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Resonance Neutron Capture in ^{138}Ba and ^{140}Ce and the Prompt Neutron Correction to γ-ray Detectors*

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Abstract

The neutron capture cross sections of ^{138}Ba and ^{140}Ce have been measured with high energy resolution between 3 and 100 keV using the capture cross section facility at the 40 m station of the Oak Ridge Electron Linear Accelerator. The average s-wave level spacings are $\langle D\rangle_s = 6\cdot3\pm1\cdot7$ and $3\cdot2\pm0\cdot8$ keV for ^{138}Ba and ^{140}Ce respectively. The deduced s-wave neutron strength functions are $10^4 S_0 = 1\cdot0\pm0\cdot4$ and $1\cdot54\pm0\cdot53$ respectively, and the average s-wave radiative widths are $\langle \Gamma_\gamma\rangle_s = 55\pm20$ and 35 ± 9 meV. The p-wave neutron strength functions are $10^4 S_1 \approx 0\cdot03$ and $0\cdot32\pm0\cdot12$ respectively. The average 30 keV Maxwellian capture cross sections are $3\cdot9\pm0\cdot8$ mb for ^{138}Ba and $7\cdot7\pm0\cdot9$ mb for ^{140}Ce. A more rigorous treatment of the prompt neutron correction for γ-ray detectors is described, and it is shown that previously published results for ^{138}Ba have underestimated this correction. The ^{140}Ce data provide excellent corroboration for the calculated magnitude and time dependence of the prompt neutron correction.

1. Introduction

In the past five years, a considerable quantity of high resolution neutron capture data has become available through a collaborative project between Oak Ridge National Laboratory and the Australian Atomic Energy Commission. These data, covering much of the periodic table, have elucidated the roles played by valence neutron capture and doorway state capture, particularly near closed neutron shells (Bird *et al.* 1976; Allen and Musgrove 1978). However, as more data accumulated, it became apparent that results previously reported for ^{138}Ba by Musgrove *et al.* (1975) were singularly difficult to accommodate in a self-consistent picture of radiative capture. They found strong correlations ($\rho(\Gamma_n^0, \Gamma_\gamma) > 0\cdot6$) between the reduced s-wave neutron widths Γ_n and the accompanying radiative widths Γ_γ. Such correlations are too strong to be ascribed comfortably to s-wave valence neutron transitions feeding the low-lying 3p levels. In addition, they found the average s-wave radiative width to be several times greater than for other nuclides in this mass region.

A preliminary analysis of the ^{140}Ce data seemed to confirm the nonstatistical behaviour found in ^{138}Ba. However, a puzzling feature of this analysis was that many of the s-wave neutron widths from the capture data were as much as a factor of 2 larger than those measured in transmission by the Columbia University group (G. Hacken, personal communication). It was soon apparent that the corrections made to the observed radiative widths for the effect of prompt neutron scattering had been considerably underestimated. The prompt background is defined as the γ-ray yield resulting from the capture of scattered neutrons which cannot be resolved

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from resonance capture events, and which therefore increase the observed resonance radiative width. The neutron energy dependence of the average prompt background sensitivity $k(E_n)$ of the capture detector system had been obtained by observing the capture yield from a ^{208}Pb target which scattered neutrons into the capture resonance in the detector and environs. From measurements of the 83 keV resonance in ^{24}Mg (Macklin and Allen 1971) and data from ^{28}Si (Boldeman *et al.* 1975), a crude overall normalization of k was established, as described recently by Allen *et al.* (1977).

However, the ^{138}Ba data pointed to the need, at least with some targets, for a more rigorous approach to the problem. The problem was successfully tackled by taking filtered beam measurements on ^{208}Pb and modifying our Monte Carlo analysis program to include scattered neutron events external to the target. The sensitivity was inferred by comparing the measured yield both with and without various filters (to ascertain the time-dependent background component to be subtracted) and then dividing the resultant yield due to prompt neutrons by the known potential scattering cross section of ^{208}Pb. The ^{140}Ce data were found to provide some of the best corroboration for the correctness of the method employed since, for this nucleus, the prompt scattered component of the capture yield was partially resolved from the primary capture yield.

The capture cross sections for ^{138}Ba and ^{140}Ce at stellar neutron temperatures have been frequently demanded by astrophysicists studying stellar nucleosynthesis. Both nuclides lie on the s-process path, by which a large fraction of the heavy-element complement of the solar system has been formed in a long time-scale accretion of single neutrons by β-stable nuclides. At the $N = 82$ closed neutron shell, the probability for adding extra neutrons is much smaller than it is for neighbouring nuclides on the s-process path, so that the predicted s-process abundances for all elements heavier than ^{140}Ce depend critically on the measured capture rates for these two $N = 82$ nuclei. The present paper provides the first measurement of the radiative capture cross section for ^{140}Ce. In addition, the present re-analysis of the ^{138}Ba data significantly reduces the previously reported cross section for that nucleus.

2. Experiment and Analysis

The capture γ-ray detector, located at the 40 m station of the Oak Ridge Electron Linear Accelerator (ORELA), consists of a pair of fluorocarbon (C_6F_6) liquid scintillators with a low sensitivity to scattered neutrons and typically $\sim 15\%$ efficiency for detecting the γ-ray cascade. The efficiency is made approximately independent of the details of the cascade (which may vary from resonance to resonance) by assigning computed weights as a function of γ-ray energy to the detected events. Details of the experimental apparatus have been published by Macklin and Allen (1971). The neutron flux was monitored by a $0 \cdot 05$ cm thick $^6Li(n, \alpha)$ glass scintillator operating in the transmission mode (Macklin *et al.* 1971). The relative glass efficiency was calibrated using the saturated resonance technique for the $4 \cdot 9$ eV resonance in ^{197}Au.

The data were corrected for dead time effects and were normalized with respect to the standard $^6Li(n, \alpha)$ cross section (Macklin *et al.* 1975). Below 100 keV the absolute error in normalizing to the $^6Li(n, \alpha)$ cross section is expected to be better than 10% for the ^{140}Ce data. However, the ^{138}Ba data were collected before the installation of the ^{6}Li monitor and were normalized to the standard cross section using the ratio of counts on the time-gated fission monitor (Musgrove *et al.* 1975). The normalization error for the ^{138}Ba data is accordingly somewhat greater, and is assumed to be $\sim 12\%$. The following run information is given for the two sample targets (that for $^{138}BaCO_3$ preceding that for ^{140}Ce in each case): isotopic enrichment, $99 \cdot 8\%$ and $99 \cdot 3\%$; isotopic thickness, $0 \cdot 0113$ and $0 \cdot 0032$ at. b^{-1}; target thickness, $1 \cdot 37$ and $0 \cdot 07$ cm; pulse width, 40 and 5 ns.

All resonances observed in the data were analysed using a modified version of the ORNL/RPI Monte Carlo code (Sullivan *et al.* 1969; Allen *et al.* 1979) to correct for multiple scattering, self-shielding and prompt neutron scattering effects. An iterative fit to the observed capture area was performed by varying the smaller of the input values for Γ_n or Γ_γ. Finally, the corrected capture kernel $\kappa = g\Gamma_n \Gamma_\gamma/\Gamma$ was obtained. The high energy resolution ($\Delta E/E \lesssim 0 \cdot 2\%$ FWHM) allows neutron widths in excess of $\sim 0 \cdot 0004\, E_n$ to be measured in the ^{140}Ce capture data. The time-dependent background was found to decrease closely as v^{-1} in the range 10–100 keV.

The multiple-scattering correction is generally small for all but the largest resonances considered; however, for those resonances, the prompt neutron correction is a far greater source of uncertainty. These corrections are handled in the Monte Carlo program as follows: For each neutron considered, the capture yield at the first collision (incident neutron energy E_1) is given by

$$Y_1(E_1) = \frac{\sigma_c(E_1)}{\sigma_T(E_1)}\{1 - T(E_1)\}, \tag{1}$$

with σ_c, σ_s and $\sigma_T = \sigma_c + \sigma_s$ being the neutron capture, scattering and total cross sections respectively. The first collision probability is $1 - T(E_1)$, where $T(E_1)$ is the transmission calculated for neutrons incident normally on the target.

At each subsequent collision in the target, a contribution to the multiple-scattering yield is accumulated. For example, after one scatter, the capture yield contribution is

$$Y_M(E_1) = \frac{\sigma_s(E_1)}{\sigma_T(E_1)}\{1 - T(E_1)\}\{1 - T(E_2)\}\frac{\sigma_c(E_2)}{\sigma_T(E_2)}, \tag{2}$$

where E_2 is the neutron recoil energy after scattering and $1 - T(E_2)$ is the probability that the second collision occurs within the target. Also, from each scattering event in the target, a weighted contribution to the prompt neutron correction is estimated for those neutrons which escape the target. After one scatter, the prompt yield is

$$Y_P(E_1') = \frac{\sigma_s(E_1)}{\sigma_T(E_1)}\{1 - T(E_1)\}\, T(E_2)\, k(E_2). \tag{3}$$

The factor $k(E_2)$ is the probability that the escaping neutron with energy E_2 is captured eventually (perhaps after several external scatters), either in the detector (mostly by ^{19}F at 27 keV) or in ^{27}Al within the beam-tube environs ($5 \cdot 9$ and 35 keV resonances). In equation (3), the prime on E_1 indicates that the prompt neutron event occurs at a slightly later time (lower energy) in the time of flight data. This energy degradation of the prompt event is simulated in the program by random sampling methods (Allen *et al.* 1979) and causes a broadening of capture resonances with large prompt background components.

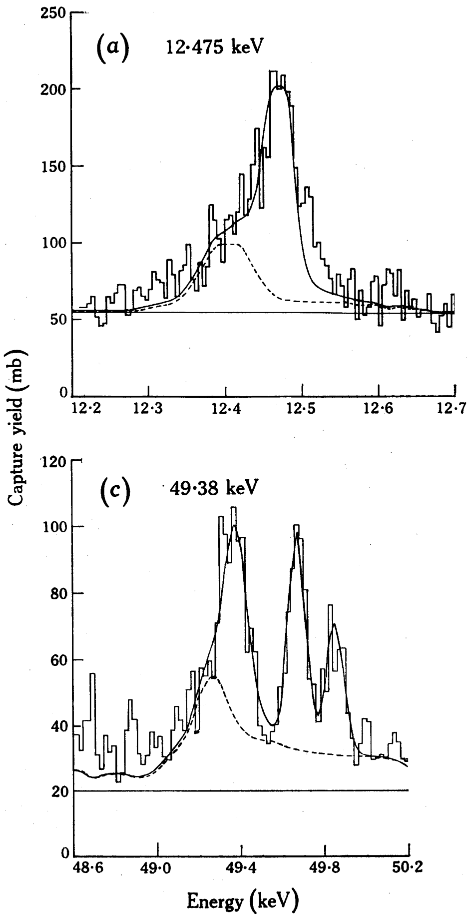

Fig. 1. Capture yield spectra showing fits to the indicated resonances in ^{140}Ce with:

(*a*) $\Gamma_n = 25$ eV, $\Gamma_\gamma = 29$ meV;

(*b*) $\Gamma_n = 55$ eV, $\Gamma_\gamma = 40$ meV;

(*c*) $\Gamma_n = 55$ eV, $\Gamma_\gamma = 137$ meV.

See the text for a description of the curves. The resonance at 12·5 keV has been omitted from (*a*) for clarity.

The sensitivity factor was determined by fitting filtered beam measurements on ^{208}Pb and was verified by fitting large scattering resonances in ^{23}Na, ^{28}Si, ^{27}Al, ^{56}Fe, ^{206}Pb and ^{208}Pb (Allen *et al.* 1979). However, ^{140}Ce has proved to be the most sensitive to the magnitude of the prompt background correction because, apart from having several resonances with large values of Γ_n/Γ_γ, the neutron widths are still small enough to allow a partial resolution of the energy-shifted prompt γ-ray component in the capture yield. Figs 1*a*–1*c* give some illustrative fits to three s-wave resonances in ^{140}Ce. In each case, the base line indicates the v^{-1} time-dependent background, the dashed curve is the calculated prompt background and the full curve is the total calculated γ-ray yield excluding multiple scattering events which were subtracted from the yield curve before fitting. The prompt background component shown in Fig. 1*a* results in a strong low energy asymmetry; in Fig. 1*b* the prompt background reaches a maximum value as a result of the capture of scattered neutrons by the 27·1 keV resonance of fluorine in the detector scintillator. The major contribution to the prompt background in Fig. 1*c* arises from the large neutron width of the 49·38 keV resonance, but there is no significant prompt background for the other resonances, which have very much smaller neutron widths.

An independent attempt was made to reproduce the derived sensitivity factor in a Monte Carlo mock-up of the detector system and environs of the ORELA target station. Known resonance capture parameters for ^{19}F, ^{27}Al and ^{28}Si were found to reproduce the fitted neutron sensitivity factor in the bombarding energy range 5–100 keV. In particular, the shape of the energy-degraded prompt background was verified. However, this full calculation is too elaborate, and too prodigal of computer time to be useful in the routine correction for prompt neutron effects. Although the uncertainty in the prompt background correction is estimated to be ~15%, there are nevertheless large uncertainties in some of the radiative widths, particularly in those for resonances in the region 25–40 keV.

Table 1. ^{138}Ba resonance parameters

E (eV)	$g\Gamma_n\Gamma_\gamma/\Gamma$ (meV)	Γ_n (eV)	Γ_γ (meV)	l	E (eV)	$g\Gamma_n\Gamma_\gamma/\Gamma$ (meV)	Γ_n (eV)	Γ_γ (meV)	l
4715	16 ± 1				51200	119 ± 40			
7876	50 ± 4	$3\cdot0\pm1\cdot5$	50 ± 5	(0)	53450	147 ± 45			
9956	26 ± 3				55500	145 ± 45			
14045	45 ± 5				58975	136 ± 24			
19700	41 ± 5				59225	163 ± 30	(70)	163 ± 30	0
19905	90 ± 8	(5)	46 ± 6	(1)	60950	89 ± 40			
23445	60 ± 7				61625	155 ± 55			
24300	48 ± 6				62950	86 ± 40	(130)	86 ± 40	0
29250	77 ± 10				65525	145 ± 30			
30900	34 ± 20	225 ± 25	34 ± 20	0	69070	178 ± 80	460 ± 100	178 ± 80	0
32630	25 ± 5				73275	126 ± 40			
32830	27 ± 5				74000	146 ± 50			
33370	48 ± 9				78000	84 ± 50			
35420	35 ± 12				79900	52 ± 40	(150)	52 ± 40	0
35700	66 ± 12				81800	187 ± 80	(20)	190 ± 90	(0)
36700	35 ± 15				83500	135 ± 65			
40300	10^{+20}_{-5}	150 ± 50	~10	0	89400	280 ± 120	(20)	280 ± 120	(0)
43780	94 ± 30				91050	296 ± 120			
49815	134 ± 30				91800	360 ± 100			
50475	111 ± 60	250 ± 50	111 ± 60	0					

3. Results

The re-analysed resonance data for ^{138}Ba below 90 keV appear in Table 1. Neutron width values contained in parentheses are those assumed in the present analysis; they are based on the early cross section analysis by Bilpuch *et al.* (1961). As stated in the previous section, considerable correction had to be applied for prompt neutron events, and so the present results supersede the earlier ones (Musgrove *et al.* 1975) in which the correction was underestimated.

The ^{140}Ce data were analysed to 65 keV using the preliminary results of the Columbia University group (G. Hacken, personal communication) together with recent data from Camarda (1979). We obtained resolved neutron widths for most of the resonances studied by the Columbia group, and their values are consistent with ours once the energy-degradation effect of the prompt neutron background is accounted for. The results for resonances in ^{140}Ce from 3 to 65 keV appear in Table 2. No resonances were detected in the range 3–5·6 keV.

Table 2. ^{140}Ce resonance parameters

E (eV)	$g\Gamma_n\Gamma_\gamma/\Gamma$ (meV)	$g\Gamma_n$ (eV)	Source of $g\Gamma_n$ data	$g\Gamma_\gamma$ (meV)	l
5640	10 ± 1				
6008	19 ± 2	$0\cdot83\pm0\cdot02$	Columbia group	19 ± 2	0
6328	2 ± 1				
6779	16 ± 1	$0\cdot114\pm0\cdot010$	Columbia group	19 ± 2	(1)
8393	36 ± 2	$0\cdot94\pm0\cdot02$	Columbia group	38 ± 3	(1)
9573	25 ± 10	65 ± 10[A]		25 ± 10	0
10328	4 ± 1				
11228	42 ± 3	$0\cdot47\pm0\cdot03$	Columbia group	46 ± 4	(1)
11432	30 ± 4	$13\cdot5\pm0\cdot5$	Columbia group	30 ± 4	0
11473	26 ± 2				
11744	7 ± 1				
12475	29 ± 5	25 ± 5	Columbia group	29 ± 6	0
12503	3 ± 1				
13170	15 ± 2				
13965	7 ± 1				
14010	41 ± 4	$0\cdot59\pm0\cdot02$	Columbia group	44 ± 5	(1)
15818	4 ± 1				
16134	15 ± 2				
16418	46 ± 4	$1\cdot75\pm0\cdot10$	Columbia group	47 ± 5	(1)
18030	20 ± 8	60 ± 2	Columbia group	20 ± 8	0
18120	34 ± 3				
18190	13 ± 2				
18775	27 ± 3				
20465	11 ± 2				
21030	17 ± 2				
21205	79 ± 9	$2\cdot0\pm0\cdot5$	Camarda (1979)	41 ± 5	1
21600	106 ± 30	450 ± 50	Columbia group	106 ± 30	0
22460	15 ± 4				
23550	32 ± 4				
23695	45 ± 5				
24105	16 ± 4				
24760	38 ± 10	70 ± 20	Columbia group	38 ± 10	0
25260	48 ± 6				
26385	61 ± 7				
27220	24 ± 3				
27650	21 ± 3				
28190	40 ± 30	55 ± 5[B]	Columbia group	40 ± 30	0
29040	20 ± 3				
29210	22 ± 3	$0\cdot8\pm0\cdot2$	Camarda (1979)	23 ± 5	(1)
29865	39 ± 4				
30650	22 ± 7	$11\cdot5\pm1\cdot0$	Columbia group	22 ± 7	(0)
30810	44 ± 6				
32420	35 ± 4				
33475	36 ± 5				
33650	39 ± 5				
33795	46 ± 5				
34600	24 ± 4	$2\cdot7\pm0\cdot4$	Camarda (1979)	24 ± 5	(1)
34950	16 ± 4				
38100	8 ± 3				
38170	20 ± 20	75 ± 10	Camarda (1979)	20 ± 20	0

[A, B] See footnotes at end of table.

Table 2 (*Continued*)

E (eV)	$g\Gamma_n\Gamma_\gamma/\Gamma$ (meV)	$g\Gamma_n$ (eV)	Source of $g\Gamma_n$ data	$g\Gamma_\gamma$ (meV)	l
38305	12 ± 6				
39133	44 ± 6	$1\cdot3\pm0\cdot2$	Camarda (1979)	46 ± 8	(1)
39650	94 ± 9				
40100	53 ± 6	$1\cdot5\pm0\cdot2$	Camarda (1979)	56 ± 8	(1)
40900	53 ± 7	$1\cdot5\pm0\cdot2$	Camarda (1979)	56 ± 9	(1)
41470	41 ± 7	$1\cdot7\pm0\cdot3$	Camarda (1979)	42 ± 8	(1)
41740	20 ± 20	260 ± 30	Camarda (1979)	20 ± 20	0
41970	13 ± 6				
42490	53 ± 6				
42620	38 ± 5	$2\cdot0\pm0\cdot4$	Camarda (1979)	40 ± 6	(1)
43763	55 ± 6				
44610	38 ± 6	$2\cdot9\pm0\cdot4$	Camarda (1979)	39 ± 8	(1)
44350	22 ± 5				
45140	32 ± 6				
45280	25 ± 5				
45560	16 ± 4				
46120	60 ± 6				
46550	47 ± 5				
46750	43 ± 5				
48470	77 ± 10	$1\cdot5\pm0\cdot3$	Camarda (1979)	80 ± 12	(1)
49380	137 ± 25	65 ± 10	Camarda (1979)	137 ± 25	0
49670	82 ± 10				
49845	53 ± 8				
50300	26 ± 12				
50575	16 ± 10				
51100	21 ± 10				
51550	39 ± 8				
52250	101 ± 10				
52750	28 ± 6				
53075	80 ± 10	$3\cdot5\pm0\cdot7$	Camarda (1979)	82 ± 15	(1)
53175	37 ± 5	15 ± 3	Camarda (1979)	37 ± 5	1
53580	22 ± 10	$2\cdot2\pm0\cdot3$	Camarda (1979)	22 ± 10	(1)
53825	13 ± 6				
54200	28 ± 5				
54550	61 ± 10				
55150	21 ± 14	190 ± 25	Camarda (1979)	21 ± 14	0
55625	62 ± 8	$3\cdot0\pm0\cdot4$	Camarda (1979)	66 ± 10	(1)
56275	66 ± 8				
58450	47 ± 8				
59425	71 ± 9				
59625	24 ± 5				
59850	26 ± 4				
60080	72 ± 8				
60543	102 ± 15	60 ± 8	Camarda (1979)	102 ± 20	1
61475	61 ± 8				
61925	69 ± 10				
62992	118 ± 18				

[A] Columbia group gives $\Gamma_n = 39\pm2$.

[B] Camarda (1979) gives $\Gamma_n = 110\pm15$ but our data agree with the Columbia result; see the discussion in Section 3.

In the case of the 28·19 keV resonance of ^{140}Ce, Camarda (1979) suggested that $\Gamma_n = 110 \pm 15$, which is exactly twice the value of 55 ± 5 (see Table 2) obtained by the Columbia group. Our data cannot be fitted to the larger of these values unless the prompt background correction for the resonance vanishes. However, that possibility is extremely remote since the neutrons scattered at this resonance are readily captured by the 27 keV resonance in the fluorine of the detector.

The (n, γ) cross sections, averaged over broad energy ranges in the interval 3–100 keV, are given for both ^{138}Ba and ^{140}Ce in Table 3. The 30 keV Maxwellian averaged cross section $\langle \sigma v \rangle / v_T$, which is the important quantity for s-process calculations, has values of $3\cdot9 \pm 0\cdot8$ and $7\cdot7 \pm 0\cdot9$ mb for ^{138}Ba and ^{140}Ce respectively. Average resonance parameters derived from the data are collected in Table 4.

Table 3. Averaged capture cross sections for ^{138}Ba and ^{140}Ce

Energy interval (keV)	$\sigma(^{138}$Ba) (mb)	$\sigma(^{140}$Ce) (mb)	Energy interval (keV)	$\sigma(^{138}$Ba) (mb)	$\sigma(^{140}$Ce) (mb)
3–4	0	0	20–30	$3\cdot0 \pm 0\cdot6$	$10\cdot9 \pm 0\cdot8$
4–5	$13\cdot9 \pm 1\cdot8$	0	30–40	$3\cdot3 \pm 0\cdot7$	$5\cdot2 \pm 0\cdot4$
5–6	0	$7\cdot1 \pm 0\cdot4$	40–50	$2\cdot1 \pm 0\cdot7$	$8\cdot7 \pm 0\cdot5$
6–8	$13\cdot0 \pm 2\cdot0$	$12\cdot1 \pm 0\cdot6$	50–60	$6\cdot4 \pm 1\cdot3$	$6\cdot5 \pm 0\cdot5$
8–10	$5\cdot5 \pm 0\cdot8$	$14\cdot5 \pm 1\cdot0$	60–80	$3\cdot3 \pm 1\cdot0$	$5\cdot0 \pm 1\cdot0$
10–15	$2\cdot7 \pm 0\cdot4$	$14\cdot0 \pm 0\cdot9$	80–100	$2\cdot5 \pm 1\cdot0$	$4\cdot0 \pm 1\cdot0$
15–20	$5\cdot6 \pm 0\cdot7$	$7\cdot6 \pm 0\cdot8$			

Table 4. Average resonance parameters for ^{138}Ba and ^{140}Ce

Parameter	Value for ^{138}Ba	Value for ^{140}Ce	Parameter	Value for ^{138}Ba	Value for ^{140}Ce
$\langle D_s \rangle^A$ (keV)	$6\cdot3 \pm 1\cdot7$	$3\cdot2 \pm 0\cdot8$	$\langle \Gamma_\gamma \rangle_s$ (meV)	55 ± 20	35 ± 9
$10^4 S_0$	$1\cdot0 \pm 0\cdot4$	$1\cdot54 \pm 0\cdot53$	$\langle \Gamma_\gamma \rangle_p$ (meV)	45 ± 10	30 ± 6
$10^4 S_1$	$\sim 0\cdot03^B$	$0\cdot32 \pm 0\cdot12$	$\rho(\Gamma_n^0, \Gamma_\gamma)$	$0\cdot1 \pm 0\cdot3$	$0\cdot32 \pm 0\cdot27$

[A] $\langle D_s \rangle$ is the average s-wave level spacing.
[B] Obtained from a fit to the average cross section.

The correlation $\rho(\Gamma_n^0, \Gamma_\gamma)$ between s-wave radiative widths and reduced neutron widths is inconclusive for both nuclei, owing to the large uncertainty associated with the uncertainties in the radiative widths. The valence model predicts a modest correlation $\rho \approx 0\cdot3$ for these nuclei, and this is consistent with the data. The optical model calculation (Lane and Mughabghab 1974; Allen and Musgrove 1978) of the valence component of the total radiative width for both nuclei yields

$$\Gamma_\gamma^V \approx 0\cdot035 \Gamma_n^0,$$

which indicates that particular resonances in both ^{138}Ba and ^{140}Ce decay predominantly via valence transitions. For example, the calculated valence width for the 21·6 keV resonance in ^{140}Ce (with measured $\Gamma_\gamma = 106$ meV) is $\sim$100 meV.

4. Conclusions

The anomalous correlation between Γ_n^0 and Γ_γ for ^{138}Ba reported by Musgrove *et al.* (1975) is now seen to have been caused by an incorrectly assessed prompt background correction. The nucleus ^{140}Ce has several resolved-width resonances with small radiative widths and is perhaps the most sensitive indicator of the magnitude and time dependence of the prompt background correction for γ-ray detectors. We have been unable to determine conclusively whether the width correlation predicted by the valence model is present in the ^{138}Ba and ^{140}Ce nuclides. However, certain resonances are expected to decay predominantly via valence neutron transitions.

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