INTERNATIONAL ATOMIC ENERGY AGENCY

INDC(HUN)-033
Distr.: ND+G

I N D C INTERNATIONAL NUCLEAR DATA COMMITTEE

TABLE OF NUCLEAR ROOT MEAN SQUARE CHARGE RADII*

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* This work was supported by the International Atomic Energy Agency under Research Contract 9333 and by the National Fund for Scientific Research (OTKA) under T 016170/95

September 1999

IAEA NUCLEAR DATA SECTION, WAGRAMER STRASSE 5, A-1400 VIENNA

Produced by the IAEA in Austria
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ABSTRACT

Nuclear root-mean-square (*rms*) charge radii have been compiled, selected and evaluated using two different procedures: a refined and a simple one. Running them on the same database, the results for weighted average radii are very close to each other: 91% of the differences are within ± ½ of the combined error. This confirms our earlier conclusion that the results are generally more sensitive to the decision *which* data we include in the averaging procedure, and less sensitive to the way *how* the selected data are weighted to form an average. The resulting weighted averages – updated in May 1999 – are presented in *Appendix IV*. All background data and program files together with a complete bibliography are also included in the *Appendices*. In addition to the data tables, simple radius formulae are also given with updated parameters. These formulae may be useful to estimate unmeasured radii ("intelligent interpolation") or to perform analytic calculations with the functions *r(A)* and *r(Z,A)*.

September 1998

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1. Introduction

The root-mean-square (*rms*) charge radius is a fundamental quantity for both nuclear structure and reaction calculations. The results from different experimental methods (fast electron scattering, muonic atom X-rays, etc.) are often compiled separately. However, data users generally prefer a single, updated and critically evaluated data set. In a previous paper [An91] an evaluation procedure for *rms* charge radii has been described and accompanied by a table of the "1990 best-values". In the years past, several new data have been published, and -what is even more important - very precise data were obtained by combined evaluation of results from electron scattering and muonic atom *X*-rays [Fr95]; for eight elements, experimental results from optical isotope shifts were also taken into account. This progress in the quantity and quality of new data, and the demand for evaluated radius values, lead to the construction of a new table updated in March 1998. The resulting „*recommended values of rms charge radii*" [An98] will probably be a useful source of information for data users. In order to check the dependence of the results on the evaluation procedure, an alternative method has also been tested and compared to the previously developed one.

The present report exceeds the above paper in several respects.

- All data search and evaluation procedures are updated in May 1999.
- The *Appendices* of the present report contain the full input data table and other background material that could not be included in [An98] because of limitation in space.
- This report is presented not only in printed form but also in electronic files, and will be distributed on *PC* diskettes and/or on the *Internet*.
- A short chapter is added with easy-to-use radius formulae *r(A)* and *r(Z,A)*.

Most data users need only a simple, self-explanatory table, where updated average values of rms charge radii are listed, or simple radius formulae with updated parameters. They may skip all the following chapters and turn directly to the main output of this work, which is contained in Appendix IV. under columns R_{FOR} and DR_{FOR}, or to Chapter 5.

On the other hand, some users may also be interested in the source of the data, and the way these data are selected and processed to get the final result, i.e. the present set of average radius values. Therefore, to meet these demands, the chapters that follow and the tables in the *Appendices* contain ample background information on data sources and details of the evaluation procedure applied.

2. Sources and Selection of Data

In addition to the compilations [Vr87, Fr95], original papers and theses up to May 1999 were also consulted, see *Appendices V-VI.* These contain all references for data from elastic electron scattering and muonic atom *X*-rays, respectively. In order to make easier the search for data for specific nuclei, the last column shows the symbol of elements investigated in the paper. Of outstanding importance is the new compilation [Fr95]; especially, table XII. contains very precise *rms* radius data for 58 isotopes of eight elements evaluated model independently by combining fast electron scattering, muonic atom *X*-rays and optical isotope shifts*. In addition to the recent precise values, a few old radius data of rather limited accuracy have also been included for nuclei, where no new measurements exist. These old data were omitted from our previous table in [An91]. However, the demand for data in the years past has shown that even radius values of limited precision are ”better than nothing”.

Quite often, the result of a measurement has been published in several places (preprints, conference proceedings, letters, archival journals); in most cases it was possible to identify them and to insure that each measurement is taken into account only once. Sometimes, an experiment was evaluated repeatedly with more or less different results, e.g. because a better reference cross section had been published in the meantime, or new, improved theoretical corrections became available. In these cases we generally accepted the most recent value, especially if the corrections were performed either by the authors themselves or by evaluators in cooperation with the authors; otherwise the original values have been retained.

Finally, some remarks on the radius data for the proton and deuteron may be proper here. The *rms* radius 0.862(12) fm for the *proton* measured on gas target [Si80] is now generally accepted without rival experimental result. However, we also included the value 0.8470(85) fm derived from dispersion theoretical analysis [Me96] of the nucleon electromagnetic form factors, and the neutron charge radius from very low energy neutron-atom cross sections. Readers who feel that this latter radius value is less reliable becuse it is ”less direct” than that from [Si80], may substitute 0.862(12) fm for the average value 0.8521(69) fm listed in *Appendix IV*.

The ten-year-old *”deuteron radius discrepancy”* [Kl86, Wo94] seems to have been solved by [Si96 and Si98] applying the Coulomb distortion correction. In our previous paper [An98] a dispersion correction of +0.008 fm was also added estimated from early theoretical calculations [Bo72, Fr79], the only experimental result for ^{12}C [Of88, Of91] and a systematic analysis of the R_{el}-R_{mu} differences [An89]. However, a recent, precise calculation [He98] resulted in a net dispersion correction of – 0.003 fm. Therefore, *in the present work no dispersion correction was applied.*

The diagram in *Appendix I* presents a chronological overview of the number of papers in two-year intervals. One can see that not many new measurements can be expected in the future. That means that a carefully evaluated data set may be valid for a fairly long time. Altogether 601 radius data have been found from elastic electron scattering and 759 data from muonic *X*-rays, for 285 nuclides. However, only 450 of these 1360 data are used in the final procedure, as it will be seen later.

At the beginning, *all* charge radii data (old and recent ones alike) measured by elastic electron scattering or muonic atom X-rays were included in the evaluation process. To find the average radius for a given nuclide, several statistical procedures were tested. Finally, we have arrived at the conclusion that the results are generally more sensitive to the decision *which data* are included in the averaging procedure, and less sensitive to the way *how* the individual data are weighted to form an average. We note here that – in a least square adjustment of the fundamental physical constants -

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* The author is indebted to Professors G.Fricke and K.Heilig for the data on Sn isotopes evaluated recently.

Taylor [Ta 82] comes to the same conclusion: *„…the actual algorithm used to carry out an adjustment is much less important than the data finally selected for inclusion in the adjustment”.*

Although no simple, clear-cut criteria can be given for the selection of data included in the final evaluation, the main points are as follows:

- Whenever possible, the 2 - 3 most recent data were included.
- If an experiment was evaluated using different methods, the result of a model independent analysis (*Fourier-Bessel*, or *Sum of Gaussians*) or that of a model independent (low-*q*) measurement is accepted rather than a model function analysis.
- Taking the risk of subjective decision, a few *„systematic outlier”* data were excluded.
- In a few cases, e.g. [Ka79] the *rms* radius for the most abundant isotope of an element has been derived from the value measured on natural isotopic compositions [An81].

3. Input Data File

In order to offer interested users as complete data set as possible, *the input data file (Appendix II.)* contains *all* measured *rms* charge radii found in the literature: old data and recent ones alike.

The headline of a data group for a given nuclide shows the atomic number (**Z**), the symbol of the element (**El**), the mass number (**A**) of the isotope, the number of radius data determined by electron scattering and muonic atom *X*-rays, respectively. The rows following the headline contain the *rms* charge radius ($\mathbf{R}^{\mathbf{o}}\langle r^2\rangle^{1/2}$), and its one standard deviation uncertainty (**dR**). Radius data are given in *fm* units (1 fm=10^{-15} m); an exception is the neutron, where – following conventions - the mean square value $\mathbf{R}^{\mathbf{2}}$ $^{\mathbf{o}}\langle r^2\rangle$ is shown in fm^2. This is followed by a short form of reference to literature, the method of measurement, a control character (*space* or **X**) and finally a comment concerning the data item. This data file is elastic: the inclusion of a radius value in (exclusion from) the evaluation process can be controlled by changing the character on position 36 from **X** to space (from space to **X**). This elasticity rendered possible to perform the evaluation on data bases with varying composition.

The final database selected for the present evaluation contains 450 radius values (from the 1360 data published) for 285 nuclides. In some cases, the error as published by the author(s) did not contain all components of uncertainty, e.g. model dependence, nuclear polarisation correction, the uncertainty of the V_2 factor in the combined (*el+mu*) analyses, etc. To be on the safe side, in these cases a further systematic error component was added, estimated after reading the respective literature.

4. Evaluation procedures

In order to investigate the influence of the evaluation procedure on the final average values, two different evaluation methods were used.

4.1 Iterative „*rmsEVA*” procedure (FORTRAN)

The first evaluation procedure was practically the same as used in [An91], and is realised through a *FORTRAN IV-Plus* program „*rmsEVA*” the source code of which is shown in *Appendix III*. The evaluation procedure consists of two algorithms. The first one *(a)* performs a search for discrepant data (*outliers*) together with an eventual re-assignment of errors; this algorithm is active only for groups containing at least five data. This algorithm had a role only in the early stages of the work, when all data were taken into account. Now, it practically never works. However, for completeness' sake, it will be described here. The second algorithm *(b)* forms a weighted mean and its uncertainty for each data group. It takes into account both external and internal errors.

4.1.1 *Search for and screening against strong deviations from the group mean value: the modified Chauvenet's criterion*

If a value falls far away from the majority of data, it seems questionable whether this *outlier* belongs to the same distribution as the others. Such large deviations may be caused by undiscovered systematic errors in the experiment, mistakes during the evaluation, printing error in the publication process, or mistakes in preparing the input data file. Although there are arguments against discarding outlier data, it is still useful to apply some criterion to look for and treat them. *„The cost of allowing one's results to be distorted by a single bad reading is much higher than that of mistakingly rejecting one good reading …”* [Pu66].

A well known statistical procedure for the search and elimination of such data is the so called *Chauvenet's criterion* [Wo58]. This criterion states that any sample out of the series of n samples shall be rejected if the magnitude of its deviation from the mean of the series is such that less than 1/2 of the samples deviates that much or more. Half of the data rejected by this criterion probably belong to the distribution (which is generally assumed to be *Gaussian*), i.e. they were „good” data. In this original form Chauvenet's criterion produces a truncated distribution. In the present work a modified version of this criterion has been developed to process radius data R_i accompanied by the errors $\pm DR_i$ $(i=1, 2, \ldots n)$. The modification consists of two points.

a) *Limit of acceptance:*

The probability limit of the new criterion is *1/nn,* where *n* can have a value different from Chauvenet's *n=2* . Experience has shown that setting *n=10* mistakes and strong outliers can still easily be discovered, while the loss of „good" data is much less: one from ten. That means, truncation is appreciably reduced. The search for outliers begins with the calculation of the *weighted average* R_{av} of the data $R_i \pm DR_i$.

$$R_{av} = \frac{\sum_i w_i R_i}{\sum_i w_i} \tag{1}$$

its *external error* $D_{ext}R_{av}$ defined by

$$(\Delta_{ext} R_{av})^2 = \frac{\sum_i w_i (R_i - R_{av})^2}{(n-1)\sum_i w_i}, \tag{2}$$

where

$$w_i = \frac{1}{\Delta R_i^C}. \tag{3}$$

At the beginning $C=1$ is set because at this stage of the evaluation procedure the data $R_i \pm DR_i$ can not be fully trusted, until outliers may be present; i.e. the conventionally used value $C=2$ would not be justified at this point. (Later, if no outliers are found, the exponent C=2 is used.). The *modified Chauvenet's criterion* is now: if

$$|R_i - R_{av}| \geq K(un).(\Delta R_i^C + \Delta_{ext} R^C)^{1/C}, \tag{4}$$

then the value R_i can be regarded as outlier. Here *K(nn)* depends on the distribution of the data. Assuming Gaussian distribution, the *K* values were calculated for several arguments ranging from *nn=10* to *100.* As *K* is a very slowly varying function of its argument, for practical applications the simple empirical function

$$\mathrm{K}(nn) \cong 0.9743\ (\ln(nn))^{0.6362} \tag{5}$$

can be used instead of tables. If the test (4) shows that several data R_i deviate strongly from the mean R_{av}, only that one showing the maximum relative deviation

$$D_i = \frac{|R_i - R_{av}|}{\Delta R_i} \tag{6}$$

is considered. Here the program prints the values of i, R_i, DR_i, and D_i. Tracing back the history of this outlier (compilation, journal, personal correspondence, etc.), often it turns out that the discrepancy is caused by some trivial mistake during data input or by a misprint in the process of publication. In such cases the mistakes are corrected accordingly.

b) *Treatment of outliers*

The modified Chauvenet’s procedure *does not discard outliers.* Instead, the error of the strongest relative outlier (i.e. that having the highest D_i value) is increased to

$$\Delta R_i' = \frac{\left|R_i - R_{av}\right|}{K(un)} \tag{7}$$

The procedure is repeated from (1) with the increased error (7) in (3), i.e. with a reduced weight w_i’ for the outlier. In this way, outliers are not completely discarded but their effect on the group mean reduced. The procedure may be repeated from Eq.(1) until outliers are found. However, in practice at most one (or none) outliers are found in a data group.

4.1.2 *Search for and taking into account common systematic errors: consistency check*

Data groups, even if „cleansed” from individual, strong outliers, still may contain several data biased by undiscovered systematic errors. This results in a significantly higher external error than predicted by the internal error.

The *external error*

$$\Delta_{ext} R_{av} = \sqrt{\frac{\sum_i \frac{1}{\Delta R_i^2}\left(R_i - R_{av}\right)^2}{(n-1)\sum_i \frac{1}{\Delta R_i^2}}} \tag{8a}$$

measures the actual spread of the data R_i (i=1, 2, …, n) around the group mean R_{av}. On the other hand, the *internal error* $D_{int}R_{av}$ defined by

$$\Delta_{\text{int}} R_{av} = \sqrt{\frac{1}{\sum_i \frac{1}{\Delta R_i^2}}} \tag{8b}$$

is a prediction on the uncertainty of the mean value. It is determined exclusively by the errors DR_i and does not depend on the spread of R_i values. Eq.(8b) follows from the additivity of *Fisher’s information* for unbiased estimates [Wa65].

To solve the eventual discrepancy, several approaches are recommended in the literature [Bi32, Wo58, Gu61, Wa65, Pu66, B t70, Co87]; however, neither of these seemed to be satisfactory for our aims. Therefore, we have used the procedure as follows. It consists of an elaborate iterative procedure, which – if necessary - gradually increases the input errors to make the *internal* and *external errors* equal. The two errors can be regarded as two different (though not quite independent) estimates of the same quantity DR_{av}.

At first glance, the simple average of the squares would offer a quick estimate for the error of the grand mean

$$\left(\Delta R_{av}\right)^2 = \frac{\left(\Delta_{\text{int}} R_{av}\right)^2 + \left(\Delta_{ext} R_{av}\right)^2}{2} \tag{9}$$

The underlying assumptions for this to be valid, are:

(i) Systematic errors are absent.
(ii) Random („statistical”) errors are correctly estimated.
(iii) The relative weights of $D_{int}R_{av}$ and $D_{ext}R_{av}$ are equal (=1) for any value of n.

In practice, neither of the above assumptions can be taken for granted. Both estimates $D_{int}R_{av}$ and $D_{ext}R_{av}$ of DR_{av} should be taken into accout but the weights assigned to them should depend on the extent of their (in)consistency. If they do not differ strongly, the difference between them is probably caused by their statistical nature. On the other hand, a significant deviation can be regarded as the manifestation of systematic errors in the group. Introducing the *consistency factor*

$$F \equiv \frac{\left(\Delta_{ext} R_{av}\right)^2}{\left(\Delta_{\text{int}} R_{av}\right)^2} \tag{10}$$

and assuming that F follows a reduced *chi-square distribution* with $n'=n-1$ degrees of freedom, the condition of consistency can be approximately expressed by the bracket of inequalities:

$$1 - \sqrt{\frac{2}{n-1}} \le F \le 1 + \sqrt{\frac{2}{n-1}} \tag{11}$$

If the value of F falls between these limits, the moderate deviation of F from unity is probably caused by statistical fluctuations, i.e. no systematic errors are present. If, however, the value of F does not fulfil the inequalities above, then the external error (measuring the actual spread of data) should be given an extra weight increasing monotonically with the deviation of F from unity, say as $(F-1)^2$. In addition, the weights must depend also on the number of data, because the form of the *chi-square* distribution is rather wide for low degrees of freedom, but tends to a narrow *Gaussian* for high n'. Therefore, we have used an expression that takes into account both the n dependence and the extra term containing $(F-1)^2$.

$$\left(\Delta R_{av}\right)^2 = \frac{w_{\text{int}}\left(\Delta_{\text{int}} R_{av}\right)^2 + w_{ext}\left(\Delta_{ext} R_{av}\right)^2}{w_{\text{int}} + w_{ext}}, \tag{12}$$

where

$$w_{\text{int}} = 3\left(\frac{n+1}{n-1}\right)^2 \quad \text{and} \quad w_{ext} = \frac{\left[1+\left(F-1\right)^2\right]\left(n-1\right)}{2}.$$

For the weight w_{int} it is assumed that the internal error follows a uniform distribution with limits of interval $(DR_{min})^2/n$ and $(DR_{min})^2$; see Eq.(8b). The expectation value of such a distribution is

$$E_{\text{int}} = \tfrac{1}{2}\left(\Delta R_{\text{min}}\right)^2 \left(1 + \tfrac{1}{n}\right) \tag{13}$$

its variance

$$D_{\text{int}}^2 = \tfrac{1}{12}\left[\left(\Delta R_{\text{min}}\right)^2 \left(1 - \tfrac{1}{n}\right)\right]^2 \tag{14}$$

and the squared reciprocal of the relative error was accepted as weight

$$w_{\text{int}} = \left(\frac{E_{\text{int}}}{D_{\text{int}}}\right)^2 = 3\left(\frac{n+1}{n-1}\right)^2 \tag{15}$$

Similarly, for a *chi-square* distribution with $n'=n-1$ degrees of freedom, at $F=1$,

$$w_{ext} = \left(\frac{E_{ext}}{D_{ext}}\right)^2 = \frac{n'^2}{2n'} = \frac{n-1}{2} \tag{16}$$

Figure 1 shows the resulting ratio $DR_{av}/D_{int}R_{av}$ as a function of $ÖF=D_{ext}R_{av}/D_{int}R_{av}$, for n=2, 3, 5 and 10. The simple quadratic mean Eq.(9) as well as the limiting cases $DR_{av}=D_{ext}R_{av}$ and $DR_{av}=D_{int}R_{av}$ Eqs. (8ab) are also plotted (thick line and dotted lines, respectively). It can be seen that the role of the internal error $D_{int}R_{av}$ is essential if there are very few data (n=2-3) *and* the inconsistency is limited: $ÖF\leq 2$. On the other hand, for data numbers $n\geq 5$ or for higher relative inconsistencies $ÖF\geq 2$, it is practically the external error $D_{ext}R_{av}$ that determines the uncertainty DR_{av} of the average radius R_{av}.

Having now the uncertainty DR_{av} of the grand mean, one may look for those modified errors DR_i' (i=1, 2, …, n) that result just in this value as a new internal error $(D_{int}R_{av}')^2$, i.e. for which

$$\left(\Delta_{\text{int}}R_{av}{}'\right)^2 = \frac{1}{\sum_i \frac{1}{(\Delta R_i')^2}} = \left(\Delta R_{av}\right)^2 \qquad (17)$$

These new errors can be formed either by adding a common systematic error S to the original errors DR_i $(i=1, 2, \ldots, n)$ linearly

$$\Delta R_i' = \Delta R_i + S_{lin} \qquad (18a)$$

or quadratically

$$\left(\Delta R_i'\right)^2 = \left(\Delta R_i\right)^2 + S_{quad}^2 \qquad (18b)$$

or by multiplying the DR_i errors by the ratio $DR_{av}/D_{int}R_{av}$

$$\Delta R_i' = \frac{\Delta R_{av}}{\Delta_{\text{int}}R_{av}}\Delta R_i \qquad (18c)$$

Although the multiplicative procedure is simple and quick, the additive way of including systematic errors has a more sound statistical basis [Bt70]. The determination of the proper S values needs an iterative procedure. It should be remarked that in the additive method the new grand mean R_{av}' generally differs from R_{av}.

In the present work all three methods (18abc) were tested. It was found that their results do not differ significantly, and in most cases the results from the linear additive method (18a) lie between those from (18bc). Therefore, in the further analysis the the final grand mean R_{av}' value from the additive procedure (17)-(18a) was accepted with an uncertainty $DR_{av}'=DR_{av}$ from Eq.(12). The resulting *rms* charge radii together with their uncertainties, are listed in the main table *Appendix IV* under columns R_{FOR} and DR_{FOR}, respectively.

4.2 Simplified procedure (EXCEL): Comparison

The question may arise that this complicated algorithm as described above may not be necessary. As a check, a much simpler procedure has also been developed and realised in *EXCEL* formulae. Here, only the selected data are introduced to the worksheet. The average radius and its uncertainty are calculated in a single step:

$$R_{av} = \frac{\sum_i R_i/\Delta R_i^2}{\sum_i 1/\Delta R_i^2}, \qquad \Delta R_{av} = \max\left(\Delta_{\text{int}}R_{av},\ \sqrt{\tfrac{1}{2}\left(\left(\Delta_{\text{int}}R_{av}\right)^2 + \left(\Delta_{ext}R_{av}\right)^2\right)}\right) \qquad (19)$$

The results of this approach are also shown in *Appendix IV* under columns R_{EXC} and $DR_{EXC.}$ It can be seen that the mean values from the two evaluation procedures are quite close to each other; more quantitatively: for all the 116 data groups with $n \geq 2$, the absolute value of the ratio

$$r \equiv \frac{R_{FOR} - R_{EXC}}{\Delta(R_{FOR} - R_{EXC})} = \frac{|R_{FOR} - R_{EXC}|}{\sqrt{\Delta R_{FOR}^2 + \Delta R_{EXC}^2}} \qquad (20)$$

is less than 1, and there are only ten groups for which $|r| \geq 0.5$, i.e. 106 mean values (91%) are within half-errors. This suggests that the simpler procedure can also be reliably used, if lack of space or time makes it necessary. However, we still feel a preference to the results R_{FOR}, DR_{FOR}, which may be recommended as the *"1999-best-values"* of *rms* charge radii.

5. Radius formulae

Tables in the *Appendices* contain all input data (*App. II.*) as well as the weighted averages (*App. IV.*) for *individual* nuclei. On the other hand, there may be applications, where radius formulae of the form *R(A)* or *R(Z,A)* are preferred to tabulated data, e.g. to estimate unmeasured charge radii, or to perform analytic calculations. Therefore, in the present chapter three simple radius formulae are given with increasing complexity. The numerical parameters are determined by a least-squares fit to the data (from ^{4}He through ^{243}Am) of *App. IV*, i.e. these formulae are also updated at 1 May 1999.

5.1 Liquid drop

The simplest formula for the mass number dependence of the nuclear radius

$$R_{st} = r_0 (Z_{st} + N_{st})^{1/3} = r_0 A_{st}{}^{1/3} \qquad (21)$$

is based on the uniform-density *liquid drop model*, which dates back to Gamow's paper [Ga30]. Using present-day data, the least-squares fit results in the radius parameter value:

$r_{0,LD}$ = 0.9541(6) fm

with a *standard deviation:* s = 0.1309 fm, and a *reduced chi-square*: P^2/n' = 1532. Although the standard deviation shows that the calculated data are fairly close to the measured ones, the high value of the reduced chi-square calls the attention to the fact that the differences –relative to the much smaller experimental uncertainties - are quite high.

5.2 Finite surface thickness

A better fit to the experimental data can be attained if a charge distribution having *finite surface thickness* is assumed instead of the uniform distribution. This assumption results in a three-parameter formula, see e.g. [El61]

$$R_{st} = \left(r_0 + \frac{r_1}{A_{st}{}^{2/3}} + \frac{r_2}{A_{st}{}^{4/3}} \right) A_{st}^{1/3} \qquad (22)$$

Terms of higher order in $A^{-2/3}$ are generally neglected. For a well-defined charge distribution (e.g. for a two-parameter *Fermi-distribution*) the parameters r_i are not independent, they are strongly correlated; their uncertainty can be characterised only by a matrix. It is therefore that in what follows, errors are not given to the parameter values.

Regarding the numerical values of the parameters, first we limit ourselves to stable nuclei. Omitting 40 data belonging to nuclides away from the region of stability, the remaining 240 radii determine the parameter values:

$r_{0,stab}$ = 0.898 fm, $r_{1,stab}$ = 1.376 fm, $r_{2,stab}$ = -2.262 fm,

s = 0.0585 fm, c^2/n' = 207.

The spectacular decrease in the value of this latter „goodness-of-fit" indicates that the introduction of finite surface thickness is not only physically reasonable, but it is of utmost practical significance.

5.3 Symmetry dependence

Nowadays, there is an increasing demand on nuclear data and especially for nuclear charge radii *off the stability line*. One way to enable formula (22) to estimate nuclear charge radii in a wider mass region is to include all the 280 data into the least squares procedure determining the above parameters r_i. The result is:

r_0 = 0.897 fm, r_1 = 1.383 fm, r_2 = -2.265 fm (all data),

with a standard deviation s = 0.0572 fm, and c^2/n' = 266.

It can be seen that the inclusion of „off-the-stability-line" nuclei deteriorated the quality of the fit. Consequently, one has to accept the fact that the charge radius is not a one-variable function *R(A)*; on the contrary, one should regard it as a surface over two coördinates: *R(Z,A)*, or *R(Z,N)* or *R(A,I)*, where *I* denotes the *symmetry parameter* *I* °*(N-Z)/A*. If neutrons are changed to protons, it may be expected that the form *r(r)* of the charge distribution –and consequently its second moment- also changes. This is indeed the case: a closer inspection of the data in *App. IV.* shows that, in order to take symmetry effects into account, an empirical *extra-charge* term should be added to the mass number dependent expression:

$$R(A,Z)=\left[\left(r_0+\frac{r_1}{A^{2/3}}+\frac{r_2}{A^{4/3}}\right)+a_Z\frac{Z-Z_{stab}}{A}\right]A^{1/3}, \qquad (23a)$$

where

$$Z_{st}=\frac{A}{1.98+0.016A^{2/3}}$$

is the proton number belonging to the line of stability for the given A. Note that Z_{stab} is not necessarily an integer number, but this is of no significance here. Instead of the proton numbers Z and Z_{stab}, the symmetry parameters I and I_{stab} °$(N_{stab}-Z_{stab})/A$

can also be used, where $N_{stab}=A-Z_{stab}$. For a fixed mass number

$$A=N+Z=N_{stab}+Z_{stab} \quad \text{and} \quad \frac{Z-Z_{stab}}{A} = -\tfrac{1}{2}\left(I - I_{stab}\right)$$

Introducing this to eq. (23a), we have the equivalent *symmetry-dependent radius formula*:

$$R_A = \left[r(A) + a\left(I - I_{st}\right)\right] A^{1/3} \tag{23b}$$

Naturally, the parameter a_I is simply related to a_Z as

$$a_I = -a_Z/2.$$

If the parameters $a_Z(a_I)$ are determined at *fixed* $r_{i,stab}$ values (see above), we get

a_Z = 0.376(50) fm, that is a_I = -0.188(25) fm,

s = 0.0564 fm, c^2/n' = 207.

The reduced chi-square returned to the „stability-line” level, which shows that the extra-charge effect (symmetry effect) has been taken into account correctly. The quantitative interpretation of this symmetry term will be discussed elsewhere.

Alternatively, we may *simultaneously fit all the four parameters*: r_i and $a_Z(a_I)$. The result is:

$r_{0,sim}$ = 0.897 fm, $r_{1,sim}$ = 1.362 fm, $r_{2,sim}$ = -2.247 fm

and

$a_{Z,sim}$ = 0.398 fm ≅ 0.40 fm that is $a_{I,sim}$ = -0.199 fm ≅ -0.20 fm ,

s = 0.0574 fm, c^2/n' = 203.

5.4 Conclusions

Which formula to use, depends on the aim and special circumstances of the work. In view of the quantitative characteristics of the different formulae and parameter sets, the following recommendations seem to be reasonable.

1) The liquid-drop formula (21) should be used only if *simplicity* is the main point of consideration.
2) To calculate radii *along the line of stability,* eq. (22) with the parameter set $r_{i,stab}$ is recommended.
3) *Off the stability line* eqs. (23*a* or *b*) produce the best result with parameter values determined by a simultaneous fit: $r_{i,sim}$ and $a_{Z,sim}$ (or $a_{I,sim}$).

Although the inclusion of the symmetry term improved the fit significantly (from c^2/n' = 266 to 203), the remaining high value of the reduced chi-square suggests the presence of further „fine” structure in the mass- and nucleon-number dependence of *rms* charge radii. It should be noted therefore, that the above three formulae describe only the smooth *A* (and *Z*) dependence of *rms* charge radii. There exist also more refined formulae that contain shell and deformation effects; see e.g. [An92].

6. Summary

Root mean-square (*rms*) nuclear charge radii have been compiled, selected and evaluated using two different procedures: a refined and a simple one. Running them on the same active database, the results for the weighted averages are very close to each other: 91% of the differences are within ±1/2 error and none of them exceeds the combined error. This confirms our earlier conclusion that the results are generally more sensitive to the decision *which* data we include in the averaging procedure, and less sensitive to the way *how* the selected data are weighted to form an average. This justifies the use of the simpler, more transparent procedure in cases where simplicity is of advance. On the other hand, for the present recommended data system the more refined evaluation algorithm was used. The resulting weighted averages, the *"1999-best-values" are presented in Appendix IV*. It is planned that all important data and program files together with a complete bibliography, will be regularly updated and distributed on *PC* diskettes or on the *Internet.*

Making use of the present data set, simple easy-to-calculate radius formulae *r(A)* and *r(Z,A)* are given with parameters updated at 1 May 1999, to facilitate the estimation of unmeasured radius values.

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Main text, Figure 1.

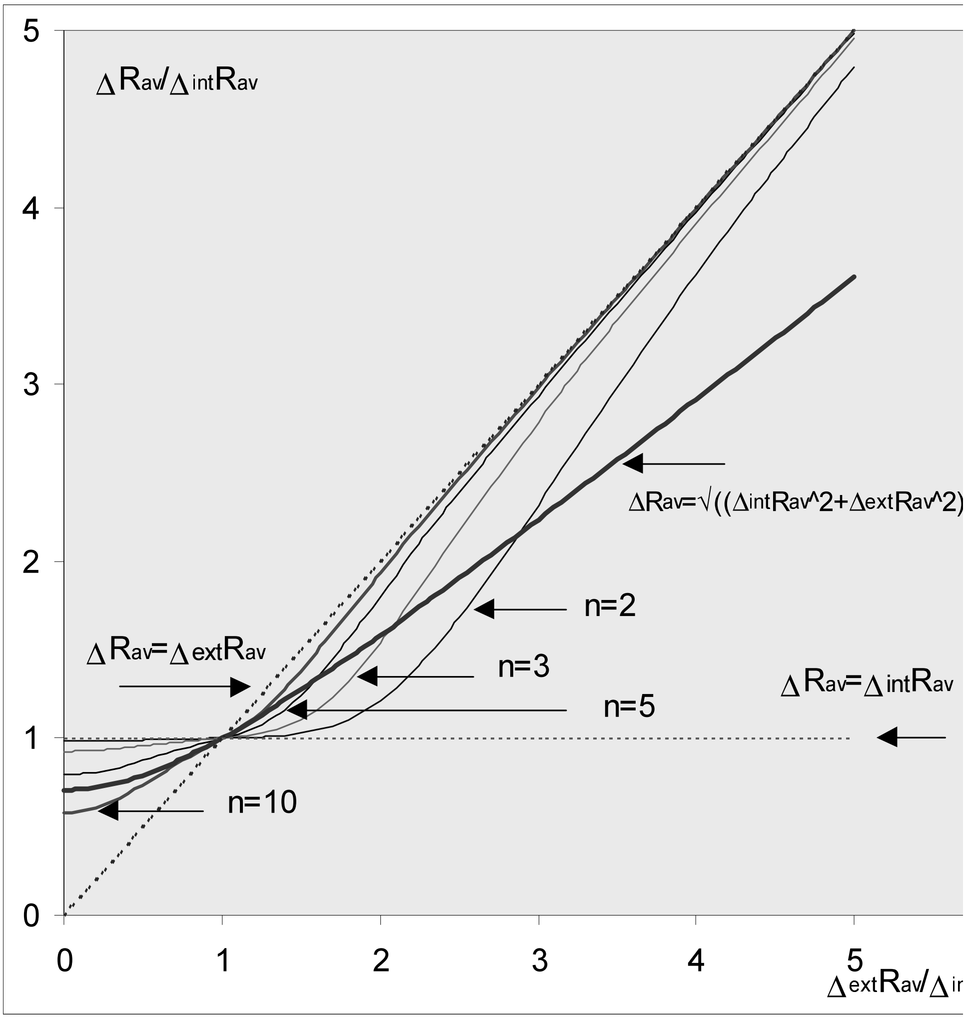
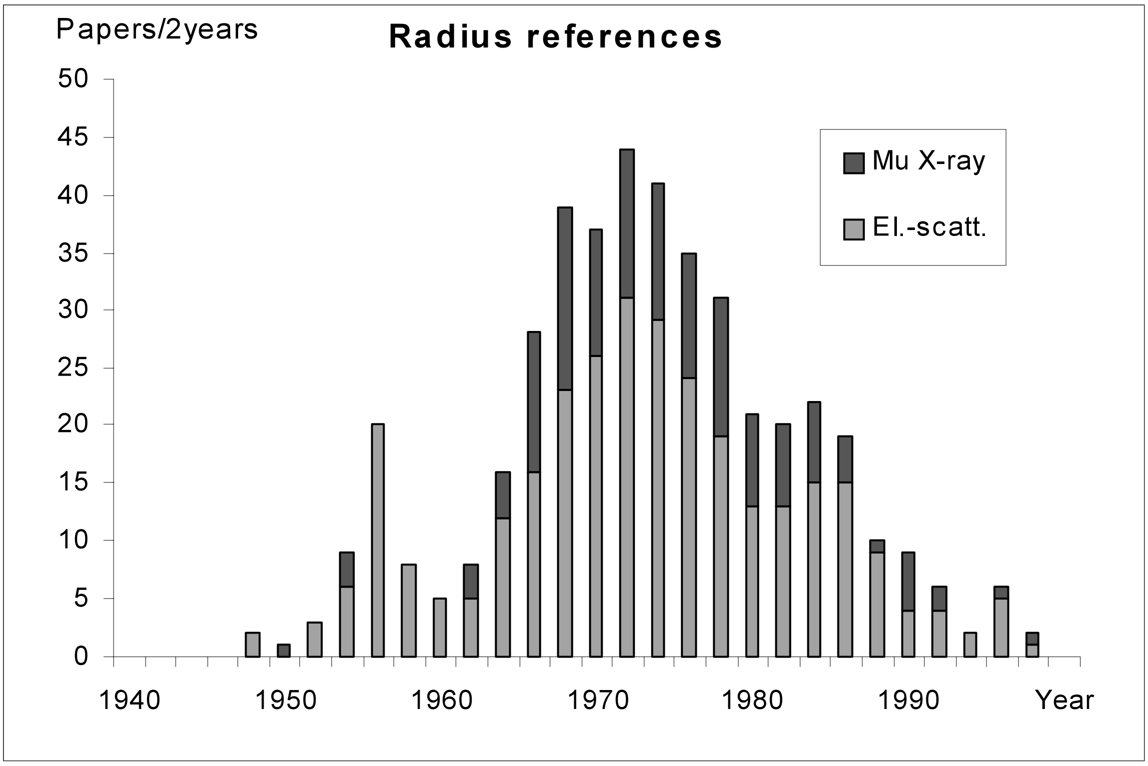


Figure 1. The ratio $\Delta R_{av}/\Delta_{int}R_{av}$ as the function of $\Delta_{ext}R_{av}/\Delta_{int}R_{av}$ for n=2, 3, 5 and 10, eq. (12). The simple quadratic mean (9) as well as the limiting cases $\Delta R_{av}=\Delta_{ext}R_{av}$ and $R_{av}=\Delta_{int}R_{av}$ (8ab) are also plotted (thick line and doted lines, respectively).

Appendix I.

Number of radius references

Updated 1 May 1999



Appendix II.

Table of Input Radius Data (fm)

Updated: 1-May-1999

0 n 1 2 el 19 mu

-0.1250	.0200	Be73a	el	X|	e+d el. scatt. Model error estimated
-0.1720	.0480	Pl90	el	X|	e+d el. scatt. Model error estimated
-0.0086	.1555	Fe47	ne	X|	b=-0.1(1.8)am. Diff. x-sect. asymm.
-0.1641	.0346	Ha51	ne	X|	b=-1.9(4)am. Transmission.
-0.1296	.0346	Ha52	ne	X|	b=-1.5(4)am. Diff. x-sect. asymm.
-0.1201	.0035	Hu53	ne	X|	b=-1.39(4)am. Crit. angle+transm.
-0.1209	.0259	Cr56	ne	X|	b=-1.4(3)am. Includes Ha52
-0.1287	.0077	Me59a	ne	X|	b=-1.49(5). Sys+.0034. Re-anal in Ko97
-0.1158	.0060	Kr66	ne	X|	b=-1.34(3). Re-an. in Kr73. Sys+.0034
-0.1123	.0060	Kr73	ne	|	b=-1.30(3). Diff.x-sec.asy. Sys+.0034
-0.1233	.0054	Ko73	ne	X|	b=-1.427(23) From Kr73. Sys+.0034
-0.1190	.0050	Ko76	ne	X|	b=-1.378(18) Re-an. in Ko86. Sys+.0034
-0.1140	.0069	Ko86	ne	X|	See Ko88, Ko95a.
-0.1140	.0069	Ko88	ne	X|	See Ko95a.
-0.1382	.0077	Al85	ne	X|	b=-1.60(5). Refl. on 186W. Sys+.0034
-0.1339	.0129	Al86	ne	X|	b=-1.55(11) Sys+.0034 See anal in Ko95a
-0.1192	.0068	Ko92	ne	X|	b=-1.38(4). Incl. in Ko95. Sys+.0034
-0.1140	.0052	Ko95a	ne	|	b=-1.32(3+3) Transm in Pb. Reanal of Bi
-0.1132	.0070	Ko95	ne	|	b=-1.31(3+4) Crit. ang.+transm.
-0.1149	.0049	Ko97	ne	|	b=-1.33(3+3) Transm. in Pb.
-0.1244	.0081	Ko97	ne	|	b=-1.44(3+6) Tr. in Bi, re-an of Me59a

1 H 1 19 el 0 mu

0.7400	.2400	Ho55	el	X|	Included in Ho56. Old
0.7700	.1000	Ch56	el	X|	Included in Ho56. Old
0.7700	.1000	Ho56	el	X|	Contains Ho55, Ch56, MA56. Old
0.8000	.0400	Ho58	el	X|	Old
0.7500	.0500	Bu61	el	X|	Included in Th72
0.8400	.0400	Le62	el	X|	Included in Th72
0.8200	.0400	Be63	el	X|	Outlier
0.8600	.0300	Du63	el	X|	Included in Si80
0.8050	.0110	Ha63	el	X|	Re-analysis of several. Old.
0.8000	.0250	Fr66	el	X|	Included in Th72
0.8100	.0200	Ak72	el	X|	Outlier
0.8500	.0200	Th72	el	X|	Analysis of Bu61, Le62, and Fr66
0.9000	.0300	Bo74	el	X|	Included in Bo75a, Si80
0.8100	.0400	Mu74	el	X|	Included in Bo75a, Si80
0.8400	.0200	Bo75	el	X|	Included in Bo75a, Si80
0.8700	.0200	Bo75a	el	X|	Analysis of Du63, Bo74, Mu74, Bo75
0.8400	.0500	An77	el	X|	From Lamb-shift!
0.8620	.0120	Si80	el	|	Contains Du63, Bo74, Mu74, Bo75
0.8470	.0085	Me96	et	|	Disp-theor. anal with rn2=-0.113fm2

1 H 2 9 el 0 mu

2.1000	.6000	MI55	el	X|	Old
2.1100	.0500	Ho57	el	X|	Contains MI56, MI57. Old
1.9500	.0200	Bu70	el	X|	Included in Be73, Si96
2.0950	.0060	Be73a	el	X|	Contains Bu70. Included in Si96
2.0800	.0270	Ak78	el	X|	Included in Si96
2.1160	.0060	Si81	el	X|	Included in Si96

```
    2.1280  .0110       Si96  el    X|  Re-an. of x-secs; corr. for Coul.dist.
    2.1390  .0080       PC97  el    X|  Priv. comm.  Not confirmed
    2.1300  .0120       Si98  el     |  Re-an. of x-secs; corr. for Coul.dist.


 1 H    3    5 el       0 mu

    1.7000  .0500       Co65  el    X|  Included in Be84
    1.6900  .0500       Be82  el    X|  Included in Be84
    1.6800  .0300       Be84  el    X|  Included in Ju85
    1.7600  .0400       Ju85  el     |  Contains Co65 and Be84
    1.7550  .0860       Am94  el     |


 2 He   3    9 el       0 mu

    1.8700  .0500       Co65  el    X|  Included in Re84b
    1.8800  .0500       MC70  el    X|  Included in MC77
    1.8900  .0500       Sz77  el    X|  Included in Re84b
    1.8440  .0450       MC77  el    X|  Contains MC70
    1.9670  .0210       Gu82  el    X|  From Ot85 (ref. 5). Unpublished?
    1.9350  .0300       Du83  el    X|  Included in Re84b
    1.8770  .0190       Re84b el     |  Contains Co65,MC70,MC77,Sz77,Du83
    1.9760  .0150       Ot85  el     |
    1.9590  .0300       Am94  el     |


 2 He   4   11 el       6 mu

    1.6100  .0400       Ho56  el    X|  Old
    1.6800  .0400       Bu60  el    X|
    1.6300  .0400       Fr65  el    X|
    1.6900  .0500       Fr66a el    X|  Re-analysed in Si76, Si82
    1.6900  .0200       Fr67  el    X|  Re-analysed in Si76, Si82
    1.6300  .0400       Er68  el    X|  Re-analysed in Si76, Si82
    1.6710  .0220       Si76  el    X|  Cont. Fr66a, Er68. Re-anal. in Si82
    1.6700  .0500       MC77  el    X|  Re-analysed in Si82
    1.6960  .0140       Gu82  el    X|  From Ot85 (ref. 5). Unpublished?
    1.6760  .0080       Si82  el     |  Re-an.of Fr66a,Fr67,Er68,MC77,Ar78
    1.6710  .0140       Ot85  el     |

    3.1000 4.7000       We67  mu    X|  From Wu69.
    1.6440  .0050       Be75  mu    X|  Preliminary. Included in Ca76
    1.6870  .0060       He76  mu     |  Re-analysis of exp. Be75
    1.6680  .0060       Ca76  mu    X|  Includes Be75. See also Ca77
    1.6730  .0030       Ca77  mu     |  Re-analysed in Bo78
    1.6730  .0010       Bo78  mu    X|  Theor. calc. Re-anal of Ca77


 3 Li   6    7 el       3 mu

    2.3800  .0500       St55  el    X|  Re-analysed in Me59
    2.7600  .1000       Bu58  el    X|  Old
    2.7000  .1500       Me59  el    X|  Re-analysis of St55. Old
    2.5100  .0300       Bi64  el    X|  From Ho67
    2.5400  .0500       Su67  el     |
    2.5600  .0500       Li71a el     |
    2.5700  .1000       Bu72  el     |  See also Vr87

    3.1000 3.9000       Je66  mu    X|  From Wu69.
    3.8000 4.6000       Ha68  mu    X|
    4.2000 4.6000       Ha68  mu    X|  MIA in En74(T.III.)


 3 Li   7    4 el       3 mu

    2.3800  .0500       St55  el    X|  Old
    2.4400  .0500       Bi64  el    X|  From Ho67
```

```
    2.3900  .0600      Su67  el    |
    2.4100  .1000      Bu72  el    |  See also Vr87

    2.6000  .9000      Je66  mu   X|  From Wu69
    3.8000 3.9000      Ha68  mu   X|
    4.2000 3.7000      Ha68  mu   X|  MIA in En74(T.III.)

 4 Be   9    9 el      4 mu

    2.2000  .2000      Ho57  el   X|  Ho53, Mi54. Old
    2.5300  .2000      Me59  el   X|  Old
    2.4200  .1200      Ng64  el   X|  From Ho67
    2.2600  .1000      Af67a el   X|  Serious outlier
    2.4600  .0900      Be67a el   X|  Re-analysed in Be69a, Fe73a
    2.5000  .0300      Be69  el   X|
    2.4300  .0800      Be69a el   X|  Re-anal. of Be67a. See also Fe73a
    2.5190  .0120      Ja72  el    |
    2.5000  .0900      Fe73a el    |  Re-analysis of Be67a

    2.7600  .6800      Je66  mu   X|  From Wu69
    2.6200  .9100      Ha68  mu   X|
    2.6000  .8000      Ha68  mu   X|  MIA in En74(T.III.)
    2.3900  .1637      Sc80a mu    |  From Fr95 T.III.A. Error estimated

 5 B   10    2 el      5 mu

    2.4500  .1200      St66b el   X|
    2.4000  .0900      Do86  el    |  Preliminary

    5.2000 3.0000      Je66  mu   X|
    2.4400 1.2700      Ba67  mu   X|
    2.7600  .6200      Ha68  mu   X|
    2.6900  .6400      Ha68  mu   X|  MIA in En74(T.III.)
    2.4400  .0600      Ol81  mu    |

 5 B   11    5 el      6 mu

    2.5000  .2000      Me59  el   X|  Old
    2.4200  .1200      St66b el   X|
    2.3800  .1000      Vl70  el   X|  Not confirmed in journal
    2.3700  .1000      Ri71  el    |  From Vr87
    2.4300  .1100      Do86  el   X|  Preliminary

    5.4000 3.0000      Je66  mu   X|
    2.2600 1.6900      Ba67  mu   X|
    2.7600  .6000      Ha68  mu   X|
    2.7100  .6000      Ha68  mu   X|  MIA in En74(T.III.)
    2.4520  .0482      Sc80a mu    |  From Fr95 T.III.A. Error estimated.
    2.3800  .0400      Ol81  mu    |

 6 C   12   25 el     10 mu

    2.4000  .2500      Fr55  el   X|  Old
    2.3700  .0500      Fr56  el   X|  Old
    2.5000  .1000      Eh59  el   X|  Re-analysed in Me59
    2.5000  .1500      Me59  el   X|  Re-analysis of Eh59. Old
    2.5300  .1000      Re63  el   X|  From Ho67
    2.4200  .0500      Cr66  el   X|
    2.4200  .0400      En67  el   X|  Included in Be69a
    2.3500  .1000      Af67  el   X|  Re-analysed in Sh67
    2.5300  .2500      Af67a el   X|  Re-analysed in Sh67
    2.4200  .0500      Sh67  el   X|  Re-analysis of Af67, Af67a
    2.3950  .0280      Be69a el   X|  =Be71. Contains En67. Rev. in Fe73a
    2.4620  .0250      Si70a el   X|  Re-analysed in Si74, Si82
    2.4500  .0200      Ja72  el   X|  Re-analysed in Si74, Si82
```

```
   2.4900  .0400      Kl73  el   X|
   2.4460  .0200      Me73a el   X|
   2.4620  .0220      Fe73a el   X|
   2.4680  .0160      Si74  el   X|  Re-anal. of Si70a, Ja72. See Si82
   2.4500  .0400      Do79  el   X|  See also Ba79
   2.4720  .0150      Ca80a el   X|  Re-analysed in Si82
   2.4640  .0120      Re82  el   X|  Re-anal. in Si82. Disp. c. in Of88
   2.4708  .0055      Si82  el   X|  Re-an. of Si70a,Ja72,Ca80. DC in Of88
   2.4690  .0040      Si82  el    |  Re-an. of Si70a, Ja72, Ca80a, Re82
   2.4757  .0090      Of88  el    |  Without disp. corr.! With DC: 2.4832
   2.4711  .0055      Of91  el   X|  Without disp. corr.! With DC: 2.4776
   2.4777  .0055      Of91  el    |  F-B anal: T.IX. in Fr95. Without DC

   2.4000  .5600      Ba67  mu   X|
   2.6000  .2600      Ha68  mu   X|
   2.4820  .0500      Du74  mu   X|  See also Sc80a
   2.5100  .0500      Du74  mu   X|  MIA in En74(T.III.)
   2.5200  .0400      Be79  mu   X|  Preliminary; see also Sc80a
   2.4670  .0170      Sc80a mu   X|  Included in Sc80a
   2.4720  .0160      Sc82  mu   X|  Re-analysed in Fr95
   2.4832  .0018      Ru82  mu   X|  Preliminary; final result in Ru84
   2.4829  .0019      Ru84  mu   X|  Re-analysed in Fr95
   2.4680  .0034      Fr95  mu    |  Table III.A. Includes Sc82, Ru84


 6 C   13    4 el      4 mu

   2.3200  .0230      Cr67  el   X|  From Ho67. Serious outlier.
   2.4400  .0250      He70a el    |
   2.3840  .0470      Be71  el   X|  Re-analysed in Fe73a
   2.4520  .0470      Fe73a el   X|  Re-analysis of Be71

   2.5100  .0400      Be79  mu   X|  Preliminary. Seealso Sc82
   2.4800  .0200      Sc82  mu   X|
   2.4628  .0039      Bo85  mu    |
   2.4660  .0144      Fr95  mu    |  Table III.A. Includes Sc82


6 C   14    1 el      1 mu

   2.5900  .0500      Kl73  el    |

   2.4920  .0111      Sc82  mu    |


7 N   14    6 el      5 mu

   2.4600  .0500      Me59  el   X|  Old
   2.4800  .1200      Bi64  el   X|  From Ho67
   2.4920  .0330      Be69a el   X|  = Be71
   2.5800  .0500      Da70  el   X|  See also Vr87
   2.5400  .0200      Sc75  el    |
   2.5240  .0230      La82  el    | From Vr87

   3.4000 1.5000      Je66  mu   X|
   2.6700  .2600      Ba67  mu   X|
   2.5450  .0300      Du74  mu   X|  See also Sc80a
   2.5600  .0300      Du74  mu   X|  MIA in En74(T.III.)
   2.5600  .0098      Sc80a mu    |  From Fr95 T.III.A. Error estimated.


7 N   15    6 el      0 mu

   2.6600  .1300      Da69  el   X|  Re-analysed in Da70, Ge72
   2.6400  .0400      Da70  el   X|  Re-analysis of Da69
   2.7000  .0300      Ge72  el   X|  Re-analysis of Da69
   2.5800  .0260      Sc75  el    |
```

2.6120	.0090	Vr88	el	X|	
2.6130	.0090	Vr88	el	|	F-B anal: T.IX. in Fr95

8 O 16 12 el 5 mu

2.6400	.0600	Ho57	el	X|	Old
2.7000	.0600	Eh59	el	X|	Included in Me59
2.6500	.0500	Me59	el	X|	Contains Eh59. Old
2.7100	.1500	La61	el	X|	From Ho67
2.7500	.0500	Cr66	el	X|	From Ho67
2.6660	.0330	Be69a	el	X|	= Be71
2.6740	.0220	Si70a	el	X|	
2.7300	.0250	Si70b	el	X|	
2.7180	.0210	Sc75	el	X|	
2.7120	.0120	Si80a	el	|	From Ba80(mu):"Priv.comm. I.Sick"
2.7370	.0080	La82	el	X|	From Vr87. Alternatively:
2.7280	.0080	La82	el	|	Priv. Comm. from J. Friedrich
2.9000	1.5000	Je66	mu	X|	
2.6100	.1400	Ba67	mu	X|	
2.7100	.0300	Du74	mu	X|	Errors: .02 exp. + .01 theor.
2.7100	.0300	Du74	mu	X|	MIA in En74(T.III.)
2.6930	.0035	Fr92	mu	|	Re-analysed in Fr95

8 O 17 2 el 0 mu

2.6620	.0260	Si70a	el	|	
2.7100	.0150	Ki78	el	|	Measured: ratio O17/O16=1.0015(25)

8 O 18 3 el 3 mu

2.7700	.1500	La61	el	X|	From Ho67
2.7270	.0200	Si70a	el	|	
2.7890	.0280	Sc75	el	|	
2.7100	.1400	Ba67	mu	X|	
2.7600	.1400	Ba67	mu	X|	MIA in En74(T.III.)
2.7780	.0200	Ba80	mu	|	From Fr92. Error: .014+model.

9 F 19 2 el 5 mu

2.8850	.0150	Ha73b	el	|	
2.9000	.0200	Oy75	el	X|	From Vr87
2.6700	.7700	Je66	mu	X|	
2.8500	.0900	Ba67	mu	X|	
2.9400	.0900	Ba67	mu	X|	MIA in En74(T.III.)
2.8980	.0110	Sc78	mu	|	M/S/Np: .001
2.8980	.0029	Fr92	mu	|	Re-analysed in Fr95

10 Ne 20 4 el 3 mu

3.0400	.0250	Mo71	el	X|	
3.0000	.0300	Fr72	el	X|	See also Fe73a
3.0040	.0250	Kn81	el	|	
2.9920	.0120	Be85	el	|	From Vr87. Err: 1.5x.008 for sys.
3.0700	.0800	Ba71	mu	X|	
3.0800	.0800	Ba71	mu	X|	MIA in En74(T.III.)
3.0060	.0041	Fr92	mu	|	Re-analysed in Fr95

10 Ne 21 0 el 1 mu

2.9670	.0036	Fr92	mu	|	Re-analysed in Fr95

10 Ne 22 1 el 1 mu

2.9690	.0210	Mo71	el		
2.9540	.0036	Fr92	mu		Re-analysed in Fr95

11 Na 23 1 el 6 mu

2.9000	.0600	Sa69a	el	X	
3.2000	.4000	Je66	mu	X	
2.9400	.0400	Ba67	mu	X	
3.0000	.0400	Ba67	mu	X	MIA in En74(T.III.)
2.9900	.0100	Du76	mu	X	Preliminary. Included in Sc78
2.9860	.0100	Sc78	mu		Contains Du76. M/S/Np: .001
2.9940	.0025	Fr92	mu		Re-analysed in Fr95

12 Mg 24 7 el 6 mu

2.9600	.0800	He56	el	X	From Ho57. Old
3.0300	.0300	Li71	el	X	
3.0340	.0300	Na72	el	X	
3.0400	.0400	Cu72	el	X	Re-analysed in Le76
3.0750	.0150	Av74	el		From Vr87
2.9850	.0300	Li74	el	X	
3.0800	.0500	Le76	el	X	Re-analysis of Cu72
3.2500	.4000	An63	mu	X	Old (NaI)
3.1200	.1300	Bj65	mu	X	From El67. Old (NaI)
3.2000	1.5000	Je66	mu	X	
3.0100	.0300	Ba67	mu	X	
3.0600	.0400	Su67	mu	X	MIA in En74(T.III.)
3.0570	.0024	Fr92	mu		Re-analysed in Fr95

12 Mg 25 3 el 1 mu

3.0800	.0500	Cu72	el	X	Re-analysed in Le76
3.1100	.0500	Le76	el	X	Re-analysis of Cu72
3.0030	.0110	Eu77a	el		
3.0290	.0024	Fr92	mu		Re-analysed in Fr95

12 Mg 26 4 el 1 mu

3.0400	.0400	Cu72	el	X	Re-analysed in Le76
3.0600	.0500	Le76	el	X	Re-analysis of Cu72
2.9600	.0040	So88	el	X	With pseudodata for q>qmax
2.9610	.0040	So88	el		F-B anal: T.IX. in Fr95
3.0340	.0025	Fr92	mu		Re-analysed in Fr95

13 Al 27 11 el 7 mu

2.9100	.1000	Lo64	el	X	From Ho67
3.0200	.0900	Af67a	el	X	
3.0100	.0900	Lo67	el	X	
3.0600	.0600	Sa67a	el	X	
2.9800	.0600	St67	el	X	From Ho67
3.0100	.0500	Be70a	el	X	Re-analysed in Fe73a
2.9100	.1000	Vl70	el	X	Not confirmed in journal
3.0500	.0500	Fe73a	el	X	Re-analysis of Be70a
3.1000	.0400	Do81	el	X	Included in Do83
3.1100	.0300	Do83	el	X	Contains Do81
3.0350	.0040	Ro86	el		From Vr87. Err: 2x.002 for sys.

```
    3.5800 1.3900      Jo62  mu   X|  Old (NaI)
    3.3000  .1900      An63  mu   X|  See also El67. Old (NaI)
    3.2300  .1400      Bj65  mu   X|  From El67. Old (NaI)
    3.0250  .0230      Ba67  mu   X|
    3.0500  .0300      Ba71a mu   X|  MIA in En74(T.III.)
    3.0580  .0060      Sc78  mu    |  M/S/Np: .001
    3.0630  .0022      Fr92  mu    |  Re-analysed in Fr95


 14 Si  28   11 el      5 mu

    3.0400  .0800      He56  el   X|  Old
    3.0600  .0600      Sa67a el   X|
    3.0600  .0500      Be70a el   X|  Re-analysed in Fe73a
    3.0800  .0400      M|70  el   X|  Re-analysed in Av74
    3.1300  .0310      Li71  el   X|
    3.1400  .0320      Na72  el   X|
    3.1000  .0500      Fe73a el   X|  Re-analysis of Be70a
    3.0780  .0300      Av74  el   X|  Re-analysis of M|70
    3.1060  .0300      Li74  el   X|
    3.1470  .0440      Br77  el   X|
    3.0850  .0170      Mi82  el    |  From Vr87 (T.IV.)

    3.1100  .2100      An63  mu   X|  Old (NaI)
    3.0860  .0180      Ba67  mu   X|
    3.1180  .0200      Su67  mu   X|  MIA in En74(T.III.)
    3.1270  .0040      Sc78  mu    |  M/S/Np: .001
    3.1230  .0026      Fr92  mu    |  Re-analysed in Fr95


 14 Si  29    3 el      1 mu

    3.1250  .0510      Br77  el    |  Two independent experiments!
    3.1000  .0740      Br77  el   X|  Err: .030(rel. to Si 28)+.044(abs)
    3.0800  .0170      Mi82  el    |  From Vr87 (T.IV.)

    3.1200  .0073      Fr92  mu    |  Re-analysed in Fr95


 14 Si  30    4 el      1 mu

    3.1700  .1640      Br77  el   X|  Err: .120(rel. to Si 28)+.044(abs)
    3.1730  .0250      Mi82  el    |  From Vr87 (T.IV.)
    3.1930  .0130      We93  el   X|  From Fr95
    3.1932  .0130      We93  el    |  F-B anal: T.IX. in Fr95

    3.1340  .0072      Fr92  mu    |  Re-analysed in Fr95


 15 P   31    7 el      5 mu

    3.2400  .1000      Ko65  el   X|
    3.1900  .0300      Si72  el   X|  Included in Mi82
    3.1870  .0240      Me73a el   X|  Error: 1.5x.016 for syst/mod
    3.1870  .0110      Me76  el   X|  Included in Mi82
    3.1870  .0100      Mi82  el    |  From Vr87. Contains Si72,Me73a,Me76
    3.1910  .0050      We93  el   X|  From Fr95
    3.1913  .0050      We93  el    |  F-B anal: T.IX. in Fr95

    3.0400  .1700      An63  mu   X|  Old (NaI)
    3.1880  .0180      Ba67  mu   X|
    3.2150  .0180      Ba67  mu   X|  MIA in En74(T.III.)
    3.1870  .0040      Sc78  mu    |  See Ka79. M/S/Np: .001
    3.1900  .0029      Sc85  mu    |  From Fr95


 16 S   32   10 el      7 mu
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3.1800	.0800	He56	el	X|	From Ho57. Old
3.1200	.1200	Lo64a	el	X|	From Ho67
3.2450	.0320	Li71	el	X|	
3.2380	.0150	Me73	el	X|	See Me76
3.2630	.0200	Av74	el	X|	Re-analysis of Hu70. From Ja74
3.2390	.0300	Li74	el	X|	Included in Me76
3.2400	.0110	Me76	el	|	Contains Li74. From Vr87
3.2480	.0110	Ry83a	el	|	Er:.004(st)+.007(sy)
3.2300	.0050	We93	el	X|	From Fr95
3.2295	.0050	We93	el	|	F-B anal: T.IX. in Fr95
2.8600	.1000	An63	mu	X|	Old (NaI). Serious outlier
3.2200	.2100	Qu64	mu	X|	Old (NaI)
3.2440	.0180	Ba67	mu	X|	
3.2420	.0160	Su67	mu	X|	MIA in En74(T.III.)
3.2610	.0050	Du74	mu	X|	Preliminary. Included in Sc78
3.2630	.0030	Sc78	mu	|	Contains Du74. M/S/Np: .001
3.2630	.0029	Sc85	mu	|	Re-analysed in Fr95

16 S 34 1 el 1 mu

3.2810	.0130	Ry83a	el	|	Er:.004(st)+.009(sy)
3.2850	.0031	Sc85	mu	|	Re-analysed in Fr95

16 S 36 1 el 1 mu

3.2780	.0110	Ry83a	el	|	Er:.006(st)+.005(sy)
3.3000	.0027	Sc85	mu	|	Re-analysed in Fr95

17 Cl 35 1 el 4 mu

3.3880	.0170	Br80	el	|	
3.1400	.1000	An63	mu	X|	Old (NaI)
3.3300	.0800	Ac66	mu	X|	
3.3220	.0180	Ba67	mu	X|	Nat.: 3.335(.018)
3.3400	.0180	Ba67	mu	|	MIA in En74(T.III.)

17 Cl 37 1 el 0 mu

3.3840	.0170	Br80	el	|	

18 Ar 36 1 el 4 mu

3.3270	.0225	Fi76	el	|	Error: 1.5x.015 for sys/mod
3.3960	.0070	Pf73	mu	X|	Included in Pf76
3.4020	.0080	Pf73	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.4020	.0060	Pf76	mu	|	Contains Pf73
3.3900	.0033	Fr82	mu	|	From Fr95 T.III.A. Error estimated

18 Ar 38 0 el 4 mu

3.4100	.0110	Pf73	mu	X|	Included in Pf76
3.4170	.0110	Pf73	mu	X|	MIA in En74(T.III.)
3.4150	.0090	Pf76	mu	|	Contains Pf73
3.4020	.0032	Fr82	mu	|	From Fr95 T.III.A. Error estimated

18 Ar 40 6 el 7 mu

3.4730	.0450	Gr71	el	X|	Included in Ot82
3.4100	.0400	Sc71	el	X|	Re-analysed in Fe73a

3.4200	.0400	Fe73a	el	X|	Re-analysis of Sc71
3.4800	.0800	We74	el	X|	Included in Ot82
3.3930	.0150	Fi76	el	X|	Included in Ot82
3.4230	.0140	Ot82	el	|	Contains Gr71, Sc71, We74, Fi76
3.4800	.0800	Bu67	mu	X|	From Fi76el
3.4150	.0050	Ba71	mu	X|	
3.4160	.0060	Ba71	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.4230	.0060	Pf73	mu	X|	Included in Pf76
3.4300	.0070	Pf73	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.4290	.0060	Pf76	mu	|	Contains Pf73
3.4270	.0034	Fr82	mu	|	From Fr95 T.III.A. Error estimated

19 K 39 2 el 6 mu

3.3600	.0700	Sa69a	el	X|	
3.4080	.0270	Si73a	el	|	
3.1600	.2100	Jo62	mu	X|	Old (NaI)
3.3800	.1700	Qu64	mu	X|	Old (NaI)
3.4400	.0300	Ba67a	mu	X|	From El67
3.4380	.0100	Eh68	mu	|	MIA in En74(T.III.)
3.4350	.0030	Sc78	mu	|	M/S/Np: .001
3.4350	.0033	Wo81	mu	|	From Fr95 T.III.A. Error estimated

19 K 41 0 el 1 mu

3.4520	.0033	Wo81	mu	|	From Fr95 T.III.A. Error estimated

20 Ca 40 9 el 10 mu

3.5200	.0800	Ho57	el	X|	Old
3.5200	.0400	Cr65	el	X|	
3.4860	.0800	Be67b	el	X|	Included in Si73a. From Ho67
3.4870	.2800	Fr68	el	X|	Er: 1% rel, 8% abs. El+mu in Wo81(mu)
3.4300	.0700	Ei69	el	X|	
3.4820	.0250	Si73a	el	X|	Contains Be67b
3.4760	.0030	Si79	el	|	Data: Private communication
3.4500	.0100	Em83a	el	X|	Included in Em83
3.4780	.0100	Em83	el	X|	Contains Em83a
3.2900	.2700	Jo62	mu	X|	Old (NaI)
3.2600	.0800	An63	mu	X|	Old (NaI). Serious outlier
3.5200	.1000	Qu64	mu	X|	Old (NaI)
3.5780	.0260	Bj65	mu	X|	From El67. Old (NaI).Serious outlier
3.4640	.0550	Ac66	mu	X|	
3.4760	.0060	Su67	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.4800	.0050	Wo78	mu	X|	.002(st)+.003(sy). See Wo81
3.4813	.0030	Wo81	mu	X|	M/S/Np: .002
3.4780	.0030	Wo81	mu	X|	From Fr95 T.III.A. Error estimated.
3.4767	.0011	Fr95	om	|	OEM combined analysis. V2 error added

20 Ca 42 2 el 4 mu

3.5300	.0800	Be67b	el	X|	From Ho67
3.5170	.2800	Fr68	el	X|	Er:1% rel., 8% abs. El+mu in Wo81(mu)
3.5100	.0043	Wo78	mu	X|	See Wo81
3.5115	.0032	Wo81	mu	X|	M/S/Np: .002
3.5080	.0032	Wo81	mu	X|	From Fr95 T.III.A. Error estimated.
3.5057	.0013	Fr95	om	|	OEM combined analysis. V2 error added

20 Ca 43 0 el 3 mu

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     3.4966  .0043      Wo78  mu   X|  See Wo81
     3.4950  .0030      Wo81  mu   X|  From Fr95 T.III.A. Error estimated.
     3.4928  .0011      Fr95  om    |  OEM combined analysis. V2 error added

 20 Ca  44    2 el      5 mu

     3.5300  .0800      Be67b el   X|  From Ho67
     3.5150  .2800      Fr68  el   X|  Er:1% rel. 8% abs. El+mu in Wo81(mu)

     3.7190  .0270      Bj65  mu   X|  From El67. Old (NaI)
     3.5201  .0043      Wo78  mu   X|  See Wo81
     3.5214  .0031      Wo81  mu   X|  M/S/Np: .002
     3.5180  .0032      Wo81  mu   X|  From Fr95 T.III.A. Error estimated.
     3.5152  .0013      Fr95  om    |  OEM combined analysis. V2 error added

 20 Ca  46    0 el      3 mu

     3.5011  .0075      Wo78  mu   X|  See Wo81
     3.4980  .0058      Wo81  mu   X|  From Fr95 T.III.A. Error estimated.
     3.4921  .0012      Fr95  om    |  OEM combined analysis. V2 error added

 20 Ca  48    4 el      4 mu

     3.4700  .0800      Be67b el   X|  From Ho67
     3.4760  .2800      Fr68  el   X|  Er:1% rel., 8% abs. El+mu in Wo81(mu)
     3.4510  .0090      Em83a el   X|  Included in Em83
     3.4810  .0090      Em83  el    |  Contains Em83a

     3.4809  .0042      Wo78  mu   X|  See Wo81
     3.4823  .0031      Wo81  mu   X|  M/S/Np: .002
     3.4790  .0030      Wo81  mu   X|  From Fr95 T.III.A. Error estimated.
     3.4736  .0011      Fr95  om    |  OEM combined analysis. V2 error added

 21 Sc  45    2 el      2 mu

     3.5200  .0900      Th70  el   X|  Re-analysed in Fe73a
     3.5500  .0900      Fe73a el   X|  Re-analysis of Th70

     3.5498  .0030      Wo81  mu   X|  M/S/Np: .002
     3.5460  .0035      Fr82  mu    |  From Fr95 T.III.A. Error estimated.

 22 Ti  46    3 el      2 mu

     3.5700  .0600      Th67  el   X|  Re-analysed in  Fe73a
     3.5740  .0300      He72  el   X|  El+mu analysis in Wo81(mu)
     3.5900  .0600      Fe73a el   X|  Re-analysis of  Th67

     3.6094  .0028      Wo81  mu   X|  M/S/Np: .002
     3.6060  .0032      Wo81  mu    |  From Fr95 T.III.A. Error estimated.

 22 Ti  47    0 el      1 mu

     3.5960  .0032      Wo81  mu    |  From Fr95 T.III.A. Error estimated.

 22 Ti  48    7 el      8 mu

     3.5900  .0500      En66  el   X|  Re-analysed in Fe73a
     3.6000  .0800      Be67b el   X|  From Ho67
     3.5844  .0700      Fr68  el   X|  (El+mu analysis in Wo81(mu))
     3.5773  .0200      He71  el    |  From Se88; error estimated
     3.5900  .0400      Fe73a el   X|  Re-analysis of En66
     3.7130  .0150      Sh78c el   X|  Outlier. Syst. error?
     3.5970  .0010      Se88  el   X|  El+mu analysis with Wo81(mu)
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3.2900	.1500	Fi53	mu	X|	Old (NaI)
3.7400	.0600	Fr62	mu	X|	From El67. Old (NaI)
3.4900	.0600	Jo62	mu	X|	Old (NaI)
3.5800	.1300	Qu64	mu	X|	Old (NaI)
3.5990	.0090	Ba66a	mu	X|	From Wu69, En74
3.6000	.0110	Ba66a	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.5956	.0028	Wo81	mu	X|	See Se88. M/S/Np: .002
3.5920	.0032	Wo81	mu	|	From Fr95 T.III.A. Error estimated.

22 Ti 49 0 el 1 mu

3.5740	.0030	Wo81	mu	|	From Fr95 T.III.A. Error estimated.

22 Ti 50 6 el 2 mu

3.5700	.0600	Th67	el	X|	Re-analysed in Fe73a
3.5617	.0200	He71	el	X|	From Se88, no error
3.5600	.0300	He72	el	X|	(El+mu analysis in Wo81(mu))
3.6000	.0600	Fe73a	el	X|	Re-analysis of Th67
3.6120	.0280	Ho75	el	X|	From Vr75. Unpublished?
3.5730	.0020	Se88	el	X|	El+mu analysis with Wo81(mu)
3.5743	.0028	Wo81	mu	X|	See Se88. M/S/Np: .002.
3.5710	.0031	Wo81	mu	|	From Fr95 T.III.A. Error estimated.

23 V 51 5 el 3 mu

3.5900	.0800	Ho57	el	X|	See also Ha56, Cr61. Old
3.6200	.0900	Th70	el	X|	Re-analysed in Fe73a
3.5800	.0400	Pe73	el	X|	
3.6600	.0900	Fe73a	el	X|	Re-analysis of Th70
3.6150	.0310	Go74	el	X|	From Vr87
3.6190	.0570	Bj65	mu	X|	From El67. Old (NaI)
3.6000	.0500	Bj65	mu	X|	MIA in En74(T.III.). Old (NaI)
3.6000	.0030	Wo81	mu	|	From Fr95 T.III.A. Error estimated.

24 Cr 50 3 el 2 mu

3.6380	.0130	La76	el	|	From Vr87
3.7070	.0200	Sh78b	el	X|	Outlier. Syst. error?
3.6280	.0130	Li83	el	X|	El+mu analysis in Wo81(mu)
3.6645	.0026	Wo81	mu	X|	M/S/Np: .002.
3.6610	.0032	Wo81	mu	|	From Fr95 T.III.A. Error estimated.

24 Cr 52 5 el 4 mu

3.6560	.0300	Be64	el	X|	From Ho67
3.6740	.0150	Li76	el	|	
3.6130	.0170	La76	el	|	From Vr87
3.6840	.0150	Sh78b	el	X|	Outlier. Syst. error?
3.6220	.0140	Li83	el	X|	El+mu analysis in Wo81(mu)
3.6200	.1200	Jo62	mu	X|	Old (NaI)
3.5900	.0800	Jo62	mu	X|	MIA in En74(T.III.). Old (NaI)
3.6452	.0025	Wo81	mu	X|	M/S/Np: .002.
3.6450	.0030	Wo81	mu	|	From Fr95 T.III.A. Error estimated.

24 Cr 53 1 el 1 mu

3.7260	.0200	Sh78b	el	X|	See other Cr isotopes.
3.6590	.0030	Wo81	mu	|	From Fr95 T.III.A. Error estimated.

24 Cr 54 3 el 2 mu

3.6730	.0140	La76	el		From Vr87
3.7760	.0200	Sh78b	el	X	Outlier. Syst. error?
3.6790	.0120	Li83	el	X	El+mu analysis in Wo81(mu)
3.6902	.0027	Wo81	mu	X	M/S/Np: .002.
3.6860	.0032	Wo81	mu		From Fr95 T.III.A. Error estimated.

25 Mn 55 1 el 3 mu

3.6800	.1100	Th69	el	X	
3.7200	.0700	Qu64	mu	X	Old (NaI)
3.7100	.0700	Qu64	mu	X	MIA in En74(T.III.). Old (NaI)
3.7060	.0033	Wo81	mu		From Fr95 T.III.A. Error estimated.

26 Fe 54 6 el 1 mu

3.7200	.0700	Be62	el	X	
3.7230	.0060	Li71b	el	X	Outlier. See also other Fe isotopes
3.6750	.0200	La76	el		From Vr87
3.6800	.0130	Wo76	el	X	Included in Wo80
3.7320	.0200	Sh78b	el	X	Outlier. Syst. error?
3.6940	.0050	Wo80	el		El+mu anal. with Wo76, Sh76(mu)
3.6940	.0035	Sh76	mu	X	From Fr95 T.III.A. Error estimated.

26 Fe 56 9 el 10 mu

3.7500	.0800	Ha56	el	X	From Ho67. Old
3.8500	.0700	Be62	el	X	
3.7100	.1100	Th70	el	X	Re-analysed in Fe73a
3.7870	.0130	Li71b	el	X	Outlier. Syst. error?
3.7400	.1100	Fe73a	el	X	Re-analysis of Th70
3.7210	.0200	La76	el		From Vr87
3.7290	.0130	Wo76	el	X	Included in Wo80
3.8010	.0150	Sh78b	el	X	Outlier. Syst. error?
3.7390	.0050	Wo80	el	X	El+mu anal. with Sh76(mu)
3.7620	.0300	Fr62	mu	X	From El67. Old (NaI)
3.7320	.0590	Jo62	mu	X	Old (NaI)
3.6890	.0590	An63	mu	X	Old (NaI)
3.7470	.0440	Qu64	mu	X	Old (NaI)
3.7620	.0590	Bj65	mu	X	From El67. Old (NaI)
3.7180	.0340	Ac66	mu	X	
3.7143	.0057	Bv71	mu	X	From En74
3.7360	.0070	Bv71	mu	X	MIA in En74(T.III.). M/S/Np: .001
3.7380	.0036	Sh76	mu		From Fr95 T.III.A. Error estimated.
3.7412	.0065	Wo81	mu		Error estimated

26 Fe 57 0 el 1 mu

3.7540	.0037	Sh76	mu		From Fr95 T.III.A. Error estimated.

26 Fe 58 3 el 1 mu

3.7830	.0300	Li71b	el	X	See Fe, Ni isotopes
3.7520	.0250	Wo76	el		
3.7770	.0050	Wo80	el	X	El+mu anal. with Sh76(mu)
3.7740	.0037	Sh76	mu		From Fr95 T.III.A. Error estimated.

27 Co 59 7 el 4 mu

3.8300	.0800	Ho57	el	X|	Re-analysed in El64
3.7600	.0800	El64	el	X|	Re-analysis of Ho57
4.0100	.0400	Br66	el	X|	From Ho67. Serious outlier
3.7700	.0500	Th70	el	X|	Re-analysed in Fe73a
3.8000	.0500	Fe73a	el	X|	Re-analysis of Th70
3.8640	.0150	Sh78a	el	X|	Outlier. See also Cr, Fe, Cu isotopes
3.7890	.0050	Sc79	el	|	
3.8600	.0600	Jo62	mu	X|	Old (NaI)
3.7700	.0700	Qu64	mu	X|	Old (NaI)
3.7600	.0700	Qu64	mu	X|	MIA in En74(T.III.). Old (NaI)
3.7880	.0035	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

28 Ni 58 14 el 6 mu

3.7900	.0700	Ha56	el	X|	From Ho67. Old
3.8230	.0140	Kh68	el	X|	Included in Kh70
3.8230	.0150	Kh70b	el	X|	Outlier. See also Ni, Sn isotopes
3.7250	.0150	Fi70	el	X|	Included in Fi74a
3.7800	.0800	Th70	el	X|	Re-analysed in Fe73a
3.7830	.0200	Li71b	el	X|	
3.8100	.0800	Fe73a	el	X|	Re-analysis of Th70
3.7620	.0100	Fi74a	el	X|	From Ja74. Contains Fi70
3.7460	.0240	Wo76	el	X|	Included in Wo80
3.7470	.0150	Ke77	el	X|	From Ja79 (priv. comm.)
3.7700	.0100	Sp79	el	|	Re-analysis of Si75
3.7720	.0040	Ca80b	el	|	From Vr87. Error: 2x.002 for syst.
3.7770	.0050	Wo80	el	|	El+mu anal. with Sh76(mu)
3.7690	.0130	Be83	el	|	From Vr87
3.9000	.0600	Jo62	mu	X|	Old (NaI)
3.6600	.0600	An63	mu	X|	Old (NaI)
3.8000	.0600	Qu64	mu	X|	Old (NaI)
3.8190	.0440	Ba66a	mu	X|	
3.8180	.0060	Ba66	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.7760	.0034	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

28 Ni 60 10 el 2 mu

3.8200	.0700	Ha57	el	X|	From Ho67. Old
3.8650	.0160	Kh70b	el	X|	Outlier. Syst. error?
3.7550	.0230	Fi70	el	X|	Included in Fi74a
3.8120	.0300	Li72	el	X|	
3.7960	.0100	Fi74a	el	|	From Ja74. Contains Fi70
3.7640	.0240	Wo76	el	X|	Included in Wo80
3.7940	.0120	Ke77	el	X|	From Ja79 (priv. comm.)
3.8740	.0200	Sh78a	el	X|	Outlier. See also Cr, Fe, Cu isotopes
3.8150	.0050	Wo80	el	|	El+mu anal. with Sh76(mu)
3.7970	.0130	Be83	el	|	From Vr87
3.8120	.0090	Eh68	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.8130	.0034	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

28 Ni 61 2 el 1 mu

3.7580	.0150	Fi70	el	X|	Included in Fi74a
3.8060	.0100	Fi74a	el	|	From Ja74. Contains Fi70
3.8230	.0034	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

28 Ni 62 7 el 1 mu

3.7870	.0150	Fi70	el	X|	Included in Fi74a
3.8560	.0100	Li71b	el	X|	Outlier.
3.8220	.0100	Fi74a	el	|	From Ja74. Contains Fi70
3.8540	.0330	Go74	el	X|	From Ja74. Unpublished?
3.8020	.0240	Wo76	el	X|	Included in Wo80
3.8270	.0130	Ke77	el	|	From Ja79 (priv. comm.)
3.8440	.0050	Wo80	el	X|	El+mu anal. with Sh76(mu)
3.8420	.0035	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

28 Ni 64 5 el 1 mu

3.9070	.0260	Kh70b	el	X|	Outlier
3.8260	.0150	Fi70	el	X|	Included in Fi74a
3.8450	.0100	Fi74a	el	|	From Ja74. Contains Fi70
3.8210	.0240	Wo76	el	X|	
3.8620	.0050	Wo80	el	X|	El+mu anal. with Sh76(mu)
3.8600	.0034	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

29 Cu 63 6 el 8 mu

3.8500	.0500	Th70	el	X|	Re-analysed in Fe73a
3.8800	.0500	Fe73a	el	X|	Re-analysis of Th70
3.9250	.0220	Go74	el	X|	From Ja74. Unpublished
3.9330	.0150	Ke77	el	|	From Vr87
3.9470	.0130	Sh78a	el	X|	Outlier. See also Cr, Fe, ... isotopes
3.8850	.0050	Sc79	el	|	
3.7300	.1200	Fi53	mu	X|	Old (NaI)
3.9480	.0620	Fr62	mu	X|	Old (NaI)
3.8870	.0620	Jo62	mu	X|	Old (NaI)
3.8560	.0650	Qu64	mu	X|	Old (NaI)
3.8870	.0310	Bj65	mu	X|	Old (NaI)
3.8900	.0060	Ba66	mu	X|	M/S/Np: .001. MIA in En74(T.III.)
3.8960	.0090	Eh68	mu	X|	MIA in En74(T.III.). M/S/Np: .001
3.8830	.0034	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

29 Cu 65 4 el 1 mu

3.9470	.0220	Go74	el	X|	From Ja74. Unpublished?
3.9860	.0200	Ke77	el	X|	From Ja79
3.9540	.0200	Sh78a	el	X|	See Cr, Fe, Ni, ... isotopes
3.9050	.0050	Sc79	el	|	
3.9020	.0034	Sh76	mu	|	From Fr95 T.III.A. Error estimated.

30 Zn 64 8 el 5 mu

4.0410	.0170	Af70	el	X|	Serious outlier
3.9000	.0500	Th70	el	X|	Re-analysed in Fe73a
3.9430	.0250	Li72b	el	X|	
3.9650	.0300	Ne72	el	X|	Corrected in Ja 74
3.9300	.0500	Fe73a	el	X|	Re-analysis of Th70
3.9020	.0230	Wo76	el	X|	
3.9230	.0130	Ke77	el	|	From Vr87
3.9320	.0050	Wo80	el	X|	El+mu anal. with Sh76(mu)
4.0380	.0620	Fr62	mu	X|	From El67. Old (NaI)
4.0380	.0620	Jo62	mu	X|	Old (NaI)

3.8200	.0620	An63	mu	X|	Old (NaI)
3.9140	.0590	Qu64	mu	X|	Old (NaI)
3.9280	.0035	Sh76	mu	|	From Fr95 T.III.A. Error estimated.
30 Zn 66	7 el	2 mu			
4.0810	.0250	Af70	el	X|	Serious outlier
3.9770	.0200	Li72b	el	X|	
4.0090	.0300	Ne72	el	X|	Corrected in Ja74
3.9910	.0270	Li73	el	X|	Outlier
3.9030	.0250	Wo76	el	X|	
3.9520	.0150	Ke77	el	|	From Vr87
3.9550	.0060	Wo80	el	X|	El+mu anal. with Sh76(mu)
3.9510	.0060	Je70	mu	|	MIA in En74(T.III.). M/S/Np: .001
3.9480	.0035	Sh76	mu	|	From Fr95 T.III.A. Error estimated.
30 Zn 68	5 el	2 mu			
3.9960	.0300	Ne72	el	X|	Corrected in Ja74
3.9790	.0310	Li73	el	X|	
3.9470	.0240	Wo76	el	X|	
3.9580	.0170	Ke77	el	|	From Vr87
3.9700	.0050	Wo80	el	X|	El+mu anal. with Sh76(mu)
3.9690	.0060	Je70	mu	|	MIA in En74(T.III.). M/S/Np: .001
3.9650	.0034	Sh76	mu	|	From Fr95 T.III.A. Error estimated.
30 Zn 70	4 el	1 mu			
4.0440	.0300	Ne72	el	X|	Corrected in Ja74
3.9810	.0310	Wo76	el	X|	
3.9930	.0200	Ke77	el	|	From Vr87
3.9860	.0050	Wo80	el	X|	El+mu anal. with Sh76(mu)
3.9830	.0033	Sh76	mu	|	From Fr95 T.III.A. Error estimated.
31 Ga 69	0 el	1 mu			
3.9960	.0032	Ma83	mu	|	From Fr95 T.III.A. Error estimated.
31 Ga 71	0 el	1 mu			
4.0110	.0032	Ma83	mu	|	From Fr95 T.III.A. Error estimated.
32 Ge 70	4 el	1 mu			
4.0700	.0200	Kl75	el	X|	
4.0280	.0200	Ma83	el	X|	See Ma84
4.0430	.0020	Ma84	em	|	From Vr87
4.0550	.0160	Kh90	el	X|	Error: 2x.0080 for syst. (Ol?)
4.0390	.0033	Si82a	mu	|	From Fr95 T.III.A. Error estimated.
32 Ge 72	4 el	1 mu			
4.0500	.0300	Kl75	el	X|	
4.0540	.0200	Ma83	el	X|	See Ma84
4.0600	.0020	Ma84	em	|	From Vr87

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    4.0880  .0160      Kh90  el   X|  Error: 2x.0080 for syst. (Ol?)

    4.0550  .0033      Si82a mu    |  From Fr95 T.III.A. Error estimated.


32 Ge  73    0 el      1 mu

    4.0610  .0033      Si82a mu    |  From Fr95 T.III.A. Error estimated.


32 Ge  74    3 el      1 mu

    4.0710  .0200      Ma83  el   X|  See Ma84
    4.0750  .0020      Ma84  em    |  From Vr87
    4.1260  .0160      Kh90  el   X|  Error: 2x.0080 for syst. (Ol?)

    4.0720  .0035      Si82a mu    |  From Fr95 T.III.A. Error estimated.


32 Ge  76    3 el      1 mu

    4.0730  .0200      Ma83  el   X|  See Ma84
    4.0810  .0020      Ma84  em    |  From Vr87
    4.1270  .0160      Kh90  el   X|  Error: 2x.0080 for syst. (Ol?)

    4.0800  .0035      Si82a mu    |  From Fr95 T.III.A. Error estimated.


33 As  75    0 el      5 mu

    4.0500  .0600      An63  mu   X|  Old (NaI)
    4.0800  .0600      Qu64  mu   X|  Old (NaI)
    4.1030  .0230      Ba66a mu   X|  From El67
    4.1040  .0060      Ba66a mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.0960  .0033      Ma83  mu    |  From Fr95 T.III.A. Error estimated.


34 Se  74    1 el      0 mu

    4.0700  .0200      Kh88  el    |


34 Se  76    2 el      1 mu

    4.1620  .0100      Kh86  el   X|  Prelim. result. Included in Kh88
    4.1620  .0100      Kh88  el    |

    4.1390  .0036      Si82b mu    |  From Fr95 T.III.A. Error estimated.


34 Se  77    0 el      1 mu

    4.1390  .0035      Si82b mu    |  From Fr95 T.III.A. Error estimated.


34 Se  78    3 el      1 mu

    4.1430  .0110      Kh86a el   X|  Preliminary result. Included in Kh88
    4.1380  .0140      Kh86  el   X|  Preliminary result. Included in Kh88
    4.1380  .0140      Kh88  el    |

    4.1400  .0036      Si82b mu    |  From Fr95 T.III.A. Error estimated.


34 Se  80    3 el      2 mu

    4.1690  .0130      Kh86a el   X|  Preliminary result. Included in Kh88
    4.1240  .0100      Kh86  el   X|  Preliminary result. Included in Kh88
    4.1240  .0100      Kh88  el    |
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    4.1430  .0029      Ka79  mu    |  M/S/Np: .001
    4.1400  .0035      Si82b mu    |  From Fr95 T.III.A. Error estimated.

34 Se  82    2 el      1 mu

    4.1180  .0110      Kh86  el   X|  Preliminary result. Included in Kh88
    4.1180  .0110      Kh88  el    |

    4.1400  .0035      Si82b mu    |  From Fr95 T.III.A. Error estimated.

35 Br  79    0 el      2 mu

    4.1630  .0790      Br76  mu   X|
    4.1630  .0035      Ma83  mu    |  From Fr95 T.III.A. Error estimated.

35 Br  81    0 el      1 mu

    4.1600  .0034      Ma83  mu    |  From Fr95 T.III.A. Error estimated.

36 Kr  78    0 el      2 mu

    4.2030  .0039      Ma85  mu   X|  From Fr95 T.III.A. Error estimated.
    4.2032  .0016      Fr95  om    |  OEM combined analysis. V2 error added.

36 Kr  80    0 el      2 mu

    4.1980  .0039      Ma85  mu   X|  From Fr95 T.III.A. Error estimated.
    4.1976  .0013      Fr95  om    |  OEM combined analysis. V2 error added

36 Kr  82    0 el      2 mu

    4.1920  .0037      Ma85  mu   X|  From Fr95 T.III.A. Error estimated.
    4.1921  .0015      Fr95  om    |  OEM combined analysis. V2 error added

36 Kr  83    0 el      2 mu

    4.1860  .0037      Ma85  mu   X|  From Fr95 T.III.A. Error estimated.
    4.1860  .0018      Fr95  om    |  OEM combined analysis. V2 error added

36 Kr  84    0 el      3 mu

    4.1870  .0100      Ma80  mu   X|  "nat" Kr: 4.187. Err: 2x.005 for sys.
    4.1880  .0036      Ma85  mu   X|  From Fr95 T.III.A. Error estimated.
    4.1884  .0016      Fr95  om    |  OEM combined analysis. V2 error added

36 Kr  86    0 el      3 mu

    4.1840  .0072      Ma80  mu   X|  Error: 2x.0036 for syst.
    4.1840  .0036      Ma85  mu   X|  From Fr95 T.III.A. Error estimated.
    4.1839  .0017      Fr95  om    |  OEM combined analysis. V2 error added

37 Rb  85    0 el      1 mu

    4.2040  .0036      He86  mu    |  From Fr95 T.III.A. Error estimated.

37 Rb  87    0 el      1 mu

    4.1990  .0036      He86  mu    |  From Fr95 T.III.A. Error estimated.

38 Sr  84    0 el      2 mu
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     4.2410  .0037      He86  mu   X|  From Fr95 T.III.A. Error estimated.
     4.2365  .0017      Fr95  om    |  OEM combined analysis. V2 error added.

  38 Sr  86    1 el      2 mu

     4.1830  .0330      Ki92  el   X|  Ref. to previous data [Sc80mu] ???

     4.2310  .0036      He86  mu   X|  From Fr95 T.III.A. Error estimated.
     4.2261  .0013      Fr95  om    |  OEM combined analysis. V2 error added.

 38 Sr  87    0 el      2 mu

     4.2240  .0036      He86  mu   X|  From Fr95 T.III.A. Error estimated.
     4.2190  .0012      Fr95  om    |  OEM combined analysis. V2 error added.

 38 Sr  88    5 el      4 mu

     4.1400  .1200      Ho57  el   X|  See also He56. Old
     4.2600  .0100      Al73  el   X|  Outlier
     4.2740  .0780      Si73c el   X|  Errors: .058 (tot.) + .020 (model)
     4.1700  .0200      Fi74  el   X|  From Ja74
     4.1880  .0050      St76  el    |  From Vr87

     4.2280  .0040      Eh68  mu   X|  From En74
     4.2280  .0060      Eh68  mu   X|  MIA in En74(T.III.). M/S/Np: .001
     4.2240  .0036      He86  mu   X|  From Fr95 T.III.A. Error estimated.
     4.2188  .0012      Fr95  om    |  OEM combined analysis. V2 error added.

 39 Y   89    4 el      3 mu

     4.2400  .1000      Sh67a el   X|  Error not given; estimated
     4.2720  .0450      Si71  el   X|  Preliminary; see: Se73c
     4.2690  .0780      Si73c el   X|  Errors: .058 (tot.) + .020 (model)
     4.2700  .0200      Fi74  el    |  From Ja74

     4.2390  .0070      Ke70  mu   X|
     4.2440  .0080      Ke70  mu    |  MIA in En74(T.III.). M/S/Np: .001
     4.2430  .0036      He86  mu    |  From Fr95 T.III.A. Error estimated.

 40 Zr  90    8 el      8 mu

     4.1200  .0500      Be70  el   X|  Serious outlier
     4.2740  .0220      Fa71  el   X|
     4.3230  .0400      Si71  el   X|  Preliminary; see: Se73c
     4.2500  .0700      Ph72  el   X|
     4.3200  .0780      Si73c el   X|  Errors: .058 (tot.) + .020 (model)
     4.2440  .0260      Dr74a el   X|  From Ja74
     4.2580  .0080      Ro76  el   X|  Re-analysed in Ma89
     4.2800  .0100      Ma89  el   X|  Re-anal of Ro76. Included in Ma89(em)

     4.2670  .0350      An63  mu   X|  Old (NaI)
     4.2500  .0060      Eh68  mu   X|  Error: 1.5x.004 for s/m
     4.2500  .0060      Eh68  mu   X|  MIA in En74(T.III.). M/S/Np: .001
     4.2724  .0019      Ph85  mu   X|  Included in Ma89(em)
     4.2700  .0037      He86  mu   X|  From Fr95 T.III.A. Error estimated.
     4.2704  .0030      Ma89  mu   X|  Included in Ma89(em)
     4.2690  .0020      Ma89  em   X|  Includes Ro76, Ph85, Ma89(mu)
     4.2692  .0014      Fr95  om    |  OEM combined analysis. V2 error added.

 40 Zr  91    1 el      3 mu

     4.3090  .0220      Fa71  el   X|
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    4.2850  .0038      He86  mu    |  From Fr95 T.III.A. Error estimated.
    4.2849  .0030      Ma89  mu   X|  Included in Ma89(em)
    4.2850  .0020      Ma89  em    |  Includes ??(el), Ma89(mu)

 40 Zr  92    3 el     4 mu

    4.3000  .0220      Fa71  el   X|
    4.2940  .0110      Ro76  el   X|  Re-analysed in Ma89(el).
    4.3120  .0110      Ma89  el   X|  Re-anal of Ro76. Included in Ma89(em)

    4.3050  .0037      He86  mu   X|  From Fr95 T.III.A. Error estimated.
    4.3052  .0030      Ma89  mu   X|  Included in Ma89(em)
    4.3050  .0020      Ma89  em   X|  Includes Ro76, Ma89(mu)
    4.3055  .0014      Fr95  om    |  OEM combined analysis. V2 error added.

 40 Zr  94    3 el     4 mu

    4.3320  .0220      Fa71  el   X|
    4.3150  .0100      Ro76  el   X|  Re-analysed in Ma89(el)
    4.3320  .0110      Ma89  el   X|  Re-anal of Ro76. Included in Ma89(em)

    4.3300  .0037      He86  mu   X|  From Fr95 T.III.A. Error estimated.
    4.3303  .0030      Ma89  mu   X|  Included in Ma89(em)
    4.3310  .0020      Ma89  em   X|  Includes Ro76, Ma89(mu)
    4.3314  .0015      Fr95  om    |  OEM combined analysis. V2 error added.

 40 Zr  96    1 el     4 mu

    4.3960  .0220      Fa71  el   X|

    4.3490  .0038      He86  mu   X|  From Fr95 T.III.A. Error estimated.
    4.3487  .0030      Ma89  mu   X|  Included in Ma89(em)
    4.3510  .0020      Ma89  em   X|  Includes ??(el), Ma89(mu)
    4.3508  .0016      Fr95  om    |  OEM combined analysis. V2 error added.

 41 Nb  93    2 el     3 mu

    4.3100  .1000      Sh67a el   X|
    4.3310  .0100      Ja76  el    |  From Vr87

    4.3175  .0028      Po72  mu   X|  From En74
    4.3247  .0040      Po72  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.3240  .0038      He86  mu    |  From Fr95 T.III.A. Error estimated.

 42 Mo  92    6 el     5 mu

    4.2800  .0700      Be70  el   X|
    4.4110  .0400      Si71  el   X|  Preliminary; see: Si73c
    4.2800  .0700      Ph72  el   X|
    4.3850  .0780      Si73c el   X|  Errors: .058 (tot.) + .020 (model)
    4.2940  .0160      Dr75  el   X|  Included in Ma89(em)
    4.3060  .0100      Ma89  el   X|  Included in Ma89(em)

    4.3170  .0060      Wu68  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.3170  .0039      Sc80  mu   X|  Included in Ma89(em). Error estimated.
    4.3171  .0030      Ma89  mu   X|  Included in Ma89(em)
    4.3150  .0020      Ma89  em   X|  Includes Dr75, Sc80, Ma89(mu)
    4.3146  .0015      Fr95  om    |  OEM combined analysis. V2 error added.

 42 Mo  94    2 el     4 mu

    4.3340  .0160      Dr75  el   X|  Included in Ma89(em)
    4.3460  .0100      Ma89  el   X|  Included in Ma89(em)
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4.3530	.0039	Sc80	mu	X|	Included in Ma89(em). Error estimated.
4.3524	.0030	Ma89	mu	X|	Included in Ma89(em)
4.3520	.0020	Ma89	em	X|	Includes Dr75, Sc80, Ma89(mu)
4.3518	.0014	Fr95	om	|	OEM combined analysis. V2 error added.

42 Mo 95 0 el 3 mu

4.3620	.0039	Sc80	mu	X|	Included in Ma89. Error estimated.
4.3622	.0030	Ma89	mu	X|	Includes Sc80
4.3617	.0013	Fr95	om	|	OEM combined analysis. V2 error added.

42 Mo 96 2 el 6 mu

4.3640	.0160	Dr75	el	X|	Included in Ma89(em)
4.3770	.0100	Ma89	el	X|	Included in Ma89(em)
4.3980	.0180	An63	mu	X|	Old (NaI)
4.3840	.0060	Ch65	mu	X|	MIA in En74(T.III.). M/S/Np: .001
4.3830	.0039	Sc80	mu	X|	Included in Ma89(em). Error estimated.
4.3834	.0030	Ma89	mu	X|	Included in Ma89(em)
4.3840	.0020	Ma89	em	X|	Includes Dr75, Sc80, Ma89(mu)
4.3840	.0011	Fr95	om	|	OEM combined analysis. V2 error added.

42 Mo 97 0 el 3 mu

4.3870	.0038	Sc80	mu	X|	Included in Ma89. Error estimated.
4.3866	.0030	Ma89	mu	X|	Includes Sc80
4.3880	.0011	Fr95	om	|	OEM combined analysis. V2 error added.

42 Mo 98 3 el 8 mu

4.3910	.0160	Dr75	el	X|	Included in Ma89(em)
4.4040	.0100	Ja76	el	X|	From Ja79 (priv. comm.)
4.4080	.0100	Ma89	el	X|	Included in Ma89(em)
4.4280	.0360	An63	mu	X|	Old (NaI)
4.4060	.0320	Qu64	mu	X|	Old (NaI)
4.4640	.0180	Ch65	mu	X|	From El67
4.4110	.0060	Ch65	mu	X|	MIA in En74(T.III.). M/S/Np: .001
4.4070	.0039	Sc80	mu	X|	Included in Ma89(em). Error estimated.
4.4075	.0030	Ma89	mu	X|	Included in Ma89(em)
4.4090	.0020	Ma89	em	X|	Includes Dr75, Sc80, Ma89(mu)
4.4089	.0014	Fr95	om	|	OEM combined analysis. V2 error added.

42 Mo 100 2 el 4 mu

4.4300	.0160	Dr75	el	X|	Included in Ma89(em)
4.4470	.0100	Ma89	el	X|	Included in Ma89(em)
4.4430	.0040	Sc80	mu	X|	Included in Ma89(em)
4.4437	.0030	Ma89	mu	X|	Included in Ma89(em)
4.4470	.0020	Ma89	em	X|	Includes Dr75, Sc80, Ma89(mu)
4.4465	.0018	Fr95	om	|	OEM combined analysis. V2 error added.

44 Ru 96 0 el 1 mu

4.3930	.0047	Ha89	mu	|	From Fr95 T.III.A. Error estimated.

44 Ru 98 0 el 1 mu

4.4230	.0055	Ha89	mu	|	From Fr95 T.III.A. Error estimated.

44 Ru 99 0 el 1 mu

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    4.4350  .0042      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

44 Ru 100    0 el      1 mu

    4.4530  .0043      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

44 Ru 101    0 el      1 mu

    4.4610  .0042      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

44 Ru 102    0 el      1 mu

    4.4810  .0042      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

44 Ru 104    0 el      1 mu

    4.5090  .0043      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

45 Rh 103    0 el      3 mu

    4.5020  .0440      Ba65  mu   X|
    4.4950  .0440      Ba65  mu   X|  MIA in En74(T.III.)
    4.4940  .0041      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

46 Pd 102    0 el      1 mu

    4.4840  .0044      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

46 Pd 104    1 el      1 mu

    4.4370  .0100      La86  el    |  From Vr87

    4.5090  .0046      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

46 Pd 105    0 el      2 mu

    4.5100  .1100      Vu78  mu   X|
    4.5160  .0046      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

46 Pd 106    1 el      3 mu

    4.4670  .0110      La86  el    |  From Vr87

    4.5010  .0330      Ba65  mu   X|
    4.5150  .0330      Ba65  mu   X|  MIA in En74(T.III.)
    4.5320  .0045      Ha89  mu    |

46 Pd 108    1 el      1 mu

    4.5240  .0100      La86  el    |  From Vr87

    4.5560  .0045      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

46 Pd 110    2 el      1 mu

    4.6390  .0190      Li76  el    |
    4.5410  .0100      La86  el    |  From Vr87

    4.5770  .0046      Ha89  mu    |  From Fr95 T.III.A. Error estimated.
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47 Ag 107    1 el      4 mu

    4.2200  .3600      Ly51  el   X|  From Fo55. Old

    4.5520  .0410      Ba65  mu   X|
    4.5370  .0050      Ca68a mu   X|
    4.5420  .0060      Ca68a mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.5440  .0042      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

47 Ag 109    0 el      3 mu

    4.5580  .0050      Ca68a mu   X|
    4.5630  .0060      Ca68a mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.5650  .0042      Ha89  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 106    0 el      1 mu

    4.5340  .0045      Fr87  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 108    0 el      1 mu

    4.5540  .0045      Fr87  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 110    1 el      1 mu

    4.5780  .0070      Gi75  el    |

    4.5740  .0045      Fr87  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 111    0 el      1 mu

    4.5790  .0044      Fr87  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 112    1 el      1 mu

    4.6080  .0070      Gi75  el    |

    4.5930  .0043      Fr87  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 113    0 el      1 mu

    4.5970  .0043      Fr87  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 114    3 el      5 mu

    4.6290  .0080      Gi75  el    |
    4.6320  .0170      Li76  el    |
    4.5910  .0150      Ja76  el    |  From Ja79 (priv. comm.)

    4.6200  .0370      Ba65  mu   X|
    4.6240  .0080      Ka71  mu   X|
    4.6130  .0090      Ka71  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.6130  .0720      Br76  mu   X|
    4.6100  .0043      Fr86  mu    |  From Fr95 T.III.A. Error estimated.

48 Cd 116    1 el      1 mu

    4.6390  .0080      Gi75  el    |

    4.6250  .0043      Fr86  mu    |  From Fr95 T.III.A. Error estimated.

49 In 113    0 el      1 mu
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    4.5980   .0053     Ja89  mu     |  From Fr95 T.III.A. Error estimated.

  49 In 115    3 el      6 mu

    4.5000  .1000      Ha56  el    X|  From Ho56. Re-analysed in El64
    4.4900  .1000      El64  el    X|  Re-analysis of Ha56
    4.6460  .0120      Ja76  el     |  From Vr87

    4.5830  .0340      Ba65  mu    X|
    4.6090  .0080      Co66  mu    X|  From El67
    4.6140  .1500      Le69  mu    X|
    4.6190  .0150      Ka71  mu    X|
    4.6170  .0160      Ka71  mu     |  MIA in En74(T.III.). M/S/Np: .001
    4.6140  .0044      Ja89  mu     |  From Fr95 T.III.A. Error estimated.

 50 Sn 110    0 el     1 mu

    4.5807  .0064      Fr97  om     |  OEM combined analysis.

 50 Sn 111    0 el     1 mu

    4.5859  .0061      Fr97  om     |  OEM combined analysis.

 50 Sn 112    3 el     2 mu

    4.6540  .0250      Kh68  el    X|  Included in Kh70
    4.6550  .0230      Kh70b el    X|  Contains Kh68. Outlier. See Cr,....
    4.5860  .0050      Fi72  el     |

    4.5930  .0045      Pi90  mu    X|  From Fr95 T.III.A. Error estimated.
    4.5974  .0052      Fr97  om     |  OEM combined analysis.

 50 Sn 113    0 el     1 mu

    4.6038  .0047      Fr97  om     |  OEM combined analysis.

 50 Sn 114    1 el     2 mu

    4.6020  .0050      Fi72  el     |

    4.6090  .0046      Pi90  mu    X|  From Fr95 T.III.A. Error estimated.
    4.6124  .0041      Fr97  om     |  OEM combined analysis.

 50 Sn 115    0 el     1 mu

    4.6167  .0038      Fr97  om     |  OEM combined analysis.

 50 Sn 116    6 el     4 mu

    4.5510  .0300      Ba67  el    X|
    4.6200  .0300      Cu69  el    X|  Included in Ca82a
    4.6190  .0050      Fi72  el    X|  Included in Ca82a
    4.6730  .0160      Li72c el    X|  Outlier. See Cr, Fe, ... isotopes
    4.6260  .0150      Li76  el    X|
    4.6270  .0050      Ca82a em    X|  Contains Cu69, Fi72. Error estimated
    4.6420  .0060      Ka71  mu    X|
    4.6280  .0070      Ka71  mu    X|  MIA in En74(T.III.). M/S/Np: .001
    4.6250  .0046      Pi90  mu    X|  From Fr95 T.III.A. Error estimated.
    4.6278  .0030      Fr97  om     |  OEM combined analysis.

 50 Sn 117    1 el     2 mu
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    4.6250  .0050      Fi72  el    |

    4.6300  .0045      Pi90  mu   X|  From Fr95 T.III.A. Error estimated.
    4.6326  .0026      Fr97  om    |  OEM combined analysis.


50 Sn 118    4 el      3 mu

    4.6400  .0300      Cu69  el   X|
    4.6790  .0140      Kh70b el   X|  Outlier. See also Cr, Fe, ...
    4.6760  .0170      Li72c el   X|  Outlier. See also Cr, Fe, ...
    4.6340  .0050      Fi72  el    |

    4.6390  .0070      Wu68  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.6410  .0046      Be93  mu   X|  From Fr95 T.III.A. Error estimated.
    4.6422  .0019      Fr97  om    |  OEM combined analysis.


50 Sn 119    1 el      2 mu

    4.6390  .0050      Fi72  el    |

    4.6430  .0045      Pi90  mu   X|  From Fr95 T.III.A. Error estimated.
    4.6463  .0016      Fr97  om    |  OEM combined analysis.


50 Sn 120    4 el      7 mu

    4.2100  .7600      Pi53  el   X|  Old
    4.6400  .0300      Ba67b el   X|
    4.6400  .0300      Cu69  el   X|
    4.6460  .0050      Fi72  el    |

    4.7320  .0380      An63  mu   X|  Old (NaI)
    4.6550  .0420      Ba65  mu   X|
    4.6490  .0070      Ac66  mu   X|
    4.6550  .0060      Eh68  mu   X|  Nat.: 4.647(.005). MIA in En74(T.III.)
    4.6550  .0060      Ma72  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.6550  .0045      Pi90  mu   X|  From Fr95 T.III.A. Error estimated.
    4.6548  .0010      Fr97  om    |  OEM combined analysis.


50 Sn 121    0 el      1 mu

    4.6589  .0013      Fr97  om    |  OEM combined analysis.


50 Sn 122    1 el      2 mu

    4.6580  .0050      Fi72  el    |

    4.6670  .0046      Pi90  mu   X|  From Fr95 T.III.A. Error estimated.
    4.6657  .0018      Fr97  om    |  OEM combined analysis.


50 Sn 123    0 el      1 mu

    4.6684  .0020      Fr97  om    |  OEM combined analysis.


50 Sn 124    6 el      5 mu

    4.6660  .0300      Ba67b el   X|
    4.6400  .0300      Cu69  el   X|  Included in Ca82a
    4.6700  .0050      Fi72  el   X|  Included in Ca82a
    4.6950  .0170      Li72c el   X|  Outlier. See also Cr, Fe, ...
    4.6770  .0050      Ca82a el   X|  Re-analysed in Ma92(el)
    4.6740  .0010      Ma92  el   X|  Re-anal of Ca82a. Included in Ma92(em)

    4.6980  .0060      Ka71  mu   X|
    4.6810  .0070      Ka71  mu   X|  MIA in En74(T.III.). M/S/Np: .001
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    4.6770  .0045      Pi90  mu   X|  From Fr95 T.III.A. Error estimated.
    4.6760  .0010      Ma92  em   X|  Includes Ca82a, Pi90
    4.6752  .0025      Fr97  om    |  OEM combined analysis.

50 Sn 125     0 el      1 mu

    4.6779  .0027      Fr97  om    |  OEM combined analysis.

51 Sb 121     1 el      5 mu

    4.6300  .0900      Ha56  el   X|  From Ho57. Old

    4.6900  .1000      Fi53  mu   X|  Old (NaI)
    4.6630  .0380      Ba65  mu   X|
    4.6830  .0053      Ac66  mu   X|
    4.6840  .0060      Ac66  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.6810  .0046      Kl88  mu    |  From Fr95 T.III.A. Error estimated.

51 Sb 123     0 el      1 mu

    4.6890  .0051      Kl88  mu    |  From Fr95 T.III.A. Error estimated.

52 Te 122     0 el      1 mu

    4.7100  .0053      Sh89  mu    |  From Fr95 T.III.A. Error estimated.

52 Te 123     0 el      1 mu

    4.7120  .0045      Sh89  mu    |  From Fr95 T.III.A. Error estimated.

52 Te 124     0 el      1 mu

    4.7190  .0046      Sh89  mu    |  From Fr95 T.III.A. Error estimated.

52 Te 125     0 el      1 mu

    4.7210  .0046      Sh89  mu    |  From Fr95 T.III.A. Error estimated.

52 Te 126     0 el      3 mu

    4.7740  .0060      Ka71  mu   X|
    4.7310  .0070      Ka71  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.7270  .0046      Sh89  mu    |  From Fr95 T.III.A. Error estimated.

52 Te 128     0 el      1 mu

    4.7350  .0046      Sh89  mu    |  From Fr95 T.III.A. Error estimated.

52 Te 130     0 el      4 mu

    4.7850  .0430      Ba65  mu   X|
    4.7420  .0060      Ac66  mu   X|
    4.7480  .0070      Ac66  mu   X|  Nat.: 4.738(.006). MIA in En74 T.III.
    4.7420  .0046      Sh89  mu    |  From Fr95 T.III.A. Error estimated.

53 I  127     0 el      5 mu

    4.7380  .0390      Ba65  mu   X|
    4.7480  .0060      Ac66  mu   X|
    4.7630  .0060      Ka71  mu   X|
    4.7520  .0070      Ka71  mu    |  MIA in En74(T.III.). M/S/Np: .001
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    4.7490  .0047      Kl88  mu    |  From Fr95 T.III.A. Error estimated.

54 Xe 124    0 el      1 mu

    4.7620  .0046      He84 mu     |  From Fr95 T.III.A. Error estimated.

54 Xe 126    0 el      1 mu

    4.7700  .0048      He84 mu     |  From Fr95 T.III.A. Error estimated.

54 Xe 128    0 el      1 mu

    4.7760  .0048      He84 mu     |  From Fr95 T.III.A. Error estimated.

54 Xe 129    0 el      1 mu

    4.7760  .0047      He84 mu     |  From Fr95 T.III.A. Error estimated.

54 Xe 130    0 el      1 mu

    4.7830  .0046      He84 mu     |  From Fr95 T.III.A. Error estimated.

54 Xe 131    0 el      1 mu

    4.7810  .0046      He84 mu     |  From Fr95 T.III.A. Error estimated.

54 Xe 132    0 el      1 mu

    4.7870  .0047      He84 mu     |  From Vr87. Error estimated

54 Xe 134    0 el      1 mu

    4.7920  .0047      He84 mu     |  From Fr95 T.III.A. Error estimated.

54 Xe 136    0 el      1 mu

    4.7990  .0047      He84 mu     |  From Fr95 T.III.A. Error estimated.

55 Cs 133    0 el      5 mu

    4.7920  .0320      Ba65  mu   X|
    4.8130  .0070      Ac66  mu   X|
    4.7860  .0700      Le69  mu   X|
    4.8070  .0070      Le69  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.8040  .0046      Kl88  mu    |  From Fr95 T.III.A. Error estimated.

56 Ba 134    0 el      3 mu

    4.8269  .0028      Sh82  mu   X|  Included in Fr95
    4.8315  .0024      Ku83  mu   X|  Included in Fr95
    4.8290  .0048      Fr95  mu    |  Includes Sh82, Ku83

56 Ba 135    0 el      1 mu

    4.8270  .0048      Sh82  mu    |  From Fr95 T.III.A. Error estimated.

56 Ba 136    0 el      4 mu

    4.8330  .0060      Th69  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.8275  .0028      Sh82  mu   X|  Included in Fr95
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    4.8320  .0021       Ku83  mu   X|  Included in Fr95
    4.8330  .0048       Fr95  mu    |  Includes Sh82, Ku83


 56 Ba 137    0 el      2 mu

    4.8330  .0060       Th69  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.8320  .0048       Sh82  mu    |  From Fr95 T.III.A. Error estimated.


 56 Ba 138    1 el      7 mu      Def.!

    4.8360  .0600       He70b el   X|  From Vr87. Error estimated

    4.8220  .0640       Ba65  mu   X|
    4.8510  .0100       Ac66  mu   X|
    4.8550  .0210       Ac66  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.8400  .0160       Ma72  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.8320  .0026       Sh82  mu   X|  Included in Fr95
    4.8354  .0020       Ku83  mu   X|  Included in Fr95
    4.8390  .0048       Fr95  mu    |  Includes Sh82, Ku83


 57 La 139    1 el      4 mu

    4.8500  .0600       Sh67b el   X|

    4.8590  .0320       Ba65  mu   X|
    4.8730  .0080       Ac66  mu   X|
    4.8550  .0050       Th69  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.8550  .0049       Re87  mu    |  From Fr95 T.III.A. Error estimated.


 58 Ce 140    0 el      6 mu

    4.8900  .0490       Ba65  mu   X|
    4.8900  .0100       Ac66  mu   X|
    4.8670  .0500       Co66  mu   X|  From El67
    4.8790  .0120       Je70  mu    |
    4.8770  .0030       Ma72  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.8770  .0049       Re87  mu    |  From Fr95 T.III.A. Error estimated.


 58 Ce 142    0 el      2 mu

    4.9060  .0030       Ma72  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.9070  .0050       Re87  mu    |  From Fr95 T.III.A. Error estimated.


 59 Pr 141    0 el      5 mu

    4.9100  .0680       Ba65  mu   X|
    4.8930  .0090       Ac66  mu   X|
    4.8880  .0300       Le69  mu   X|
    4.8930  .0040       Th69  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.8920  .0050       Re87  mu    |  From Fr95 T.III.A. Error estimated.


 60 Nd 142    4 el      4 mu

    4.9130  .0300       He71a el   X|
    4.7700  .1000       Ma71  el   X|  Re-analysed in Ca73
    4.8630  .0340       Ca73  el   X|  Re-analysis of Ma71
    4.9930  .0350       Ma74  el   X|  Outlier

    4.8960  .0100       Ac66  mu   X|
    4.9030  .0110       Ac66  mu   X|  Nat.: 4.940(.010). MIA in En74 T.III.
    4.9150  .0040       Th69  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    4.9140  .0051       Re87  mu    |  From Fr95 T.III.A. Error estimated.
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60 Nd 143     0 el      1 mu

    4.9240  .0053      Re87  mu    |  From Fr95 T.III.A. Error estimated.

60 Nd 144     1 el      2 mu

    4.9260  .0350      He71a el   X|

    4.9420  .0050      Ma70  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.9410  .0050      Re87  mu    |  From Fr95 T.III.A. Error estimated.

60 Nd 145     0 el      1 mu

    4.9530  .0054      Re87  mu    |  From Fr95 T.III.A. Error estimated.

60 Nd 146     3 el      2 mu

    4.9680  .0400      He71a el   X|
    4.6100  .0700      Ma71  el   X|  Outlier!
    4.9930  .0370      Ma74  el    |

    4.9690  .0050      Ma70  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.9680  .0050      Re87  mu    |  From Fr95 T.III.A. Error estimated.

60 Nd 148     1 el      2 mu

    5.0020  .0800      He71a el   X|

    4.9980  .0040      Ma70  mu    |  MIA in En74(T.III.). M/S/Np: .001
    4.9980  .0048      Re87  mu    |  From Fr95 T.III.A. Error estimated.

60 Nd 150     4 el      3 mu      Def.!

    5.0480  .0600      He71a el   X|
    4.7100  .1300      Ma71  el   X|  Outlier!
    5.0150  .0370      Ma74  el    |
    4.9480  .0400      Hi77  el   X|  From Vr87. Error estimated

    5.0480  .0270      Hi70  mu    |
    5.0390  .0040      Ma70  mu    |  MIA in En74(T.III.). M/S/Np: .001
    5.0470  .0051      Be92  mu    |  From Fr95 T.III.C. Error estimated.

62 Sm 144     1 el      3 mu      Def.!

    4.9470  .0090      Mo81  el   X|  El+mu analysis  with Po79(mu)

    4.9520  .0120      Po79  mu   X|  Included in Fr95
    4.9490  .0053      Fr95  mu   X|  Includes Po79, Ja89, Ma92a
    4.9373  .0015      Fr95  om    |  OEM combined analysis. V2 error added.

 62 Sm 147    0 el      4 mu      Def.!

    5.0000  .1500      Wi67  mu   X|
    4.9870  .0063      Ba81  mu   X|  Included in Fr95
    4.9830  .0053      Fr95  mu   X|  Includes Ba81, Ja89, Ma92a
    4.9824  .0014      Fr95  om    |  OEM combined analysis. V2 error added.

62 Sm 148     4 el      6 mu      Def.!

    4.9890  .0370      Ca73  el   X|
    4.9760  .0090      Ho79  el   X|  Re-analysed in Ma92(el)
    5.0020  .0060      Mo81  el   X|  El+mu analysis with Po79(mu)
    4.9760  .0080      Ma92  el   X|  Re-anal of Ho79. Included in Ma92(em)
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5.0100	.1500	Wi67	mu	X|	
5.0000	.0140	Po79	mu	X|	Included in Fr95
4.9940	.0053	Ma92	mu	X|	Included in Fr95
4.9990	.0020	Ma92	em	X|	Includes Ho79, Ja89
4.9940	.0053	Fr95	mu	X|	Includes Po79, Ja89, Ma92a
5.0002	.0013	Fr95	om	|	OEM combined analysis. V2 error added.
62 Sm 149	0 el	4 mu		Def.!	
5.0200	.1500	Wi67	mu	X|	
5.0090	.0065	Ba81	mu	X|	Included in Fr95
5.0080	.0053	Fr95	mu	X|	Includes Ba81, Ja89, Ma92a
5.0129	.0013	Fr95	om	|	OEM combined analysis. V2 error added.
62 Sm 150	2 el	5 mu		Def.!	
5.0230	.0460	Ca73	el	X|	
5.0450	.0060	Mo81	el	X|	El+mu analysis with Ya78(mu), Po79(mu)
5.0300	.1500	Wi67	mu	X|	
5.0470	.0048	Ya78	mu	X|	Included in Fr95
5.0340	.0160	Po79	mu	X|	El+mu analysis in Mo81(el)
5.0470	.0068	Fr95	mu	X|	Includes Ya78, Ma92a
5.0379	.0014	Fr95	om	|	OEM combined analysis. V2 error added.
62 Sm 152	6 el	8 mu		Def.!	
5.1630	.0460	Ca73	el	X|	
5.0922	.0060	Co76	el	X|	rms from others
5.0250	.0170	Na77	el	X|	El+mu analysis in Mo81
5.0980	.0090	Ho79	el	X|	Re-analysed in Ma92(el)
5.0930	.0060	Mo81	el	X|	El+mu anal. with Na77,Ya78(mu),Po79(mu)
5.0990	.0080	Ma92	el	X|	Re-anal of Ho79. Included in Ma92(em)
4.9500	.1500	Wi67	mu	X|	
5.0900	.0260	Hi70	mu	X|	
5.0938	.0022	Ya78	mu	X|	El+mu analysis in Mo81el
5.0830	.0140	Po79	mu	X|	Included in Ma92(em), also in Fr95
5.0920	.0020	Ma92	mu	X|	Includes Ya78, Po79, Ja89
5.0870	.0020	Ma92	em	X|	Includes Ho79, Ya87, Po79, Ja89
5.0920	.0056	Fr95	mu	X|	Includes Po79, Ja89, Ma92a
5.0870	.0013	Fr95	om	|	OEM combined analysis. V2 error added.
62 Sm 154	3 el	5 mu		Def.!	
5.1257	.0200	Co76	el	X|	rms from others
5.1270	.0090	Ho79	el	X|	Re-analysed in Ma92(el)
5.1260	.0080	Ma92	el	X|	Re-anal of Ho79. Included in Ma92(em)
4.9800	.1500	Wi67	mu	X|	
5.1130	.0110	Po79	mu	X|	Included in Ma92(em), also in Fr96
5.1130	.0020	Ma92	em	X|	Includes Ho79, Po79
5.1130	.0063	Fr95	mu	X|	Includes Po79, Ja89
5.1143	.0014	Fr95	om	|	OEM combined analysis. V2 error added.
63 Eu 151	0 el	3 mu		Def.!	
5.0300	.1500	Wi67	mu	X|	
4.9880	.1000	Ca68	mu	X|	
5.0440	.0053	Fr95	mu	|	Includes Ta84b, Ja89
63 Eu 153	0 el	3 mu		Def.!	
5.0800	.1500	Wi67	mu	X|	

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    5.0400  .1200      Ca68  mu   X|
    5.1180  .0055      Fr95  mu    |  Includes Ta84b, Ja89

64 Gd 154     1 el      3 mu      Def.!

    5.1240  .0200      He82  el   X|  From Vr87. Error estimated

    5.1224  .0060      La83  mu   X|  Included in Fr95
    5.1220  .0062      Fr95  mu   X|  Includes La83, Ja89, Ma92a
    5.1240  .0019      Fr95  om    |  OEM combined analysis. V2 error added.

64 Gd 155     0 el      3 mu      Def.!

    5.1265  .0055      La83  mu   X|  Included in Fr95
    5.1300  .0058      Fr95  mu   X|  Includes La83, Ja89, Be92, Ma92a
    5.1353  .0016      Fr95  om    |  OEM combined analysis. V2 error added.

64 Gd 156     1 el      3 mu      Def.!

    5.0680  .0200      Hi77  el   X|  From Vr87. Error estimated

    5.1413  .0050      La83  mu   X|  Included in Fr95
    5.1420  .0058      Fr95  mu   X|  Includes La83, Ja89, Ma92a
    5.1460  .0014      Fr95  om    |  OEM combined analysis. V2 error added.

64 Gd 157     0 el      3 mu      Def.!

    5.1431  .0055      La83  mu   X|  Included in Fr95
    5.1460  .0058      Fr95  mu   X|  Includes La83, Ja89, Be92, Ma92a
    5.1492  .0014      Fr95  om    |  OEM combined analysis. V2 error added.

64 Gd 158     2 el      5 mu      Def.!

    5.1720  .0065      M|83  el   X|  Re-analysed in Ma92(el)
    5.1720  .0060      Ma92  el   X|  Re-anal of Mu87. Included in Ma92(em)

    5.1583  .0043      La83  mu   X|  Included in Fr95
    5.1590  .0040      Ma92  mu   X|  From T.III.C Fr95. Included in Ma9(em)
    5.1620  .0020      Ma92  em   X|  Includes Mu83, Ja89
    5.1590  .0058      Fr95  mu   X|  Includes La83, Ja89, Ma92a
    5.1618  .0018      Fr95  om    |  OEM combined analysis. V2 error added.

64 Gd 160     0 el      3 mu      Def.!

    5.1723  .0042      La83  mu   X|  Included in Fr95
    5.1740  .0058      Fr95  mu   X|  Includes La83, Ja89, Ma92a
    5.1782  .0021      Fr95  om    |  OEM combined analysis. V2 error added.


65 Tb 159     0 el      1 mu      Def.!

    5.0600  .1500      Wi67  mu    |


66 Dy 161     0 el      1 mu      Def.!

    5.1960  .0061      Be92  mu    |  From Fr95 T.III.C. Error estimated.

66 Dy 162     0 el      2 mu      Def.!

    5.2110  .0260      Hi70  mu    |
    5.2090  .0060      Be92  mu    |  From Fr95 T.III.C. Error estimated.

66 Dy 163     0 el      1 mu      Def.!
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    5.2110  .0059      Be92  mu    |  From Fr95 T.III.C. Error estimated.

66 Dy 164    0 el      2 mu       Def.!

    5.2180  .0290      Hi70  mu    |
    5.2240  .0059      Be92  mu    |  From Fr95 T.III.C. Error estimated.

67 Ho 165    2 el      2 mu       Def.!

    5.2000  .1000      Sa67  el   X|  From Ja74. No error given; estimated
    5.1900  .0500      Uh71  el    |

    5.1100  .1500      Wi67  mu   X|
    5.2100  .0400      Po76  mu    |

68 Er 166    4 el      2 mu       Def.!

    5.2380  .0200      Co76  el   X|  From Vr87. Err. est. Re-anal. in Ca78
    5.3030  .0200      Cr77  el   X|  From Vr87. Err. est. Re-anal. in Ca78
    5.2370  .0160      Ca78  el   X|  Re-analysed in Ma92(el)
    5.2270  .0200      Ma92  el   X|  Re-anal of Ca78. Included in Ma92(em)

    5.2500  .0061      Ma92  mu   X|  From T.III.C Fr95. Included in Ma92(em)
    5.2390  .0060      Ma92  em    |  Includes Ca78, Ma92(mu)

68 Er 167    0 el      1 mu       Def.!

    5.2580  .0060      Ma92a mu    |  From Fr95 T.III.C. Error estimated.

68 Er 168    0 el      2 mu       Def.!

    5.2600  .0250      Hi70  mu    |
    5.2720  .0063      Ma92a mu    |  From Fr95 T.III.C. Error estimated.

68 Er 170    0 el      2 mu       Def.!

    5.2640  .0250      Hi70  mu    |
    5.2860  .0063      Ma92a mu    |  From Fr95 T.III.C. Error estimated.

69 Tm 169    0 el      1 mu       Def.!

    5.2256  .0035      De73  mu    |  M/S/Np: .002

70 Yb 170    0 el      1 mu       Def.!

    5.2860  .0063      Ze73  mu    |  From Fr95 T.III.C. Error estimated.

70 Yb 171    0 el      2 mu       Def.!

    5.1400  .0300      Ad73  mu    |  From En74. Err. est. 2x0.015 for mod.
    5.2930  .0063      Ze73  mu    |  From Fr95 T.III.C. Error estimated.

70 Yb 172    0 el      2 mu       Def.!

    5.1550  .0440      Ad73  mu    |  From En74. Err. est. 2x0.022 for mod.
    5.3010  .0063      Ze73  mu    |  From Fr95 T.III.C. Error estimated.

70 Yb 173    0 el      2 mu       Def!

    5.1480  .0740      Ad73  mu   X|  From En74. Err. est. 2x0.037 for mod.
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    5.3060  .0063      Ze73  mu    |  From Fr95 T.III.C. Error estimated.

70 Yb 174    1 el      3 mu      Def!

    5.4100  .0300      Sa79  el    |  From Vr87

    5.1570  .0300      Ad73  mu    |  From En74. Err. est. 2x0.015 for mod.
    5.3100  .0100      Ze73  mu   X|  Included in Fr95
    5.3170  .0063      Be92  mu    |  From Fr95 T.III.C. Error estimated.

70 Yb 176    2 el      2 mu      Def!

    5.3150  .0200      Co76  el   X|  From Vr87. Err. est. Anal. in Cr77
    5.4430  .0200      Cr77  el    |  From Vr87. Includes Co76

    5.1830  .0600      Ad73  mu   X|  From En74. Err. est. 2x0.030 for mod.
    5.3210  .0063      Ze73  mu    |  From Fr95 T.III.C. Error estimated.

71 Lu 175    1 el      1 mu      Def.!

    5.3700  .0300      Sa79  el    |  From Vr87

    5.2500  .1100      Su68  mu   X|  From En74

72 Hf 176    0 el      1 mu      Def!

    5.3310  .0065      Ta84a mu    |  From Fr95 T.III.C. Error estimated.

72 Hf 177    0 el      2 mu      Def.!

    5.2200  .1500      Wi67  mu   X|
    5.3340  .0065      Ta84a mu    |  From Fr95 T.III.C. Error estimated.

72 Hf 178    0 el      2 mu      Def.!

    5.2200  .1500      Wi67  mu   X|
    5.3380  .0065      Ta84a mu    |  From Fr95 T.III.C. Error estimated.

72 Hf 179    0 el      2 mu      Def.!

    5.2300  .1500      Wi67  mu   X|
    5.3390  .0065      Ta84a mu    |  From Fr95 T.III.C. Error estimated.

72 Hf 180    0 el      2 mu      Def.!

    5.2400  .1500      Wi67  mu   X|
    5.3490  .0063      Ta84a mu    |  From Fr95 T.III.C. Error estimated.

73 Ta 181    2 el      3 mu      Def.!

    5.5000  .2000      Ha55  el   X|  From Ho57. Old
    5.4800  .2000      Do57  el   X|  Anal. of Ha55. Old

    5.2600  .1500      Wi67  mu   X|
    5.3280  .0340      ML76  mu    |
    5.3540  .0064      Be92  mu    |  From Fr95 T.III.C. Includes Po77.

74 W  182    1 el      4 mu      Def.!

    5.3610  .0040      Ma92  el   X|  Re-anal of Pe86

    5.3200  .1500      Wi67  mu   X|
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    5.3570  .0220      Hi70  mu   X|
    5.3640  .0065      Ma92  mu   X|  From T.III.C Fr95. Incl. in Ma92(em)
    5.3550  .0020      Ma92  em    |  Includes Pe86, Ma92(mu)

74 W  183    0 el      1 mu      Def.!

    5.3300  .1500      Wi67  mu    |

74 W  184    4 el      6 mu      Def!

    4.4100  .8800      Pi53  el   X|  Old
    5.2000  .4400      Pi55  el   X|  Old
    5.4200  .0700      Ka73  el   X|
    5.3670  .0040      Ma92  el   X|  Re-anal of Pe86

    5.4180  .0440      Fr62  mu   X|  Old (NaI)
    5.3300  .2000      Ac65  mu   X|
    5.3400  .1500      Wi67  mu   X|
    5.3690  .0230      Hi70  mu   X|
    5.3730  .0065      Ma92  mu   X|  From Fr95 T.III.C. Incl. in Ma92(em)
    5.3640  .0020      Ma92  em    |  Includes Pe86, Ma92(mu)

74 W  186    1 el      3 mu      Def!

    5.4000  .0400      Ka73  el    |

    5.3400  .1500      Wi67  mu   X|
    5.3730  .0220      Hi70  mu    |
    5.3810  .0065      Ma92a mu    |  From Fr95 T.III.C. Error estimated.

76 Os 186    0 el      1 mu      Def.!

    5.3870  .0072      Ho81  mu    |  From Fr95 T.III.C. Error estimated.

76 Os 188    1 el      2 mu      Def.!

    5.4001  .0013      Bo88  el    |  El+mu analysis with Ho81(mu)

    5.3500  .1500      Wi67  mu   X|
    5.3950  .0072      Ho81  mu   X|  El+mu anal. in Bo88(el). Err. est.

76 Os 189    0 el      1 mu      Def.!

    5.3600  .1500      Wi67  mu    |

76 Os 190    1 el      2 mu      Def.!

    5.4062  .0014      Bo88  el    |  El+mu analysis with Ho81(mu)

    5.3700  .1500      Wi67  mu   X|
    5.4010  .0070      Ho81  mu   X|  El+mu analysis in Bo88(el). Err. est.

76 Os 192    3 el      3 mu      Def.!

    5.4130  .0040      Re84a el   X|  Re-analysed in Ma92
    5.4100  .0010      Bo88  el   X|  El+mu analysis with Ho81(mu)
    5.4120  .0040      Ma92  el   X|  Re-anal of Re84a. Included in Ma92(em)

    5.3800  .1500      Wi67  mu   X|
    5.4060  .0070      Ho81  mu   X|  Included in Ma92(em). Err. est.
    5.4100  .0020      Ma92  em    |  Includes Re84a, Ho81
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77 Ir 191    0 el      1 mu      Def.!

    5.3900  .1500      Wi67  mu    |

77 Ir 193    0 el      1 mu      Def.!

    5.4100  .1500      Wi67  mu    |

78 Pt 194    1 el      1 mu

    5.3690  .0090      Bo88  el    |

    5.4250  .0069      Be90  mu    |  From Fr95 T.III.A. Error estimated.

78 Pt 195    0 el      1 mu

    5.4270  .0069      Be90  mu    |  From Fr95 T.III.A. Error estimated.

78 Pt 196    2 el      1 mu

    5.3800  .0200      Bo83  el    |  From Vr87
    5.3700  .0030      Bo88  el    |

    5.4320  .0068      Be90  mu    |  From Fr95 T.III.A. Error estimated.

78 Pt 198    0 el      1 mu

    5.4410  .0063      Be90  mu    |  From Fr95 T.III.A. Error estimated.

79 Au 197    3 el      5 mu

    5.1800  .4500      Ly51  el   X|  Old
    5.3300  .0500      Ho57  el   X|  Old
    5.2700  .0900      Be60  el   X|  Old

    5.4150  .0070      Ac66  mu   X|
    5.4340  .0020      Ro73  mu   X|  From En74
    5.4370  .0030      Ro73  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    5.4390  .0070      Po74  mu    |
    5.4370  .0063      Be90  mu    |  From Fr95 T.III.A. Error estimated.

80 Hg 198    2 el      1 mu

    5.4390  .0040      La86a el   X|  From T.VIII. of Fr95. Error estimated
    5.4369  .0040      La86a el   X|  F-B anal: T.IX. in Fr95. Error est.

    5.4480  .0065      Bu89  em    |  From Fr95 T.III.A. Error estimated.

80 Hg 199    0 el      1 mu

    5.4490  .0069      Gu83  mu    |  From Fr95 T.III.A. Error estimated.

80 Hg 200    0 el      1 mu

    5.4570  .0065      Bu89  mu    |  From Fr95 T.III.A. Error estimated.

80 Hg 202    0 el      3 mu

    5.4910  .0140      Ac66  mu   X|
    5.4830  .0150      Ac66  mu   X|  MIA in En74(T.III.). M/S/Np: .001
    5.4670  .0066      Bu89  mu    |  From Fr95 T.III.A. Error estimated.
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80 Hg 204     2 el       2 mu

    5.4717  .0028       Bu89  em    X|  Re-analysed in Ma92(el)
    5.4720  .0020       Ma92  el    X|  Re-anal of Bu89. Included in Ma92(em)

    5.4780  .0072       Bu89  mu    X|  From Fr95 T.III.A. Error estimated.
    5.4720  .0020       Ma92  em     |  Includes Bu89, Ha79??

81 Tl 203     2 el       2 mu

    5.4572  .0274       Eu78  el    X|  Errors: .0074(stat.) + .0200(syst.)
    5.4634  .0056       Eu78  el     |  Er.0046(st)+.001(sy).El+mu with Ba72

    5.4720  .0076       Ba72  mu    X|  From Fr95 T.III.A. Error estimated.
    5.4720  .0060       Ke75  mu     |

81 Tl 205     3 el       4 mu

    5.4566  .0274       Eu78  el    X|  Errors: .0074(stat.) + .0200(syst.)
    5.4699  .0056       Eu78  mu     |  Er.0046(st)+.001(sy).El+mu with Ba72
    5.4790  .0100       Fr83  el     |  From Vr87. Error estimated.

    5.4330  .0460       Fr62  mu    X|  Old (NaI)
    5.4830  .0070       Ac66  mu    X|
    5.4830  .0076       Ba72  mu    X|  From Fr95 T.III.A. Error estimated.
    5.4800  .0060       Ke75  mu     |

82 Pb 196     0 el       1 mu

    5.4420  .0105       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 197     0 el       1 mu

    5.4420  .0105       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 198     0 el       1 mu

    5.4500  .0085       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 199     0 el       1 mu

    5.4500  .0085       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 200     0 el       1 mu

    5.4590  .0075       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 201     0 el       1 mu

    5.4610  .0075       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 202     0 el       1 mu

    5.4690  .0055       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 203     0 el       1 mu

    5.4710  .0055       Fr95  om     |  OEM combined analysis. V2 error added.

82 Pb 204     3 el       5 mu
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5.4733	.0273	Eu78	el	X|	Re-analysed in Ma92a
5.4795	.0025	Eu78	el	X|	Re-analysed in Ma92a
5.4600	.0240	Ma92a	el	X|	Re-anal of Eu78. Included in Ma92(em)
5.4860	.0030	Fo73	mu	X|	Re-anal of Ke75
5.4857	.0024	Ke75	mu	X|	Included In Ma92(em)
5.4820	.0068	Be88	mu	X|	From Fr95 T.III.A. Error estimated.
5.4790	.0020	Ma92	em	X|	Includes Eu78, Ke75
5.4793	.0013	Fr95	om	|	OEM combined analysis. V2 error added.

82 Pb 205 0 el 1 mu

5.4820	.0035	Fr95	om	|	OEM combined analysis. V2 error added.

82 Pb 206 5 el 8 mu

5.5090	.0290	Ja73	el	X|	From Ja74
5.4878	.0274	Eu78	el	X|	Re-analysed in Ma92a(el)
5.4905	.0028	Eu78	el	X|	Re-analysed in Ma92a(el)
5.4900	.0100	Fr83	el	X|	From Vr87. Error estimated
5.4740	.0240	Ma92a	el	X|	Re-anal of Eu78. Included in Ma92(em)
5.4890	.0070	Ac66	mu	X|	
5.4760	.0140	An66	mu	X|	
5.4839	.0028	An69	mu	X|	
5.4970	.0030	Fo73	mu	X|	Re-an of An69,Ke(75)
5.4970	.0030	Ke75	mu	X|	Included in Ma92(em)
5.4930	.0067	Be88	mu	X|	From Fr95 T.III.A. Error estimated.
5.4900	.0020	Ma92	em	X|	Includes Eu78, Ke75
5.4896	.0012	Fr95	om	|	OEM combined analysis. V2 error added.

82 Pb 207 6 el 6 mu

5.4600	.0600	Ni69	el	X|	Re-analysed in Ja74
5.5000	.0600	Ni69	el	X|	From Ja74
5.5130	.0320	Ja73	el	X|	From Ja74
5.4956	.0274	Eu78	el	X|	Re-analysed in Ma92a(el)
5.4968	.0026	Eu78	el	X|	Re-analysed in Ma92a(el)
5.4840	.0240	Ma92a	el	X|	Re-anal of Eu78. Included in Ma92(em)
5.4910	.0050	An69	mu	X|	
5.5030	.0030	Fo73	mu	X|	Re-an of An69,Ke(75)
5.5036	.0008	Ke75	mu	X|	Included in Ma92(em)
5.4970	.0068	Be88	mu	X|	From Fr95 T.III.A. Error estimated.
5.4950	.0020	Ma92	em	X|	Includes Eu78, Ke75
5.4938	.0013	Fr95	om	|	OEM combined analysis. V2 error added.

82 Pb 208 16 el 13 mu

5.4200	.2000	Ho57	el	X|	Old
5.4100	.1000	Fi64	el	X|	From Ho67. See also Mi57, Pe65
5.4800	.0700	Ni66	el	X|	From Ho67
5.3850	.0300	Be67	el	X|	Serious outlier
5.5400	.0100	He69	el	X|	Re-analysed in Dr74, Fr77b
5.4600	.0600	Ni69	el	X|	Re-analysed in Ja74, Fr74b
5.5000	.0600	Ni69	el	X|	From Ja74. Re-analysed in Fr77b
5.4900	.0900	Fr72b	el	X|	
5.5210	.0290	Ja73	el	X|	From Ja74
5.4980	.0100	Dr74	el	X|	Re-analysis of He69
5.4940	.0240	Eu76	el	X|	Reanalysed in Fr77b
5.5030	.0200	Fr77a	el	X|	From Vr87. Err. est. Re-an. in Fr77b
5.4987	.0034	Fr77b	el	|	Re-an of He69,Ni69,Fr72b. M/S/Np: .002
5.4927	.0274	Eu78	el	X|	Re-analysed in Ma92a(el)

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    5.5032  .0026      Eu78  el   X|  Re-analysed in Ma92a(el)
    5.4790  .0240      Ma92a el   X|  Re-anal of Eu78. Included in Ma92(em)

    5.3600  .1000      Fi53  mu   X|  Old (NaI)
    5.5050  .0460      Fr62  mu   X|  Old (NaI)
    5.4820  .0320      Ba65  mu   X|
    5.4970  .0070      Ac66  mu   X|
    5.4820  .0140      An66  mu   X|
    5.4980  .0050      An69  mu   X|
    5.5060  .0120      Je71  mu   X|
    5.5100  .0030      Fo73  mu   X|  Re-an of An69,Ke(75)
    5.5097  .0012      Ke75  mu   X|  Included in Ma92(em)
    5.5090  .0070      Cl76  mu   X|
    5.5031  .0068      Be88  mu   X|  Error est.    Included in Ma92(em)
    5.5020  .0020      Ma92  em   X|  Includes Eu78, Ke75, Be88
    5.5013  .0013      Fr95  om    |  OEM combined analysis. V2 error added.


82 Pb 209    0 el      1 mu

    5.5110  .0025      Fr95  om    |  OEM combined analysis. V2 error added.


82 Pb 210    0 el      1 mu

    5.5230  .0035      Fr95  om    |  OEM combined analysis. V2 error added.


82 Pb 211    0 el      1 mu

    5.5330  .0055      Fr95  om    |  OEM combined analysis. V2 error added.


82 Pb 212    0 el      1 mu

    5.5450  .0075      Fr95  om    |  OEM combined analysis. V2 error added.


82 Pb 214    0 el      1 mu

    5.5650  .0105      Fr95  om    |  OEM combined analysis. V2 error added.


83 Bi 209   11 el      6 mu

    5.5200  .1200      Ha57  el   X|  From Ho57. Old
    5.2900  .1100      Be60  el   X|  Old
    5.3200  .1200      Cr61  el   X|  See also El64
    5.5400  .1000      Go63  el   X|  From Ho67
    5.1700  .0500      Br66  el   X|  From Ho67. Serious outlier
    5.5100  .0600      Ni66  el   X|  From Ho67
    5.4800  .0500      Ni69  el   X|  Re-analysed in Ja74
    5.5100  .0500      Ni69  el   X|  From Ja74
    5.5270  .0200      Si73b el    |
    5.5165  .0275      Eu78  el   X|  Errors: .0075(stat.) + .0200(syst.)
    5.5186  .0047      Eu78  el    |  Er.0037(st)+.001(sy). El+mu analysis

    5.5620  .0460      Fr62  mu   X|  Old (NaI)
    5.5160  .0410      Ba65  mu   X|
    5.5130  .0070      Ac66  mu   X|
    5.5140  .0670      Ba67a mu   X|
    5.5330  .0060      Ze70  mu    |  MIA in En74(T.III.). M/S/Np: .001
    5.5330  .0095      Ru84b mu    |  From Fr95 T.III.A. Error estimated.


 90 Th 232    2 el      4 mu      Def.!
```

```
    5.7723  .0200      Co76  el   X|  rms from others
    5.6450  .0200      Hi77  el    |  From Vr87. Error estimated

    5.7000  .0600      Wi67  mu   X|
    5.7900  .0100      MK69  mu   X|
    5.7290  .0220      Co69  mu   X|
    5.7625  .0080      Cl78  mu    |


92 U  233     0 el     2 mu     Def.!

    5.7200  .1500      Wi67  mu   X|
    5.8160  .0080      Zu84  mu    |


92 U  234     0 el     1 mu     Def.!

    5.8289  .0050      Zu84  mu    |


92 U  235     0 el     3 mu     Def.!

    5.7300  .0600      Wi67  mu   X|
    5.7940  .0100      Cl78  mu    |
    5.8343  .0050      Zu84  mu    |


92 U  238     2 el     7 mu     Def.!

    5.8400  .0200      Co76  el   X|  rms from others
    5.8540  .0200      Cr77  el    |  From Vr87. Error estimated

    5.8080  .0480      Fr62  mu   X|  Old (NaI)
    5.8700  .2000      Ac65  mu   X|
    5.7500  .0600      Wi67  mu   X|
    5.7860  .0340      Co69  mu   X|
    5.8500  .0100      MK69  mu   X|
    5.8160  .0100      Cl78  mu    |
    5.8604  .0040      Zu84  mu    |


94 Pu 239     0 el     2 mu     Def.!

    5.7500  .1000      Wi67  mu   X|
    5.8300  .0200      Cl78  mu    |


95 Am 241     0 el     1 mu     Def.!

    5.8929  .0035      Jo85  mu    |  M/S/Np: .002


95 Am 243     0 el     1 mu     Def.!

    5.9047  .0035      Jo85  mu    |  M/S/Np.: .002
```

Control data:

```
 0   1  95 243    0.000  0.000  0.000
```

Appendix III.

```
      program rmsEVA
C     1-May-1999
C     Evaluation of RMS charge radii using the modified              72|
C     CHAuvenet criterion and the internal and external                |
C     CONsistecy check for systematic errors                           |
      integer*2 el,sp,lt,Ol,syst,du(4),ra(50),ry(50),rf(50),md(50),
     1cm(50),da1(8),da2(8),sqsum(3)
      integer mc,z1,aa1,z2,aa2,zz,aa,za,zb,ne,nm,df,ne1,nm1,A0,
     1n1,n2,i,m,n,nucha,k,kk1,kk2,ech,us,SOl,ng1,num,num0,num1,isq,
     2degfr
      real dummy,as,ax,dax,p1,p2,conf,conf2,gn1,fna,fna0,fnb,fnc,fnd,
     1elr,delr,mur,dmur,elmu,delmu,emr,demr,relmu,drelmu,avr,rel,drel,
     2avp1,y(50),dy(50),x(50),dx(50),r0,r00,r01,r02,sa,sqs0(3),sqs1(3),
     3rms(3),drms(3),sump1,rpar0,drpar0,rp1,drp1,sq(3),sqs(3),
     4lin(3),lins(3),lins0(3),lins1(3),khi1,khi2,
     5cn89,dcorr0,dcorr1,ddcorr
      common/ci/mc,n,n1,n2,nucha,k,kk1,kk2,ra,ry,rf,md,cm,ech,syst
      common/cr/x,dx,ax,dax,p1,p2,conf,conf2
      common/cc/cn89
C     open (unit=1,name='rmsdata.doc',type='old',readonly)
C     open (unit=2,name='table.doc', type='new')
C     open (unit=3,name='averad.doc',type='new')
C     open (unit=4,name='control.doc',type='old', readonly )
      data SOl/0/
C     data mc,nucha,ech,SOl/5,5,1,0/
C     SOl=0/1:Ser. outliers ex/included
      data sp,us,lt,Ol/2H  ,2H__,2H 2,2HSO/
C     data cn89/1.0/
C     cn89=1.0: no spread of int. cons. taken into account
      REWIND 1
      REWIND 2
      REWIND 3
      REWIND 4
      read (4, 4000)  z1, aa1,  z2, aa2,   dcorr0, dcorr1, ddcorr
 4000 format (4i4, 2x, 3f7.3)
      write (2, 2009)
 2009 format (3x, 'Output file  TABLE.doc  from program  rmsEVA.ftn'/ )
    1 read (1,101) (dummy, i=1,15)
      read (1,112) du,da2
  112 format (22x,4a2//37x,8a2//)
      write (2, 113) da2
  113 format ( / 1x, 'Weighted averages of  RMS charge radii' /
     110x, 'Data updated:', 8a2 / / )
      write (2, 6000) z1, aa1, z2, aa2,
     1dcorr0, dcorr1,   ddcorr
 6000 format ( 1x, 'Z1=', i2, 3x, 'AA1=', i3, 6x,
     1'Z2=', i3, 3x, 'AA2=', i4 / / 1x, 'dcorr0=', f5.1,
     23x, 'dcorr1=', f7.3, 4x, 'ddcorr=', f4.1 / )
      write (2, 126) (us, j=1,15)
      write (2, 120)
  120 format ( 6x, '|', 11x, '|', 16x, '|' )
      write (2, 59)
   59 format ( 6x, '|  Z El   A |      R      dR |' )
      write (2, 126)  (us, j=1,15 )
  126 format ( 6x, 15a2 )
      write (2, 120)
  604 continue
      sump1=0.0
      ng1=0
C     Finding the designated data group                                |
    2 za=-1
      read (1,111) zz,el,aa,ne,nm,df
  111 format (i3,1x,a2,i4,1x,i4,6x,i4,9x,a2)
      if (zz-z1) 5,156,21
```

```
   21 continue
      write (3,104)
  104 format (//20x,14Hzz=z1 missing?//)
  156 if (aa-aa1) 5,6,151
  151 continue
      write (3,154)
  154 format (/20x,15Haa=aa1 missing?/)
      go to 6
    5 za=zz
      if (ne) 7,7,9
    9 read (1,101) (dummy, i=1,ne+1)
    7 if (nm) 19,19,20
   20 read (1,101) (dummy, i=1,nm+1)
   19 read (1,101) (dummy, i=1,2)
  101 format (A1)
      go to 2
    6 if (zz-z2) 33,153,35
  153 if (aa-aa2) 33,33,35
   33 zb=zz
      aaf=float(aa)
C     Selection and input of data to be processed                      |
      m=0
      if (ne) 3,3,4
    4 read (1,101) dummy
      do 37 i=1,ne
      m=m+1
      read (1,106) y(m),dy(m),ra(m),ry(m),rf(m),md(m),cm(m)
  106 format (4x,2f7.4,6x,4a2,2x,a2)
      if (abs(y(m)).gt.0.0001) go to 12
   11 continue
      write (3,103) zz,el,aa,m
  103 format (/i3,1x,a2,i4,13Hadathiba?  m=,i3/)
      stop 1
   12 if ((cm(m).eq.sp).or.(cm(m).eq.lt)) go to 37
      if ((cm(m).eq.Ol).and.(SOl.eq.1)) go to 37
      m=m-1
   37 continue
    3 ne1=m
      if (nm) 38,38,36
   36 read (1,101) dummy
      do 39 i=1,nm
      m=m+1
      read (1,106) y(m),dy(m),ra(m),ry(m),rf(m),md(m),cm(m)
      if (abs(y(m)).gt.0.0001) go to 14
   15 continue
      write (3,103) zz,el,aa,m
      stop 1
   14 if ((cm(m).eq.sp).or.(cm(m).eq.lt)) go to 39
      if ((cm(m).eq.Ol).and.(SOl.eq.1)) go to 39
      m=m-1
   39 continue
   38 nm1=m-ne1
      if (ne1+nm1) 308, 308, 6011
 6011 continue
C     Transfer of selected data from arrays  y,dy  to arrays  x,dx  and|
C     treatment of data groups                                         |
  168 kk1=0
      kk2=0
      p1=0.0
      p2=0.0
      conf2=1.0
C     Data from electron scattering
  304 if (ne1) 44,44,45
   45 n1=1
      n2=ne1
      n=ne1
C     Dispersion correction to  r(el)
      if (aa-1) 6048,6048,6045
 6045 do 6047 i=1,ne1
```

```
      y(i)=y(i)+(dcorr0+dcorr1*aaf)/1000.0
      dy(i)=sqrt(dy(i)**2+(ddcorr/1000.0)**2)
 6047 continue
 6048 continue
      do 47 i=n1,n2
      x(i)=y(i)
  301 dx(i)=dy(i)
   47 continue
      call CHACON
      elr=ax
      delr=dax
      if (nm1.ne.0) go to 44
  171 rms(2)=elr
      drms(2)=delr
      if (ne1-1) 44,44,179
  179 sump1=sump1+p1
      ng1=ng1+1
C     Data from muonic X-rays
   44 if (nm1) 48,48,49
   49 n1=ne1+1
      n2=ne1+nm1
      n=nm1
      do 50 i=n1,n2
      x(i)=y(i)
  351 dx(i)=dy(i)
   50 continue
      call CHACON
      mur=ax
      dmur=dax
      if (ne1.ne.0) go to 48
  174 rms(2)=mur
      drms(2)=dmur
      if (nm1-1) 48,48,182
  182 sump1=sump1+p1
      ng1=ng1+1
C     El + mu  data processed together
   48 if (ne1*nm1) 164,164,54
   54 n1=1
      n2=ne1+nm1
      n=ne1+nm1
      do 53 i=n1,n2
      x(i)=y(i)
  361 dx(i)=dy(i)
   53 continue
      call CHACON
      emr=ax
      demr=dax
   94 rms(2)=emr
      drms(2)=demr
      ng1=ng1+1
  164 continue
      kk1=0
      kk2=0
      p1=0.0
      p2=0.0
      conf2=1.0
      write (3,*) zz,aa,rms(2),drms(2)
   10 if (za-zb) 46, 51, 46
   46 write (2, 129) zz, el, aa, rms(2), drms(2)
  129 format (6x, '|', i3, 1x, a2, i4, 1x, '|', 1x,
     1f7.4, 2x, f5.4, 1x, '|' )
      go to 308
   51 write (2, 139) aa, rms(2), drms(2)
  139 format (6x, '|', 6x, i4, 1x, '|', 1x,
     1f7.4, 2x, f5.4, 1x, '|' )
  308 continue
 1015 continue
 1025 continue
    8 read (1,111) zz,el,aa,ne,nm,df
```

```
      if (aa) 8,8,127
  127 za=zb
      zb=zz
      go to 6
   35 continue
      write (2, 126) (us, j=1,15)
      gn1=float (ng1)
C     End of main program rmsEVA                                         |
      stop
      end

      subroutine CHACON
      integer*2 el,syst,ra(50),ry(50),rf(50),md(50),cm(50)
      integer mc,i,k,kk1,kk2,m,n,n1,n2,ml,ja,nucha,ech,k1,k2,l(50)
      real kap,fn,ax,kax,bax,dax,maxd,b,sy,p1,p2,
     1av,int,ext,conf,conf2,aux,del2,lim,
     2x(50),dx(50),d(50),w(50),z(50),
     3cn89
      real*8 a,ab,s,sw,emi,semi1,semi2,dz(50)
      common/ci/mc,n,n1,n2,nucha,k,kk1,kk2,ra,ry,rf,md,cm,ech,syst
      common/cr/x,dx,ax,dax,p1,p2,conf,conf2
      common/cc/cn89
C     Beginning of modified CHAuvenet procedure                          |
      ech=1
      fn=float (n)
   16 if (n-mc) 18,17,17
   17 nu=1*nucha
   79 kap=1.656242560*alog10(float(nu*n))**0.636171095
   26 s=0.0
      sw=0.0
      do 22 i=n1,n2
      w(i)=dx(i)**(-ech)
      sw=sw+w(i)
   22 s=s+w(i)*x(i)
      ax=s/sw
      s=0.0
      do 23 i=n1,n2
   23 s=s+w(i)*(x(i)-ax)**2
      kax=sqrt(s/(fn-1.0)/sw)
C     Recording outliers                                                 |
      k=0
      do 27 i=n1,n2
      rech=1.0/float(ech)
      if (kap*(kax**ech+dx(i)**ech)**rech-abs(x(i)-ax)) 28,27,27
   28 k=k+1
      d(k)=abs(x(i)-ax)/dx(i)
      l(k)=i
   27 continue
      if (k-1) 18,123,123
  123 maxd=d(1)
      ml=l(1)
      if (k-1) 75,75,29
   29 do 32 m=2,k
      if (maxd-d(m)) 30,31,31
   30 maxd=d(m)
      ml=l(m)
   31 continue
   32 continue
C     Assigning new error to the strongest outlier                       |
   75 dx(ml)=abs(x(ml)-ax)/kap
  125 continue
      go to 17
   18 continue
C     End of procedure modified CHAuvenet                                |
C     CONsistency check by internal and external consistency,            |
C     search for SYSTematic errors, weighted averaging                   |
   52 if (n-1) 70,70,62
   62 s=0.0
      sw=0.0
```

```
      do 72 i=n1,n2
      w(i)=dx(i)**(-2)
      s=s+w(i)*x(i)
   72 sw=sw+w(i)
      ax=s/sw
      av=ax
      ax0=av
      bax=1.0/sqrt(sw)
C     Internal consistency  !
      int=bax
C     First value of  "       "          !
      s=0.0
      do 82 i=n1,n2
   82 s=s+w(i)*(x(i)-ax)**2
      kax=sqrt(s/(fn-1.0)/sw)
C     External consistency  !
      ext=kax
C     First value of   "         "        !
      a=int/20.0
      emi=ext-int
      semi1=emi*a/abs(emi)
C     Step in linear iteration for syst. errors!
      conf=ext/int
C     Consistency factor  !
      aux=((conf**2-1.0)**2+1.0)*(fn-1.0)*0.5/cn89
      fn89=3.0*((fn+1.0)/(fn-1.0))**2
  334 del2=sqrt ((aux*ext**2+fn89*int**2)/(aux+fn89))
      lim=del2
  400 do 401 i=n1,n2
      z(i)=x(i)
  401 dz(i)=dx(i)
      k=0
      p=0.0
  410 if (semi1*(lim-bax).lt.0.0) go to 409
      k=k+1
  412 p=p+semi1
      do 411 i=n1,n2
  411 dz(i)=dz(i)+semi1
  512 continue
      s=0.0
      sw=0.0
      do 414 i=n1,n2
      w(i)=dz(i)**(-2)
      s=s+w(i)*z(i)
  414 sw=sw+w(i)
      ax0=ax
      ax=s/sw
      bax=1.0/sqrt(sw)
      s=0.0
      do 415 i=n1,n2
  415 s=s+w(i)*(z(i)-ax)**2
      kax=sqrt(s/(fn-1.0)/sw)
      go to 410
  409 ax=0.5*(ax0+ax)
      dax=del2
  187 p1=p
      kk1=k
      go to 81
   70 ax=x(n1)
      dax=dx(n1)
   81 continue
      return
C     End of subroutine CHACON                                          |
      end

      BLOCK DATA
      common/ci/mc,n,n1,n2,nucha,k,kk1,kk2,ra,ry,rf,md,cm,ech,syst
      common/cr/x,dx,ax,dax,p1,p2,conf,conf2
      common/cc/cn89
```

```
      data mc,nucha,ech/5,5,1/
      data cn89/1.0/
      end
```

Appendix IV.

Table of average charge radii. Comparison

Updated: 1 May 1999

El	Z	A	R_FOR	DR_FOR	R_EXC	DR_EXC	r (eq.20)
n	0	1	-0.1149	.0024	-0.1149	.0027	.01
H	1	1	0.8521	.0069	0.8520	.0070	.01
		2	2.1300	.0120	2.1300	.0120	.00
		3	1.7591	.0356	1.7591	.0363	.00
He	2	3	1.9373	.0296	1.9408	.0240	-.09
		4	1.6758	.0026	1.6757	.0028	.04
Li	3	6	2.5521	.0311	2.5522	.0333	.00
		7	2.3952	.0506	2.3953	.0514	.00
Be	4	9	2.5180	.0114	2.5180	.0119	.00
B	5	10	2.4278	.0492	2.4277	.0499	.00
		11	2.4059	.0291	2.4060	.0294	.00
C	6	12	2.4704	.0023	2.4705	.0023	-.02
		13	2.4625	.0036	2.4625	.0037	.00
		14	2.4978	.0126	2.4966	.0165	.06
N	7	14	2.5519	.0083	2.5520	.0087	-.01
		15	2.6094	.0085	2.6095	.0094	-.01
O	8	16	2.7061	.0084	2.6995	.0068	.61
		17	2.6975	.0136	2.6980	.0173	-.02
		18	2.7603	.0141	2.7599	.0162	.02
F	9	19	2.8976	.0027	2.8976	.0028	.01
Ne	10	20	3.0046	.0038	3.0045	.0038	.01
		21	2.9670	.0036	2.9670	.0036	.00
		22	2.9544	.0035	2.9544	.0035	-.01
Na	11	23	2.9935	.0024	2.9935	.0024	-.01
Mg	12	24	3.0575	.0024	3.0574	.0026	.01
		25	3.0269	.0034	3.0278	.0042	-.17
		26	2.9987	.0328	3.0135	.0232	-.37
Al	13	27	3.0527	.0078	3.0566	.0058	-.41
Si	14	28	3.1234	.0027	3.1236	.0030	-.04
		29	3.1131	.0075	3.1140	.0086	-.08
		30	3.1595	.0163	3.1494	.0132	.48
P	15	31	3.1893	.0019	3.1893	.0021	.01
S	16	32	3.2522	.0059	3.2572	.0045	-.68
		34	3.2848	.0030	3.2848	.0030	.00
		36	3.2984	.0031	3.2987	.0041	-.07
Cl	17	35	3.3652	.0145	3.3654	.0191	-.01
		37	3.3840	.0170	3.3840	.0170	.00
Ar	18	36	3.3910	.0058	3.3917	.0053	-.09
		38	3.4035	.0031	3.4035	.0036	.01
		40	3.4273	.0027	3.4273	.0029	.00
K	19	39	3.4350	.0020	3.4350	.0022	.01
		41	3.4520	.0033	3.4520	.0033	.00
Ca	20	40	3.4766	.0010	3.4766	.0010	-.01
		42	3.5057	.0013	3.5057	.0013	.00
		43	3.4928	.0011	3.4928	.0011	.00
		44	3.5152	.0013	3.5152	.0013	.00
		46	3.4921	.0012	3.4921	.0012	.00
		48	3.4737	.0011	3.4737	.0011	-.01
Sc	21	45	3.5460	.0035	3.5460	.0035	.00
Ti	22	46	3.6060	.0032	3.6060	.0032	.00
		47	3.5960	.0032	3.5960	.0032	.00
		48	3.5916	.0031	3.5916	.0032	-.01
		49	3.5740	.0030	3.5740	.0030	.00
		50	3.5710	.0031	3.5710	.0031	.00

V	23	51	3.6000	.0030	3.6000	.0030	.00
Cr	24	50	3.6595	.0033	3.6597	.0044	-.03
		52	3.6452	.0042	3.6452	.0044	.01
		53	3.6590	.0030	3.6590	.0030	.00
		54	3.6854	.0031	3.6854	.0031	.01
Mn	25	55	3.7060	.0033	3.7060	.0033	.00
Fe	26	54	3.6929	.0048	3.6929	.0049	.00
		56	3.7383	.0030	3.7383	.0031	-.01
		57	3.7540	.0037	3.7540	.0037	.00
		58	3.7735	.0037	3.7735	.0037	-.01
Co	27	59	3.7883	.0028	3.7883	.0029	-.01
Ni	28	58	3.7745	.0020	3.7745	.0022	.01
		60	3.8116	.0028	3.8117	.0029	-.03
		61	3.8211	.0034	3.8212	.0043	-.03
		62	3.8387	.0035	3.8390	.0041	-.06
		64	3.8584	.0033	3.8584	.0040	-.01
Cu	29	63	3.8877	.0053	3.8853	.0049	.33
		65	3.9029	.0028	3.9029	.0028	-.01
Zn	30	64	3.9277	.0033	3.9277	.0034	.01
		66	3.9488	.0028	3.9489	.0030	-.02
		68	3.9657	.0028	3.9657	.0029	-.01
		70	3.9833	.0032	3.9833	.0033	.01
Ga	31	69	3.9960	.0032	3.9960	.0032	.00
		71	4.0110	.0032	4.0110	.0032	.00
Ge	32	70	4.0419	.0017	4.0419	.0017	-.01
		72	4.0586	.0017	4.0587	.0020	-.02
		73	4.0610	.0033	4.0610	.0033	.00
		74	4.0743	.0017	4.0743	.0017	.02
		76	4.0808	.0017	4.0808	.0017	.02
As	33	75	4.0960	.0033	4.0960	.0033	.00
Se	34	74	4.0700	.0200	4.0700	.0200	.00
		76	4.1426	.0045	4.1416	.0057	.13
		77	4.1390	.0035	4.1390	.0035	.00
		78	4.1399	.0034	4.1399	.0035	.00
		80	4.1409	.0023	4.1409	.0025	-.01
		82	4.1376	.0039	4.1380	.0051	-.06
Br	35	79	4.1630	.0035	4.1630	.0035	.00
		81	4.1600	.0034	4.1600	.0034	.00
Kr	36	78	4.2032	.0016	4.2032	.0016	.00
		80	4.1976	.0013	4.1976	.0013	.00
		82	4.1921	.0015	4.1921	.0015	.00
		83	4.1860	.0018	4.1860	.0018	.00
		84	4.1884	.0016	4.1884	.0016	.00
		86	4.1839	.0017	4.1839	.0017	.00
Rb	37	85	4.2040	.0036	4.2040	.0036	.00
		87	4.1990	.0036	4.1990	.0036	.00
Sr	38	84	4.2365	.0017	4.2365	.0017	.00
		86	4.2261	.0013	4.2261	.0013	.00
		87	4.2190	.0012	4.2190	.0012	.00
		88	4.2090	.0068	4.2171	.0050	-.96
Y	39	89	4.2438	.0032	4.2439	.0032	-.02
Zr	40	90	4.2692	.0014	4.2692	.0014	.00
		91	4.2850	.0017	4.2850	.0018	.00
		92	4.3055	.0014	4.3055	.0014	.00
		94	4.3314	.0015	4.3314	.0015	.00
		96	4.3508	.0016	4.3508	.0016	.00
Nb	41	93	4.3248	.0025	4.3248	.0027	.00
Mo	42	92	4.3146	.0015	4.3146	.0015	.00
		94	4.3518	.0014	4.3518	.0014	.00
		95	4.3617	.0013	4.3617	.0013	.00
		96	4.3840	.0011	4.3840	.0011	.00
		97	4.3880	.0011	4.3880	.0011	.00
		98	4.4089	.0014	4.4089	.0014	.00

		100	4.4465	.0018	4.4465	.0018	.00
Ru	44	96	4.3930	.0047	4.3930	.0047	.00
		98	4.4230	.0055	4.4230	.0055	.00
		99	4.4350	.0042	4.4350	.0042	.00
		100	4.4530	.0043	4.4530	.0043	.00
		101	4.4610	.0042	4.4610	.0042	.00
		102	4.4810	.0042	4.4810	.0042	.00
		104	4.5090	.0043	4.5090	.0043	.00
Rh	45	103	4.4940	.0041	4.4940	.0041	.00
Pd	46	102	4.4840	.0044	4.4840	.0044	.00
		104	4.4780	.0269	4.4964	.0196	-.55
		105	4.5160	.0046	4.5160	.0046	.00
		106	4.5061	.0221	4.5227	.0164	-.60
		108	4.5462	.0091	4.5506	.0090	-.35
		110	4.5759	.0132	4.5739	.0102	.12
Ag	47	107	4.5440	.0042	4.5440	.0042	.00
		109	4.5650	.0042	4.5650	.0042	.00
Cd	48	106	4.5340	.0045	4.5340	.0045	.00
		108	4.5540	.0045	4.5540	.0045	.00
		110	4.5752	.0037	4.5752	.0038	.01
		111	4.5790	.0044	4.5790	.0044	.00
		112	4.5974	.0041	4.5971	.0054	.04
		113	4.5970	.0043	4.5970	.0043	.00
		114	4.6140	.0039	4.6136	.0041	.07
		116	4.6282	.0039	4.6281	.0049	.01
In	49	113	4.5980	.0050	4.5980	.0053	.00
		115	4.6189	.0052	4.6177	.0058	.15
Sn	50	110	4.5807	.0064	4.5807	.0064	.00
		111	4.5859	.0061	4.5859	.0061	.00
		112	4.5915	.0038	4.5915	.0048	.00
		113	4.6038	.0047	4.6038	.0047	.00
		114	4.6082	.0033	4.6082	.0042	.00
		115	4.6167	.0038	4.6167	.0038	.00
		116	4.6278	.0030	4.6278	.0030	.00
		117	4.6310	.0023	4.6310	.0027	.00
		118	4.6411	.0018	4.6412	.0023	-.02
		119	4.6456	.0015	4.6456	.0018	-.01
		120	4.6544	.0011	4.6545	.0014	-.03
		121	4.6589	.0013	4.6589	.0013	.00
		122	4.6648	.0017	4.6648	.0021	-.01
		123	4.6684	.0020	4.6684	.0020	.00
		124	4.6752	.0025	4.6752	.0025	.00
		125	4.6779	.0027	4.6779	.0027	.00
Sb	51	121	4.6810	.0046	4.6810	.0046	.00
		123	4.6890	.0051	4.6890	.0051	.00
Te	52	122	4.7100	.0053	4.7100	.0053	.00
		123	4.7120	.0045	4.7120	.0045	.00
		124	4.7190	.0046	4.7190	.0046	.00
		125	4.7210	.0046	4.7210	.0046	.00
		126	4.7282	.0038	4.7282	.0038	.00
		128	4.7350	.0046	4.7350	.0046	.00
		130	4.7420	.0046	4.7420	.0046	.00
I	53	127	4.7499	.0038	4.7499	.0039	-.01
Xe	54	124	4.7620	.0046	4.7620	.0046	.00
		126	4.7700	.0048	4.7700	.0048	.00
		128	4.7760	.0048	4.7760	.0048	.00
		129	4.7760	.0047	4.7760	.0047	.00
		130	4.7830	.0046	4.7830	.0046	.00
		131	4.7810	.0046	4.7810	.0046	.00
		132	4.7870	.0047	4.7870	.0047	.00
		134	4.7920	.0047	4.7920	.0047	.00
		136	4.7990	.0047	4.7990	.0047	.00
Cs	55	133	4.8040	.0046	4.8040	.0046	.00

Ba	56	134	4.8290	.0048	4.8290	.0048	.00
		135	4.8270	.0048	4.8270	.0048	.00
		136	4.8330	.0048	4.8330	.0048	.00
		137	4.8320	.0048	4.8320	.0048	.00
		138	4.8391	.0045	4.8391	.0046	.00
La	57	139	4.8550	.0049	4.8550	.0049	.00
Ce	58	140	4.8771	.0023	4.8771	.0025	.00
		142	4.9063	.0025	4.9063	.0026	.01
Pr	59	141	4.8920	.0050	4.8920	.0050	.00
Nd	60	142	4.9140	.0051	4.9140	.0051	.00
		143	4.9240	.0053	4.9240	.0053	.00
		144	4.9415	.0035	4.9415	.0035	.00
		145	4.9530	.0054	4.9530	.0054	.00
		146	4.9687	.0034	4.9687	.0035	.00
		148	4.9980	.0030	4.9980	.0031	.00
		150	5.0419	.0030	5.0419	.0031	-.01
Sm	62	144	4.9373	.0015	4.9373	.0015	.00
		147	4.9824	.0014	4.9824	.0014	.00
		148	5.0002	.0013	5.0002	.0013	.00
		149	5.0129	.0013	5.0129	.0013	.00
		150	5.0379	.0014	5.0379	.0014	.00
		152	5.0870	.0013	5.0870	.0013	.00
		154	5.1143	.0014	5.1143	.0014	.00
Eu	63	151	5.0440	.0053	5.0440	.0053	.00
		153	5.1180	.0055	5.1180	.0055	.00
Gd	64	154	5.1240	.0019	5.1240	.0019	.00
		155	5.1353	.0016	5.1353	.0016	.00
		156	5.1460	.0014	5.1460	.0014	.00
		157	5.1492	.0014	5.1492	.0014	.00
		158	5.1618	.0018	5.1618	.0018	.00
		160	5.1782	.0021	5.1782	.0021	.00
Tb	65	159	5.0600	.1500	5.0600	.1500	.00
Dy	66	161	5.1960	.0061	5.1960	.0061	.00
		162	5.2091	.0057	5.2091	.0058	.00
		163	5.2110	.0059	5.2110	.0059	.00
		164	5.2238	.0057	5.2238	.0058	.00
Ho	67	165	5.2022	.0308	5.2022	.0312	.00
Er	68	166	5.2390	.0060	5.2390	.0060	.00
		167	5.2580	.0060	5.2580	.0060	.00
		168	5.2713	.0060	5.2713	.0061	.00
		170	5.2847	.0061	5.2847	.0061	.00
Tm	69	169	5.2256	.0035	5.2256	.0035	.00
Yb	70	170	5.2860	.0063	5.2860	.0063	.00
		171	5.2534	.0295	5.2865	.0222	-.90
		172	5.2875	.0168	5.2981	.0151	-.47
		173	5.3060	.0063	5.3060	.0063	.00
		174	5.3033	.0258	5.3143	.0191	-.34
		176	5.3655	.0341	5.3320	.0251	.79
Lu	71	175	5.3700	.0300	5.3700	.0300	.00
Hf	72	176	5.3310	.0065	5.3310	.0065	.00
		177	5.3340	.0065	5.3340	.0065	.00
		178	5.3380	.0065	5.3380	.0065	.00
		179	5.3390	.0065	5.3390	.0065	.00
		180	5.3490	.0063	5.3490	.0063	.00
Ta	73	181	5.3531	.0063	5.3531	.0063	.00
W	74	182	5.3550	.0020	5.3550	.0020	.00
		183	5.3300	.1500	5.3300	.1500	.00
		184	5.3640	.0020	5.3640	.0020	.00
		186	5.3808	.0058	5.3808	.0062	.00
Os	76	186	5.3870	.0072	5.3870	.0072	.00
		188	5.4001	.0013	5.4001	.0013	.00
		189	5.3600	.1500	5.3600	.1500	.00
		190	5.4062	.0014	5.4062	.0014	.00

		192	5.4100	.0020	5.4100	.0020	.00
Ir	77	191	5.3900	.1500	5.3900	.1500	.00
		193	5.4100	.1500	5.4100	.1500	.00
Pt	78	194	5.3986	.0259	5.4043	.0195	-.17
		195	5.4270	.0069	5.4270	.0069	.00
		196	5.3937	.0160	5.3801	.0115	.69
		198	5.4410	.0063	5.4410	.0063	.00
Au	79	197	5.4379	.0046	5.4379	.0047	.00
Hg	80	198	5.4480	.0065	5.4480	.0065	.00
		199	5.4490	.0069	5.4490	.0069	.00
		200	5.4570	.0065	5.4570	.0065	.00
		202	5.4670	.0066	5.4670	.0066	.00
		204	5.4720	.0020	5.4720	.0020	.00
Tl	81	203	5.4674	.0041	5.4674	.0042	.00
		205	5.4752	.0038	5.4752	.0038	-.01
Pb	82	196	5.4420	.0105	5.4420	.0105	.00
		197	5.4420	.0105	5.4420	.0105	.00
		198	5.4500	.0085	5.4500	.0085	.00
		199	5.4500	.0085	5.4500	.0085	.00
		200	5.4590	.0075	5.4590	.0075	.00
		201	5.4610	.0075	5.4610	.0075	.00
		202	5.4690	.0055	5.4690	.0055	.00
		203	5.4710	.0055	5.4710	.0055	.00
		204	5.4793	.0013	5.4793	.0013	.00
		205	5.4820	.0035	5.4820	.0035	.00
		206	5.4896	.0012	5.4896	.0012	.00
		207	5.4938	.0013	5.4938	.0013	.00
		208	5.5010	.0012	5.5010	.0012	.02
		209	5.5110	.0025	5.5110	.0025	.00
		210	5.5230	.0035	5.5230	.0035	.00
		211	5.5330	.0055	5.5330	.0055	.00
		212	5.5450	.0075	5.5450	.0075	.00
		214	5.5650	.0105	5.5650	.0105	.00
Bi	83	209	5.5254	.0035	5.5253	.0038	.02
Th	90	232	5.7161	.0393	5.7463	.0291	-.62
U	92	233	5.8160	.0080	5.8160	.0080	.00
		234	5.8289	.0050	5.8289	.0050	.00
		235	5.8191	.0140	5.8262	.0118	-.39
		238	5.8473	.0098	5.8543	.0080	-.55
Pu	94	239	5.8300	.0200	5.8300	.0200	.00
Am	95	241	5.8929	.0035	5.8929	.0035	.00
		243	5.9047	.0035	5.9047	.0035	.00

Appendix V.

References for Electron Scattering

Updated: 1 May, 1999

		Elements investigated
Fe47	E.Fermi, and L.Marshall: *Phys. Rev.* **72** (1947) 1139	neutron
Ha47	W.W.Havens Jr., I.I.Rabi, and L.J.Rainwater: *Phys. Rev***. 72**(1947)634	neutron
Ha51	W.W.Havens Jr., L.J.Rainwater, and I.I.Rabi: *Phys. Rev.* **82**(1951)345	neutron
Ly51	E.Lyman, A.Hanson, and M.Scott: *Phys. Rev*. **84** (1951) 626	Cu, Ag, Au
Ha52	M.Hamermesh, G.R.Ringo, and A.Wattenberg: *Phys. Rev.* **85**(1952)483L	neutron
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Hu53	D.J.Hughes, J.A.Harvey, et al.: *Phys. Rev.* **90** (1953) 497	neutron
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		In, Sb, Au, Bi
He56	R.H.Helm: *Phys. Rev.* **104** (1956) 1466	Mg, Si, S
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Appendix VI.

References for Muonic Atom *X*-Rays

Updated: 1 May 1999

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Fr62	W.Frati, and J.Rainwater: *Phys. Rev.* **128** (1962) 2360	Ti, Fe, Cu, Zn Tl, Pb, Bi
Jo62	C.S.Johnson, E.P.Hincks, H.L.Anderson: *Phys. Rev.* **125**(1962)2102	Al, K, Ca, Ti, Cr, Mn Fe, Co, Ni, Cu, Zn
An63	H.L.Anderson, C.S.Johnson, E.P.Hincks: *Phys. Rev.* **130**(1963)2468	Mg, Al, Si, P, S, Cl, Ca Fe, Ni, Zn, As, Zr, Mo
Bj64	J.A.Bjorkland, et al.: *Phys. Rev.* **136** (1964) B 341	Ca
Eh64	R.D.Ehrlich, et al.: *Phys. Rev. Lett.* **13** (1964) 550	Th, U
Qu64	D.Quitmann, et al.: *Nucl. Phys.* **51** (1964) 609	S, K, Ca, Ti, Mn, Fe Co, Ni, Cu, Zn, As, Mo
Ac65	H.L.Acker, et al.: *Phys. Letters*, **14** (1965) 317	Au, Pb, Bi, W, U
Ba65	G.Backenstoss, et al.: *Nucl. Phys.* **62** (1965) 449	Rh, Pd, Ag, Cd, In Sn, Sb, Te, I, Cs, Ba La, Ce, Pr, Pb, Bi
Bj65	J.A.Bjorkland, et al.: *Nucl. Phys.* **69** (1965) 161	Mg, Al, Ca, V Fe, Cu, Ni, Zn
Ch65	C.Chasman, et al.: *Phys. Rev. Lett.* **14** (1965) 181	Mo
Ac66	H.L.Acker, et al.: *Nucl. Phys.* **87** (1966) 1	Cl, Ca, Fe, Sn, Sb, Te I, As, Ba, La, Ce, Pr Nd, Au, Hg, Tl, Pb, Bi
An66	H.L.Anderson, et al.: *Phys. Rev. Lett.* **16** (1966) 434	Pb
Ba66	T.T.Bardin, et al.: *Phys. Rev. Lett.* **16** (1966) 429	Bi
Ba66a	T.T.Bardin et al: *Prog. Rep. Jan*. 1 (1966) GEN-72; ONR-666(72) (From Wu69 and En74)	Ti
Ba66b	T.T.Bardin, et al.: *Phys. Rev. Lett.* **16** (1966) 718	Sn, Nd, W
Eh66	R.D.Ehrlich, et al.: *Phys. Rev. Lett.* **16** (1966) 425	Bi
Eh66a	R.D.Ehrlich, et al.: *Phys. Letters*, **23** (1966) 468	Pb
Je66	D.A.Jenkins, et al.: *Phys. Rev. Lett.* **17** (1966) 1	Li, Be, B, C, N O, F, Na, Mg
Ba67	C.G.Backenstoss, et al.: *Phys. Letters*, **25**B (1967) 547	B, C, N, O, F, Na Mg, Al, Si, P, S, Cl
Ba67a	T.T.Bardin, et al.: *Phys. Rev.* **160** (1967) 1043	Bi
Be67	S.Bernow, et al.: *Phys. Rev. Lett.* **18** (1967) 787	Sm
Bu67	Yu.T.Budyashov, et al.: *Yad. Fiz.* **5** (1967) 134	Ar, S, Cl, K, Ca, Cr

El67 L.R.B.Elton: *Landolt-Bornstein, Gruppe I.: Kernphysik und Kerntechnik,* **Band 2:** *Kernradien;* Springer, Berlin (1967) pp.1-20 .... *Many; compilation*
Su67 A.Suzuki: *Phys. Rev. Lett.* **19** (1967) 1005 .... Mg, Si, S, Ca
We67 R.J.Wetmore, et al.: *Phys. Rev. Lett.* **19** (1967) 1003........ He
Wi67 S.A.De Wit, et al.: *Nucl. Phys.* **87** (1967)657 .... Sm, Eu, Tb, Ho, Hf, Ta W, Os, Ir, Th, U, Pu

Be68 S.Bernow, et al.: *Phys. Rev. Lett*. **21** (1968) 457 .... Nd, Sm, Gd, Er, W
Ca68 R.A.Carrigan,Jr., et al.: *Phys. Rev. Lett.* **20** (1968) 874........ Eu
Ca68a R.A.Carrigan,Jr., et al.: *Phys. Letters,* **27B** (1968) 622 .... Ag
Eh68 R.D.Ehrlich: *Phys. Rev*. **173** (1968) 1088 .... K, Ca, Fe, Ni, Cu, Sr, Zr, Sn
Ha68 R.J Harris, et al.: *Phys. Rev. Lett.* **20** (1968) 505........ Li, Be, B, C
Po68 R.J.Powers: *Phys. Rev.* **169** (1968) 1 .... Pb, Bi
Su68 M.N.Suzuki: *Thesis, Carnegie-Mellon Univ.* (1968) unp. (from En74) .... Lu

An69 H.L.Anderson, et al.: *Phys. Rev*. **187** (1969) 1565........ Pb
Co69 R.E.Coti, et al.: *Phys. Rev.* **179** (1969) 1134 .... Th, U
Fo69 K.W.Ford, and J.G.Wills: *Phys. Rev.* **185** (1969) 1429........ Theory
Le69 W.Y.Lee, et al.: *Phys. Rev. Lett.* **23** (1969) 648........ In, Cs, Pr
MK69 R.J.McKee: *Phys. Rev.* **180** (1969) 1139 .... Th, U
Wu69 C.S.Wu and L.Wilets: *Ann. Rev. Nucl. Sci.* **19** (1969) 546 .... Review

Be70 A.Bertin, et al.: *Phys. Letters,* **55B** (1970) 411........ He
Hi70 D.Hitlin, et al.: *Phys. Rev,* **C1** (1970) 1184........ Nd, Sm, Dy, Er, W
Je70 D.A.Jenkins, et al.: *Phys. Letters,* **32B** (1970) 267........ Ce
Ke70 D.Kessler, et al.: *Can. J. Phys.* **48** (1970) 3029 .... Y
Ma70 E.R.Macagno, et al.: *Phys. Rev.* **C1** (1970) 1202........ Ca, Cr, Cu, Mo, Sn, Nd

Ba71 G.Backenstoss, et al.: *Phys. Letters,* **36B** (1971) 422........ Ne, Ar
Ba71a H.Backe: *Z. Physik,* **241** (1971) 435........ W, Os, Bi
Bv71 T.Bôhringer: *Trav. dipl. ETH Zurich* (1971) unpubl. (From En74)........ Fe
Di71 M.S.Dixit, et al.: *Phys. Rev. Lett.* **27** (1971) 878 .... Ca, Ti, Fe, Sr, Ag Cd, Sn, Ba, Pb
Je71 D.A.Jenkins, et al.: *Nucl. Phys.* **A175** (1971) 73 .... Pb
Ka71 J.W.Kast, et al.: *Nucl Phys.* **A169** (1971) 62 .... Cd, In, Sn, Te, I
Ki71 Y.N.Kim: *Mesic atoms and nuclear structure.* North-Holland P.Co.(1971)...... Review
Pl71 A.Placci, et al.: *Nuovo Cimento* **1A** (1971) 445........ He

Ba72 H.Backe, et al.: *Nucl. Phys.* **A189** (1972) 472 .... Tl
Ki72 Y.N.Kim, and M.Khan: *Phys. Letters,* **40B** (1972) 217........ Pb (theory)
Ma72 P.Martin: *Thesis, William and Mary College*, **WM-38-72** (from En74)........ Ba
Po72 H.P.Povel: *Thesis, Karlsruhe,* **KFK 1602** (1972) to be publ. (from En74) .... Nb
Wa72 H.K.Walter, et al.: *Phys. Letters,* **40B** (1972) 197 .... Hg, Tl

Ad73 D.T.Adler: *Thesis, Carnegie-Mellon Univ.* (1973) (from En74) .... Yb
De73 E.Deci: *Thesis, State Univ. NY at Binghampton* (1973) unp. (from En74) .... Tm
Fo73 K.W.Ford, and G.A.Rinker: *Phys. Rev.* **C7** (1973) 1206 .... Pb (Re-anal.)
Pf73 H.J.Pfeiffer et al: *Proc. Int. Conf. Nucl. Phys.* (1973) Munich Vol.1 p.313....... Ar
Ro73 B.Robert-Tissot, et al.: *Helv. Phys. Acta,* **46** (1973) 51........ Au
Ze73 A.Zehnder: *Thesis, ETH Zurich* (1973) to be publ. (from En74)........ Yb

Ba74 G.Backenstoss, et al.: *Nucl. Phys.* **A232** (1974) 519........ He
Da74 H.Daniel, et al.: *Phys. Letters,* **48B** (1974) 109 .... Ar
Du74 T.Dubler, et al.: *Nucl. Phys.* **A219** (1974) 29 .... C, N, O
Eg74 T.von Egidy, and H.P.Povel: *Nucl. Phys.* **A232** (1974) 511 .... C, O

En74	R.Engfer, et al.: *At. Data Nucl. Data Tables*, **14** (1974) 509	Many; compilation
Po74	R.J.Powers, et al.: *Nucl. Phys.* **A230** (1974) 413	Au
Ke75	D.Kessler, et al.: *Phys. Rev.* **C11** (1975) 1719	Pb
Sh75	E.B.Shera, et al.: *Phys. Rev. Lett.* **34** (1975) 535	Fe
Br76	A.Brandco d'Oliviera, and T.von Egidy: *Z.Naturf.* **31a** (1976) 211	Br, Cd
Ca76	G.Carboni, et al.: *Nuovo Cimento*, **34** (1976) 493	He
Cl76	D.A.Close, J.J.Malanify, J.P.Davidson: *Nuovo Cim.* **34A**(1976)301	Pb
Du76	T.Dubler et al: *Proc. Europhys. Conf. Rad. Shape Nucl.* 1976 Cracow, p.9	Na, S
He76	E.M.Henley, F.R.Krejs, L.Wilets: *Nucl. Phys.* **A256** (1976) 349	He
ML76	D.McLoughlin, et al.: *Phys. Rev.* **C13** (1976) 1644	Ta
Pf76	H.-J.Pfeiffer, and H.Daniel: *Nucl. Phys.* **A264** (1976) 498	Ar
Po76	R.J.Powers, et al.: *Nucl. Phys.* **A262** (1976) 493	Ho
Sh76	E.B.Shera, et al.: *Phys. Rev.* **C14** (1976) 731	Fe, Co, Ni, Cu, Zn
Ca77	G.Carboni, et al.: *Nucl. Phys.* **A278** (1977) 381	He
Du77	T.Dubler, et al.: *Helv. Phys. Acta*, **50** (1977) 205	Na, S
Bo78	E.Borie, and G.A.Rinker: *Phys. Rev.* **A18** (1978) 324	He
Cl78	D.A.Close, J.J.Malanfy, J.P.Davidson: *Phys. Rev.* **C17**(1978)1433	Th, U, Pu
Du78	T.Dubler, et al.: *Helv. Phys. Acta*, **51** (1978) 513	Mo, Sr, Zr
Pl78	G.R.Plattner, and I.Sick: *Helv. Phys. Acta*, **51** (1978) 514	He
Ri78	G.A.Rinker, and J.Speth: *Nucl. Phys.* **A306** (1978) 360	Pb; (theory)
Sc78	L.A.Schaller, et al.: *Nucl. Phys.* **A300** (1978) 225	F, Na, Al, Si, P, S, K
Vu78	J.-L.Vuilleumier, et al.: *Nucl. Phys.* **A294** (1978) 273	Pd
Wo78	H.D.Wohlfahrt, et al.: *Phys. Letters*, **73B** (1978) 131	Ca
Wo78a	H.D.Wohlfahrt, et al.: *Bull. Am. Phys. Soc.* **23** (1978) HL4	K, Ca, Sc, Ti V, Cr, Mn, Fe
Ya78	Y.Yamazaki, et al.: *Phys. Rev.* **C18** (1978) 1474	Sm
Be79	G.A.Beer et al: 8^{th} *Int. Conf. High En. Phys. Nucl. Struct.* Aug. 13-17 1979, Vancouver, Canada, Contr. 1B27, p.21	B, C
Ha79	A.A.Hahn, et al.: *Nucl. Phys.* **A314** (1979) 361	Hg
Ka79	K.Kaeser, et al.: *Helv. Phys. Acta*, **52** (1979) 238	P, Se
Po79	R.J.Powers, et al.: *Nucl. Phys.* **A316** (1979) 295	Sm
Ba80	G.Backenstoss, et al.: *Phys. Letters*, **95B** (1980) 212	O
Ma80	G.Mallot: *Diplomarbeit, Univ. Mainz* (1980)	Kr
Sc80	L.Schellenberg, et al.: *Nucl. Phys.* **A333** (1980) 333	Mo
Sc80a	L.A.Schaller, et al.: *Nucl. Phys.* **A343** (1980) 333	Be, B, C, N
Ba81	P.Barreau, L.Roussel, R.J.Powers: *Nucl. Phys.* **A364**(1981)446	Sm
Ho81	M.V.Hoehn, et al.: *Phys. Rev.* **C24** (1981) 1667	Os
Ol81	A.Olin, et al.: *Nucl. Phys.* **A360** (1981) 426	B
Wo81	H.D.Wohlfahrt, et al.: *Phys. Rev.* **C23** (1981) 533	K, Ca,Sc,Ti,Cr,Mn,Fe
Fr82	G.Fricke, et al.: *SIN Newsletter*, **14** (1982) 61 (From Fr95)	Ar, Sc
Ru82	W.Ruckstuhl, et al.: *Phys. Rev. Lett.* **49** (1982) 859	C
Sc82	L.A.Schaller, et al.: *Nucl. Phys.* **A379** (1982) 525	C
Sh82	E.B.Shera, et al.: *Phys. Letters*, **112B** (1982) 124	Ba
Si82a	H.G.Sieberling, *Dipl. Thesis U. Mainz, 1982* **KPH 16/82** (From Fr95)	Ge
Si82b	H.G.Sieberling, (From Fr95)	Se
Ku83	W.Kunold, et al.: *Z. Physik*, **A312** (1983) 11	Ba
La83	D.B.Laubacher, et al.: *Phys. Rev.* **C27** (1983) 1772	Gd
Ma83	G.Mallott (From Fr95)	Ga

He84 Th.Hennemann, *PhD thesis, Univ. Mainz* **KPH 2/84**(1984) (from Sh89) .... Xe
Ru84 W.Ruckstuhl, et al.: *Nucl. Phys.* **A430** (1984) 685 C
Ta84 Y.Tanaka, et al.: *Phys. Rev.* **C29** (1984) 1897.. Eu
Ta84a Y.Tanaka, et al.: *Phys. Rev.* **C30** (1984) 350.. Hf
Zu84 J.D.Zumbro, et al.: *Phys. Rev. Lett.* **53** (1984) 1888 .... U

Bo85 F.W.N.de Boer, et al.: *Nucl. Phys.* **A444** (1985) 589 C
Jo85 M.W.Johnson, et al.: *Phys. Letters*, **161B** (1985) 75... Am
Ph85 T.Q.Phan, et al.: *Phys. Rev.* **C32** (1985) 609.. Zr
Sc85 L.A.Schaller, et al.: *Phys. Rev.* **C31** (1985) 1007 .... P, S

He86 Th.Hennemann, and J.Herberz (Ma83 data re-analysed. From Fr95)................ Rb

Fr87 G.Fricke, et al.: (From Fr95).. Cd
Re87 M.Reutter, *Dipl. Thesis, U. Mainz, 1987,* **KPH 6/87** (From Fr95).................... La

Be88 P.Bergem, et al.: *Phys. Rev.* **C37** (1988) 2821.. Pb
Kl88 R.M.Klein, *Dipl. Thesis, U. Mainz, 1988,* **KPH 8/88** (From Fr95).................. Sb

Bu89 A.J.C.Burghardt, *Ph.D. thesis, Univ. Amsterdam* (1989).................................. Hg
Ha89 Th.Hack, *Dipl. Thesis, U. Mainz, 1989,* **KPH 9/89** (From Fr95)...................... Ru
Ja89 J.Jansen: *Diplomarbeit*, Institut für Kernphysik, KPH 9/89 Mainz (1989)........ Sm, Gd
Ma89 P.Mazanek: *Dipl. Th., Inst. f. Kernph.* **PKH 11/89**, U. Mainz 1989 .... Zr, Mo
Sh89 E.B.Shera. et al.: *Phys. Rev.* **C39** (1989) 195 .... Te

Be90 C.Bernhadt: *Dipl. Thesis U. Mainz, 1990* **KPH 7/90** (From Fr95).................... Pt
Pi90 C.Piller, et al.: *Phys. Rev.* **C42** (1990) 182... Sn

Be92 C.Bernhardt: *Ph.D. Thesis U. Mainz, 1992* **KPH 6/92** (From Fr95) .... Nd
Fr92 G.Fricke, et al.: *Phys. Rev.* **C45** (1992) 80 .... O, F, Ne, Na
Mg, Al, Si
Ma92a P.Mazanek, *Ph.D. Th. Inst. f. Kernph.* **PKH 5/92**, U. Mainz 1992 .... Pb

Be93 C.Bernhardt, et al. (From Fr95) Sn

Fr95 G.Fricke, et al.: *Atomic Data Nucl Data Tables*, **60** (1995) 177........................ Many: combined anal.

Fr97 G.Fricke, private communication, November, 1997.. Sn: combined analysis

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RIPL for FTP file transfer of RIPL;
NDSONL for FTP access to files sent to NDIS "open" area.
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