\( \mathcal{F} \) values of the \( T = 1/2 \) mirror \( \beta \) transitions

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A complete survey is presented of all half-life and branching-ratio measurements related to the isospin \( T = 1/2 \) mirror \( \beta \) transitions ranging from \( ^3\)He to \( ^{83}\)Mo. No measurements are ignored, although some are rejected for cause. Using the decay energies obtained in the 2003 Mass Evaluation experimental \( \mathcal{F} \) values are then determined for the transitions up to \( ^{45}\)V. For the first time also all associated theoretical corrections needed to convert these results into ”corrected” \( \mathcal{F} \) values, similar to the superallowed \( 0^+ \rightarrow 0^+ \) pure Fermi \( \beta \) transitions, were calculated. Precisions of the resulting \( \mathcal{F} \) values are in most cases between 0.1% and 0.4%. These \( \mathcal{F}^{\text{mirror}} \) values can now be used to extract precise weak interaction information from past and ongoing correlation measurements in the beta decay of the \( T = 1/2 \) mirror \( \beta \) transitions.

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I. INTRODUCTION

In the past, several experiments in nuclear \( \beta \)-decay searching for non-Standard Model contributions to the weak interaction were performed with \( T = 1/2 \) mirror nuclei \( ^1\)H, \( ^2\)He, \( ^3\)He, \( ^{14}\)N, \( ^{19}\)F, \( ^{20}\)Ne, \( ^{21}\)Na, \( ^{22}\)Na, \( ^{37}\)K, \( ^{39}\)Ar, \( ^{40}\)Ca, \( ^{45}\)V, \( ^{46}\)Ti, etc. \( \beta \) transitions, were calculated. Precisions of the resulting \( \mathcal{F} \) values are in most cases between 0.1% and 0.4%. These \( \mathcal{F}^{\text{mirror}} \) values can now be used to extract precise weak interaction information from past and ongoing correlation measurements in the beta decay of the \( T = 1/2 \) mirror \( \beta \) transitions.

On the experimental side, half-lives, \( t_{1/2} \), branching ratios, \( BR \), and \( Q_{\text{EC}} \) values are required for the determination of \( \mathcal{F} \) values. As for the first two, the literature was searched and data were evaluated, leading to adopted values for each isotope. The \( Q_{\text{EC}} \) values were taken from the 2003 Mass Evaluation [18]. Since for most nuclei up to \( A \approx 40 \) the experimental data turned out to be sufficiently precise to yield \( \mathcal{F} \) values with a precision at the few \( 10^{-3} \) level we decided to perform, for the first time for these mirror \( \beta \) transitions, a full analysis of all radiative and nuclear structure corrections leading to the corrected \( \mathcal{F} \) values. Up to now such complete evaluation of the \( \mathcal{F} \) value was only carried out for the superallowed \( 0^+ \rightarrow 0^+ \) pure Fermi \( \beta \) transitions [21]. For all \( T = 1/2 \) mirror nuclei up to \( ^{45}\)V \( \mathcal{F} \) values with a precision ranging from 0.10% to about 2.3% were obtained. For the heavier nuclei experimental data are either not available or not sufficiently precise. Nevertheless, all experimental data reported in the literature are listed here.

In a first section the equation for the \( \mathcal{F} \) value of an allowed \( \beta \) transition, including all corrections, is derived. From this the equation for the \( \mathcal{F} \) value for the \( T = 1/2 \) mirror \( \beta \) transitions is then deduced. The next section explains the selection and treatment of the experimental data, while the last section deals with the \( \mathcal{F} \) values themselves. At the end of this paper tables are given that list all experimental data and adopted values leading to the \( \mathcal{F} \) values of the \( T = 1/2 \) mirror transitions, the values for the different correction factors applied for the nuclei up to \( ^{45}\)V and, finally, the derived results for the \( \mathcal{F}^{\text{mirror}} \) values.

II. FORMALISM

The decay rate for an allowed \( \beta \)-decay from an unpolarized nucleus is written [22]

\[
d\Gamma = d\Gamma_0 \xi \left[ 1 + \frac{\gamma}{W^b} \right], \tag{1}
\]

with

\[
d\Gamma_0 = \frac{G_F^2 V_{ud}^2}{(2\pi)^5} \frac{1}{(m_e c^2)^5} F(\pm Z, W) S(\pm Z, W) (W - W_0)^2 \rho W dW d\Omega_e d\Omega_\nu, \tag{2}
\]

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where $W$ is the total electron energy in electron rest-mass units, $W_0$ its maximum value, $p = \sqrt{W^2 - 1}$ its momentum and $m_e c^2$ the electron rest mass. Further, $\gamma = \sqrt{1 - (aZ)^2}$, with $a$ the fine structure constant and $Z$ the charge of the daughter nucleus (taken positive for electron emission, negative for positron emission). $G_F$ is the fundamental weak interaction coupling constant taken from muon decay, $G_F/(\hbar c)^3 = (1.16639 \pm 0.00001) \times 10^{-5}$ GeV$^{-2}$, $V_{ud}$ is the up-down quark-mixing element of the Cabibbo-Kobayashi-Maskawa (CKM) matrix, $F(\pm Z,W)$ the Fermi-function, and $S(\pm Z,W)$ is the shape-correction function the value of which is unity in the allowed approximation, but whose value differs weakly from one when this approximation is relaxed. In addition, we define

$$\xi = 2 \left[ M_F^2 C_V^2 + M_{GT}^2 C_A^2 \right],$$  \hfill (3)

where $M_F$ and $M_{GT}$ are the Fermi and Gamow-Teller matrix elements respectively, and $C_V$ and $C_A$ are the strength of the weak vector and axial-vector interactions (in units of $G_F$) as defined in the Hamiltonian of Jackson, Treiman and Wyld [22]. We have assumed maximal parity violation for V- and A-currents. Finally, $b$ is the Fierz interference term [22]. The mean lifetime $\tau$ of the decaying state is $\hbar/\Gamma$, which after integrating over neutrino and electron directions, yields

$$\hbar/\tau = \int d\Gamma = \int \frac{G_F^2 V_{ud}^2}{2\pi^3} \frac{1}{(m_ec^2)^5} \xi \ F(\pm Z,W) \ S(\pm Z,W) \ (W-W_0)^2 \ p \ W \ \left[ 1 + \frac{\gamma}{W} b \right] dW.$$  \hfill (4)

We isolate the partial half-life $t$ by correcting for electron capture competition, $P_{EC}$, and selecting the branching ratio, $BR$, for the particular transition under study, to obtain

$$1/t = \frac{G_F^2 V_{ud}^2}{2K} \ \xi \ f \ b',$$  \hfill (5)

with

$$t = \ln 2 \ \tau \left( \frac{1 + P_{EC}}{BR} \right),$$  \hfill (6)

and

$$K/(\hbar c)^6 = \frac{2\pi^3 \ln 2 \ \hbar}{(m_ec^2)^5} = (8120.278 \pm 0.004) \times 10^{-10} \text{ GeV}^{-4} \text{ s}.$$  \hfill (7)

The statistical rate function, $f$, and the Fierz correction factor, $b'$, are defined as

$$f = \int F(\pm Z,W) \ S(\pm Z,W) \ (W-W_0)^2 \ p \ W \ dW,$$  \hfill (8)

$$b' = 1 + \langle \frac{\gamma}{W} \rangle b'.$$  \hfill (9)

where

$$\langle \frac{\gamma}{W} \rangle = \frac{1}{f} \int F(\pm Z,W) \ S(\pm Z,W) \ (W-W_0)^2 \ p \ W \ \frac{\gamma}{W} \ dW.$$  \hfill (10)

Inserting these definitions into Eq. (5), we come to our principal result

$$ft = \frac{2K}{G_F^2 V_{ud}^2} \frac{1}{\xi} \frac{1}{b'},$$

$$= \frac{K}{G_F^2 V_{ud}^2} \left[ M_F^2 C_V^2 + M_{GT}^2 C_A^2 \right] \frac{1}{b'}.$$  \hfill (11)

We now introduce two classes of small corrections: those due to radiative processes that go undetected in the experiment, and those due to isospin not being an exact symmetry in nuclei. Details on the nature of these corrections can e.g. be found in ref. [23]. We discuss the radiative corrections first. These are divided into terms that depend on the nucleus in question (’outer radiative correction’), $\delta_R$, and those that do not (’inner radiative correction’), $\Delta_R$:

$$1 + RC = (1 + \delta_R)(1 + \Delta_R).$$  \hfill (12)

The nuclear-dependent term can be further divided into those pieces that depend trivially on the nucleus, $\delta_R'$ (depending only on $Z$ and $W_0$), and those that require a detailed nuclear-structure calculation, $\delta_{NS}$:

$$1 + RC = (1 + \delta_R')(1 + \delta_{NS})(1 + \Delta_R).$$  \hfill (13)
The $\delta_R'$ term is mainly obtained from a standard QED calculation that has been completed to orders $\alpha$ and $Z\alpha^2$ and estimated to order $Z^2\alpha^3$ \cite{24, 25, 26}. These three contributions we will call $\delta_1$, $\delta_2$ and $\delta_3$ respectively

$$\delta_R' = \delta_1 + \delta_2 + \delta_3 + \delta_{\alpha^2},$$

(14)

while the $\delta_{\alpha^2}$-term is a leading log extrapolation of a low-energy term in the evaluation of the inner radiative correction $\Delta_R$ \cite{33} that turned out to be weakly nucleus-dependent and was therefore shifted from the inner radiative correction to the outer one \cite{37}. All four contributions in Eq. (14) are the same for both Fermi and Gamow-Teller transitions. By contrast, the contributions $\delta_{NS}$ and $\Delta_R$ differ between Fermi and Gamow-Teller transitions and so their notation will include a superscript of $V$ or $A$ as required. Details of the calculation of $\delta_{NS}$ can be found in refs. \cite{27, 28, 29, 30, 37}. The nucleus-independent radiative correction $\Delta_R$ was originally evaluated by Marciano and Sirlin \cite{31} and Sirlin \cite{32}, yielding $\Delta_R = 2.40(8)$ % and has recently been addressed again by Marciano and Sirlin \cite{33} leading to the new value $\Delta_R = (2.361 \pm 0.038)\%$, in agreement with the previous value, but a factor of about two more precise. The reduction of the central value by approximately 0.04% is due to the fact that the aforementioned term $\delta_{\alpha^2}$ was shifted from the inner radiative correction to the outer one.

The Fermi matrix element in the isospin-symmetry limit is precisely known – it is given in terms of an isospin Clebsch-Gordan coefficient. In practice, however, nuclei are impacted by Coulomb and other charge-dependent forces that weakly break the isospin symmetry. So we write

$$M_F^2 = |M_F^0|^2 (1 - \delta_V),$$

(15)

where $\delta_V$ is the isospin-symmetry breaking correction in Fermi transitions \cite{34, 35} and $|M_F^0|^2$ is the isospin symmetry limit value of the matrix element squared given by $|M_F^0|^2 = 2$ for $T = 1 \rightarrow T = 1$ transitions, and $|M_F^0|^2 = 1$ for $T = 1/2 \rightarrow T = 1/2$ transitions. By contrast, the Gamow-Teller matrix element is not known in the isospin symmetry limit. Nevertheless, to maintain a consistency in the equations, we write

$$M_{GT}^2 = |M_{GT}^0|^2 (1 - \delta_A),$$

(16)

although separate values of the symmetry-limit matrix element, $M_{GT}^0$, and the symmetry-breaking correction, $\delta_A$, are not required for the development here. The isospin-symmetry breaking correction in Fermi transitions, $\delta_C$, is typically separated into two components \cite{37}

$$\delta_V = \delta_C^1 + \delta_C^2,$$

(17)

where the first term quantifies the impact of charge-dependent configuration mixing leading to differing wave functions for the parent and daughter nuclei, while the second term accounts for the differences in the single-particle neutron and proton radial wave functions, which cause the radial overlap integral of the parent and daughter nucleus to be less than unity.

Including now all corrections, and noting the shape-correction function $S(\pm Z, W)$ in the statistical rate function differs between Fermi and Gamow-Teller transitions, we have (setting $b' = 1$)

$$t = \frac{K}{G_F^2 V_{ud}^2} \frac{1}{(1 + \delta_R') \left[fV|M_F^0|^2 (1 + \delta_{NS}^V - \delta_C^V) C_V (1 + \Delta_R') + fA|M_{GT}^0|^2 (1 + \delta_{NS}^A - \delta_C^A) C_A (1 + \Delta_A') \right]}$$

(18)

For the superallowed $0^+ \rightarrow 0^+$ pure Fermi transitions, with $|M_F^0|^2 = 2$ and $M_{GT}^0 = 0$, one then has

$$fV^{0^+\rightarrow0^+} = \frac{K}{2G_F^2 V_{ud}^2 (1 + \delta_R') (1 + \delta_{NS}^V - \delta_C^V) C_V (1 + \Delta_R')}$$

(19)

or

$$F^{0^+\rightarrow0^+} = fV^{0^+\rightarrow0^+} (1 + \delta_R') (1 + \delta_{NS}^V - \delta_C^V) = \frac{K}{2G_F^2 V_{ud}^2 C_V (1 + \Delta_R')}.$$ 

(20)

For a mixed Fermi and Gamow-Teller transition, we can recast Eq. (18) into the form

$$fV t (1 + \delta_R')(1 + \delta_{NS}^V - \delta_C^V) = \frac{K}{G_F^2 V_{ud}^2 |M_F^0|^2 C_V (1 + \Delta_R') \left(1 + \frac{f_A}{f_F} \rho^2\right)} \frac{1}{(1 + \frac{f_A}{f_F} \rho^2)},$$

$$= \frac{2F^{0^+\rightarrow0^+}}{|M_F^0|^2 \left(1 + \frac{f_A}{f_F} \rho^2\right)}.$$ 

(21)
where a mixing ratio is defined as

$$\rho = \frac{C_AM^0_{GT}}{C_VM^0_F} \left( \frac{(1 + \delta^A_{NS} - \delta^A_C)(1 + \Delta^A_R)}{(1 + \delta^V_{NS} - \delta^V_C)(1 + \Delta^V_R)} \right)^{1/2} \simeq \frac{C_AM^0_{GT}}{C_VM^0_F}. \tag{22}$$

Lastly, restricting our attention to the $T = 1/2$ mirror $\beta$-transitions, for which $|M_F|^2 = 1$, Eq. (21) reduces to

$$F(t)^{\text{mirror}} \equiv f_V t(1 + \delta^V_R)(1 + \delta^V_{NS} - \delta^V_C) = \frac{2F(t)^{0+\rightarrow0+}}{(1 + \Delta^V_R)^2}. \tag{23}$$

This is our master equation. Our goal now is to extract values of the mixing ratio squared $\rho^2$ using data on the partial half-lives, $t_i$ for mirror transitions in odd-mass nuclei. To this end we need apart from experimental data also calculations of the statistical rate function, $f_V$ and the ratio $f_A/f_V$, the nucleus-dependent radiative corrections, $\delta_R$ and $\delta^V_{NS}$, and the isospin-symmetry breaking correction, $\delta^V_C$. Further, we take the current best value of $F(t)^{0+\rightarrow0+}$ from the most recent work of Towner and Hardy.

### III. EXPERIMENTAL DATA

To determine the $f t$ value for a $\beta$ transition three measured quantities are required: the half-life, $t_{1/2}$, of the parent state, the branching ratio, $BR$, of the particular transition of interest, and the total transition energy, $Q_{EC}$. The half-life and the branching ratio combine to yield the partial half-life, $t$, (Eq. (6)), whereas the $Q_{EC}$ value is required to determine the statistical rate function, $f_V$, (Eq. (8)). In our treatment of the data all half-life and branching ratio measurements published before January 2008 are considered. Since the evaluation of the $Q_{EC}$ values from different types of measurements would be too vast a project in itself it was decided to rely for these on the very extended 2003 Mass Evaluation [18]. Half-life and branching ratio data are available for mirror nuclei up to $^{83}$Mo. All original experimental data were checked in detail. In Tables I and II we present all measured values for the half-life and the branching ratio that were used in our analysis. References to these data are listed in Tables VII and IX. Each datum appearing in these tables is attributed to its original journal reference via an alphanumeric code comprising the initial two letters of the first author’s name and the last two digits of the publication date. If data were obviously wrong they were rejected. All rejected data are listed in Tables VIII and X with the reason for this rejection.

Similar evaluation principles and statistical procedures as those that are adopted for the analysis of the superallowed $0^+ \rightarrow 0^+$ pure Fermi transitions [21] were used. Thus, of the surviving results, only those with uncertainties that are within a factor of 10 of the most precise measurement for each quantity were retained for averaging in the tables.

The statistical procedures followed in analyzing the tabulated data are based on those used by the Particle Data Group in their periodic reviews of particle properties (e.g. Ref. [30]). In the tables and throughout this work, ”error bars” and ”uncertainties” always refer to plus/minus one standard deviation (68% confidence level).

For a set of $N$ independent measurements, $x_i \pm \delta x_i$, of a particular quantity, a Gaussian distribution is assumed, the weighted average being calculated according to the equation

$$\bar{x} \pm \delta \bar{x} = \frac{\sum_i w_i x_i}{\sum_i w_i} \pm \left( \frac{\sum_i w_i}{\sum_i w_i} \right)^{-1/2}, \tag{24}$$

where

$$w_i = 1/\delta x_i^2 \tag{25}$$

and the sums extend over all $N$ measurements. For each average the $\chi^2$ is also calculated and a scale factor, $S$, determined from

$$S = [\chi^2/(N - 1)]^{1/2}. \tag{26}$$

This factor is then used to establish the quoted uncertainty. If $S \leq 1$, the value of $\delta \bar{x}$ from Eq. (24) is left unchanged. If $S > 1$ and the input $\delta x_i$ are all about the same size, then $\delta \bar{x}$ is increased by the factor $S$, which is equivalent to assuming that all the experimental errors were underestimated by the same factor. Finally, if $S > 1$ but the $\delta x_i$ are of widely varying magnitudes, $S$ is recalculated with only those results for which $\delta x_i \leq 3N^{1/2}\delta \bar{x}$ being retained; the recalculated scale factor is then applied in the usual way. In all three cases, no change is made to the original average $\bar{x}$ calculated with Eq. (24).

Adopted values for the half-life and the branching ratio are listed in Table III together with the calculated electron-capture fraction, $P_{EC}$, the deduced partial half-life, $t$, (cf. Eq. (4)) and the $Q_{EC}$ value from ref. [18]. The $P_{EC}$ values were obtained from the tables of Bambbynek et al. [19] and Firestone [20]. No errors were assigned to these $P_{EC}$ values as they are expected to be accurate to a few parts in $100$ [14, 21] such that they do not contribute perceptibly to the overall uncertainties.
Having surveyed the experimental data we can now turn to the determination of the $ft$ values. The statistical rate function, $f$, for each transition was calculated using the procedure and the code described in Ref.\[21\]. Results appear in column 2 of Table IV. To obtain $F^{mirror}_t$ values according to Eq. (23) we must still deal with the small correction terms. The values for the nucleus dependent radiative correction $\delta_3 = \delta_1 + \delta_2 + \delta_3 + \delta_{\alpha}$ are listed in columns 5 to 9 of Table IV. Similar to the superallowed Fermi decay we have assigned an uncertainty equal to the $\delta_3$ term as an estimate of the error made in stopping the calculations at the order $Z_\nu^{33}$. Finally, one still has to deal with the nuclear-structure dependent corrections $\delta_{NS}^C = \delta_{C1}^V + \delta_{C2}^V$ and $\delta_{NS}^R$. Two of these corrections, $\delta_{NS}^V$ and $\delta_{NS}^R$, are very sensitive to the details of the shell-model calculation used in their evaluation. Fortunately, these two terms are also the smallest of the corrections we need in Eq. (23). We have mounted shell-model calculations using standard effective interactions and modest-size model spaces to evaluate them following exactly the same procedures as discussed in Ref.\[35\]. Further we assigned a generous error to account for their inherent model dependence. Less dependent on nuclear structure is the larger radial overlap correction, $\delta_\alpha$. Here we are guided by the recent work of Towner and Hardy \[37\], who pointed out the importance of including ‘core’ orbitals in the shell-model evaluation of spectroscopic amplitudes. A decision has to be made as to which core orbitals should be included in the active model space. Towner and Hardy’s criterion is that experimental neutron pick-up reactions should observe strong spectroscopic factors for the orbitals in question. We have followed this criterion in obtaining our values for $\delta_\alpha$. All these corrections are listed in columns 10 to 12 in Table IV with their sum in column 13. In total, these nuclear-structure dependent corrections are of order one percent or less.

One other quantity that depends weakly on a shell-model calculation is the ratio $f_A/f_V$. Here a modest shell-model calculation is sufficient. We can also use these shell-model calculations to determine the relative sign of the Fermi and Gamow-Teller matrix elements, which can then be taken as the sign of $\rho$. We can also use these shell-model calculations to determine the relative sign of the Fermi and Gamow-Teller matrix elements, which can then be taken as the sign of $\rho$. With these values for $\rho$ we can now calculate the standard model values for correlation coefficients in $\beta$ decay \[22\] that are of interest to search for physics beyond the standard electroweak model (e.g. $^{39}$Ca, $^{35}$Cl, $^{37}$K, $^{43}$Ti and $^{45}$V). The theoretical corrections, $\delta_R$ and $\delta_C - \delta_{NS}$ contribute less than 1 part in 1000 to the final $F^{mirror}_t$ values in all cases except $^{43}$Ti and $^{45}$V.

V. STANDARD MODEL VALUES FOR THE $\beta$ DECAY CORRELATION COEFFICIENTS

With these values for $\rho$ we can now calculate the standard model values for correlation coefficients in $\beta$ decay \[22\] that are of interest to search for physics beyond the standard electroweak model (e.g. $^{39}$Ca, $^{35}$Cl, $^{37}$K, $^{43}$Ti and $^{45}$V). The standard model assumes only vector and axial-vector interactions with maximal parity violation. In addition it is expected that the effects due to CP (or T) violation are negligible in the light quark sector at the present level of precision. These assumptions result in the conditions $C_V = C_A = C_S = C_T = C_{\alpha} = 0$ and $\text{Im}(C_{\nu}) = \text{Im}(C_{\tau}) = 0$ for $i = V, A$. Neglecting Coulomb as well as induced recoil effects one then obtains (the upper sign is for $\beta^-$ decay, the lower sign for $\beta^+$ decay), for the $\beta$-neutrino angular correlation coefficient:

$$a_{SM} = \frac{1 - \rho^2/3}{1 + \rho^2}$$ \hspace{1cm} (27)

for the $\beta$ asymmetry parameter:

$$A_{SM} = \frac{\mp \lambda_{J,J} \rho^2 - 2 \delta_{J,J} \sqrt{J(J+1)\rho}}{1 + \rho^2}$$ \hspace{1cm} (28)

for the neutrino asymmetry parameter:

$$B_{SM} = \frac{\pm \lambda_{J,J} \rho^2 - 2 \delta_{J,J} \sqrt{J(J+1)\rho}}{1 + \rho^2}$$ \hspace{1cm} (29)
and for the $\beta$ particle longitudinal polarization

$$ G_{SM} = \mp 1, \quad (30) $$

where $\delta_{J',J}$ is the Kronecker delta and

$$ \lambda_{J',J} = \frac{1}{J + 1} \quad (31) $$

for the $J \rightarrow J' = J$ mirror $\beta$ transitions.

Note that the coefficients $b_{SM} = D_{SM} = 0$ in the standard model. When including also the effect of the Coulomb interaction of the charged nucleus and emitted $\beta$ particle (i.e. final state interaction, FSI) it turns out that, to first order in $\alpha$, this depends for the $a$, $b$, $A$, $B$, $D$ and $G$ correlation coefficients on interferences between the standard model $V, A$ coupling constants and the non-standard model $S, T$ coupling constants [22], and therefore vanishes in the standard model. For the $N$ and $R$ correlation coefficients, however, the final state effects contain terms that depend on the time reversal invariant parts of the vector and/or axial-vector coupling constants and are thus non-zero in the standard model. To first order in $\alpha Z$ one has [22]

$$ N_{FSI}^{SM} = \mp \frac{\gamma m_e}{E_e} A_{SM} \quad (32) $$

and

$$ R_{FSI}^{SM} = \mp \frac{\alpha Z m_e}{p} A_{SM} \quad (33) $$

with $E_e$ the total electron energy. Numerical calculations [42] have shown that the values obtained for $N_{FSI}$ and $R_{FSI}$ within the used approximation are accurate at the 10% level.

The standard model values for the coefficients $a$, $A$ and $B$ as well as the values for $N_{FSI}$ and $R_{FSI}$ at the $\beta$ spectrum endpoint, all calculated with the values for $\rho$ obtained from our fit value analysis, are listed in Table VI. A full analysis of the sensitivity of the different correlation coefficients to several types of physics beyond the standard model as well as the effect of recoil order corrections (i.e. weak magnetism) on the correlation coefficients is in preparation and will be published elsewhere [43].
Figure 1: Histogram of the fractional uncertainties attributed to each experimental and theoretical input factor that contributes to the final $F_{mirror}$ values.
Table VII: References to data used in the calculation of the half-lives, $t_{1/2}$, of the $T = 1/2$ mirror nuclei.

| Code | Authors | Reference | Measured nuclei |
|------|---------|-----------|-----------------|
| Ak04 | Y.A. Akulov et al. | Phys. Lett. B 600, 41 (2004) | $^3$H |
| Ak88 | Y.A. Akulov et al. | Pis'ma Zh. Tekh. Fiz. 14, 940-942 (1988), English translation: Sov. Tech. Phys. Lett. 14, 416 (1988) | $^2$H |
| Al67 | A.M. Aldridge et al. | Nucl. Phys. A 98, 323 (1967) | $^{43}$Ti |
| A172 | D.E. Alburger, D.H. Wilkinson | Phys. Rev. C 6, 2019 (1972) | $^{17}$F |
| A173 | D.E. Alburger, D.H. Wilkinson | Phys. Rev. C 8, 657 (1973) | $^{39}$Ca, $^{41}$Sc |
| A174 | D.E. Alburger | Phys. Rev. C 9, 991 (1974) | $^{21}$Na, $^{23}$Mg, $^{31}$S |
| A177 | D.E. Alburger | Phys. Rev. C 16, 889 (1977) | $^{17}$F |
| Ar58 | S.E. Arneil et al. | Nucl. Phys. A 6, 196 (1958) | $^{11}$C, $^{13}$N, $^{21}$Na |
| Ar84 | Y. Arai et al. | Nucl. Phys. A 420, 193 (1984) | $^{59}$Zn |
| Aw69 | M. Awschalom et al. | Nucl. Instrum. Methods 75, 93 (1969) | $^{11}$C |
| Ay84 | J. Aystö et al. | Phys. Lett. B 138, 369-372 (1984) | $^{51}$Fe, $^{55}$Ni |
| Az74 | G. Azuelos et al. | Nucl. Instrum. Methods 117, 233 (1974) | $^{23}$Mg |
| Az75 | G. Azuelos, J.E. Kitching | Phys. Rev. C 12, 563 (1975) | $^{11}$C, $^{19}$Ne, $^{21}$Na, $^{23}$Mg, $^{25}$Al, $^{27}$Si, $^{29}$P |
| Az77 | G. Azuelos et al. | Phys. Rev. C 15, 1847 (1977) | $^{13}$N, $^{15}$O, $^{17}$F, $^{23}$Mg, $^{31}$S, $^{33}$Cl, $^{35}$Ar, $^{37}$K, $^{39}$Ca |
| Ba55 | S. Bashkin et al. | Phys. Rev. 99, 107 (1955) | $^{11}$C |
| Ba77 | P.H. Barker et al. | Nucl. Phys. A 275, 37 (1977) | $^{27}$Si |
| Ba84 | P. Baumann et al. | Phys. Rev. C 50, 1180 (1994) | $^{67}$Se |
| Be75 | H. Behrens et al. | Nucl. Phys. A 246, 317 (1975) | $^{11}$C |
| Bi68 | J. Black, J. Mahieux | Nucl. Instrum. Methods 58, 93 (1968) | $^{27}$Si |
| B95 | B. Blank et al. | Phys. Lett. B 364, 8 (1995) | $^{67}$Se, $^{71}$Kr |
| B99 | B. Blank | J. Phys. G 25, 629 (1999) | $^{79}$Zr |
| Bo65 | M. Bormann et al. | Nucl. Phys. A 63, 438 (1965) | $^{13}$N |
| Bu85 | T.W. Burrows et al. | Phys. Rev. C 31, 1490 (1985) | $^{47}$Cr |
| Bu91 | B. Budick et al. | Phys. Rev. Lett. 67, 2630-2633 (1991) | $^{23}$H |
| Cl58 | J.E. Cline, P.R. Chagnon | Bull. Am. Phys. Soc. 3, No.3, 206, $^{31}$S, $^{39}$Ca RA5 (1958) |
| Di51 | J.M. Dickson, T.C. Randle | Proc. Phys. Soc. (London) 64A, 11C 902 (1951) |
| Ea62 | L.G. Earwaker et al. | Nature 195, 271 (1962) | $^{19}$Ne |
| Eb65 | T.G. Ebrey, P.R. Gray | Nucl. Phys. A 61, 479 (1965) | $^{13}$N |
| Ed77 | M.D. Edmiston et al. | Nucl. Instrum. Methods 141, 315 (1977) | $^{47}$Cr |
| Ew81 | G.T. Ewan et al. | Nucl. Phys. A 352, 13 (1981) | $^{71}$Kr |
| Ge76 | H. Genz et al. | Nucl. Instrum. Methods 134, 309 (1976) | $^{27}$Si |
| Go68 | J.D. Goss et al. | Nucl. Phys. A 115, 113 (1968) | $^{13}$Ne, $^{23}$Mg, $^{27}$Si |
| Gr71 | D. Grober, W. Gruhle | BMBW-FBK-71-09, p.90 (1971) | $^{31}$Si |
| Ha52 | R.N.H. Haslam et al. | Can. J. Phys. 30, 257 (1952) | $^{31}$S |
| Ha80 | J.C. Hardy et al. | Phys. Lett. B 91, 207 (1980) | $^{49}$Mn |
| Ha87 | H. Hama et al. | Proc. 5th Int. Conf. Nuclei Far from Stability, Rosseau Lake, Canada 1987, Ed., I.S. Towner, p.650 (1988) |
| Ho77 | P. Hornshoj et al. | Nucl. Phys. A 288, 429 (1977) | $^{55}$Ni |
| Ho82 | P. Hornshoj et al. | Phys. Lett. B 116, 4 (1982) | $^{45}$V |
| Ho87 | J. Honkanen et al. | Nucl. Phys. A 471, 489 (1987) | $^{43}$Ti |
| Ho89 | J. Honkanen et al. | Nucl. Phys. A 496, 462 (1989) | $^{53}$Co |
| Hu03 | J. Huikari et al. | Eur. Phys. J. A16, 359 (2003) | $^{79}$Sr |
| Hu54 | S.E. Hunt et al. | Phys. Rev. 95, 611A (1954) | $^{31}$S |
| Ia06 | V.E. Iacob et al. | Phys. Rev. C 74, 055502 (2006) | $^{35}$Ar |
| Code  | Authors                   | Reference                  | Measured nuclei |
|-------|---------------------------|----------------------------|-----------------|
| [Ja60]| J. Janecke                | Z.Naturforsch. 15a, 593 (1960) | $^{13}$N, $^{15}$O, $^{29}$P, $^{31}$S, $^{33}$Cl, $^{35}$Ar, $^{41}$Sc, $^{43}$Ti |
| [Ja61]| J. Janecke, H. Jung       | Z. Phys. 165, 94 (1961)       | $^{13}$Ti       |
| [Je50]| G.H. Jenkins et al.       | Phys. Rev. 80, 990-995 (1950) | $^{3}$H        |
| [Je51]| W.M. Jones                | Phys. Rev. 83, 537-539 (1950) | $^{3}$H        |
| [Je55]| W.M. Jones                | Phys. Rev. 100, 124-125 (1955) | $^{3}$H        |
| [Je67]| P.M.S. Jones              | J. Nucl. Mater. 21, 239-240 (1967) | $^{3}$H        |
| [Ju71]| F. Jundt et al.           | Nucl.Phys. A 170, 12 (1971)   | $^{25}$Al      |
| [Ka64]| R.W. Kavanagh, D.R. Goosman | Phys. Lett. 12, 229 (1964); Erratum Phys.Lett. 13, 358 (1964) | $^{37}$K       |
| [Ka64a]| R.W. Kavanagh et al.      | Can. J. Phys. 42, 1429 (1964) | $^{11}$C       |
| [Ka68]| J.A. Kadleccek            | Bull. Am. Phys. Soc. 13, 676, $^{39}$Ca | HF15 (1968)    |
| [Ki01]| K. Kienle et al.          | Prog. Part. Nucl. Phys. 46 77Y, $^{79}$Zr, $^{83}$Mo (2001)73 |
| [Kl54]| R.M. Kline, D.J. Zaffarano  | Phys.Rev. 96, 1620 (1954)  | $^{39}$Ca     |
| [Ko73]| S. Kochan et al.          | Nucl. Phys. A 204, 185 (1973) | $^{53}$Co      |
| [Ku53]| D. N. Kundu et al.        | Phys. Rev. 89, 1200 (1953)   | $^{11}$C       |
| [Li60]| K.H. Lindenberger, J.A. Scheer | Z.Physik 158, 111 (1960) | $^{31}$S, $^{39}$Ca |
| [Lo02]| M. Lopez-Jimenez, B. Blank et al. | Phys. Rev. C 66, 025803 (2002) | $^{53}$Co, $^{55}$Ni, $^{57}$Cu, $^{59}$Zn, $^{61}$Ga, $^{63}$Ge, $^{65}$As, $^{67}$Se, $^{71}$Kr |
| [Lu00]| L.L. Lucas and M.P. Unterweger | J. Res. Natl. Inst. Stand. Technol. $^{5}$H | 541 (2000)    |
| [Ma06]| D. MacMahon               | Appl. Rad. Isot. 64, 1417-1419 | $^{5}$H       |
| [Me66]| J.S. Merritt and J.G.V. Taylor | Report AECL-2510, Atomic Energy of Canada Limited, Chalk River Laboratory, Chalk River, Ontario (1966), p28 |
| [Mi58]| M.V. Mihailovic, B. Povh   | Nuclear Phys. 7, 296 (1958)  | $^{27}$Si, $^{39}$Ca |
| [Mo95]| D.J. Morrissey            | Nucl. Phys. A 588, c203 (1995) | $^{65}$As      |
| [Mu58]| T. Muller et al.          | Physica 24, 577 (1958)        | $^{25}$Al, $^{33}$Cl |
| [Ne63]| J.W. Nelson et al.        | Phys.Rev. 129, 1723 (1963)   | $^{15}$O, $^{33}$S, $^{35}$Ar |
| [No47]| A. Novick                 | Phys. Rev. 72, 972 (1947)     | $^{3}$H       |
| [Oj97]| M.Oimonen et al.          | Phys.Rev. C 56, 745 (1997)    | $^{71}$Kr       |
| [Ol87]| B.M. Oliver et al.        | Appl. Radiat. Isot. 38, 959-965 (1987) | $^{5}$H |
| [Pe57]| J.R. Penning, F.H. Schmidt | Phys.Rev. 105, 647(1957)      | $^{15}$O, $^{19}$Ne |
| [Pi85]| L. E. Pihonen             | PhD thesis, Princeton University $^{19}$Ne |
| [Pl62]| H.S. Plendl et al.        | Conf. Low Energy Nuclear Phys. Harwell (september 1962): AERE-R-4131, 22 (1962) abstr.7a8 |
| [Po59]| M.M. Povov et al.         | Atomnaya Energiya 4, 196-298 $^{3}$H (1958). English translations: Soviet J. At. Energy 4, 393-396 (1958) and J. Nucl. Energy 9, 190-193 (1959) |
| [Pr57]| I.D. Prokoshkin, A.A. Tiapkin | Zhur. Eksptl.I Teoret.Fiz. 32,117 $^{11}$C (1957); Soviet Phys. JETP 5, 148 (1957) |
| [Re99]| I. Reusen et al.           | Phys. Rev. C 59, 2416 (1999)  | $^{55}$Ni     |
| [Ri68]| A.I.M. Ritchie            | Nucl.Instr.Methods 64, 181 (1968) $^{14}$N |
| Code | Authors | Reference | Measured nuclei |
|------|---------|-----------|----------------|
| [Ru77] | C.R. Rudy and K.C. Jordan | Progress Report MLM-2458, U.S. Department of Energy, Mound Laboratory, Miamisburg, Ohio, December 1977, pp. 2-10 | \(^{3}\text{H}\) |
| [Sc48] | A.D. Schelberg et al. | Rev. Sci. Instr. 19, 458 (1948) | \(^{43}\text{Ti}\) |
| [Sc58] | F. Schweizer | Phys.Rev. 110, 1414 (1958) | \(^{37}\text{K}\) |
| [Sc70] | P.J. Scanlon, D. Crabtree | Can.J.Phys. 48, 1578 (1970) | \(^{29}\text{P},^{33}\text{Cl}\) |
| [Se96] | D.R. Semon et al. | Phys.Rev. C 53, 96 (1996) | \(^{57}\text{Cu}\) |
| [Sh89] | T. Shinozuka et al. | Proc. XXIII Yamada Conference on Nuclear Weak Process and Nuclear Structure, Osaka 1989, Eds. M. Morita, H. Ejiri, H. Ohtsubo, and T. Sato (World Scientific, Singapore, 1989), p. 108 | \(^{67}\text{Cu}\) |
| [Sh93] | B.M. Sherrill et al. | Proc. 6th Int. Conf. On Nuclei Far from Stability + 9th Conf. On Atomic Masses and Fundamental Constants, Germany 1992, R. Neugard, A. Wohr eds., 891 (1993) | \(^{63}\text{Ge}\) |
| [Si87] | J.J. Simpson | Phys. Rev. C 35, 752-754 (1987) | \(^{3}\text{H}\) |
| [Sm41] | J.H.C. Smith, D.B. Cowie | J. Appl. Phys. 12, 78 (1941) | \(^{11}\text{C}\) |
| [Su62] | D.C. Sutton | Thesis, Princeton University (1962) | \(^{27}\text{Si}\) |
| [Ta73] | I.Tanihata et al. | J.Phys.Soc.Jap. 34, 848 (1973) | \(^{25}\text{Al},^{29}\text{P},^{33}\text{Cl},^{41}\text{Sc}\) |
| [Un00] | M.P. Unterweger and L. L. Lucas | Appl. Radiat. Isot. 52, 527-531 (2000) | \(^{3}\text{H}\) |
| [Va63] | S.S. Vasilev, L.Y. Shavtvalov | Zhur. Eksperim. I Teor. Fiz. 45, 1385 (1963), Soviet Phys. JETP 18, 995 (1964) | \(^{43}\text{Ti}\) |
| [Va69] | S.S. Vasilev et al. | Vestn.Mosk.Univ., Fiz., Astron. No.5, 3 (1969) | \(^{43}\text{Ti}\) |
| [Wa60] | R. Wallace, J.A. Welch, Jr. | Phys.Rev. 117, 1297 (1960) | \(^{31}\text{S}\) |
| [We02] | L. Weissman et al. | Phys.Rev. C 65, art. No. 044321 | \(^{61}\text{Ga}\) |
| [Wi69] | G.L. Wick et al. | Nucl.Phys. A 138, 209 (1969) | \(^{35}\text{Ar}\) |
| [Wi74] | D.H. Wilkinson, D.E. Alburger | Phys.Rev. C 10, 1993 (1974) | \(^{19}\text{Ne}\) |
| [Wi80] | H.S. Wilson et al. | Phys.Rev. C 22, 1696 (1980) | \(^{29}\text{P},^{31}\text{S}\) |
| [Wi93] | J.A. Winger et al. | Phys.Lett. B 299, 214 (1993), Phys. Rev. C 48, 3097 (1993) | \(^{61}\text{Ga},^{63}\text{Ge},^{65}\text{As}\) |
| [Wo02] | D.H. Woods et al. | App. Rad. Isot. 56, 327 (2002) | \(^{11}\text{C}\) |
| [Wo99] | V.K. Wohleben, E. Schuster | Radiochim.Acta 12, 75 (1969) | \(^{15}\text{F}\) |
| [Yo65] | D.H. Youngblood et al. | Nucl.Phys. 65, 602 (1965) | \(^{41}\text{Sc}\) |
| Code     | Authors                  | Reference               | Measured nuclei                  |
|----------|--------------------------|-------------------------|-----------------------------------|
| [A57]    | W.P. Alford, D.R. Hamilton | Phys. Rev. 105, 673 (1957) | $^{13}$Ne, $^{35}$Ar            |
| [A59]    | J.S. Allen et al.        | Phys. Rev. 116, 134 (1959) | $^{13}$Ne, $^{35}$Ar            |
| [Ar58]   | S.E. Arnell et al.       | Nucl. Phys. 6, 196 (1958) | $^{35}$Al                       |
| [Ar81]   | Y. Arai et al.           | Phys. Lett. B 104,186 (1981) | $^{65}$Zn                    |
| Ba64     | J.E.E. Baglin, B.M. Spicer | Nucl. Phys. 54, 549 (1964) | $^{39}$Ca                      |
| Ba70     | T.T. Bardin et al.       | Phys. Rev. C 2, 2283 (1970) | $^{33}$Cl                      |
| Bi51     | J.P. Blaser et al.       | Helv. Phys. Acta 24, 441 (1951) | $^{27}$Si                  |
| Bi95     | B. Blank et al.          | Phys. Lett. B 364, 8 (1995) | $^{75}$Sr                      |
| Bo53     | F.I. Boley               | Iowa State Coll. J. Sci. 27,129 (1953) | $^{41}$Na, $^{23}$Mg, $^{27}$Si, $^{31}$S, $^{33}$Cl, $^{37}$K, $^{39}$Ca |
| Br53     | R. Braams, C.L. Smith    | Phys. Rev. 90, 995 (1953) | $^{39}$Ca                      |
| Bu65     | I.F. Bubb et al.         | Nucl. Phys. 65, 655 (1965) | $^{27}$Si                      |
| Ch53     | J.L.W. Churchill et al.  | Nature 172, 460 (1953) | $^{21}$Al                      |
| C[58]    | J.E. Cline, P.R. Chagnon | Bull. Am. Phys. Soc. 3, No.3, 206, 170 (1953) | $^{21}$Al                  |
| Cr40     | E.C. Creutz et al.       | Phys. Rev. 57, 567 (1940) | $^{21}$Na, $^{27}$Si             |
| Cr62     | J.G. Cramer Jr., C.M. Class | Nucl. Phys. 34, 580 (1962) | $^{41}$Sc                       |
| Cs63     | J. Csikai, G. Peto       | Phys.Letters 4, 252 (1963) | $^{13}$O                       |
| E[41]    | D.R. Elliott, L.D. King  | Phys. Rev. 60, 489 (1941) | $^{37}$Si, $^{35}$Ar, $^{41}$Sc |
| Es72     | M.A. Eswaran et al.      | Phys. Rev. C 5, 1270 (1972) | $^{33}$Cl                      |
| Fr69     | J.M. Freeman et al.      | Phys. Lett. B5, 296 (1969) | $^{35}$Ar                      |
| Ge71     | J.S. Geiger, B.W. Hooton | Can. J. Phys. 49, 663 (1949) | $^{35}$Ar                  |
| Go64     | S. Gorodetzky et al.     | Compt. Rend. Congr. Intern. Phys. Nucl., Paris, P.Gugenberger, Ed., Centre National de la Recherche Scientifique, Paris, Vol.II, p.408 (1964) | $^{37}$Si                  |
| Gr71     | D. Grober, W. Gruhle     | BMWB-FBK-71-09, p.90 (1971) | $^{25}$Al, $^{29}$P             |
| Ho73     | K.R. Hogstrom et al.     | Nucl. Phys. A 215, 598 (1973) | $^{13}$C                    |
| Ho77     | P. Hornshoj et al.       | Nucl. Phys. A 288, 429 (1977) | $^{37}$Cr                    |
| Ho81     | J. Honkanen et al.       | Nucl. Phys. A 366, 109 (1981) | $^{37}$Zn                    |
| Hu41     | P. Huber                | Helv. Phys. Acta 14, 163 (1941) | $^{31}$S                     |
| Hu43     | O. Huber et al.          | Helv. Phys. Acta 16, 33 (1943) | $^{27}$Mg, (1,06 of 1,08)      |
| Hu44     | O. Huber et al.          | Helv. Phys. Acta 17, 195 (1944) | $^{27}$Si                    |
| Hu54     | S.E. Hunt et al.         | Phys. Rev. 95, 611A (1954) | $^{35}$Al, $^{27}$Si             |
| Ja60     | J. Janecke              | Z. Naturforsch. 15A, 593 (1960) | $^{35}$Ar                  |
| Ki01     | K. Kienle et al.         | Prog. Part. Nucl. Phys. 46, 73 (2001) | $^{77}$Sr, $^{79}$Zr         |
| Ki56     | O.C. Kistner et al.      | Phys. Rev. 104, 154 (1956) | $^{35}$Ar                      |
| La49     | R.V. Langmuir           | Phys. Rev. 74, 1559A (1948) | $^{37}$K                      |
| Lo02     | M.J. Lopez-Jimenez et al.| Phys. Rev. C 66, 025803 (2002) | $^{53}$Co, $^{55}$Ni, $^{57}$Cu, $^{59}$Zn, $^{61}$Ga, $^{63}$Ge, $^{65}$As, $^{67}$Se, $^{71}$Kr |
| Mc49     | J. McElhinney et al.     | Phys. Rev. 75, 542 (1949) | $^{31}$S                      |
| Mo71     | C.E. Moss et al.         | Nucl. Phys. A 170, 111 (1971) | $^{25}$Al, $^{37}$K             |
| Na54     | M.E. Nahmias            | J. Phys. Radium 15, 677 (1954) | $^{13}$Ne                    |
| Ne63     | J.W. Nelson et al.       | Phys. Rev. 129, 1723 (1963) | $^{15}$O, $^{33}$S, $^{35}$Ar |
| Pa65     | J.R. Patterson et al.    | Proc. Phys. Soc. (London) 86, 11 (1965) | $^{13}$C                     |
| Ph53     | P. Phipps, D.J. Zaffarano | ISC-443 (1953) | $^{21}$Na                      |
| Rl55     | C.S. Ring Jr., D.J. Zaffarano | ISC-648 (1955) | $^{39}$Ca                      |
| Sc52     | G. Schrank, J.R. Richardson | Phys. Rev. 86, 248-248 (1952) | $^{13}$Ne, $^{21}$Na             |
| Sh84     | T. Shinozuka et al.      | Phys. Rev. C 30, 2111 (1984) | $^{37}$Cu                     |
| Si44     | K. Siegbahn             | Arkiv. Mat. Astron. Fysik 30A, no. 20 (1944) | $^{11}$C                  |
| Code       | Authors                  | Reference                                                                 | Measured nuclei           |
|------------|--------------------------|---------------------------------------------------------------------------|---------------------------|
| [Si73]     | J. Singh                 | Proc. Nucl. Phys. and Solid State 11^C, 13^N                              |                           |
|            |                          | Phys. Symp., Chandigarh, Vol. 15B, p. 1 (1973)                            |                           |
| [So41]     | A.K. Solomon             | Phys. Rev. 60, 279 (1941)                                                | 11^C                      |
| [Su53]     | R.G. Summers-Gill et al. | Can. J. Phys. 31, 70 (1953)                                              | 22^Si                     |
| [Su58]     | C.R. Sun, B.T. Wright    | Phys. Rev. 109, 109 (1958)                                               | 37^K                      |
| [Ty54]     | H. Tyren, P.A. Tove      | Phys. Rev. 96, 773 (1954)                                                | 43^Ti                     |
| [Va60]     | S.S. Vasilev, L.Y. Shavtvalov | Zhur. Eksptl. I teoret. Fiz. 39, 27^Si (1960)                           | Soviet Phys. JETP 12, 851 (1961) |
| [Va62]     | S.S. Vasilev, L.Y. Shavtvalov | Izvest. Akad. Anuk SSSR, Ser. Fiz. 26, 1495 (1962); Columbia Tech. Transl. 26, 1521 (1963) |
| [Wa60]     | R. Wallace, J.A. Welch, Jr. | Phys. Rev. 117, 1297 (1960)                                             | 21^Na, 23^Mg, 25^Al, 27^Si, 29^P, 33^Cl, 35^Ar, 37^K, 39^Ca, 43^Sc |
| [Wh39]     | M.G. White et al.        | Phys. Rev. 56, 512-518 (1939)                                            | 19^Ne, 23^Mg              |
| [Wh41]     | M.G. White et al.        | Phys. Rev. 59, 63-68 (1941)                                              | 29^P, 31^S, 33^Cl, 35^Ar |
|            |                          | No error bar quoted, and/or no definite value, merely a limit.            |                           |
| [Ho40]     | J.B. Hoag                | Phys. Rev. 57, 937 (1940)                                                | 33^Cl                     |
| [Ma52]     | W.M. Martin, S.W. Breckon | Can. J. Physics 30, 64 (1952)                                            | 39^Ca                     |
| [B98]      | B. Blank                 | J. Phys. G 24, 1385 (1998)                                               | 77^Y                      |
| [Ki01]     | K. Kienle et al.         | Prog. Part. Nucl. Phys. 46, 73 (2001)                                     |                           |
|            |                          | Updated in [Re95]                                                        |                           |
| [Re95]     | I. Reusen et al.         | Proc. Intern. Conf. On exotic 55^Ni                                      |                           |
|            |                          | Nuclei and Atomic Masses, Arles 1995, 757                                |                           |
| [Ve94]     | L. Vermeeren et al.      | Phys. Rev. Lett. 73, 1935 (1994)                                         | 55^Ni                     |
|            |                          | Pre-1958 data that are systematically higher than later and equally precise results. |
| [Ch53]     | J.L.W. Churchill et al.  | Nature 172, 460 (1953)                                                   | 13^N                      |
| [Da57]     | H. Daniel, U. Schmidt-Rohr | Z. Naturforsch. 12A, 750 (1957)                                          | 13^N                      |
| [De57]     | A.S. Deineko et al.      | Zhur. Eksptl. I Teoret. Fiz. 32, 251 (1957); Soviet Phys. JETP 5, 201 (1957) |
|            |                          | 13^N SUPPORTED BY 35^Cl                                                   |                           |
| [Ho50]     | W.F. Hornyak et al.      | Rev. Mod. Phys. 22, 291 (1950), 13^N                                     |                           |
| [No57]     | E. Norbeck Jr., C.S. Littlejohn | Phys. Rev. 108, 754 (1957)                                               | 13^N                      |
| [Si45]     | K. Siegbahn, Slaetis     | Arkiv. Mat. Astron. Fysik 32A, 13^N                                       |                           |
| [Wa39]     | Ward                    | Proc. Camb. Phil. Soc. 35, 523 (1939)                                     | 13^N                      |
| [Wi55]     | D.H. Wilkinson           | Phys. Rev. 100, 32 (1955)                                                | 13^N                      |
|            |                          | Strongly deviating values, possible contamination.                        |                           |
| [Ba55]     | S. Bashkin et al.        | Phys. Rev. 99, 107 (1955)                                                | 15^O                      |
| [Br50]     | H. Brown and V. Perez-Mendez | Phys. Rev. 78, 649 (1950)                                               | 15^O                      |
| [Ki57]     | O.C. Kistner et al.      | Phys. Rev. 105, 1339 (1957)                                             | 15^O                      |
| [Kl54]     | R. M. Kline, D.J. Zaffarano | Phys. Rev. 96, 1620 (1954)                                               | 15^O                      |
|            |                          | Pre-1969 data that are systematically higher, possibility of 15^O contamination. |
| [Ar58]     | S.E. Arnell et al.       | Nucl. Phys. 6, 196 (1968)                                                | 17^F                      |
| [Br49]     | H. Brown and V. Perez-Mendez | Phys. Rev. 75, 1286A (1949)                                             | 17^F                      |
| [Ja60]     | J. Janecke               | Z. Naturforsch. 15A, 593 (1960)                                          | 17^F                      |
| [Ko54]     | L. Koester              | Z. Naturforsch. 9A, 104 (1954)                                           | 17^F                      |
| Code  | Authors                  | Reference                | Measured nuclei |
|-------|--------------------------|--------------------------|-----------------|
| [La51] | R.A. Laubenstein *et al.* | Phys. Rev. 84, 12 (1951) | $^{17}$F        |
| [Wo54] | C. Wong                  | Phys. Rev. 95, 765-766 (1954) | $^{17}$F        |

**Strongly deviating measurements.**

| Code  | Authors | Reference | Measured nuclei |
|-------|---------|-----------|-----------------|
| [Ja60] | J. Janecke | Z. Naturforsch. 15A, 593 (1960) | $^{19}$Ne |
| [Va64] | S.S. Vasilev *et al.* | Zhur. Eksperim. I Teor. Fiz. 47, 1164 (1964), Soviet Phys. JETP 20, 783 (1965) | $^{19}$Ne |
| [Wa60] | R. Wallace, J.A. Welch, Jr. | Phys. Rev. 117, 1297 (1960) | $^{19}$Ne |
| [Mi58] | M.V. Mihailovic, B. Povh | Nuclear Phys. 7, 296 (1958) | $^{23}$Mg |
| [Ro55] | H. Roderick *et al.* | Phys. Rev. 97, 97-101 (1955) | $^{29}$P |
| [El41] | D.R. Elliott, L.D. King | Phys. Rev. 60, 489 (1941) | $^{31}$S |
| [Mi58] | M.V. Mihailovic, B. Povh | Nucl. Phys. 7, 296 (1958) | $^{31}$S |
| [El41] | D.R. Elliott, L.D. King | Phys. Rev. 60, 489 (1941) | $^{41}$Sc |
| [Wa60] | R. Wallace, J.A. Welch, Jr. | Phys. Rev. 117, 1297 (1960) | $^{41}$Sc |
| [Ho77] | P. Hornshoj *et al.* | Nucl. Phys. A 288, 429 (1977) | $^{51}$Fe |
[1] F. P. Calaprice, S. J. Freedman, W. C. Mead and H. C. Vantine, Phys. Rev. Lett. 35, 1566 (1975).
[2] D. F. Schreiber, Ph.D. thesis, Princeton University (Princeton, NJ, 1983).
[3] J. D. Garnett, E. D. Commins, K. T. Lesko and E. B. Norman, Phys. Rev. Lett. 60, 499 (1988).
[4] N. Severijns, J. Wouters, J. Vanhaeverbeke and L. Vanneste, Phys. Rev. Lett. 63, 1050 (1989).
[5] G. S. Masson and P. A. Quin, Phys. Rev. C 42, 1110 (1990).
[6] A. Converse et al., Phys. Lett. B 304, 60 (1993).
[7] D. Melconian et al., Phys. Lett. B 649, 370 (2007).
[8] N. D. Scielzo, Ph.D. thesis (UC Berkeley, Berkeley), unpublished (2003).
[9] N. D. Scielzo, S. J. Freedman, B. K. Fujikawa and P. A. Vetter, Phys. Rev. Lett. 93, 102501 (2004).
[10] P. A. Vetter, J. R. Abo-Shaeer, S. J. Freedman and R. Maruyama, Phys. Rev. C 77, 035502 (2008).
[11] V.E. Iacob, J.C. Hardy, C.A. Gagliardi, J. Goodwin, N. Nica, G. Tabacaru, L. Trache, R.E. Tribble, Y. Zhai and I.S. Towner, Phys. Rev. C 74, 015501 (2006).
[12] M. Beck et al., Nucl. Instr. and Methods in Phys. Res. A 503, 567 (2003).
[13] J. A. Behr et al., Eur. Phys. J. A 25, 685 (2005).
[14] G. P. Berg et al., Nucl. Instr. and Methods in Phys. Res. B 204, 532 (2003).
[15] L. Broussard et al., KVI Annual Report 2005, p. 11.
[16] M. Sohani, Acta Physica Polonica B37, 1001 (2006).
[17] S. Raman, C. A. Houser, T. A. Walkiewicz and I. S. Towner, Atomic Data and Nuclear Data Tables 21, 567 (1978).
[18] G. Audi, O. Bersillon, J. Blachot and H. Wapstra, Nucl. Phys. A 729, 3 (2003).
[19] W. Bambryne, H. Behrens, M. H. Chen, B. Crasemann, M. L. Fitzpatrick, K. W. D. Leding-ham, H. Genz, M. Muttererand, R. L. Intemann, Rev. Mod. Phys. 49, 77 (1977).
[20] R. B. Firestone, Table of Isotopes, Eighth Edition, (Wiley, New York, 1996).
[21] J. C. Hardy and I. S. Towner, Phys. Rev. C 71, 055501 (2005).
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| Parent | Measured half-lives, $t_{1/2}$ (s) | Average half-life scale $t_{1/2}$ (s) |
|--------|----------------------------------|----------------------------------|
|        |                                  |                                  |
| $^3$H  | $4419 \pm 183$ d [No47]          | $122.3 \pm 0.23$ [Az77]          |
|        | $4596 \pm 66$ d [Po58]           | $17.7 \pm 0.1$ [Pe57]            |
|        | $4498 \pm 11$ d [Si87]           | $7.24 \pm 0.03$ [Mu58]           |
|        | $4504 \pm 9$ d [Un00]            | $4.14 \pm 0.03$ [Kl58]           |
|        | $0.25 \pm 0.2$ m [Sm41]         | $0.49 \pm 0.02$ [Ja60]           |
|        | $0.8 \pm 0.2$ m [P75]           | $0.84 \pm 0.02$ [W80]            |
|        | $0.38 \pm 0.02$ m [Az75]        | $2.66 \pm 0.03$ [Ha52]           |
|        | $0.96 \pm 0.02$ m [EB65]        | $2.57 \pm 0.01$ [Ja60]           |
|        | $123.95 \pm 0.50$ [P57]         | $2.54 \pm 0.008$ [Az77]          |
| $^{11}$C|                                  |                                  |
|        | $20.35 \pm 0.08$ m [Sm41]       | $121.4 \pm 0.5$ [Ki59]           |
|        | $20.8 \pm 0.2$ m [P75]          | $122.23 \pm 0.23$ [Az77]         |
| $^{13}$N| $9.96 \pm 0.03$ m [Az58]        | $17.219 \pm 0.017$ [Az75]        |
|        | $9.96 \pm 0.02$ m [EB65]        | $23.0 \pm 0.2$ [Az58]            |
| $^{15}$O| $123.95 \pm 0.50$ [P57]         | $20.11 \pm 0.05$ [Go68]          |
|        | $12.1 \pm 0.1$ [Mi58]           | $11.327 \pm 0.014$ [Az75]        |
| $^{17}$F| $65.2 \pm 0.2$ [W69]            | $20.57 \pm 0.1$ [Ja60]           |
| $^{19}$Ne| $17.7 \pm 0.1$ [Pe57]          | $7.24 \pm 0.03$ [Mu58]           |
|        | $23.0 \pm 0.2$ [Az58]           | $4.14 \pm 0.03$ [Kl58]           |
| $^{25}$Al| $7.24 \pm 0.03$ [Mu58]          | $4.14 \pm 0.03$ [Kl58]           |
|        | $2.65 \pm 0.03$ [Mu58]          | $2.53 \pm 0.02$ [Mu58]           |
| $^{29}$P| $4.19 \pm 0.02$ [Ja60]          | $0.49 \pm 0.05$ [V63]            |
|        | $0.48 \pm 0.02$ [W80]           | $0.539 \pm 0.018$ [Ho82]         |
| $^{31}$S| $2.66 \pm 0.03$ [Ha52]          | $0.4600 \pm 0.0015$ [Ed77]       |
| $^{33}$Cl| $2.53 \pm 0.02$ [Mu58]          | $1.79 \pm 0.01$ [Ja60]           |
|        | $2.57 \pm 0.02$ [Mu58]          | $0.384 \pm 0.017$ [Ha80]         |
| $^{35}$Ar| $1.79 \pm 0.01$ [Ja60]          | $1.23 \pm 0.02$ [Sc58]           |
|        | $0.90 \pm 0.01$ [Kl51]          | $0.865 \pm 0.007$ [Kl66]         |
| $^{37}$K| $1.23 \pm 0.02$ [Sc58]          | $0.58 \pm 0.04$ [Sc48]           |
|        | $0.90 \pm 0.01$ [Kl51]          | $0.40 \pm 0.05$ [V63]            |
| $^{39}$Ca| $1.23 \pm 0.02$ [Sc58]          | $0.539 \pm 0.018$ [Ho82]         |
|        | $0.90 \pm 0.01$ [Kl51]          | $0.4600 \pm 0.0015$ [Ed77]       |
| $^{41}$Sc| $0.58 \pm 0.04$ [Sc48]          | $0.384 \pm 0.017$ [Ha80]         |
| $^{43}$Ti| $0.40 \pm 0.05$ [V63]           | $0.539 \pm 0.018$ [Ho82]         |
| $^{45}$V| $0.539 \pm 0.018$ [Ho82]        | $0.4600 \pm 0.0015$ [Ed77]       |
| $^{47}$Cr| $0.4600 \pm 0.0015$ [Ed77]     | $0.384 \pm 0.017$ [Ha80]         |
| $^{49}$Mn| $0.384 \pm 0.017$ [Ha80]        | $0.310 \pm 0.005$ [Ay84]         |
| $^{51}$Fe| $0.310 \pm 0.005$ [Ay84]        | $0.262 \pm 0.025$ [Ko73]         |
| $^{53}$Co| $0.262 \pm 0.025$ [Ko73]        | $0.189 \pm 0.005$ [Ho79]         |
| $^{55}$Ni| $0.189 \pm 0.005$ [Ho79]        | $0.196 \pm 0.005$ [Lo02]         |
|        | $0.194 \pm 0.0032$ [Sh89]       | $0.194 \pm 0.0032$ [Sh89]        |
|        | $0.182 \pm 0.0018$ [Ar84]       | $0.173 \pm 0.014$ [Lo02]         |
| $^{57}$Cu| $0.15 \pm 0.03$ [W93]           | $0.15 \pm 0.03$ [W93]            |
|        | $0.95 \pm 0.023$ [W93]          | $0.19 \pm 0.01$ [W93]            |
| $^{61}$Ga| $0.11 \pm 0.07$ [W93]           | $0.107 \pm 0.02$ [Ba94]          |
|        | $0.26 \pm 0.025$ [Ko73]         | $0.217 \pm 0.009$ [Ew81]         |
| $^{67}$Sc| $0.060 \pm 0.017$ [Ba94]        | $0.088 \pm 0.003$ [Hu63]         |
|        | $0.097 \pm 0.009$ [Ew81]        | $0.057 \pm 0.002$ [Ko101]        |
| $^{75}$Sr| $0.056 \pm 0.030$ [Bi99]        | $0.060 \pm 0.000$ [Mo103]        |
| $^{83}$Mo| $0.006 \pm 0.003$ [Mo103]       | $0.028 \pm 0.019$ [Ko101]        |

*We did not perform the analysis of the tritium half-lives ourselves, but rather used the value (and the references) from [Ma60]. An interesting effect is mentioned in [Ak04]; the half-life of molecular and atomic $^3$H would differ by about 9 days. Due to a lack of additional information on this (recently observed) effect we have not included it in the present compilation. All measurements, except for [Ak04], have been performed on molecular tritium.

6*The weighted average including [Mi58] is $11.330 \pm 0.030$, compared to $11.3243 \pm 0.0098$ without [Mi58], both with scaling. Since [Mi58] has a strongly deviating value, it was decided to drop this result.

7*Note that without [Mi58], the central value of which differs from later results, the weighted average becomes $2.567 \pm 0.011$ s.

8*The weighted average discarding [Ja60] is $0.5124 \pm 0.0085$ s, compared to $0.5222 \pm 0.0057$ s, both with scaling included. Since there is no clear reason to drop [Ja60] it was decided to keep it. Note that this is the most precise result, yet it dates from 1960.

Table I: Half-lives, $t_{1/2}$, of the mirror nuclei, expressed in seconds unless specified differently (days (d), minutes (m)). References to data listed in this table are given in Table VII. References to data that were not used are listed in Table VIII.
| Parent nucleus | Measured branching ratio, BR (%) | Average value scale |
|---------------|---------------------------------|---------------------|
|               |                                 | BR (%)   | S         |
| $^3$H         | 100 [Ti87]                      | 100      |           |
| $^{11}$C      | 100 [Aj75]                      | 100      |           |
| $^{13}$N      | 100 [Aj70]                      | 100      |           |
| $^{15}$O      | 100 [Aj70]                      | 100      |           |
| $^{17}$F      | 100 [Aj70]                      | 100      |           |
| $^{19}$Ne     | BR(1.55MeV): $0.0021 \pm 0.0003$ [Al76] | $0.0023 \pm 0.0003$ [Ad83] | 99.9858 ± 0.0020 1 |
|               | BR(0.11MeV): $0.012 \pm 0.002$ [Ad81] | $0.011 \pm 0.009$ [Sa93] | 99.151 ± 0.031 1 |
| $^{21}$Na     | 94.9 ± 0.2 [Al74]               | 95.8 ± 0.2 [Az77] | 94.98 ± 0.13 [Wi80] | 95.235 ± 0.069 2.0 |
| $^{23}$Mg     | 90.9 ± 0.5 [Ta60]               | 91.4 ± 0.4 [Ar68a] | 90.9 ± 0.4 [Al74] | 91.78 ± 0.26 1.8 |
| $^{25}$Al     | 99.16 ± 0.07 [Ju71]             | 99.1 ± 0.2 [Ma69] | 99.11 ± 0.08 [Ma76] | 98.290 ± 0.030 1 |
| $^{27}$Si     | 99.90 ± 0.02 [Go64]             | 99.80 ± 0.07 [De71] | 99.82 ± 0.05 [Be71] | 98.837 ± 0.031 1 |
| $^{29}$P      | 99.77 ± 0.02 [Ma74]             | 99.81 ± 0.01 [Az77] | 99.981 ± 0.022 2.8 |
| $^{31}$S      | 98.8 ± 0.3 [Lo62]               | 98.81 ± 0.30 [Az77] | 98.29 ± 0.03 [Wi80] | 98.45 ± 0.14 1 |
| $^{33}$Cl     | 98.9 ± 0.1 [Ta60]               | 99.2 ± 0.4 [De71] | 98.75 ± 0.06 [Al74] | 98.358 ± 0.066 2.2 |
| $^{35}$Ar     | 98.89 ± 0.20 [Az77]             | 98.86 ± 0.04 [Wi80] | 98.837 ± 0.031 1 |
| $^{37}$K      | 98.3 ± 0.2 [Ba70]               | 98.58 ± 0.19 [Wi80] | 98.358 ± 0.066 2.2 |
| $^{39}$Ca     | 97.89 ± 0.11 [Ha97]             | 97.99 ± 0.14 1.7 |
| $^{41}$Sc     | 99.9975 ± 0.0002 [Ha94]          | 99.9975 ± 0.0002 |
| $^{43}$Ti     | 99.963 ± 0.0003 [Wi80]           | 99.963 ± 0.003 |
| $^{45}$V      | 90.2 ± 0.8 [Ho87]               | 90.2 ± 0.8 |
| $^{47}$Cr     | 95.7 ± 1.5 [Ho82]               | 95.7 ± 1.5 |
| $^{49}$Mn     | 96.3 ± 1.2 [Bu85]               | 96.3 ± 1.2 |
| $^{51}$Fe     | 93.6 ± 2.6 [Ha80]               | 91.9 ± 2.8 [Ho89] | 92.8 ± 1.9 1 |
| $^{53}$Co     | 95.0 ± 1.3 [Ay84]               | 93.8 ± 1.3 [Ho89] | 94.0 ± 0.92 1 |
| $^{55}$Cu     | 94.4 ± 1.7 [Ho89]               | 94.4 ± 1.7 |
| $^{57}$Zn     | 94.3 ± 1.7 [Ho89]               | 94.3 ± 1.7 |
| $^{61}$Ga     | 94 ± 1 [We02]                   | 94 ± 1 |
| $^{71}$Kr     | 82.1 ± 1.6 [Oh97]               | 82.1 ± 1.6 |
| $^{75}$Sr     | 90.3 ± $\frac{1}{2}$ [Hu03] a  | 89.6 ± 2.4 |

*aThese asymmetric errors have been symmetrized for the analysis by using standard recommendations of the Particle Data Group.

Table II: Branching ratios, BR, for the $T = 1/2$ mirror $\beta$ transitions. References to data listed here are given in Table IX. References to rejected are listed in Table X.
Table III: Overview of the adopted values for the half-lifes, $t_{1/2}$, and the branching ratios, $BR$, for the $T = 1/2$ mirror $\beta$ transitions, together with the electron capture probabilities, $P_{EC}$, (from [19, 20]), the deduced partial half-lifes, $t$, (cf. Eq. (6)) and the $Q_{EC}$ values (from [18]).

| Parent nucleus | $t_{1/2}$ (s) | $P_{EC}$ (%) | $BR$ (%) | $t$ (s) | $Q_{EC}$ (keV) |
|---------------|---------------|--------------|----------|---------|---------------|
| $^3$H         | $(38854 \pm 35) \times 10^4$ N/A | 100          |          | $(38854 \pm 35) \times 10^4$ 18.5912 ± 0.0010 |
| $^{11}$C      | 1221.6 ± 1.5  | 0.231        | 100      | 1224.4 ± 1.5   | 1982.40 ± 0.90 |
| $^{13}$N      | 597.88 ± 0.23 | 0.196        | 100      | 599.05 ± 0.23  | 2220.47 ± 0.27 |
| $^{15}$O      | 122.24 ± 0.27 | 0.100        | 100      | 122.37 ± 0.27  | 2754.16 ± 0.50 |
| $^{17}$F      | 64.61 ± 0.17  | 0.147        | 100      | 64.70 ± 0.17   | 2760.51 ± 0.27 |
| $^{19}$Ne     | 17.248 ± 0.029| 0.101 99.9858 ± 0.0020 | 17.268 ± 0.029 | 3283.83 ± 0.30 |
| $^{21}$Na     | 22.487 ± 0.054| 0.094 95.235 ± 0.069 | 23.634 ± 0.060 | 3547.58 ± 0.70 |
| $^{23}$Mg     | 11.3243 ± 0.0098 | 0.073 91.78 ± 0.26 | 12.348 ± 0.037 | 4056.1 ± 1.3 |
| $^{25}$Al     | 7.182 ± 0.012  | 0.079 99.151 ± 0.031 | 7.250 ± 0.012 | 4276.63 ± 0.50 |
| $^{27}$Si     | 4.135 ± 0.019  | 0.065 99.818 ± 0.022 | 4.145 ± 0.020 | 4812.36 ± 0.10 |
| $^{29}$P      | 4.140 ± 0.016  | 0.075 98.290 ± 0.030 | 4.215 ± 0.016 | 4942.45 ± 0.60 |
| $^{31}$S      | 2.574 ± 0.017  | 0.069 98.837 ± 0.031 | 2.606 ± 0.017 | 5396.3 ± 1.5  |
| $^{33}$Cl     | 2.5111 ± 0.0040 | 0.075 98.45 ± 0.14 | 2.5526 ± 0.0055 | 5582.59 ± 0.40 |
| $^{35}$Ar     | 1.7752 ± 0.0010 | 0.073 98.358 ± 0.066 | 1.8062 ± 0.0016 | 5966.14 ± 0.70 |
| $^{37}$K      | 1.2248 ± 0.0073 | 0.080 97.99 ± 0.14 | 1.2510 ± 0.0077 | 6147.46 ± 0.20 |
| $^{39}$Ca     | 0.8609 ± 0.0028 | 0.078 99.9975 ± 0.0002 | 0.8616 ± 0.0028 | 6532.61 ± 1.9  |
| $^{41}$Sc     | 0.5962 ± 0.0022 | 0.096 99.963 ± 0.003 | 0.5970 ± 0.0022 | 6495.37 ± 0.16 |
| $^{43}$Ti     | 0.5222 ± 0.0057 | 0.094 90.2 ± 0.8 | 0.5795 ± 0.0082 | 6866.9 ± 7.3  |
| $^{45}$V      | 0.5465 ± 0.0051 | 0.098 95.7 ± 1.5 | 0.572 ± 0.010 | 7126 ± 17  |
| Parent nucleus | \( f_V \) | \( f_V t \) | \( \frac{\delta_V}{f_V} \) | \( \delta_1 \) | \( \delta_2 \) | \( \delta_3 \) | \( \delta_{\alpha^2} \) | \( \delta_R \) | \( \delta_{V1} \) | \( \delta_{V2} \) | \( \delta_{NS}^V \) | \( \delta_{V} - \delta_{NS}^V \) |
|---------------|---------|------------|----------------|-----|-----|-----|---------|-----|-----|-----|---------|---------|
| \(^3\text{H}\) | 2.8757 ± 0.0026 \times 10^{-6} | 1117.3(14) | 1.00492 | 1.816 | -0.084 | 0.001 | 0.035 | 1.768(1) | 0.002(2) | 0.025(1) | -0.13(2) | 0.16(2) |
| \(^{11}\text{C}\) | 3.193 ± 0.012 | 3910(16) | 1.01052 | 1.450 | 0.179 | 0.004 | 0.027 | 1.660(4) | 0.003(3) | 0.925(20) | -0.12(2) | 1.04(3) |
| \(^{13}\text{N}\) | 7.716 ± 0.007 | 4622.0(47) | 1.00450 | 1.396 | 0.208 | 0.006 | 0.025 | 1.635(6) | 0.006(6) | 0.265(15) | -0.06(2) | 0.33(3) |
| \(^{15}\text{O}\) | 35.500 ± 0.044 | 4344(11) | 1.00263 | 1.298 | 0.225 | 0.008 | 0.024 | 1.555(8) | 0.016(10) | 0.165(15) | -0.04(2) | 0.22(3) |
| \(^{17}\text{F}\) | 35.217 ± 0.024 | 2278.6(61) | 1.01704 | 1.297 | 0.257 | 0.010 | 0.023 | 1.587(10) | 0.025(10) | 0.560(25) | -0.04(2) | 0.62(3) |
| \(^{19}\text{Ne}\) | 98.532 ± 0.058 | 1701.4(30) | 1.01428 | 1.226 | 0.272 | 0.012 | 0.022 | 1.533(12) | 0.140(30) | 0.275(25) | -0.11(2) | 0.52(4) |
| \(^{21}\text{Na}\) | 170.97 ± 0.21 | 4041(11) | 1.01801 | 1.186 | 0.291 | 0.015 | 0.021 | 1.514(15) | 0.028(10) | 0.320(25) | -0.06(2) | 0.41(3) |
| \(^{23}\text{Mg}\) | 378.59 ± 0.73 | 4675(17) | 1.01935 | 1.129 | 0.309 | 0.017 | 0.020 | 1.476(17) | 0.023(10) | 0.270(20) | -0.11(2) | 0.40(3) |
| \(^{25}\text{Al}\) | 508.45 ± 0.35 | 3686.1(67) | 1.02373 | 1.108 | 0.328 | 0.020 | 0.020 | 1.475(20) | 0.061(40) | 0.400(25) | -0.06(2) | 0.52(5) |
| \(^{27}\text{Si}\) | 993.61 ± 0.12 | 4119(19) | 1.02697 | 1.059 | 0.342 | 0.023 | 0.019 | 1.443(23) | 0.052(30) | 0.260(15) | -0.11(2) | 0.42(4) |
| \(^{29}\text{P}\) | 1136.7 ± 0.8 | 4791(18) | 1.02231 | 1.047 | 0.361 | 0.026 | 0.020 | 1.453(26) | 0.091(40) | 0.885(35) | -0.09(2) | 1.07(6) |
| \(^{31}\text{S}\) | 1841.5 ± 2.9 | 4798(33) | 1.01951 | 1.011 | 0.372 | 0.029 | 0.018 | 1.430(29) | 0.220(30) | 0.495(20) | -0.08(2) | 0.79(4) |
| \(^{33}\text{Cl}\) | 2190.0 ± 0.9 | 5590(12) | 0.98777 | 0.996 | 0.389 | 0.032 | 0.018 | 1.435(32) | 0.145(20) | 0.720(55) | -0.06(2) | 0.93(6) |
| \(^{35}\text{Ar}\) | 3121.9 ± 2.1 | 5638.8(63) | 0.98938 | 0.969 | 0.399 | 0.035 | 0.017 | 1.421(35) | 0.038(10) | 0.455(45) | -0.04(2) | 0.53(5) |
| \(^{37}\text{K}\) | 3623.9 ± 0.7 | 4533(28) | 1.00456 | 0.958 | 0.417 | 0.039 | 0.017 | 1.431(39) | 0.054(10) | 0.680(60) | -0.06(2) | 0.79(6) |
| \(^{39}\text{Ca}\) | 4985.8 ± 8.0 | 4296(16) | 1.00101 | 0.934 | 0.428 | 0.042 | 0.017 | 1.421(42) | 0.330(60) | 0.525(55) | -0.09(2) | 0.95(8) |
| \(^{41}\text{Sc}\) | 4745.0 ± 0.6 | 2833(11) | 1.03671 | 0.941 | 0.449 | 0.047 | 0.017 | 1.453(47) | 0.041(20) | 0.780(60) | -0.04(2) | 0.86(7) |
| \(^{43}\text{Ti}\) | 6336 ± 37 | 3671(56) | 1.03184 | 0.918 | 0.459 | 0.050 | 0.016 | 1.449(50) | 0.170(100) | 0.330(30) | -0.13(2) | 0.63(11) |
| \(^{45}\text{V}\) | 7628 ± 100 | 4361(98) | 1.04112 | 0.903 | 0.466 | 0.054 | 0.016 | 1.439(54) | 0.170(100) | 0.695(70) | -0.06(2) | 0.93(12) |

Table IV: Calculated quantities and corrections needed to obtain the \( f_{\text{mirror}} \) values (Eq. (23)). Details are given in the text.
| Parent nucleus | $\mathcal{F}t$ (s) | $\delta\mathcal{F}t$ (%) | $\rho$ | $\delta\rho$ (%) |
|----------------|-------------------|--------------------------|-------|------------------|
| $^3$H          | 1135.3 ± 1.5      | 0.13                     | -2.0951 ± 0.0020 | 0.10           |
| $^{11}$C       | 3933 ± 16         | 0.41                     | 0.7456 ± 0.0043  | 0.58           |
| $^{13}$N       | 4682.0 ± 4.9      | 0.10                     | 0.5573 ± 0.0013  | 0.23           |
| $^{15}$O       | 4402 ± 11         | 0.25                     | -0.6281 ± 0.0028 | 0.45           |
| $^{17}$F       | 2300.4 ± 6.2      | 0.27                     | -1.2815 ± 0.0035 | 0.27           |
| $^{19}$Ne      | 1718.4 ± 3.2      | 0.19                     | 1.5933 ± 0.0030  | 0.19           |
| $^{21}$Na      | 4085 ± 12         | 0.29                     | -0.7034 ± 0.0032 | 0.45           |
| $^{23}$Mg      | 4725 ± 17         | 0.36                     | 0.5426 ± 0.0044  | 0.81           |
| $^{25}$Al      | 3721.1 ± 7.0      | 0.19                     | -0.7973 ± 0.0027 | 0.34           |
| $^{27}$Si      | 4160 ± 20         | 0.48                     | 0.6812 ± 0.0053  | 0.78           |
| $^{29}$P       | 4809 ± 19         | 0.40                     | -0.5209 ± 0.0048 | 0.92           |
| $^{31}$S       | 4828 ± 33         | 0.68                     | 0.5167 ± 0.0084  | 1.63           |
| $^{33}$Cl      | 5618 ± 13         | 0.23                     | 0.3076 ± 0.0042  | 1.37           |
| $^{35}$Ar      | 5686.6 ± 7.2      | 0.13                     | -0.2841 ± 0.0025 | 0.88           |
| $^{37}$K       | 4562 ± 28         | 0.61                     | 0.5874 ± 0.0071  | 1.21           |
| $^{39}$Ca      | 4315 ± 16         | 0.37                     | -0.6504 ± 0.0041 | 0.63           |
| $^{41}$Sc      | 2849 ± 11         | 0.39                     | -1.0561 ± 0.0053 | 0.50           |
| $^{43}$Ti      | 3701 ± 56         | 1.51                     | 0.800 ± 0.016    | 2.00           |
| $^{45}$V       | 4382 ± 99         | 2.26                     | -0.621 ± 0.025   | 4.03           |

Table V: The $\mathcal{F}t^{\text{mirror}}$ values and Gamow-Teller/Fermi mixing ratios, $\rho$, with their relative uncertainties.
Table VI: Calculated standard model values for the $a, A, B, N$ and $R$ correlation coefficients for the $T = 1/2$ mirror $\beta$ transitions up to $^{45}$V, using the mixing ratios listed in Table V. The $D$ triple correlation is zero in the standard model. The $\beta$ particle longitudinal polarization, $G$, is $-1$ for $\beta^-$ decay and $+1$ for $\beta^+$ decay. The $N$ and $R$ correlations are non-zero due to final state interactions (FSI). Note that the about 10% accuracy to which the Eqs. (32,33) used to calculate $N_{FSI}$ and $R_{FSI}$ are valid [2] is not included in the error bars.
Table IX: References to data used in the calculation of the various branching ratios.

| Code | Authors | Reference | Nucleus |
|------|---------|-----------|---------|
| [Ac07] | N. Achouri and O. Naviliat-Cuncic | private communication | 21Na |
| [Ad81] | E.G. Adelberger et al. | Phys. Rev. C **24**, 313 (1981) | 19Ne |
| [Ad83] | E.G. Adelberger et al. | Phys. Rev. C **27**, 2833 (1983) | 19Ne |
| [Ad84] | E.G. Adelberger et al. | Nucl. Phys. A **417**, 269 (1984) | 35Ar |
| [Al74] | D.E. Alburger | Phys. Rev. C **9**, 991 (1974) | 21Na, 23Mg, 31S |
| [Al76] | D.E. Alburger | Phys. Rev. C **13**, 2593 (1976) | 19Ne |
| [Ar64] | S.E. Arnell, E. Wernbom | Arkiv Fysik **25**, 389 (1964) | 17F, 21Na, 25Al |
| [Ar84] | Y. Arai et al. | Nucl. Phys. A **417**, 269 (1984) | 59Zn |
| [Ay84] | J. Äystö et al. | Phys. Lett. B **138**, 369-372 (1984) | 51Fe |
| [Az77] | G. Azuelos et al. | Phys. Rev. C **15**, 1847 (1977) | 21Na, 23Mg, 25Al, 27Si, 29P, 31S, 35Ar, 37K |
| [Bu85] | T.W. Burrows et al. | Phys. Rev. C **31**, 1490 (1985) | 27Si, 31S, 35Ar |
| [De71] | C. Détraz et al. | Phys. Lett. B **34**, 128 (1971) | 21Na |
| [Ga71] | J.S. Geiger, B.W. Hooton | Can. J. Phys. **49**, 663 (1971) | 35Ar |
| [Go68a] | S. Gorodetzky et al. | Nucl. Phys. A **109**, 417 (1968) | 23Mg |
| [Ha84] | E. Hagberg et al. | Nucl. Phys. A **571**, 555 (1994) | 39Ca |
| [Ha94] | E. Hagberg et al. | Phys. Rev. C **56**, 135 (1997) | 37K |
| [Ha97] | E. Hagberg et al. | Nucl. Phys. A **471**, 489 (1987) | 25Mg, 27Si |
| [Ho69] | L. Makela et al. | Bull. Am. Phys. Soc. **14**, 550 (1969) | 25Al |
| [Ma74] | F.M. Mann, R.W. Kavanagh | Nucl. Phys. A **235**, 299 (1974) | 23Mg, 27Si |
| [Ma76] | F.M. Mann et al. | Nucl. Phys. A **258**, 341 (1976) | 25Al, 37K |
| [Mo71] | C.E. Moss et al. | Nucl. Phys. A **170**, 111 (1971) | 25Al, 37K |
| [Qi97] | M. Oinonen et al. | Nucl. Phys. A **496**, 462 (1989) | 49Mn |
| [So93] | E.J. Saettler et al. | Phys. Rev. C **48**, 3069 (1993) | 51Fe |
| [Wi80] | H.S. Wilson et al. | Phys. Rev. C **22**, 1696 (1980) | 21Na, 25Al, 29P, 31S, 35Cl, 35Ar, 31Sc |

[11C]: C. Détraz et al. | Phys. Lett. B **34**, 128 (1971) | 3H |
| [We02] | L. Weissman et al. | Phys. Rev. C **65**, art. No. 044321 | 61Ga |
| [Wi69] | G.L. Wick et al. | Nucl. Phys. A **138**, 209 (1969) | 35Ar |
| [Wi80] | H.S. Wilson et al. | Phys. Rev. C **22**, 1696 (1980) | 21Na, 25Al, 29P, 31S, 35Cl, 35Ar, 31Sc |
| Code | Authors | Reference | Nucleus |
|------|---------|-----------|---------|
| [St59] | R.S. Storey, K.G. McNeill | Can. J. Phys. 37, 1072 (1959) | $^{23}\text{Mg}$ |
| [Va60] | S.S. Vasilev, L.Y. Shavtvalov | Zhur. Eksp. Teor. Fiz. 39, 1221 (1960), Soviet Phys. JETP 12, 851 (1961) | $^{22}\text{Si}$ |
| [Ma76] | F.M. Mann et al. | Nucl. Phys. A 258, 341 (1976) | $^{39}\text{Ca}$ |
| [En73] | P.M. Endt, C. van der Leun | Nucl. Phys. A 214, 1 (1973) | $^{43}\text{Ti}$ |
| [Ko73] | S. Kochan et al. | Nucl. Phys. A 204, 185 (1973) | $^{53}\text{Co}$ |
| [Ho77] | P. Hornshoj et al. | Nucl. Phys. A 288, 429 (1977) | $^{55}\text{Ni}$ |
| [Ay84] | J. Aystö et al. | Phys. Lett. B 138, 369-372 (1984) | $^{55}\text{Ni}$ |
| [Ar81] | Y. Arai et al. | Phys. Lett. B 104, 186 (1981) | $^{59}\text{Zn}$ |
| [Wi93] | J.A. Winger et al. | Phys. Lett. B 299, 214 (1993), Phys. Rev. C 48, 3097 (1993) | $^{63}\text{Ge}, ^{65}\text{As}$ |
| [Ba94] | P. Baumann et al. | Phys. Rev. C 50, 1180 (1994) | $^{67}\text{Se}$ |
| [Bl95] | B. Blank et al. | Phys. Lett. B 364, 8 (1995) | $^{67}\text{Se}, ^{71}\text{Kr}$ |
| [Ew81] | G.T. Ewan et al. | Nucl. Phys. A 352, 13 (1981) | $^{71}\text{Kr}$ |

**Error bar 10 times higher than most precise measurement**

| Code | Authors | Reference | Nucleus |
|------|---------|-----------|---------|
| [Ro55] | H. Roderick et al. | Phys. Rev. 97, 97-101 (1955) | $^{29}\text{P}$ |
| [Ki56] | O.C. Kistner et al. | Phys. Rev. 104, 154 (1956) | $^{35}\text{Ar}$ |
| [Ad84] | E.G. Adelberger et al. | Nucl. Phys. A 417, 269 (1984) | $^{39}\text{Ca}$ |
| [Oj99] | M. Oinonen et al. | Eur. Phys. J. A 5, 151 (1999) | $^{61}\text{Ga}$ |

**No branching ratio is given, only a (lower) limit**

| Code | Authors | Reference | Nucleus |
|------|---------|-----------|---------|
| [Kj58] | O.C. Kistner, B.M. Rustad | Phys. Rev. 112, 1972 (1958) | $^{39}\text{Ca}$ |
| [De71] | C. Détraz et al. | Phys. Lett. B 34, 128 (1971) | $^{39}\text{Ca}$ |
| [Az77] | G. Azuelos et al. | Phys. Rev. C 15, 1847 (1977) | $^{39}\text{Ca}$ |
| [Ho77] | P. Hornshoj et al. | Nucl. Phys. A 288, 429 (1977) | $^{47}\text{Cr}, ^{51}\text{Fe}$ |

$\beta^+$ contamination from $^{21}\text{F}$ according to [Al74]

| Code | Authors | Reference | Nucleus |
|------|---------|-----------|---------|
| [Ta60] | W.L. Talbert, Jr. and M.G. Stewart | Phys. Rev. 119, 272 (1960) | $^{21}\text{Na}$ |
| [Ar64] | S.E. Arnell, E. Wernbom | Arkiv Fysik 25, 389 (1964) | $^{21}\text{Na}$ |

**Only one important level in daughter was used, while there are more**

| Code | Authors | Reference | Nucleus |
|------|---------|-----------|---------|
| [Sh84] | T. Shinozuka et al. | Phys. Rev. C 30, 2111 (1984) | $^{57}\text{Cu}$ |

Table X: References to data that were not used in the calculation of the branching ratios, with the reason for their rejection.