SELF-CONSISTENT APPROACH TO THE GAMOW-TELLER BETA DECAY OF PROTON-RICH KR ISOTOPES

A. PETROVICI

Institute for Physics and Nuclear Engineering, Bucharest, Romania
Institut für Theoretische Physik, Universität Tübingen, Germany

- ${}^{74}\mathrm{Kr} \quad \rightarrow \quad {}^{74}\mathrm{Br}$

  $0^+_{ground-state} \rightarrow 1^+$

- ${}^{72}\mathrm{Kr} \quad \rightarrow \quad {}^{72}\mathrm{Br}$

  $0^+_{ground-state} \rightarrow 1^+$

  $0^+_{first-excited} \rightarrow 1^+$

  $2^+_{yrast} \rightarrow 1^+$

within

the *complex* **EXCITED VAMPIR** variational approach

VAMPIR - Variational approaches to the nuclear many-body problem

Framework

- the model space is defined by a finite dimensional set of spherical single particle states
- the effective many-body Hamiltonian is represented as a sum of one- and two-body terms
- the basic buiding blocks are Hartree-Fock-Bogoliubov (HFB) vacua
- the HFB transformations are essentially *complex* and allow for proton-neutron, parity and angular momentum mixing being only restricted by time-reversal and axial symmetry
- the broken symmetries (s=N, Z, I, π) are restored before variation by projection techniques

Variational approaches to the nuclear many-body problem with symmetry projection before variation

Model space

$$\{|i\rangle \equiv |\tau n l j m\rangle\}$$

$$\{c_i^\dagger, c_k^\dagger, \ldots\}_M$$

$$\{c_i, c_k, \ldots\}_M$$

Effective many-body Hamiltonian

$$\hat{H} = \sum_{i=1}^{M} \varepsilon(i) c_i^\dagger c_i + \frac{1}{4} \sum_{i,k,r,s=1}^{M} v(ikrs) c_i^\dagger c_k^\dagger c_s c_r$$

Hartree-Fock-Bogoliubov transformation

$$\begin{pmatrix} a^\dagger \\ a \end{pmatrix} = F \begin{pmatrix} c^\dagger \\ c \end{pmatrix} = \begin{pmatrix} A^T & B^T \\ B^\dagger & A^\dagger \end{pmatrix} \begin{pmatrix} c^\dagger \\ c \end{pmatrix}$$

Quasi-particle vacuum

$$|F\rangle = \prod_{\alpha=1}^{M'} a_\alpha|0\rangle \qquad \text{with} \quad \left\{ \begin{array}{ll} a_\alpha|0\rangle \neq 0 & \text{for } \alpha = 1, ..., M' \leq M \\ a_\alpha|0\rangle = 0 & \text{else} \end{array} \right\}$$

$$\hat{\Theta}^{s}_{MK} \equiv \hat{P}(I;MK)\hat{Q}(N)\hat{Q}(Z)\hat{p}(\pi)$$

$$\hat{p}(\pi) \equiv \frac{1}{2}\left(1 + \pi\hat{\Pi}\right)$$

$$\hat{Q}(N_\tau) \equiv \frac{1}{2\pi}\int_0^{2\pi} d\phi_\tau \exp\{i\phi_\tau(N_\tau - \hat{N}_\tau)\})$$

$$\hat{P}(I;MK) \equiv \frac{2I+1}{8\pi^2}\int d\Omega D^{I}_{MK}{}^{*}(\Omega)\hat{R}(\Omega)$$

$$|\psi(F^s);sM\rangle = \sum_{K=-I}^{+I} \hat{\Theta}^{s}_{MK}|F^s\rangle\, f^s_K$$

$$|\psi(F^s);sM\rangle = \frac{\hat{\Theta}^{s}_{M0}|F^s\rangle}{\sqrt{\langle F^s|\hat{\Theta}^{s}_{00}|F^s\rangle}}$$

$$|F>=\{\prod_{m=1/2}^{m_{max}}(\prod_{\alpha}^{(m)}[u_\alpha+v_\alpha b_\alpha^\dagger b_{\bar{\alpha}}^\dagger])\}|0>$$

$$b_\alpha^\dagger \;=\; \sum_{\tau_i,n_i,l_i,j_i}^{(m_\alpha>0)} D_{i\alpha}^*\, c_i^\dagger$$

$$b_\alpha^\dagger b_{\bar{\alpha}}^\dagger=\sum_{\tau=p,n}\sum_{\mathrm{i<k}}^{(m_\alpha\tau)}[1+\delta(\mathbf{i},\underline{\mathrm{k}})]^{-1}\sum_{I}(-)^{j_k+l_k-m_\alpha}(j_ij_kI|m_\alpha-m_\alpha 0)$$

$$\times\{[Re(D_{i_\tau\alpha}^*D_{k_\tau\alpha})[1+(-)^{l_i+l_k+I}]+iIm(D_{i_\tau\alpha}^*D_{k_\tau\alpha})[1-(-)^{l_i+l_k+I}]][c_{\underline{\mathrm{i}}}^\dagger c_{\underline{\mathrm{k}}}^\dagger]_{12\tau}^{I0}\}$$

$$+\sum_{\underline{\mathrm{i}}}^{(m_\alpha p)}\sum_{\underline{\mathrm{k}}}^{(m_\alpha n)}\sum_{IT}(1/2 1/2 T|-1/2 1/2 0)(-)^{j_k+l_k-m_\alpha}(j_ij_kI|m_\alpha-m_\alpha 0)$$

$$\times\{[Re(D_{i_p\alpha}^*D_{k_n\alpha})[1+(-)^{l_i+l_k+I}]+iIm(D_{i_p\alpha}^*D_{k_n\alpha})[1-(-)^{l_i+l_k+I}]][c_{\underline{\mathrm{i}}}^\dagger c_{\underline{\mathrm{k}}}^\dagger]_{T0}^{I0}\}$$

$$[c_{\underline{\mathrm{i}}}^\dagger c_{\underline{\mathrm{k}}}^\dagger]_{TT_z}^{IM}\equiv\sum_{m_im_k\tau_i\tau_k}(j_ij_kI|m_im_kM)(\frac{1}{2}\frac{1}{2}T|\tau_i\tau_kT_z)c_i^\dagger c_k^\dagger$$

Variational procedures

complex Vampir approach

$$E^s[F_1^s] = \frac{\langle F_1^s | \hat{H} \hat{\Theta}^s_{00} | F_1^s \rangle}{\langle F_1^s | \hat{\Theta}^s_{00} | F_1^s \rangle}$$

$$|\psi(F_1^s); sM\rangle = \frac{\hat{\Theta}^s_{M0} | F_1^s \rangle}{\sqrt{\langle F_1^s | \hat{\Theta}^s_{00} | F_1^s \rangle}}$$

complex Excited Vampir approach

$$|\psi(F_2^s); sM\rangle = \hat{\Theta}^s_{M0}\left\{|F_1^s\rangle\alpha_1^2 + |F_2^s\rangle\alpha_2^2\right\}$$

$$|\psi(F_i^s); sM\rangle = \hat{\Theta}^s_{M0}\sum_{j=1}^{i} |F_j^s\rangle\,\alpha_j^i \qquad \text{for} \quad i = 1, \ldots, n$$

$$|\Psi_\alpha^{(n)}; sM > = \sum_{i=1}^{n} |\psi_i; sM > f_{i\alpha}^{(n)}, \qquad \alpha = 1, \ldots, n$$

$$(H - E^{(n)}N)f^n = 0$$

$$(f^{(n)})^+ N f^{(n)} = 1$$

A= 70 − 90 mass region

^{40}Ca - core

model space (π, ν):

$1p_{1/2}\ 1p_{3/2}\ 0f_{5/2}\ 0f_{7/2}\ 1d_{5/2}\ 0g_{9/2}$

renormalized G–matrix (OBEP, Bonn A)

- short range Gaussians in the *nn, pp, np channels*
- monopole shifts:

$\langle 0g_{9/2}0f;T=0|\hat{G}|0g_{9/2}0f;T=0\rangle$

$\langle 1p1d_{5/2};T=0|\hat{G}|1p1d_{5/2};T=0\rangle$

$f_{5/2}$ $f_{7/2}$
(ms1): -0.590 MeV / -0.060 MeV
(ms2): -0.500 MeV / -0.150 MeV
(ms3): -0.400 MeV / -0.250 MeV

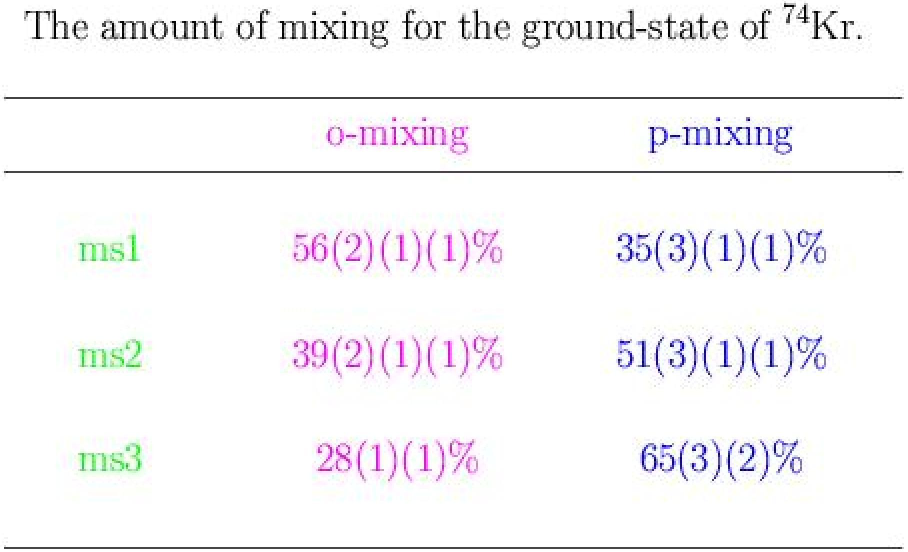
Gamow-Teller β Decay of ^{74}Kr

CERN/ISOLDE E. Poirier et al., Phys.Rev. C69(2004)034307

$$^{74}\mathrm{Kr} \rightarrow {}^{74}\mathrm{Br}$$

$$Q_{EC} = 3.140 \pm 0.060\ \mathrm{MeV}$$

$$0^+_{ground-state} \rightarrow 1^+$$



The amount of mixing for the ground-state of ^{74}Kr.

	o-mixing	p-mixing
ms1	56(2)(1)(1)%	35(3)(1)(1)%
ms2	39(2)(1)(1)%	51(3)(1)(1)%
ms3	28(1)(1)%	65(3)(2)%

The amount of mixing for the lowest calculated 1^+ states of ^{74}Br (ms1).

o-mixing /p-mixing
94(3)(3)%
61(35)(2)(1)%
89(3)(2)(2)(1)(1)(1)%
44(28)(19)(4)(1)(1)(1)%
97%
69(19)(5)(2)(2)%
70(7)(3)(2)(1)(1)(1)%4(3)(2)(2)%
9(3)% 25(24)(11)(10)(3)(2)(2)(1)(1)(1)(1)(1)(1)(1)%
7(1)(1)% 71(8)(5)(1)(1)(1)(1)(1)%
43(12)(9)(7)(7)(3)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)%
57(3)(2)(1)(1)(1)(1)%13(5)(4)(2)(2)(1)(1)(1)(1)%
26(1)(1)% 36(20)(4)(3)(2)(1)(1)(1)%
21(21)(14)(14)(6)(5)(4)(2)(2)(1)(1)(1)(1)(1)(1)%
1%26(20)(8)(7)(6)(5)(4)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
2(1)(1)(1)% 36(14)(12)(6)(6)(5)(4)(2)(2)(1)(1)(1)(1)(1)(1)%
10(2)(2)(1)(1)% 27(13)(11)(9)(3)(3)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)%
50(16)(9)(5)(3)(3)(2)(2)(2)(1)(1)(1)% 2(2)%
33(21)(12)(8)(5)(5)(3)(3)(2)(2)(1)(1)% 1(1)(1)%
1(1)%34(18)(13)(9)(4)(3)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)%

The amount of mixing for the lowest calculated 1^+ states of ^{74}Br (ms1).

o-mixing /p-mixing
94(3)(3)%
61(35)(2)(1)%
89(3)(2)(2)(1)(1)(1)%
44(28)(19)(4)(1)(1)(1)%
97%
69(19)(5)(2)(2)%
70(7)(3)(2)(1)(1)(1)%4(3)(2)(2)%
9(3)% 25(24)(11)(10)(3)(2)(2)(1)(1)(1)(1)(1)(1)(1)%
7(1)(1)% 71(8)(5)(1)(1)(1)(1)(1)%
43(12)(9)(7)(7)(3)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)%
57(3)(2)(1)(1)(1)(1)%13(5)(4)(2)(2)(1)(1)(1)(1)%
26(1)(1)% 36(20)(4)(3)(2)(1)(1)(1)%
21(21)(14)(14)(6)(5)(4)(2)(2)(1)(1)(1)(1)(1)(1)%
1%26(20)(8)(7)(6)(5)(4)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
2(1)(1)(1)% 36(14)(12)(6)(6)(5)(4)(2)(2)(1)(1)(1)(1)(1)(1)%
10(2)(2)(1)(1)% 27(13)(11)(9)(3)(3)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)%
50(16)(9)(5)(3)(3)(2)(2)(2)(1)(1)(1)% 2(2)%
33(21)(12)(8)(5)(5)(3)(3)(2)(2)(1)(1)% 1(1)(1)%
1(1)%34(18)(13)(9)(4)(3)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)%

The amount of mixing for the lowest calculated 1^+ states of ^{74}Br (ms2).

o-mixing /p-mixing
94(3)(1)%
61(35)(2)%
46(29)(17)(3)(1)(1)%
91(2)(2)(1)(1)(1)(1)%
97(1)%
40(37)(14)(4)(1)%
69(28)(1)(1)%
54(20)(11)(6)(1)(1)%2%
46(27)(9)(6)(2)(2)(1)(1)(1)(1)(1)%
5% 65(16)(4)(1)(1)(1)(1)%
49(8)(8)(5)(5)(4)(4)(3)(2)(2)(2)(1)(1)(1)%
29(14)(11)(10)(9)(7)(7)(2)(2)(1)(1)(1)(1)(1)(1)%
1% 61(19)(7)(2)(1)(1)(1)(1)(1)(1)(1)%
57(11)(8)(5)(3)(3)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
78(6)(2)(1)(1)(1)(1)(1)(1)% 1(1)(1)(1)%
3% 33(23)(10)(7)(6)(5)(3)(2)(2)(1)(1)%
31(10)(10)(6)(6)(5)(3)(3)(3)(2)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
(1)1% 25(19)(14)(7)(6)(5)(4)(4)(2)(2)(2)(2)(1)(1)%
2% 42(10)(9)(6)(5)(4)(4)(3)(3)(3)(1)(1)(1)(1)(1)(1)%
28(19)(13)(10)(7)(4)(3)(1)(1)(1)% 3(1)(1)(1)(1)(1)(1)%
23(16)(14)(6)(5)(4)(2)(1)(1)(1)(1)% 12(3)(2)(1)(1)(1)(1)%
(1)1% 28(13)(12)(10)(6)(5)(3)(3)(3)(2)(1)(1)(1)(1)(1)(1)(1)%
51(16)(11)(3)(3)(3)(2)(2)(2)(1)(1)% 1(1)(1)%
25(19)(11)(10)(8)(8)(3)(3)(2)(2)(1)(1)(1)(1)% 2(1)%

The amount of mixing for the lowest calculated 1$^+$ states of ^{74}Br (ms1).

o-mixing /p-mixing
94(3)(3)%
61(35)(2)(1)%
89(3)(2)(2)(1)(1)(1)%
44(28)(19)(4)(1)(1)(1)%
97%
69(19)(5)(2)(2)%
70(7)(3)(2)(1)(1)(1)%4(3)(2)(2)%
9(3)% 25(24)(11)(10)(3)(2)(2)(1)(1)(1)(1)(1)(1)(1)%
7(1)(1)% 71(8)(5)(1)(1)(1)(1)(1)%
43(12)(9)(7)(7)(3)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)%
57(3)(2)(1)(1)(1)(1)%13(5)(4)(2)(2)(1)(1)(1)(1)%
26(1)(1)% 36(20)(4)(3)(2)(1)(1)(1)%
21(21)(14)(14)(6)(5)(4)(2)(2)(1)(1)(1)(1)(1)(1)%
1%26(20)(8)(7)(6)(5)(4)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
2(1)(1)(1)% 36(14)(12)(6)(6)(5)(4)(2)(2)(1)(1)(1)(1)(1)(1)%
10(2)(2)(1)(1)% 27(13)(11)(9)(3)(3)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)%
50(16)(9)(5)(3)(3)(2)(2)(2)(1)(1)(1)% 2(2)%
33(21)(12)(8)(5)(5)(3)(3)(2)(2)(1)(1)% 1(1)(1)%
1(1)%34(18)(13)(9)(4)(3)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)%

The amount of mixing for the lowest calculated 1$^+$ states of ^{74}Br (ms3).

o-mixing /p-mixing
61(35)(2)%
94(4)(1)%
48(31)(15)(2)(2)(1)%
92(3)(1)(1)(1)(1)(1)%
94(2)(2)%
76(16)(3)(2)(1)%
2(2)%63(10)(10)(3)(3)(1)(1)(1)(1)(1)%
45(42)(5)(1)% 2(1)(1)%
2(1)(1)% 64(15)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)%
45(19)(15)(13)(1)(1)(1)%1%
67(21)(3)(2)(2)(1)(1)(1)%
2% 54(16)(12)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
53(12)(5)(4)(4)(3)(2)(2)(2)(2)(2)(2)(2)(1)(1)(1)(1)%
41(26)(7)(7)(3)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
32(26)(16)(5)(5)(3)(2)(2)(2)(1)(1)(1)%
20(19)(10)(8)(7)(6)(4)(4)(3)(2)(2)(2)(2)(2)(2)(1)(1)(1)(1)(1)%
52(24)(11)(4)(1)(1)(1)(1)%1%
36(10)(8)% 16(13)(3)(2)(2)(2)(1)(1)(1)%
31(18)(9)(8)(6)(6)(3)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)%
41(11)(8)(7)(6)(5)(4)(3)(2)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
1%33(13)(7)(7)(6)(5)(4)(4)(4)(3)(2)(1)(1)(1)(1)(1)(1)(1)(1)%
61(7)(7)(6)(3)(2)(1)(1)(1)(1)(1)% 2(1)(1)(1)(1)%
42(9)(7)(4)(2)(2)(1)(1)(1)% 4(4)(3)(2)(2)(2)(1)(1)(1)(1)(1)(1)(1)%
25(20)(13)(12)(8)(5)(3)(3)(2)(1)(1)(1)(1)(1)% 3(1)(1)%
57(12)(10)(2)(2)(1)% 11%
3(1)% 25(19)(14)(6)(6)(5)(4)(3)(2)(1)(1)(1)(1)(1)(1)(1)(1)(1)(1)%
1(1)(1)(1)% 38(9)(8)(7)(5)(5)(5)(4)(2)(2)(2)(1)(1)(1)(1)(1)(1)%
1%23(16)(9)(7)(5)(4)(4)(4)(3)(3)(2)(2)(2)(2)(2)(1)(1)(1)(1)(1)(1)%

Spectroscopic quadrupole moments Q_2^{sp} (in efm^2) for the lowest calculated 1^+ states of the ^{74}Br nucleus (ms1).

1^+_I	1^+_{II}	1^+_{III}	....							
48.6	-49.4	46.6	-46.7	-47.7	45.1	45.3	47.7	-56.6	33.2	-38.2
-40.1	42.0	-50.7	-58.1	-52.4	-51.0	16.7	-22.0	-50.9	-50.5	-48.5
-43.4	37.2	45.0	-40.3	-34.3	26.2	39.2	41.0	-44.5	-49.0	40.9
-51.3	-39.8	-42.3	14.4	18.4	37.9	41.0	-37.4	15.0	-40.4	29.3
-39.3	41.5	-54.2	-52.3	38.4	-47.6	-45.3	-8.4	-1.4	-41.4	-48.2
40.3	48.7	-40.6	43.1	-24.0	46.0	-45.3	-61.4	-54.8	-55.0	-16.1

Spectroscopic quadrupole moments Q_2^{sp} (in efm^2) for the lowest calculated 1^+ states of the ^{74}Br nucleus (ms1).

1^+_I	1^+_{II}	1^+_{III}	....							
48.6	-49.4	46.6	-46.7	-47.7	45.1	45.3	47.7	-56.6	33.2	-38.2
-40.1	42.0	-50.7	-58.1	-52.4	-51.0	16.7	-22.0	-50.9	-50.5	-48.5
-43.4	37.2	45.0	-40.3	-34.3	26.2	39.2	41.0	-44.5	-49.0	40.9
-51.3	-39.8	-42.3	14.4	18.4	37.9	41.0	-37.4	15.0	-40.4	29.3
-39.3	41.5	-54.2	-52.3	38.4	-47.6	-45.3	-8.4	-1.4	-41.4	-48.2
40.3	48.7	-40.6	43.1	-24.0	46.0	-45.3	-61.4	-54.8	-55.0	-16.1

Spectroscopic quadrupole moments Q_2^{sp} (in efm^2) for the lowest calculated 1^+ states of the ^{74}Br nucleus (ms2).

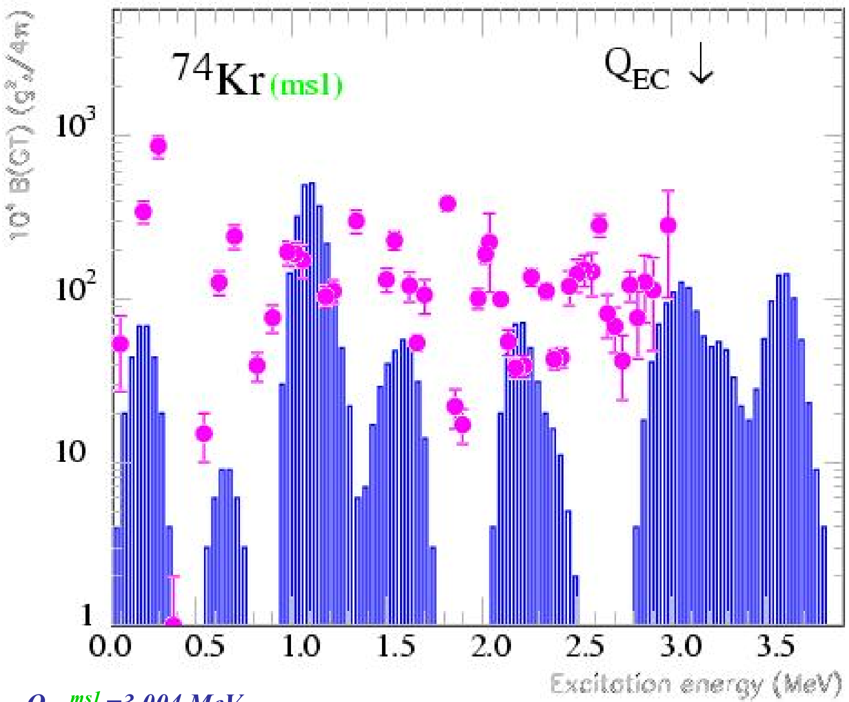
1^+_I	1^+_{II}	1^+_{III}	....							
48.5	-49.0	-47.6	47.0	-48.5	48.2	44.1	45.4	-51.7	-53.1	42.5
-43.3	-50.8	40.0	-50.2	-52.5	-55.0	-50.8	-50.5	42.4	-49.1	-46.1
47.6	-44.1	-44.2	-43.7	40.9	35.6	34.3	-31.5	-47.3	-45.3	39.5
-51.4	42.4	-53.4	-47.3	-44.0	35.9	-46.5	39.9	-44.1	-59.6	-48.5
33.8	38.4	-44.4	40.8	-43.4	7.6	-3.8	33.0	-51.7	-46.1	-45.2
33.3	-34.7	-14.7	5.6	44.4	14.6	-12.2	-62.2	44.9	-44.2	-52.2
40.3	-55.1	-52.2	46.6	33.3	-15.5					

Spectroscopic quadrupole moments Q_2^{sp} (in efm^2) for the lowest calculated 1^+ states of the ^{74}Br nucleus (ms1).

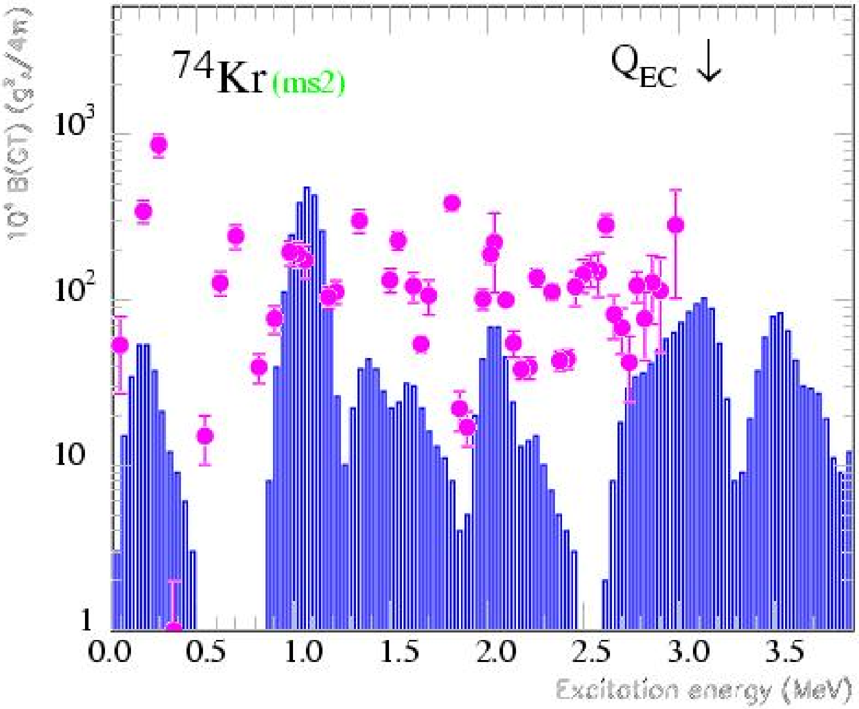
1^+_I	1^+_{II}	1^+_{III}	....							
48.6	-49.4	46.6	-46.7	-47.7	45.1	45.3	47.7	-56.6	33.2	-38.2
-40.1	42.0	-50.7	-58.1	-52.4	-51.0	16.7	-22.0	-50.9	-50.5	-48.5
-43.4	37.2	45.0	-40.3	-34.3	26.2	39.2	41.0	-44.5	-49.0	40.9
-51.3	-39.8	-42.3	14.4	18.4	37.9	41.0	-37.4	15.0	-40.4	29.3
-39.3	41.5	-54.2	-52.3	38.4	-47.6	-45.3	-8.4	-1.4	-41.4	-48.2
40.3	48.7	-40.6	43.1	-24.0	46.0	-45.3	-61.4	-54.8	-55.0	-16.1

Spectroscopic quadrupole moments Q_2^{sp} (in efm^2) for the lowest calculated 1^+ states of the ^{74}Br nucleus (ms3).

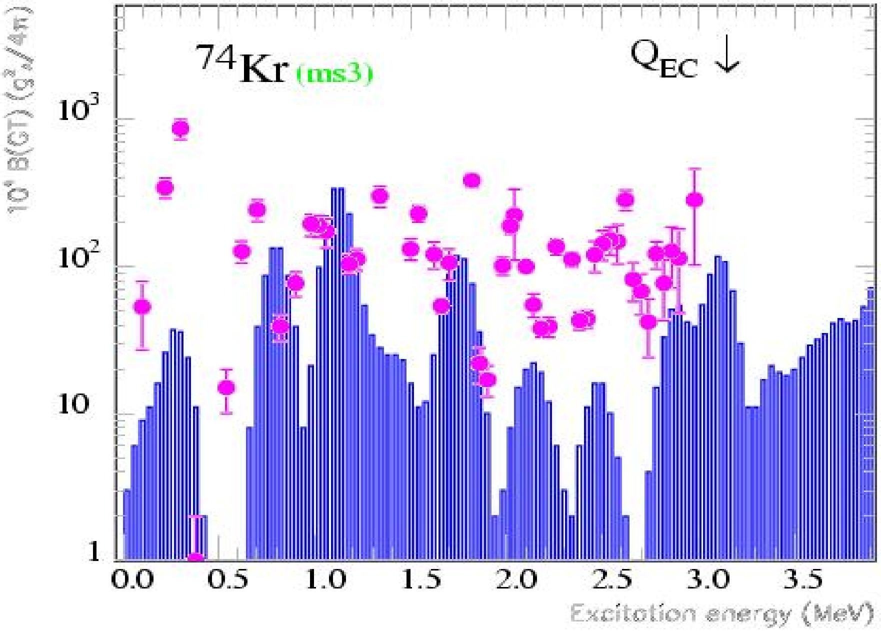
1^+_I	1^+_{II}	1^+_{III}	....							
-49.3	48.4	-48.7	47.1	-49.5	47.8	-48.0	40.9	-51.3	45.5	-49.8
-51.3	45.0	-50.1	-51.4	-44.9	38.1	-53.7	-49.6	-50.9	44.7	6.6
-3.4	-47.3	-52.1	-46.2	-52.0	4.9	-11.9	-43.4	-45.4	38.9	-27.5
16.7	39.2	-44.9	30.9	-42.0	-42.5	-45.3	-52.9	-44.2	-27.3	28.1
-0.1	-4.7	-45.8	39.4	-37.3	-45.4	32.0	39.6	-40.3	-41.4	30.4
-43.5	-24.2	20.6	41.9	13.0	-16.0	38.4	-34.4	25.8	-55.7	-15.5
14.5	-52.2	40.9	35.2	29.1	2.7	-15.9	4.7			



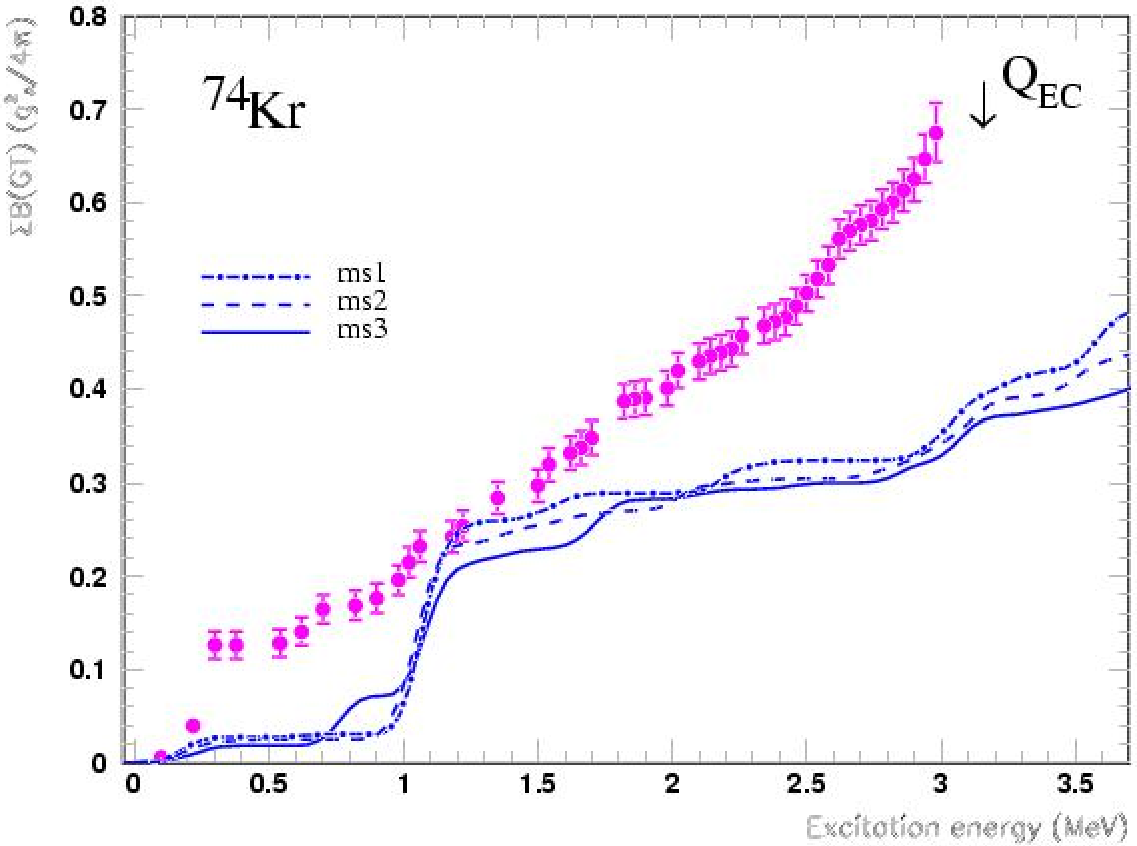
Q_{EC}^{ms1} =3.004 MeV



Q_{EC}^{ms2} =2.945 MeV



Q_{EC}^{ms3} =2.912 MeV



^{74}Kr
$\downarrow Q_{EC}$
ms1
ms2
ms3
ΣB(GT) (g²A/4π)
Excitation energy (MeV)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0
0.5
1
1.5
2
2.5
3
3.5

Gamow-Teller β Decay of ^{72}Kr

CERN/ISOLDE I. Piqueras, Eur. Phys. J. A16(2003)313

$^{72}\mathrm{Kr} \rightarrow {}^{72}\mathrm{Br}$ $Q_{EC} = 5.040 \pm 0.375$ *MeV*

$0^+_{ground-state} \rightarrow 1^+$

$0^+_{first-excited} \rightarrow 1^+$ $E_{0_2^+} = 0.671$ *MeV*

$2^+_{yrast} \rightarrow 1^+$ $E_{2_1^+} = 0.710$ *MeV*

The amount of mixing for the calculated states of the ^{72}Kr nucleus (ms3).

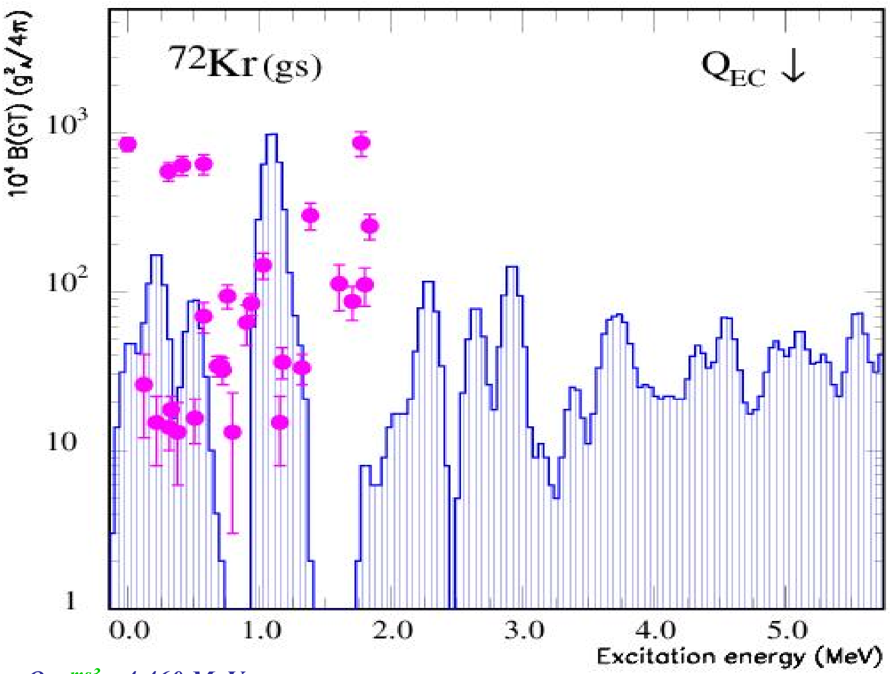
$I[\hbar]$	o-mixing	p-mixing
0_1^+	64(2)%	29(2)(1)(1)%
0_2^+	35(2)%	57(3)(1)(1)%
2_1^+	92(1)%	6%

The amount of mixing for the lowest calculated 1^+ states of ^{72}Br (ms3) with significant B(GT).

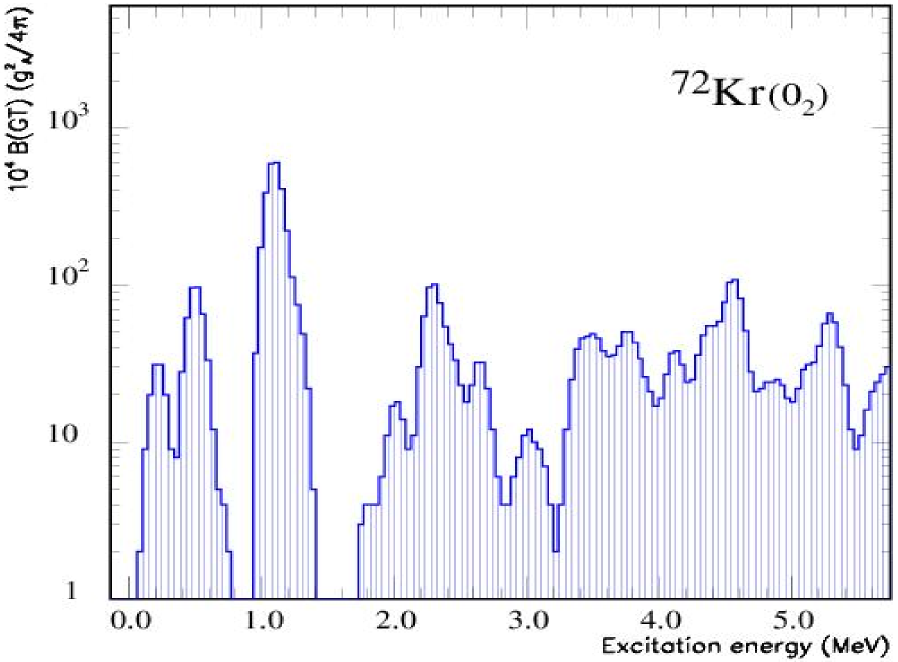
o-mixing	/p-mixing
85(12)%	
81(11)(4)%	
	87(2)(2)(2)(2)(1)(1)%
	81(4)(4)(2)(2)(1)(1)(1)%
78(16)(2)(1)%	
	78(4)(3)(3)(2)(2)(1)(1)(1)(1)%
	49(24)(8)(6)(5)(2)(1)(1)(1)%
	32(31)(15)(9)(3)(2)(1)(1)(1)(1)%
79(15)(1)%	
31(2)(2)(1)%	20(16)(13)(2)(1)(1)(1)(1)(1)(1)(1)%
50(5)(1)(1)%	12(10)(8)(2)(1)(1)(1)(1)(1)%
2%	68(10)(5)(3)(3)(2)(1)(1)(1)%
	36(24)(7)(6)(5)(4)(3)(3)(2)(1)(1)(1)%
72(12)(4)(2)(1)(1)(1)(1)(1)%	1%
62(17)(8)(4)(2)%	1%
56(15)(11)(2)(2)(1)(1)(1)(1)(1)%	1(1)%

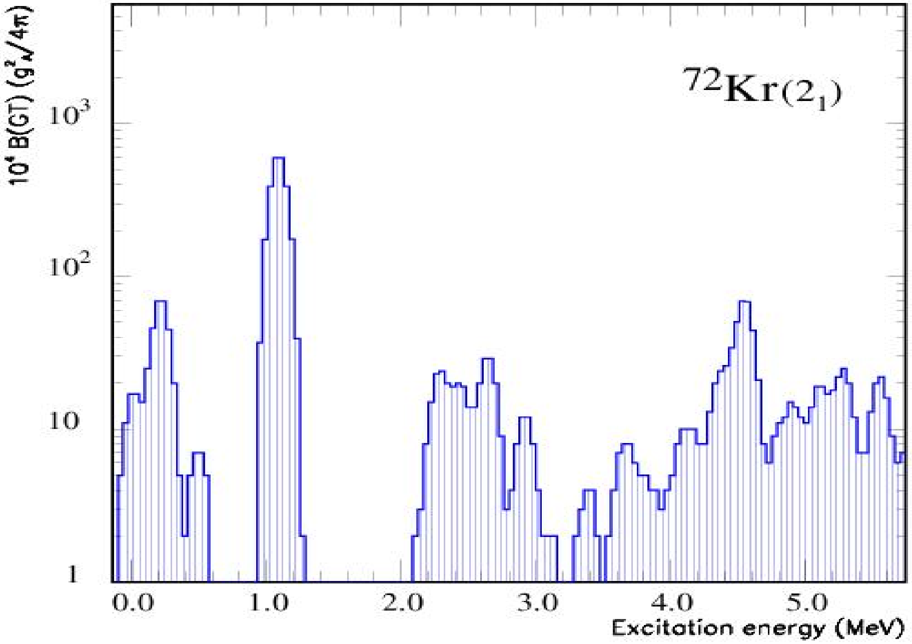
Spectroscopic quadrupole moments Q_2^{sp} (in efm^2) for the calculated 1^+ states of the ^{72}Br nucleus (ms3).

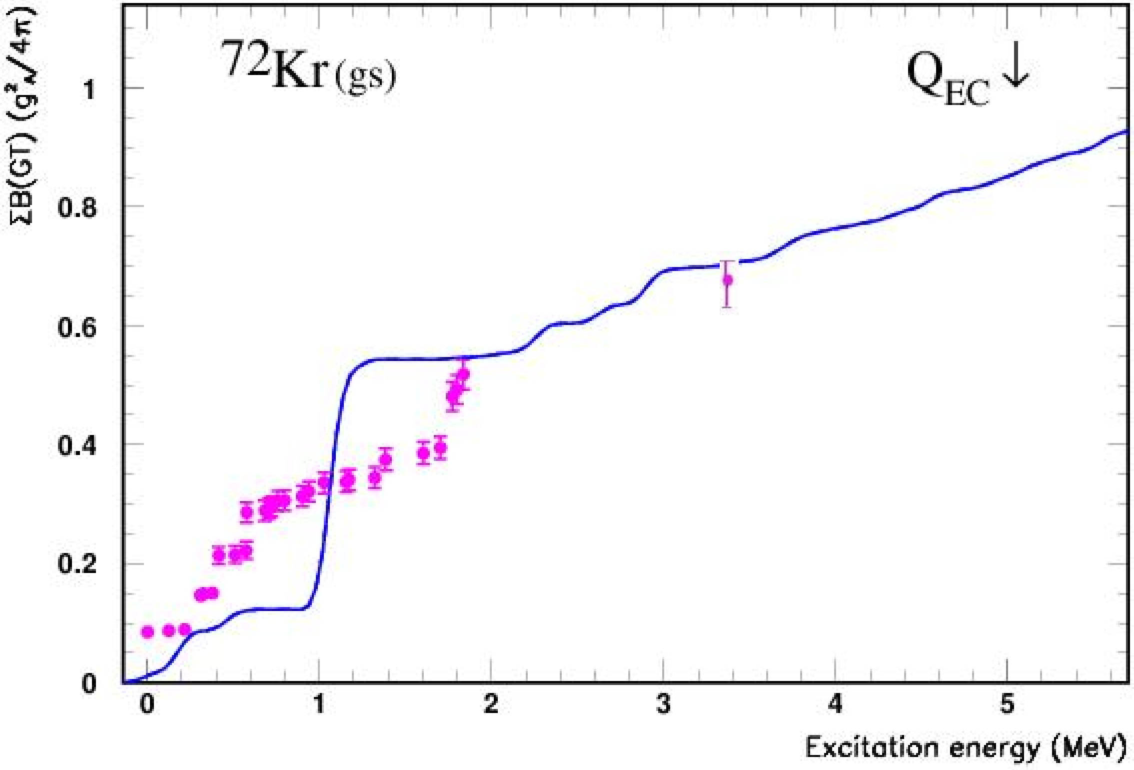
1_I^+	1_{II}^+	1_{III}^+	....							
48.5	48.7	-49.9	-49.4	46.5	45.5	-51.6	-50.1	-49.5	46.8	-11.5
8.7	-46.5	-48.7	45.4	44.0	-53.5	-39.1	27.0	41.0	-48.9	-46.5
-49.2	42.5	-39.8	35.8	-46.3	41.8	-45.0	-43.5	42.4	-46.9	-46.6
-26.3	10.7	-37.3	37.4	-36.5	35.5	-46.6	47.6	-48.8	-40.0	-1.2
-24.0	-35.8	37.1	-47.7	-53.2	-42.8	27.0	-7.2	10.2	-45.8	-32.8
30.8	40.7	-24.2	21.8	-23.9	-41.8	15.0	-13.5	-38.3	39.6	11.8
36.4	-47.6	-24.7	21.8	41.7	37.4	29.5	12.1	-20.2	-23.6	-39.3
-33.2	37.6	27.7	-50.9	43.6	24.1	-10.7	15.6	-32.7	44.3	-46.4
-33.9	32.5	-42.2	-23.1	43.3	20.9	38.6	-44.1	-52.3	-45.8	21.0
-45.0	1.5	-1.8	-37.6	39.6	45.1	-48.9	-43.6	-23.9	31.5	36.1
16.1	34.9	-53.6	43.2	-41.8	-45.9	-43.5				



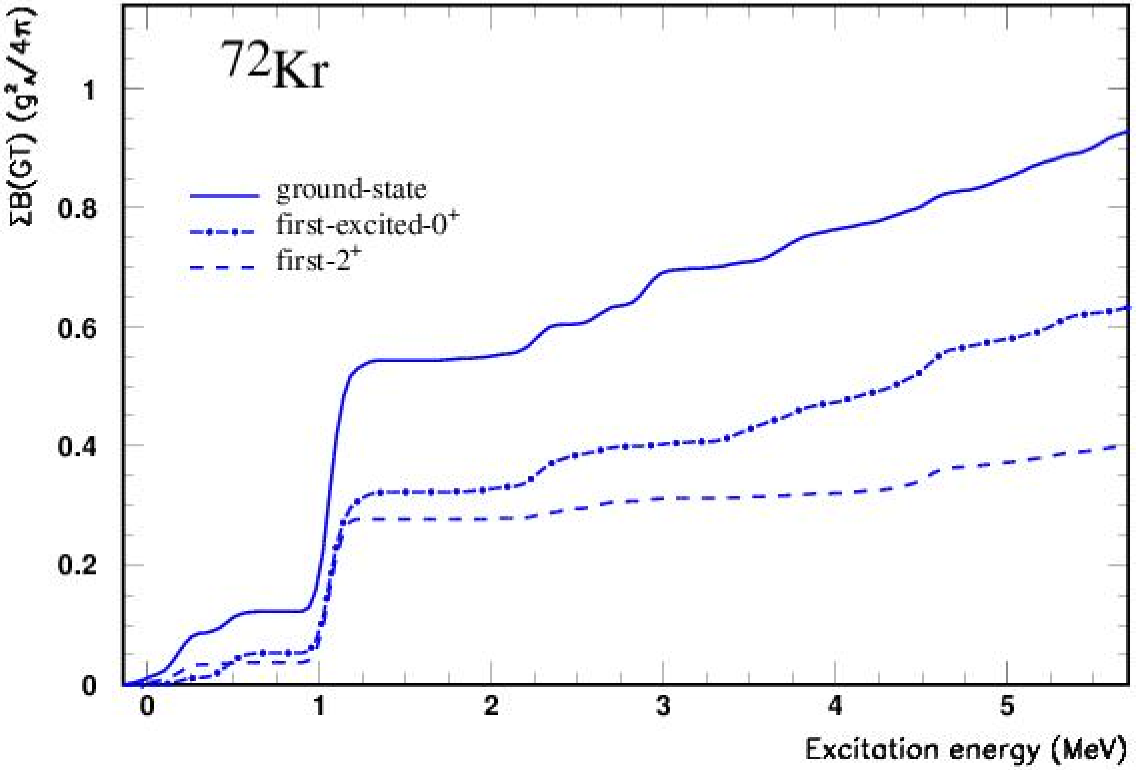
Q_{EC}^{ms3} =4.460 MeV







72Kr(gs)
Q_EC ↓
ΣB(GT) (g²A/4π)
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5
Excitation energy (MeV)



^{72}Kr
ground-state
first-excited-0$^+$
first-2$^+$
ΣB(GT) ($g_A^2/4\pi$)
Excitation energy (MeV)
0
0.2
0.4
0.6
0.8
1
0
1
2
3
4
5

$$\frac{1}{T_{1/2}} = \frac{g_A^2}{D} \sum_i f(Z, E_i) |\left\langle 1_i^+ || \beta^+ || 0^+ \right\rangle|^2$$

$D = 6146$ s $\quad$ $g_A = 1.26$

$T_{1/2}^{\mathrm{exp}} = 17.1(2)$ s

$T_{1/2}^{(\mathrm{gs})} = 20.8$ s

$T_{1/2}^{(\text{first-excited } 0^+)} = 17.3$ s

Summary and outlook

- the Gamow-Teller β decay of ^{74}Kr was investigated for the first time within the complex Excited Vampir variational approach, describing consistently the shape-coexistence and –mixing in both parent and daughter nucleus

- the first results concerning the Gamow-Teller strength distribution as well as the accumulated strength for the ground state, the first-excited 0^+ and the yrast 2^+ of ^{72}Kr are obtained in a self-consistent approach. A good agreement with available data is revealed

- the uncertainties in the effective interaction require systematic investigations

In collaboration with:

K. W. Schmid, Amand Faessler

Tuebingen University, Germany

O. Radu

*National Institute for Physics and Nuclear Engineering,
Bucharest, Romania*