PHYSICAL REVIEW C VOLUME 10, NUMBER 6 DECEMBER 1974

Removal of an apparent discrepancy of excitation energies of ^{55}Co[†]

J. D. Goss, P. L. Jolivette, A. A. Rollefson, and C. P. Browne
Department of Physics, University of Notre Dame, Notre Dame, Indiana 46556
(Received 17 July 1974)

Excitation energies in ^{55}Co have been recalculated, eliminating a systematic error in values previously reported in a study of the ^{58}Ni(p,α)^{55}Co reaction.

[NUCLEAR REACTIONS ^{58}Ni(p, α)^{55}Co, measured ^{55}Co excitation energies.]

In our recent paper on the states of ^{55}Co,[1] studied with the ^{58}Ni(p, α)^{55}Co reaction, we pointed out that there appeared to be a shift between our results and the accurately quoted excitation energies of Martin *et al.*[2] who used the ^{54}Fe(p, γ) reaction. The average difference between the two sets of excitation energies is 4.3 ±0.5 keV as compared to the average uncertainty of 1.3 keV quoted by Martin *et al.* and 2.4 keV quoted by us. At that time we investigated several possibilities for this apparent shift but without success. As the differences in the two measurements were only slightly outside the estimates of uncertainties, it was hard to conclude that there was a real disagreement.

While performing a series of Q-value measurements which gave us a stringent test of our internal consistency on a set of absolute energy measurements we found a systematic difference in the effective field of the 100 cm spectrograph magnet

TABLE I. Excitation energies of levels of ^{55}Co.

Group number	Excitation energy (MeV ± keV)	Group number	Excitation energy (MeV ± keV)	Group number	Excitation energy (MeV ± keV)	Group number	Excitation energy (MeV ± keV)
0	g.s.	25	4.5473 ± 1.4	49	5.3650 ± 1.7	72	6.1266 ± 1.9
1	2.1646 ± 0.9	26	4.5861 ± 1.4	50	5.4266 ± 1.8	73	6.1445 ± 1.9
2	2.5645 ± 1.1	27	4.6272 ± 1.4	51	5.4593 ± 1.5	74	6.1671 ± 1.8
3	2.6583 ± 1.0	28	4.6857 ± 1.5	52	5.4838 ± 1.7	75	6.2037 ± 1.8
4	2.9189 ± 1.1	29	4.7154 ± 1.5	53	5.5261 ± 1.6	76	6.2177 ± 2.1
5	2.9378 ± 1.2	30	4.7238 ± 1.7	54	5.5411 ± 1.7	77	6.2501 ± 1.9
6	2.9738 ± 1.1	31	4.7471 ± 1.5	55	5.5568 ± 1.6	78	6.2631 ± 2.1
7	3.3018 ± 1.1	32	4.8512 ± 1.4	56	5.6419 ± 1.7	79	6.3255 ± 1.9
8	3.3226 ± 1.1	33	4.8694 ± 1.5	57	5.6727 ± 1.6	80	6.3409 ± 2.0
9	3.5628 ± 1.1	34	4.8825 ± 1.5	58	5.6972 ± 1.7	81	6.3613 ± 2.0
10	3.6415 ± 1.2	35[a]	4.9035 ± 1.5	59	5.7134 ± 1.6	82	6.3767 ± 2.4
11	3.7244 ± 1.3		(4.920)	60	5.7430 ± 1.6	83	6.4047 ± 2.0
12	3.7359 ± 1.3	36	4.9619 ± 1.5	61	5.7638 ± 1.7	84	6.4263 ± 2.0
13	3.7732 ± 1.2	37	4.9876 ± 1.5	62	5.7815 ± 1.6	85	6.4466 ± 1.9
14	3.8578 ± 1.2	38	5.0648 ± 1.5		(5.850)		(6.486)
15	3.9408 ± 1.3	39	5.0810 ± 1.6	63[b]	(5.860)	86[a]	6.5082 ± 1.9
16	4.1639 ± 1.3	40	5.0983 ± 1.5		(5.872)		(6.531)
17	4.1766 ± 1.3	41	5.1200 ± 1.5	64	5.9333 ± 1.7	87	6.5411 ± 2.1
18	4.2628 ± 1.3	42	5.1720 ± 1.5	65	5.9597 ± 1.7	88	6.5763 ± 2.0
19	4.3253 ± 1.3	43	5.1888 ± 1.5	66	5.9858 ± 1.7	89	6.6034 ± 1.9
20	4.3393 ± 1.3	44	5.2568 ± 2.1	67	6.0074 ± 1.7		(6.627)
21	4.4715 ± 1.3	45	5.2679 ± 1.6	68	6.0354 ± 1.7	90	6.6522 ± 1.9
22	4.4906 ± 1.3	46	5.2910 ± 1.6	69	6.0626 ± 1.7		
23	4.5140 ± 1.5	47	5.3095 ± 1.8	70	6.0737 ± 1.8		
24	4.5370 ± 1.4	48	5.3498 ± 1.7	71	6.0935 ± 1.7		

[a] Possible doublet.

[b] Possible triplet.

TABLE II. Comparison of excitation energies of ^{55}Co.

Present work (MeV ± keV)	^{54}Fe(p,γ)^{55}Co Ref. 2 (MeV ± keV)	Δ difference (keV)
2.1646 ± 0.9	2.166 ± 1	−1.4
2.5645 ± 1.1	2.565 ± 1	−0.5
2.6583 ± 1.0	2.660 ± 1	−1.7
2.9189 ± 1.1	2.918 ± 1	+0.9
2.9378 ± 1.2	2.938 ± 1	−0.2
3.3018 ± 1.1	3.302 ± 1	−0.2
3.3226 ± 1.1	3.324 ± 2	−1.4
3.7244 ± 1.3	3.725 ± 1	−0.6
3.8578 ± 1.2	3.860 ± 1	−2.2
4.1639 ± 1.3	4.164 ± 2	−0.1
4.1766 ± 1.3	4.176 ± 2	+0.6
4.7238 ± 1.7	4.722 ± 2	+1.8
		⟨Δ⟩ = −0.4 ± 0.3

and the field measured by the NMR probe. The cycling procedure for the magnet had been designed to minimize differential hysteresis, but this newly found difference in the effective and measured fields is more subtle and is described in detail in our Q-value paper.[3] We have since recalculated our ^{55}Co excitation energies correcting for the systematic error and our revised numbers are given in Table I. The uncertainties on each excitation energy have been recalculated according to the procedures discussed in Ref. 3 and because the systematic uncertainty has been eliminated we now quote considerably lower errors. A comparison with the energies of Martin *et al.*[2] is given in Table II. The agreement is now excellent, the average difference being 0.4 ± 0.3 keV.

†Research supported by National Science Foundation Grant No. GP-27456.

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