 31 | 13 | 44 | 55.13 | | −0.52 | 0.82 |
| | 32 | 13 | 45 | 62.65 | | 0.55 | 0.03 |
| Si | 14 | 14 | 28 | −21.46 | −0.03 | 0.00 | 0.00 |
| | 15 | 14 | 29 | −21.92 | 0.03 | 8.53 | 0.00 |
| | 16 | 14 | 30 | −24.43 | 0.00 | 10.58 | 19.11 |
| | 17 | 14 | 31 | −22.92 | −0.03 | 6.56 | 17.14 |
| | 18 | 14 | 32 | −24.13 | 0.04 | 9.28 | 15.84 |
| | 19 | 14 | 33 | −21.05 | 0.48 | 5.00 | 14.28 |
| | 20 | 14 | 34 | −20.66 | | 7.67 | 12.67 |
| | 21 | 14 | 35 | −15.02 | | 2.44 | 10.11 |
| | 22 | 14 | 36 | −12.77 | | 5.82 | 8.26 |
| | 23 | 14 | 37 | −6.86 | | 2.16 | 7.98 |
| | 24 | 14 | 38 | −4.42 | | 5.63 | 7.79 |
| | 25 | 14 | 39 | 1.48 | | 2.17 | 7.80 |
| | 26 | 14 | 40 | 4.53 | | 5.03 | 7.19 |
| | 27 | 14 | 41 | 10.67 | | 1.93 | 6.96 |
| | 28 | 14 | 42 | 13.62 | | 5.12 | 7.05 |
| | 29 | 14 | 43 | 21.12 | | 0.57 | 5.69 |
| | 30 | 14 | 44 | 25.98 | | 3.22 | 3.79 |
| | 31 | 14 | 45 | 34.80 | | −0.75 | 2.47 |
| | 32 | 14 | 46 | 40.64 | | 2.23 | 1.48 |
| | 33 | 14 | 47 | 50.04 | | −1.33 | 0.90 |
| | 34 | 14 | 48 | 56.83 | | 1.28 | −0.05 |
| P | 16 | 15 | 31 | −24.47 | 0.03 | 0.00 | 0.00 |
| | 17 | 15 | 32 | −24.30 | 0.00 | 7.91 | 0.00 |
| | 18 | 15 | 33 | −26.31 | −0.03 | 10.07 | 17.98 |
| | 19 | 15 | 34 | −24.55 | −0.00 | 6.31 | 16.39 |
| | 20 | 15 | 35 | −24.79 | −0.15 | 8.32 | 14.63 |
| | 21 | 15 | 36 | −20.80 | | 4.09 | 12.40 |
| | 22 | 15 | 37 | −18.83 | | 6.10 | 10.19 |
| | 23 | 15 | 38 | −14.62 | | 3.86 | 9.96 |
| | 24 | 15 | 39 | −12.62 | | 6.07 | 9.93 |
| | 25 | 15 | 40 | −8.19 | | 3.63 | 9.71 |
| | 26 | 15 | 41 | −5.53 | | 5.42 | 9.05 |
| | 27 | 15 | 42 | −0.81 | | 3.34 | 8.76 |
| | 28 | 15 | 43 | 1.93 | | 5.34 | 8.68 |
| | 29 | 15 | 44 | 7.55 | | 2.45 | 7.79 |
| | 30 | 15 | 45 | 12.64 | | 2.98 | 5.43 |
| | 31 | 15 | 46 | 19.78 | | 0.94 | 3.92 |
| | 32 | 15 | 47 | 25.43 | | 2.41 | 3.35 |
| | 33 | 15 | 48 | 33.71 | | −0.20 | 2.21 |
| | 34 | 15 | 49 | 40.50 | | 1.28 | 1.07 |
| | 35 | 15 | 50 | 49.89 | | −1.31 | −0.04 |
| | 36 | 15 | 51 | 57.59 | | 0.37 | −0.95 |
| S | 16 | 16 | 32 | −25.99 | −0.03 | 0.00 | 0.00 |
| | 17 | 16 | 33 | −26.62 | 0.03 | 8.70 | 0.00 |
| | 18 | 16 | 34 | −29.93 | 0.00 | 11.39 | 20.09 |
| | 19 | 16 | 35 | −28.81 | −0.04 | 6.95 | 18.34 |
| | 20 | 16 | 36 | −30.70 | 0.04 | 9.96 | 16.91 |
| | 21 | 16 | 37 | −27.00 | 0.09 | 4.37 | 14.33 |
| | 22 | 16 | 38 | −26.73 | −0.14 | 7.80 | 12.17 |
| | 23 | 16 | 39 | −22.96 | | 4.30 | 12.10 |
| | 24 | 16 | 40 | −22.42 | | 7.54 | 11.84 |
| | 25 | 16 | 41 | −18.38 | | 4.03 | 11.57 |
| | 26 | 16 | 42 | −17.14 | | 6.83 | 10.86 |
| | 27 | 16 | 43 | −12.63 | | 3.56 | 10.40 |

TABLE II *(Continued)*

| | N | Z | A | Mass excess Calc (MeV) | Mass excess Exp-calc (MeV) | Binding energy Neutron (MeV) | Binding energy 2 neutron (MeV) |
|---|---|---|---|---|---|---|---|
| S | 28 | 16 | 44 | −11.77 | | 7.21 | 10.77 |
| | 29 | 16 | 45 | −5.92 | | 2.22 | 9.43 |
| | 30 | 16 | 46 | −2.51 | | 4.67 | 6.88 |
| | 31 | 16 | 47 | 4.44 | | 1.12 | 5.78 |
| | 32 | 16 | 48 | 8.97 | | 3.54 | 4.66 |
| | 33 | 16 | 49 | 17.25 | | −0.21 | 3.33 |
| S | 34 | 16 | 50 | 22.90 | | 2.43 | 2.22 |
| | 35 | 16 | 51 | 32.37 | | −1.40 | 1.03 |
| | 36 | 16 | 52 | 39.01 | | 1.42 | 0.02 |
| | 37 | 16 | 53 | 49.13 | | −2.05 | −0.62 |
| | 38 | 16 | 54 | 56.39 | | 0.82 | −1.23 |

stead of an estimated value for $^{10}$Li in the last calculation;

(2) the experimental mass of $^{14}B^6$ is used instead of our value[1] assuming that it is just bound;

(3) parameters have also been readjusted for slight changes in the masses of $^{26}$Na[7] and $^{34}$P.[8]

Another improvement has been introduced in the evaluation of a consistent set of calculated mass values. When the mass table is restricted to light nuclei there are very few cases of redundancy and one given mass $M_i$ is calculated by just one relation.[9] A least-squares fit can thus be done exactly and we have done it as follows: Let there be a relation between six masses $M_i$ which is not satisfied exactly:

$$\sum_i M_i = \Delta \neq 0 \; .$$

The difference between experiment and calculation for mass $M_i$ is taken to be

$$\delta_i = \pm\left(\frac{\Delta - \sum_{i=1}^{6}\sigma_i}{6} + \sigma_i\right) \; ,$$

where $\sigma_i$ is the experimental uncertainty on $M_i$ and where $\sum_{i=1}^{6}\sigma_i \ll \Delta$.

This formula is slightly different from the one used by Garvey *et al.*[2] where $\sigma_i = 0$, but the main difference comes from the fact that in this simple case the fit can be done without any approximation or iterative procedure.

## III. RESULTS

Table I gives the values of the parameters $g_1$, $g_2, g_3$ when they are different from the values published by Garvey *et al.*[2] Table II gives the mass excesses and neutron binding energies calculated for nuclei $Z \leq 16$ and $N \leq (2Z+6)$. Nuclei with $Z > 16$ are unchanged. Some new consequences for the limit of stability have to be pointed out: Five nuclei ($^{14}$Be, $^{19}$C, $^{25}$N, $^{28}$O, $^{28}$F) which were predicted unstable in our last table are now calculated to be bound. This is in better agreement with experiment as two of them have already been observed: $^{19}$C, which was first reported by Raisbeck *et al.*[10] and recently confirmed by Bowman *et al.*,[11] and $^{14}$Be.[4] The only case of discrepancy for the limit of particle stability is thus $^{32}$Na which is calculated unbound by 310 keV while it is found experimentally bound.[5,12] This is probably within the limits of uncertainty of the mass predictions.

## IV. CONCLUSION

This table is now the best fit which can be done, based on the assumptions of Garvey *et al.*[2] and using as input only $T_z \leq 2$ known masses. It will thus be very interesting to carefully compare the predictions to the new experimental masses such as the masses of $T_z = \frac{5}{2}$ nuclei or of the sodium isotopes with $T_z > 2$, to see if the differences reveal some systematic deviations which were not taken into account or some abrupt changes which could reflect changes in the structure of the nucleus.


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