Reaction : ^{23}Na(p,γ)^{24}Mg

More than 80 resonances are identified up to $E = 3.7$ MeV. The reaction rates are computed using the $\omega\gamma$ values of SW75 and GÖ89b and normalized to the $E_r = 491$ keV resonance yield [PA78, PA79]. Two subthreshold states with $J^\pi = 2^+$ ($\ell = 0$) are included [SW75, SC83] with a reduced width $\gamma_p^2 = 305$ keV (10% of the Wigner limit at $a = 4.6$ fm). These subthreshold states determine the rate up to $T_9 \approx 0.03$. The lower and upper limits on γ_p^2 are taken as 0 and 3.05 MeV (the Wigner limit). Since interference effects cannot be evaluated, they are neglected, and a factor of 2 is included in the uncertainty on the contribution of subthreshold and low-energy states. Between $T_9 = 0.04$ and $T_9 = 0.14$, the rate is essentially determined by the properties of the 138 keV resonance, for which an upper limit on the $\omega\gamma$ value is available [GÖ89b]. Two other 2^+ resonances ($E_r = 0.238$ and 0.294 MeV) also contribute substantially. Above $T_9 = 5$, HF estimates are used (see Sect. 2.5). As the CA88 and FO75 rates are identical, it is likely that the data of FI78, SC83, and probably also of SW75 have not been taken into account in CA88. The large differences between our rates and the CA88 rates between $T_9 = 0.04$ and $T_9 = 0.14$ are due to the 138 keV resonance, which was not included in CA88. Moreover, the direct-capture term in CA88 is obtained with $S_1 > 0$, which implies that subthreshold states have been disregarded. Our thermalization effects reduce the ratio to CA88 by a factor $r_{tt} = 0.90$ to 0.77 for $T_9 = 3.5$ to 10 (CA88 adopt $r_{tt} = 1$ at all temperatures).

E_r (keV)	J^π	Γ_{tot} (keV)	Γ_γ (eV)	γ_p^2 (keV)	
-238 ± 1	2^+	< 2 [SC83]	0.24 ± 0.04 [SC83]	305	
-171 ± 1	2^+	< 3 [SC83]	0.16 ± 0.04 [SC83]	305	
			$\omega\gamma$ (eV)		
138 ± 3			$5^{+45}_{-5} \times 10^{-7}$ [GÖ89b]		I
238 ± 1	2^+	< 0.02	$(5.3 \pm 1.8) \times 10^{-4}$ [SW75]		I
294 ± 1	2^+	< 0.02	0.11 ± 0.02 [SW75]		I
Res. 294 – 3700 MeV		see comments			

T_9	low	adopt	high	exp	ratio	T_9	low	adopt	high	exp	ratio	T_9	low	adopt	high	exp	ratio
0.018	0.02	4.39	86.8	-26	0.2	0.15	1.53	7.19	42.2	-5	1.4	1	3.93	7.25	15.2	2	0.9
0.02	0.03	6.16	122	-25	0.2	0.16	0.55	1.99	9.19	-4	1.1	1.25	0.85	1.33	2.53	3	0.9
0.025	0.01	1.21	23.9	-22	0.2	0.18	0.48	1.35	4.36	-3	0.9	1.5	1.51	2.11	3.71	3	0.9
0.03	0.04	6.81	133	-21	0.2	0.2	2.67	6.97	19.0	-3	0.8	1.75	2.38	3.09	5.10	3	0.9
0.04	1.6e-3	4.43	46.5	-17	3.3	0.25	0.58	1.44	3.52	-1	0.8	2	3.40	4.25	6.76	3	1.0
0.05	1.1e-4	9.04	90.5	-14	97	0.3	0.44	1.07	2.57	0	0.8	2.5	5.79	7.00	10.8	3	1.0
0.06	4.2e-6	1.43	14.3	-11	600	0.35	1.78	4.37	10.4	0	0.9	3	0.84	1.01	1.56	4	1.1
0.07	6.4e-5	5.13	51.3	-10	150	0.4	0.50	1.23	2.90	1	0.9	3.5	1.10	1.32	2.05	4	1.2
0.08	7.7e-4	7.34	73.3	-9	1300	0.45	1.10	2.69	6.35	1	0.9	4	1.34	1.61	2.51	4	1.3
0.09	3.5e-3	5.69	56.9	-8	370	0.5	2.06	4.97	11.7	1	0.9	5	1.76	2.10	3.24	4	1.1
0.1	0.01	2.90	28.8	-7	94	0.6	0.52	1.22	2.85	2	0.9	6	2.13	2.79	5.00	4	1.3
0.11	0.01	1.10	10.8	-6	29	0.7	1.02	2.29	5.25	2	0.9	7	2.44	3.49	7.00	4	1.4
0.12	0.10	3.42	32.2	-6	9.7	0.8	1.73	3.67	8.21	2	0.9	8	2.73	4.22	9.21	4	1.5
0.13	0.67	9.59	82.6	-6	4.1	0.9	2.69	5.32	11.6	2	0.9	9	2.99	4.97	11.6	4	1.7
0.14	0.36	2.61	19.1	-5	2.2							10	3.22	5.74	14.2	4	1.8