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Microscopic calculation of neutrino capture rates in ^{69,71}Ga and the detection of solar and galactic neutrinos

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Calculations of the neutrino capture cross sections for ^{69,71}Ga based on a microscopic treatment of the Gamow-Teller matrix elements are presented. A strong enhancement of the cross section for highly energetic neutrinos is found compared to previous phenomenological estimates. As a consequence, the present assumptions on the signal from ^{8}B neutrinos in ^{71}Ga have to be revised. A nonnegligible solar model dependent background of ^{8}B neutrinos has to be expected in a gallium solar neutrino experiment together with the pp signal. The calculations yield a larger sensitivity of the gallium detector than assumed previously for galactic neutrinos.

I. INTRODUCTION

It is generally believed that neutrinos play a key role in resolving the unification problem of strong and electroweak interactions. Therefore a large number of efforts have been undertaken to answer the fundamental questions: Are neutrinos Dirac or Majorana particles? Do they have a finite mass and if so, does mixing occur between neutrinos of different families?

Experiments, from which one expects information on these questions, are, e.g., neutrino oscillation, beta decay, and double beta decay experiments, or experiments on the larger scales provided by astrophysics. We discuss in this paper the neutrino-capture cross section for a gallium detector with respect to solar neutrino and collapsing star neutrino detection and in particular its dependence on nuclear structure.

One explanation of the so-called solar neutrino problem[1,2] could be the occurrence of neutrino oscillations.[3] In this case the electron neutrinos produced in the sun would be converted on the way to the earth partly into $\bar{\nu}_e,\nu_\mu,\bar{\nu}_\mu,\nu_\tau,\bar{\nu}_\tau$, for which detectors based on nuclear ν_e capture are insensitive. However, the neutrino deficit observed in the famous ^{37}Cl experiment cannot be unambiguously connected with such phenomena. One reason for this is, that ^{37}Cl, due to the high capture Q value, is sensitive mainly for high-energetic neutrinos originating from the decay of ^{8}B (endpoint energy 14.06 MeV), which is produced in a very solar model dependent rare reaction chain.

It is expected that measuring the practically solar model independent main part of the solar neutrino flux, namely that coming from the reaction $p+p\rightarrow d+\nu_e+e^+$ (pp neutrinos) using an at least 30 ton large gallium detector (containing 39.9% of ^{71}Ga) should answer the question of the origin of the observed ^{8}B neutrino deficit.[4,5] The endpoint energy of the pp neutrinos (0.42 MeV) is well above the threshold for neutrino capture in ^{71}Ga (0.233 MeV).

However, although in principle extremely small neutrino-mass differences lead to sizable effects, even in the favorable case of maximum 2ν mixing with $\Delta m^2 \gtrsim 2\times 10^{-8}$ eV^2 corresponding to a mixing length L smaller than R_0 (the solar radius) the expected reduction in the ν_e flux would only be a factor 2. For smaller than maximum mixing and also for $L \gtrsim R_0$ (effects might be observable down to $\Delta m^2 \gtrsim 10^{-12}$ eV^2) the reduction could be considerably smaller. Therefore, a comparison of the experimental capture rate with theoretical expectations requires very accurate knowledge of the neutrino capture cross section $\sigma_\nu(E_\nu)$. We shall show that the existing phenomenological estimates[6,7] for the capture rates of high energy neutrinos, particularly for ^{8}B neutrinos, in Ga are insufficient.

We want to draw attention to the point that the capture rate of ^{8}B neutrinos is a more serious problem for a solar neutrino gallium experiment than generally assumed up to now. This problem adds to the known problem connected with the large contribution to the pp signal from ^{7}Be decay neutrinos[2] and to the solar model connected problems of understanding the observed ^{8}B neutrino flux.

II. CALCULATION OF THE NEUTRINO CAPTURE CROSS SECTION IN ^{69,71}Ga

$\sigma_\nu(E_\nu)$ is dominated by the simple isospin invariance determined Fermi transition to the isobaric analog state (IAS) and the more complex Gamow Teller (GT) transitions:

$$\sigma_\nu(E_\nu)=\frac{g_A^2}{\pi c^3\hbar^2}\int_0^{E_\nu-Q} p_e E_e F(Z,E_e) S_\beta(E')\,dE' , \qquad (1)$$

with

$$S_\beta(E)=\frac{1}{dE}\sum_{E'=E}^{E+dE}\left[B_{GT}(E')+B_F(E')\left[\frac{g_V}{g_A}\right]^2\right]$$

and

$$E_e=E_\nu-Q-E'+m_e c^2 .$$

In the above formula g_V and g_A are the vector and axial vector coupling constants, respectively, p_e and E_e are the electron momentum and energy, respectively, and $F(Z,E)$ is the usual Fermi function. The beta strength function $S_\beta(E)$ is defined as reduced transition probability B_i per energy unit.

Refining earlier studies[8,9] in this paper we apply the BCS pairing model to calculate the GT strength for ^{69,71}Ga in a space consisting of 12 shells ranging from $1d_{5/2}$ to $2d_{3/2}$. Besides the pairing (short-range) part of the residual interaction the spin-isospin dependent part has an essential influence on the GT transitions. It is well known, that the latter arises mainly from π- and ρ-meson exchange.[10] The total Hamiltonian used in the present calculation reads therefore

$$H=H_{\mathrm{s.p.}}+H_{\mathrm{pair}}+H_{\sigma\tau}\ , \tag{2a}$$

with

$$H_{\mathrm{pair}}=-G\sum_{kk'}a^\dagger_{k'}a^\dagger_{\bar{k}'}a_k a_{\bar{k}}\ , \tag{2b}$$

$$H_{\sigma\tau}(1,2)=C_0 g'_0\frac{m_\pi^3}{4\pi}\left[\frac{e^{-m_\pi r_{12}}}{m_\pi r_{12}}\right]\sigma(1)\tau^+(1)\sigma(2)\tau^-(2)\ . \tag{2c}$$

The interaction parameters used are

$$G=(17\ \mathrm{MeV})/A,\quad C_0=300\ \mathrm{MeV/fm}^3,\quad g'_0=0.74\ .$$

After a Bogoliubov transformation of the particle operators $a^\dagger, a$ into quasiparticle operators $\alpha^\dagger,\alpha$, $H_{\sigma\tau}$ is diagonalized in a space consisting of one- and three-quasiparticle (q.p.) configurations. Including, however, all possible three-quasiparticle configurations in the used large model space would lead to a too large number of basis states, which could hardly be diagonalized. Therefore only the leading contributions in β decay are taken into account. These are configurations with a proton-neutron pair coupled to 1^+ and appropriately orthonormalized.

The ground and excited states in the odd proton mother nuclei are described then by wave functions of the form:

$$|I\rangle_{\mathrm{p}}=\sum_{\mathrm{p}}C^I_{\mathrm{p}}\alpha^\dagger_{\mathrm{p}}(J_{\mathrm{p}}=J_I)\,|\mathrm{BCS}\rangle+\sum_{\substack{\mathrm{n,n'}\\ \mathrm{p'}}}C^I_{\mathrm{n,n'p'}}[\alpha^\dagger_{\mathrm{n}}\times[\alpha^\dagger_{\mathrm{n'}}\times\alpha^\dagger_{\mathrm{p'}}]^1]^{J_I}\,|\mathrm{BCS}\rangle\ . \tag{3a}$$

Similarly for the final states in the odd neutron daughter nuclei one has

$$|F\rangle_{\mathrm{n}}=\sum_{\mathrm{n}}C^F_{\mathrm{n}}\alpha^\dagger_{\mathrm{n}}(J_{\mathrm{n}}=J_F)\,|\mathrm{BCS}\rangle+\sum_{\substack{\mathrm{p,p'}\\ \mathrm{n'}}}C^F_{\mathrm{p,n'p'}}[\alpha^\dagger_{\mathrm{p}}\times[\alpha^\dagger_{\mathrm{n'}}\times\alpha^\dagger_{\mathrm{p'}}]^1]^{J_F}\,|\mathrm{BCS}\rangle \tag{3b}$$

with expansion coefficients C^I_{p}, C^F_{n} $C^I_{\mathrm{n,n'p'}}$, and $C^F_{\mathrm{p,n'p'}}$ obtained by diagonalization of $H_{\sigma\tau}$. The fact that these wave functions include the most important configurations for β decay is seen in the following way: The parent nucleus ground state $|\mathrm{g.s.}\rangle$ has mainly a proton one-quasiparticle configuration

$$\alpha^\dagger_{\mathrm{p}}(\mathrm{p}=p_{3/2})\,|\mathrm{BCS}\rangle\left[\sum_{\mathrm{n,n'p'}}|C^{\mathrm{g.s.}}_{\mathrm{n,n'p'}}|^2\ll 1\right]\ .$$

The GT operator acting on this dominant component leads either to a neutron one q.p. configuration or excites a 1^+ neutron-proton pair leading to $[\alpha^\dagger_{\mathrm{p}}\times[\alpha^\dagger_{\mathrm{n'}}\times\alpha^\dagger_{\mathrm{p'}}]^1]^{J_F}|\mathrm{BCS}\rangle$. On the other hand for the small admixed three q.p. components in the parent ground state, $[\alpha^\dagger_{\mathrm{n}}\times[\alpha^\dagger_{\mathrm{n}}\times\alpha^\dagger_{\mathrm{p'}}]^1]^{J_I}|\mathrm{BCS}\rangle$, the matrix elements of the GT operator are large for final configurations $\alpha^\dagger_{\mathrm{n}}|\mathrm{BCS}\rangle$ (deexcitation of $[\mathrm{n'}\times\mathrm{p'}]^{1^+}$) and $[\alpha^\dagger_{\mathrm{p}}\times[\alpha^\dagger_{\mathrm{n'}}\times\alpha^\dagger_{\mathrm{p'}}]^1]^{J_F}|\mathrm{BCS}\rangle$ (GT operator transforms n into p, whereas n′ and p′ act as spectators) and give sizable corrections to the dominant $p_{3/2}$ decay. The choice of the wave functions (3a) and (3b) corresponds to the idea

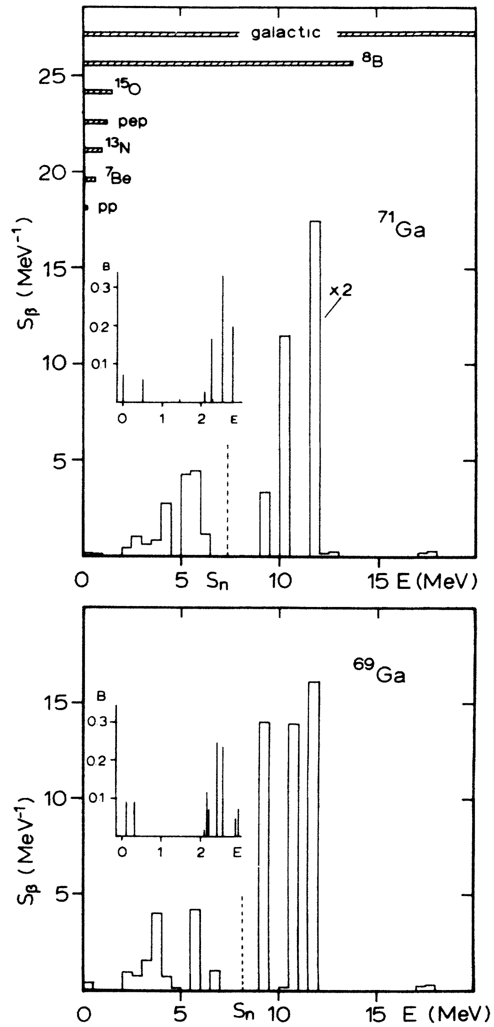

FIG. 1. (a) Microscopically calculated Gamow-Teller (GT) part of the beta strength distribution $S_\beta(E)$ $[=(1/\Delta E)\sum_{\Delta E}B_{\mathrm{GT}}(E);\ \Delta E=0.5\ \mathrm{MeV}$ in this figure] for ^{71}Ga. The insert shows the calculations for the low-energy part on an expanded scale. The energy range important for the detection of solar neutrinos from different sources is indicated. (b) Microscopically calculated $S_\beta(E)$ for GT decay of ^{69}Ga.

TABLE I. Calculated GT strength.

^{71}Ga decay			^{69}Ga decay		
E^*(MeV) in ^{71}Ge	$B(E^*)$	logft (Ga→Ge)	E^*(MeV) in ^{69}Ge	$B(E^*)$	logft (Ga→Ge)
0	0.071	4.75	0[a]	0.089	4.66
0.164	0.0001	7.6	0.03[b]	0	
0.522	0.061	4.82	0.32	0.090	4.65
1–2	0.006	5.83	1–2	0.006	5.83
2–3	0.730	3.74	2–3	0.816	3.69
3–4	0.717	3.75	3–4	2.777	3.16
4–5	1.412	3.46	4–5	0.403	4.00
5–6	4.359	2.97	5–6	2.092	3.28
6–7	0.023	5.24	6–7	0.496	3.91
7–9	0		7–9	0	
9–10	1.676	3.38	9–10	6.996	2.76
10–11	5.793	2.85	10–11	7.022	2.76
11–12	17.447	2.36	11–12	8.069	2.70
12–13	0.233	4.24	12–13	0.029	5.14

[a] Lowest $\frac{1}{2}^-$ state.

[b] Lowest $\frac{5}{2}^-$ state.

of a random phase approximation (RPA) calculation for even-even nuclei. (A similar treatment has recently led to a better understanding of double beta decay rates[11] and the extracted neutrino masses.[12])

We present the calculated distributions of GT strength for ^{71}Ga and ^{69}Ga in Table I and also in Fig. 1 (see also Ref. 13). It turns out that details of the low-lying GT strength of ^{71}Ga are decisive for a reliable prediction of the ^{8}B neutrino capture rates. Figures 2 and 3 show the neutrino-capture cross sections as a function of E_ν calculated by Eq. (1) on the basis of the strength distributions of Table I.

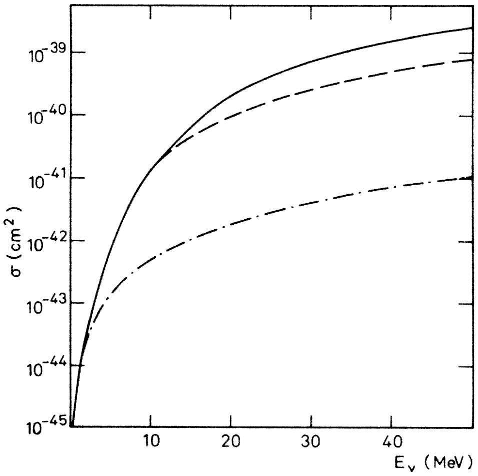

FIG. 2. Neutrino capture cross section as deduced from the calculated $S_\beta(E)$ of Fig. 1. The solid line includes all strength (also the Fermi strength in the isobaric analog state), the dashed line only the strength lying below S_n. The dashed-dotted line is the contribution from the ^{71}Ge ground state alone, on which previous estimates were mainly based.

III. DISCUSSION

A. Detection of solar neutrinos by ^{71}Ga

Our calculation reproduces quite well (and best of the presently existing calculations, see Table II) the reduced transition probability B for the transition $^{71}\mathrm{Ga}_{\mathrm{g.s.}} \to {}^{71}\mathrm{Ge}_{\mathrm{g.s.}}$ which is known to be 0.09 from the β^+ decay of ^{71}Ge. The calculation shows also (see also our earlier presentation[13]) that the large GT strength for the first excited $\frac{5}{2}^-$ state claimed by Orihara *et al.*[14] based on their (p,n) experiment at 35 MeV proton energy, could hardly be correct (see Table II). The investigation by Baltz *et al.*[15] cleared up this problem in detail. The latter authors calculated the ^{71}Ga(p,n)^{71}Ge cross section for 35

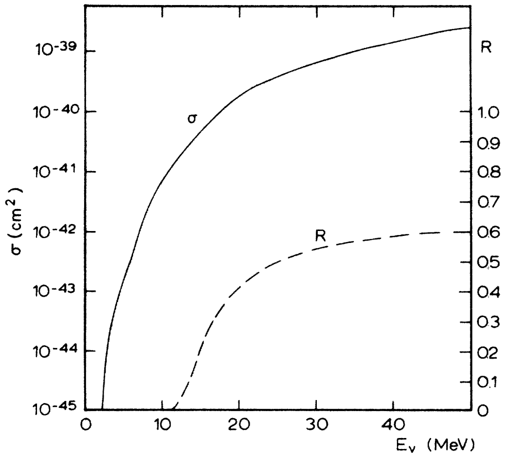

FIG. 3. $\sigma_\nu(E_\nu)$ for ^{69}Ga including all strength (also the Fermi strength). Shown is also R, the fraction of the total capture cross section resulting from population of states above the neutron separation energy S_n, i.e., mainly of the Gamow-Teller giant resonance [process (3) in Sec. III B].

TABLE II. Gamow-Teller strength for β^- decay of ^{71}Ga to ^{71}Ge calculated in various models compared with values from (p,n) data and the g.s. β-decay value.

Final state in ^{71}Ge (MeV)	This work (see also Ref. 13)	Baltz *et al.* (Ref. 15)	Mathews *et al.* (Ref. 26)	g.s. β decay	(p,n) Orihara *et al.* (Ref. 14)
g.s.	0.071	0.238	0.052	0.09	0.083
0.175 ($\frac{5}{2}^-$)	0.0001	0.011	0.012		0.080
0.500 ($\frac{3}{2}^-$)	0.061	0.058	7.5×10^{-4}		0.019

MeV bombarding energy at zero degree and also the GT strength in an (fp) model space and found that there is only little correspondence between these two quantities at such a low bombarding energy, since the (p,n) cross section for the $\frac{3}{2}^- \rightarrow \frac{5}{2}^-$ transition at this energy is totally dominated by higher multipoles.

It might be noted that underestimating one individual transition, the g.s. transition, in our calculation by about 20%, of course, does not mean that the strength integrated over a larger region of excitation energy will systematically be underestimated. This can be seen, e.g., from β-decay half-life calculations we have performed within a simpler model earlier, see Ref. 16.

Figure 1 shows that a sizable fraction of the total GT strength is found between 2 and 6 MeV excitation energy in ^{71}Ge. (This is of particular importance since the strength beyond the neutron separation energy S_n does not contribute to capture events detectable by the gallium detector, because subsequent decay by neutron emission leads to the stable ^{70}Ge.) As a consequence the capture cross section rises strongly—compared to the cross section originating only from the g.s. contribution—for neutrino energies $\gtrsim 2$ MeV (Fig. 2). The consequence is that earlier calculated rates for detection of ^{8}B neutrinos by the Ga detector have to be revised (while because of their lower energies the rates from all other solar neutrino sources such as pp, pep, ^{7}Be, ^{13}N, ^{15}O, will remain essentially unchanged, see Table IV).

For typical energies of the ^{8}B neutrinos (which have their intensity maximum at ~ 7 MeV) the microscopically calculated capture cross section is more than an order of magnitude larger than calculated from the g.s. transition alone.

So, in contrast to the widely spread belief (see, e.g., Refs. 2, 6, 7, and 17) that ^{8}B neutrinos are of minor importance with respect to background events for a gallium detector looking for pp neutrinos, we find, based on the standard solar model flux prediction and the calculated $\sigma_\nu(E_\nu)$ for ^{71}Ga, that they produce a background of the order of about 15 solar neutrino units (SNU) (to be compared to the pp neutrino signal of 71 SNU). This value is still dependent on the degree of quenching of GT strength in the "nuclear" region of excitation (Table III). Various mechanisms have been discussed as responsible for the "missing GT strength," such as mixture of NN^{-1} excitations with ΔN^{-1} configurations and a purely nucleonic quenching by coupling to 2p2h and more complex excitations. Experimentally the quenching, i.e., reduction of strength mainly in the GT giant resonance (GTGR) was first given to be around 50–70%.[18–20] More recent analyses[21] and particularly the better understanding of the "background" below the GTGR (Ref. 22) led to considerably smaller values between 35–50%. Δ excitations can account for a reduction of about 30% compared to the

TABLE III. Calculated ratios $\sigma_{\text{tot}}/\sigma_{\text{g.s.}}$ for the capture rates of ^{8}B solar neutrinos as a function of quenching of low-lying GT strength and the predicted capture rates for solar ^{8}B neutrinos (by states in ^{71}Ge below S_n) in SNU (1 SNU = 1 neutrino capture per second in 10^{36} target atoms; capture in the g.s. state corresponds to 1.2 SNU). The quenching factor q is defined as $q = 1 - B_{\text{GT}}^{\text{quench}}/B_{\text{GT}}$. The last line gives the result of an analysis of the (p,n) experiment by Krofcheck *et al.* (Ref. 27).

	$\sigma_{\text{tot}}/\sigma_{\text{g.s.}}$	q	$\sigma_{^8\text{B}-\nu}$ (SNU)	$\sigma_{^8\text{B}-\nu}$ (SNU) $q = 0.35\pm0.15$
This work	22.0	0	26.4	
	14.3	0.35	17.2	17.2±4
	11.0	0.5	13.2	
Mathews *et al.* (Ref. 26)	19.5	0	23.4	
	12.7	0.35	15.2	15.2±4
	10.4	0.5	12.8	
Bahcall (Ref. 7)	1.86		2.2	2.2
Krofcheck *et al.* (Ref. 27)	10.9		13±4	13±4

TABLE IV. Calculated solar neutrino capture rates in ^{71}Ga for various solar neutrino sources. The nonstandard solar model is that of Davis *et al.* (Ref. 2). The rates of the standard solar model are, except for the new ^{8}B values, those given by Hampel (Ref. 17).

	Standard solar model			Solar model with 1.9 SNU in ^{37}Cl		
Neutrino source	SNU	% of total rate	% of pp signal	SNU	% of total rate	% of pp signal
$p+p\rightarrow d+e^{+}+\nu$	71.3	55.3	100	71.3	78	100
$p+p+e^{-}\rightarrow d+\nu$	2.5	1.9	3.4	2.4	2.6	3.4
^{7}Be decay	31.2	24.2	43.8	12.3	13.4	17.3
^{8}B decay	17.2±4	13.3±3.1	24.1±6	3.6±1.3	4.0±1.5	5.1±1.8
^{13}N decay	2.9	2.2	4.1	0.9	1.0	1.2
^{15}O decay	4.0	3.1	5.6	1.2	1.3	1.7
Total rate in SNU	129			91.7		

GT sum rule.[23–25] It has been found further that the quenching by Δ excitations of strength *below* the GTGR is *smaller* (by the order of a factor of 2, in detail depending on the neutron excess) than the quenching for the GTGR.[25]

We would, therefore, favor a quenching factor of $q=1-B_{\rm GT}^{\rm quench}/B_{\rm GT}=0.35$. This would lead, with an assumed uncertainty of ± 0.15, to the capture rates given in the last column of Table III. We compare our result in Table III also with the recent calculation by the Livermore group.[26] These authors give in their Table 5 a factor $\sigma_{\rm tot}/\sigma_{\rm g.s.}=10.4$, corresponding to 12.8 SNU. However, this value corresponds to an assumed quenching factor $q=0.5$. When comparing both calculations, however, the same quenching factors should be used. It seems to us quite remarkable, that the very different theoretical approach of these authors leads to practically the same result as our calculation when making the same assumption on the quenching factor in both cases, see Table III. (It might be mentioned that these authors use a smaller shell model space including only the *f-p* shells, on the other hand allow within this restricted space for more final configurations.)

Recently, there has been measured the ^{71}Ga(p,n)^{71}Ge reaction at $E_{\rm p}=120$ MeV.[27] The authors deduce from this experiment a correction factor $\sigma_{\rm tot}/\sigma_{\rm g.s.}$ for the ^{8}B neutrinos of 10.9 yielding a capture rate of 13 SNU in the standard solar model. Taking into account the experimental uncertainty this is in good agreement with our calculation and also with the Livermore results (see Table III).

It should be recognized in this context, that according to the ^{37}Cl experiment,[1,2] the ^{8}B neutrino flux might be smaller than the standard solar model prediction on which the above capture rates are based.

Table IV comprises the predicted capture rates in a gallium detector for neutrinos from different sources in the sun for two solar models, the standard solar model, and a model (from Davis *et al.*[2]) yielding a total rate of 1.9 SNU in ^{37}Cl. The solar model dependent contribution to the gallium detector signal (^{8}B+^{7}Be neutrinos) is seen to amount to 22–68 % of the pp signal.

The background (and particularly its uncertainty arising from the solar model and the beta strength distribution in ^{71}Ge) produced by ^{8}B neutrinos in the detection of pp neutrinos by the ^{71}Ga detector will naturally complicate the interpretation of the experiment for cases of neutrino oscillations with no maximum mixing.

From the experimental point, it should be noted that probing the neutrino capture cross section with a ^{51}Cr source (see the discussion in Ref. 28) is not sufficient for the ^{8}B component, since this source produces only low-energetic neutrinos ($E_{\nu}\leq 0.75$ MeV).

B. Detection of galactic neutrinos by ^{69}Ga and ^{71}Ga

In hydrodynamical models of the gravitational collapse of a massive star, neutrino interactions are an essential ingredient. The trapping of neutrinos in the core and also the neutrino-pair production rate depends not only on hydrodynamical model parameters but also on the Weinberg angle θ_W, the number of generations of quarks and leptons, and on whether neutrinos possess Majorana masses or not.[29] The observation of the neutrino burst emitted by a collapsing star is therefore of fundamental interest.

Hampel[30] has estimated the feasibility of measuring with a gallium detector a neutrino burst of 1.8×10^{53} ergs emitted at 1 kpc distance, however, based only on phenomenological estimates for $\sigma_{\nu}(E_{\nu})$, dominated by the ground state transition in the case of ^{71}Ga and by the IAS in the case of ^{69}Ga. These estimates lead to too small capture rates for the high energetic (centered around 10–15 MeV) neutrinos expected in such a collapse.

Three different mechanisms have to be considered:

(1) Capture by ^{71}Ga leading to states in ^{71}Ge below the neutron separation energy $S_{\rm n}$ (see Fig. 2). These events can be distinguished only statistically from solar neutrino events.

(2) Capture by ^{69}Ga to states below $S_{\rm n}$ in ^{69}Ge.

(3) Capture by ^{69}Ga to ^{69}Ge states above $S_{\rm n}$, decaying to the ^{68}Ge g.s. (see Fig. 3).

In Table V we give the calculated number of nuclei produced in these three channels assuming two different neutrino spectra as calculated by Wilson[31] and Roberts *et al.*[32] The figures hold for a 30 ton detector. Probably the most important point is the high expectation for process (1). Also given in Table V is the saturation value of the normal solar contribution, which is the number of nuclei being present in statistical equilibrium between production and decay.

Our expectation of 120 ^{71}Ge nuclei (255 for the ν spectrum of Ref. 32) is much larger than the solar saturation value and of the same order as the production rate by processes (2) and (3). Since the IAS in ^{69}Ge lies *below* $S_{\rm n}$,

TABLE V. Expected number of nuclei produced in a 30 t gallium detector by a 1.8×10^{53} ergs neutrino burst at 1 kpc distance.

Process	Capture product	$T_{1/2}$	Number of nuclei produced by Solar neutrinos	Collapsing star neutrinos ν spectrum from Ref. 31	Ref. 32
(1)	^{71}Ge	11.2 d	18	120	255
(2)	^{69}Ge	39 h	0.3	147	370
(3)	^{68}Ge	288 d		67	275

process (2) has the largest cross section, but has the disadvantage of the short half-life of ^{69}Ge, therefore needing a trigger signal. The disadvantage of process (3) is the large half-life of ^{68}Ge of 288 d, which, despite the large production rate, would lead only to a very small decay rate of 0.7 per day for the assumed hypothetical neutrino burst.

IV. CONCLUSION

The cross sections for capture of solar and galactic neutrinos by ^{69}Ga and ^{71}Ga have been calculated based on a microscopic description of the Gamow-Teller strength distribution. A correct treatment of the latter is found to be decisive for reliable predictions of the ν capture rates as function of the neutrino energies, i.e., for reliable prediction of the capture probability of neutrinos from different sources (reactions) in the sun.

We find that the presently used[2,7,17] assumptions on the signal from solar ^{8}B neutrinos in ^{71}Ga have to be revised.

A non-negligible solar model dependent background of ^{8}B has to be expected in a gallium solar neutrino experiment besides the pp signal. In the standard solar model it would amount to $(24\pm6)\%$ of the pp signal depending on the assumed degree of quenching of Gamow-Teller strength. This background adds to the contribution from ^{7}Be decay neutrinos (44% of the pp signal in the standard solar model) which is expected (see Ref. 2) to require an independent ^{81}Br detector experiment to interpret the results of a gallium experiment.

The total solar model dependent background in the gallium detector (^{8}B and ^{7}Be neutrinos) thus ranges depending on the solar model somewhere between 22% and 68% of the pp signal.

This background thus has to be carefully considered in the interpretation of a future gallium solar neutrino experiment, particularly in the case of neutrino oscillations with no maximum mixing angle.

The calculations yield a larger sensitivity of the gallium detector than assumed up to now, for galactic neutrinos.

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