$^{24}_{11}\mathrm{Na}_{13}$

1 Decay Scheme

Na-24 disintegrates by emission of beta- particles (100%). The main transition (99.939%) has a maximum energy of 1393 keV and populates the 4123 keV level of Mg-24. This process is followed by two gamma rays in a cascade (2754 and 1393 keV) which leads through the 1368 keV level to the ground state of Mg-24. Due to the high transition energies internal pair formation takes place.
Le Na-24 se désintègre par emission bêta moins (100%). La transition principale a une énergie maximale de 1393 keV et peuple le niveau d'énergie 4123 keV du Mg-24. Cette désintégration est suivie par deux émissions gamma en cascade vers le niveau fondamental de Mg-24. Les énergies élevées de ces transitions permettent la création de paires électron-positon.

2 Nuclear Data

$T_{1/2}(^{24}\mathrm{Na})$	:	14,9574	(20)	h
$Q^-(^{24}\mathrm{Na})$	:	5515,78	(16)	keV

2.1 β^- Transitions

	Energy keV	Probability × 100	Nature	lg ft
$\beta^-_{0,4}$	279,3 (6)	0,057 (7)	Allowed	6,74
$\beta^-_{0,3}$	1277,5 (11)	0,001 (1)	2nd forbidden	10,6
$\beta^-_{0,2}$	1392,94 (16)	99,939 (8)	Allowed	6,12
$\beta^-_{0,1}$	4147,11 (16)	0,003 (2)	2nd forbidden	12,7

2.2 Gamma Transitions and Internal Conversion Coefficients

	Energy keV	$P_{\gamma+ce}$ × 100	Multipolarity	α_K (10^{-5})	α_L (10^{-6})	α_T (10^{-5})	α_π (10^{-5})
$\gamma_{4,3}$(Mg)	996,09 (6)	0,00123 (27)	M1+18,1%E2	1,6 (5)	1	1,7 (5)	
$\gamma_{1,0}$(Mg)	1368,669 (5)	99,9990 (3)	E2	0,98	0,6	1,04	4,5 (4)
$\gamma_{2,1}$(Mg)	2754,177 (11)	99,940 (7)	E2	0,26	0,17	0,28	68 (4)
$\gamma_{3,1}$(Mg)	2869,69 (6)	0,00024 (3)	M1+99,8%E2	0,25	0,16	0,26	
$\gamma_{4,1}$(Mg)	3866,48 (10)	0,056 (7)	E2	0,14	0,1	0,15	
$\gamma_{3,0}$(Mg)	4238,37 (6)	0,00084 (10)	E2	0,15	0,1	0,16	

3 Atomic Data

3.1 Mg

ω_K : 0,0291 (9)
$\bar{\omega}_L$: 0,00030 (12)
n_{KL} : 1,938 (6)

3.1.1 X Radiations

		Energy keV		Relative probability
X_K				
	$K\alpha_2$	1,254		50,31
	$K\alpha_1$	1,254		100
	$K\beta_1$	1,302	}	
	$K\beta_5''$		}	2,6
X_L				
	$L\ell$	0,039		
	$L\eta$	0,049		

3.1.2 Auger Electrons

	Energy keV	Relative probability
Auger K		
KLL	1,10 – 1,18	

4 Electron Emissions

		Energy keV		Electrons per 100 disint.
e_{AK}	(Mg)			0,00145 (11)
	KLL	1,10	- 1,18	}
$ec_{1,0\ \alpha}$	(Mg)	346,62	(1)	0,0045 (4)
$ec_{1,0\ K}$	(Mg)	1367,321	(5)	0,00028 (3)
$ec_{2,1\ \alpha}$	(Mg)	1732,177	(11)	0,068 (4)
$ec_{2,1\ K}$	(Mg)	2752,72		0,00026 (3)
$\beta^-_{0,4}$	max:	279,3	(6)	0,057 (7)
$\beta^-_{0,4}$	avg:	89,56	(19)	
$\beta^-_{0,3}$	max:	1277,5	(11)	0,001 (1)
$\beta^-_{0,3}$	avg:	502,7	(5)	
$\beta^-_{0,2}$	max:	1392,94	(16)	99,939 (8)
$\beta^-_{0,2}$	avg:	555,15	(8)	
$\beta^-_{0,1}$	max:	4147,11	(16)	0,003 (2)
$\beta^-_{0,1}$	avg:	1866,79	(8)	

5 Photon Emissions

5.1 X-Ray Emissions

		Energy keV	Photons per 100 disint.	
XL	(Mg)	0,039 — 0,049	0,00000071 (29)	
$XK\alpha_2$	(Mg)	1,254	0,0000119 (5)	} Kα
$XK\alpha_1$	(Mg)	1,254	0,0000236 (10)	}

5.2 Gamma Emissions

	Energy keV	Photons per 100 disint.
$\gamma^{\pm}$	511	0,145 (11)
$\gamma_{4,3}$(Mg)	996,09 (6)	0,00123 (27)
$\gamma_{1,0}$(Mg)	1368,626 (5)	99,9935 (5)
$\gamma_{2,1}$(Mg)	2754,007 (11)	99,872 (8)
$\gamma_{3,1}$(Mg)	2869,50 (6)	0,00024 (3)
$\gamma_{4,1}$(Mg)	3866,14 (10)	0,056 (7)
$\gamma_{3,0}$(Mg)	4237,96 (6)	0,00084 (10)

6 Main Production Modes

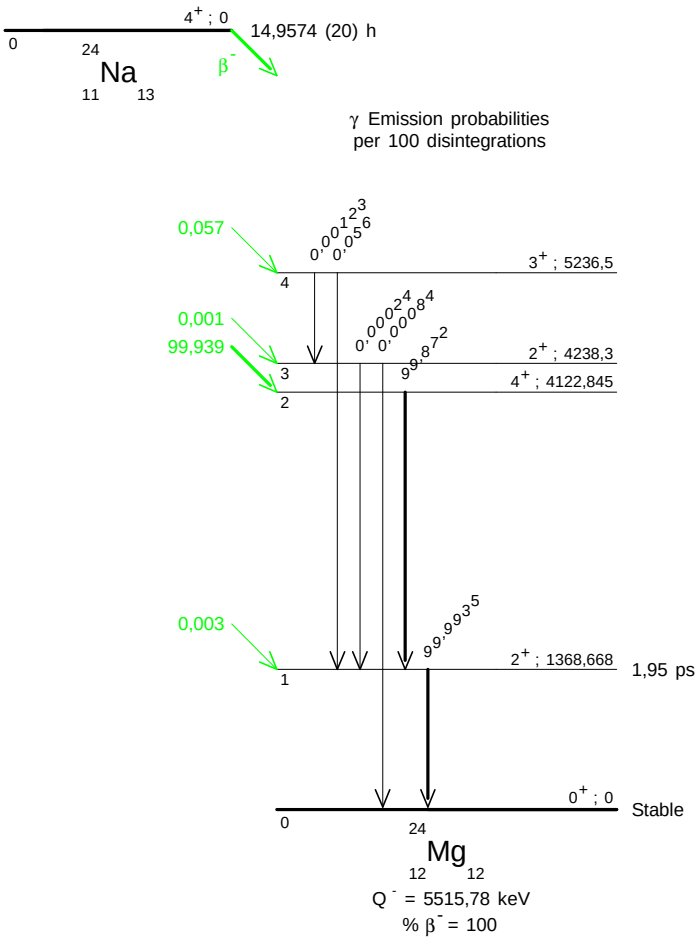
$\mathrm{Na-23(n,\gamma)Na-24}$

7 References

- E. R. Rae. Phil. Mag. 40 (1949) 1155
  (Internal pair creation coefficient)
- R. Wilson, G. R. Bishop. Proc. Phys. Soc. (London) 62 (1949) 457
  (Half-life)
- J. W. Cobble, R. W. Atteberry. Phys. Rev. 80 (1950) 917
  (Half-life)
- P. Grant. Proc. Phys. Soc. (London) 63 (1950) 1298
  (Transition Probability - beta- transition)
- W. Mims, H. Halban, R. Wilson. Nature 166 (1950) 1571
  (Internal pair creation coefficient)
- M. R. Cleland, J. Townsend, A. L. Hughes. Phys. Rev. 84 (1951) 298
  (Internal pair creation coefficient)
- J. F. Turner, P. E. Cavanagh. Phil. Mag. 42 (1951) 636
  (Transition Probability - beta- transition)
- H. Slätis, K. Siegbahn. Arkiv f. Fysik 4 (1952) 485
  (Internal pair creation coefficient)
- S. D. Bloom. Phys. Rev. 88 (1952) 312
  (Internal pair creation coefficient)
- E. E. Lockett, R. H. Thomas. Nucleonics 11 (1953) 14
  (Half-life)
- J. Tobailem. J. Phys. Radium 16 (1955) 48
  (Half-life)
- F. T. Porter, F. Wagner Jr., M. S. Freedman. Phys. Rev. 107 (1957) 135
  (Beta- particle maximum energy)
- P. J. Campion, J. S. Merritt. Can. J. Phys. 36 (1958) 983
  (Half-life)
- H. Daniel. Nucl. Phys. 8 (1958) 191
  (Beta- particle maximum energy)
- R. Batchlor, A. J. Ferguson, H. E. Gove, A. E. Litherland. Nucl. Phys. 16 (1960) 38
  (Mixing of different multipolarities)
- G. Wolf. Nukleonik 2 (1960) 255
  (Half-life)
- P. Depommier, M. Chabrc. J. Phys. Radium 22 (1961) 656 ,
  (Beta- particle maximum energy)
- K. P. Artamonova, L. V. Gustova, Y. N. Podkapaev, O. V. Chubinskii. Soviet Phys. JETP 12 (1961) 1109
  (Gamma ray emission probability)
- E. I. Wyatt, S. A. Reynolds, T. H. Handlcy, W. S. Lyon, H. A. Parkcr. Nucl. Sci. Eng. 11 (1961) 74
  (Half-life)
- J. E. Monahan, S. Raboy, C. C. Trail. Nucl. Phys. 33 (1962) 633
  (Gamma ray emission probability)
- J. E. Monahan, S. Raboy, C. C. Trail. Nucl. Instrum. Meth. 17 (1962) 225
  (Half-life)
- C. Broude, H. E. Gove. Ann. Phys. (New York) 23 (1963) 71
  (Mixing of different multipolarities)
- H. Paul, F. P. Viehböck, P. Skarek, H. Baicr, I. Hoffmann, H. Wotke. Acta Phys. Austr. 16 (1963) 278
  (Beta- particle maximum energy)
- J. Lehmann. J. Phys. 25 (1964) 326
  (Beta- particle maximum energy)
- G. Murray, R. L. Graham, J. S. Geiger. Nucl. Phys. 63 (1965) 353
  (Gamma ray energy)
- J. J. Reidy, M. L. Wiedenbeck. Bull. Am. Phys. Soc. (abstract SP2) 10 (1965) 1131
  (Gamma ray energy)

- H. Beekhuis, H. De Waard. Nucl. Phys. 74 (1965) 459
  (Beta- particle maximum energy)
- E. Spring. Phys. Lett. 18 (1965) 132
  (Total internal conversion coefficient)
- P. M. Endt, C. van der Leun. Nucl. Phys. A105 (1967) 1
  (Gamma ray emission probability)
- J. A. Bearden. Rev. Mod. Phys. 39 (1967) 78
  (X-Ray energies)
- F. Lagoutine, Y. le Gallic, J. Lcgrand. Int. J. Appl. Rad. Isot. 19 (1968) 475
  (Half-life)
- J. van Klinken, F. Pleiter, H. T. Dijkstra. Nucl. Phys. A112 (1968) 372
  (Gamma ray emission probability)
- P. Kemeny. Radiochem. Radioanal. Letters 2 (1969) 119
  (Half-life)
- H. M. W. Booij, E. A. Van Hoek., J. Blok. Nucl. Instrum. Meth. 72 (1969) 40
  (Beta- particle maximum energy)
- J. Lebowitz, A. R. Sayres, C. C. Trail, B. Weber, P. L. Zirkind. Nuovo Cim. 65A (1970) 675
  (Gamma ray energy, Gamma ray emission probability)
- M. A. Meyer, J. P. L. Reinecke, D. Reitmann. Nucl. Phys. A196 (1972) 635
  (Gamma ray energy, Gamma ray emission probability)
- J. F. Emery, S. A. Reynolds, E. I. Wyatt, G. I. Gleason. Nucl. Sci. Eng. 48 (1972) 319
  (Half-life)
- F. Rahn, H. Camarda, G. Hacken, W. W. Havens Jr., H. Liou, J. Rainwater, M. Slagowitz, S. Wynchank. Nucl. Sci. Eng. 47 (1972) 372
  (Gamma ray energy)
- S. Raman, N. B. Gove, J. K. Dicken, T. A. Walkiewicz. Phys. Lett. 40B (1972) 89
  (Gamma ray energy, Gamma ray emission probability)
- H. J. Gils, D. Flothmann, R. Löhken, W. Wiesner. Nucl. Instrum. Meth. 105 (1972) 179
  (Beta- particle maximum energy)
- M. A. Meyer, J. P. L. Reinecke, D. Reitmann. Nucl. Phys. A185 (1972) 625
  (Gamma ray energy, Gamma ray emission probability)
- D. Branford. Austral. J. Phys. 26 (1973) 1995
  (Transition Probability - beta- transition)
- F. Leccia, M. M. Alconard, D. Castera, P. Hubert, P. Mennrath. J. Phys. 34 (1973) 147
  (Gamma ray emission probability, Multipolarities)
- S. Raman, N.B.Gove. Phys. Rev. C7 (1973) 1995
  (Transition Probability - beta- transition)
- S. Chakraborty. Radiochem. Radioanal. Lett. 17 (1974) 61
  (Half-life)
- S. G. Boydell, D. G. Sargood. Austral. J. Phys. 28 (1975) 369
  (Gamma ray emission probability)
- H. Genz, J. Reisberg, A. Richter, B. M. Schmitz, G. Schrieder, K. Werner, H. Behrens. Nucl. Instrum. Methods 134 (1976) 309
  (Half-life, Beta particle maximum energy)
- I. M. Band, M. B.Trzhaskovskaya, M. A. Listengarten. At. Data Nucl. Data Tables 18 (1976) 433
  (Total internal conversion coefficient)
- F. P. Larkins. At. Data Nucl. Data Tables 20 (1977) 311
  (Energy, Auger electrons)
- M. C. Davis, W. C. Bowman, J. C. Robertson. Int. J. Appl. Radiat. Isotop. 29 (1978) 331
  (Half-life)
- R. C. Greenwood, R. G. Helmer, R. J. Gehrke. Nucl. Instrum. Methods 159 (1979) 465
  (Gamma ray energy)
- P. Schlüter, G. Soff. At. Data Nucl. Data Tables 24 (1979) 509
  (Gamma ray emission probability)
- H. Houtermans, O. Milosevic, F. Reichel. Int. J. Appl. Radiat. Isotop. 31 (1980) 153
  (Half-life)
- W. Muckenheim, P. Rullhusen, F. Smend, M. Schumacher. Nucl. Instrum. Meth. 173 (1980) 403
  (Half-life)
- A. R. Rutledge, L. V. Smith, J. S. Merritt. Report AECL 6692 (1980)
  (Half-life)

- E. K. Warburton, C. J. Lister, D. E. Alburger, J. W. Olness. Phys. Rev. C23 (1981) 1242
  (Gamma ray emission probability)
- D. D. Hoppes, J. M. R. Hutchinson, F. J. Schima, M. P. Unterweger. Report NBS-SP 626 (1982) 85
  (Half-life)
- F. Lagoutine, J. Legrand. Int. J. Appl. Radiat. Isotop. 33 (1982) 711
  (Half-life)
- A. R. Rutledge, L. V. Smith, J. S. Merritt. Report NBS-SP 626 (1982) 5
  (Half-life)
- K. F. Walz, K. Debertin, H. Schrader. Int. J. Appl. Radiat. Isotop. 34 (1983) 1191
  (Half-life)
- W. L. Zijp. Report ECN FYS/RASA 85/19 (1985)
  (averages)
- A. Abzouzi, M. S. Antony, V. B. Ndocko Ndonguc. J. Radioanal. Nucl. Chem. 135 (1989) 1
  (Half-life)
- P. M. Endt et al.. Nucl. Phys. A510 (1990) 209
  (Gamma ray emission probability)
- P. M. Endt. Nucl. Phys. A521 (1990) 209
  (Spin and parity)
- P. Bode, M. J. J. Ammerlaan, M. Koese. Appl. Radiat. Isot. 42 (1991) 692
  (Half-life)
- P. M. Endt. Nucl. Phys. A529 (1991) 763
  (Spin and parity)
- M. U. Rajput, T. D. MacMahon. Nucl. Instrum. Methods 312 (1992) 289
  (Half-life)
- M. P. Unterweger, D. D. Hoppes, F. J. Schima. Nucl. Instrum. Methods 312 (1992) 349
  (Half-life)
- P.M.Endt. Nucl. Phys. A564 (1993) 609
  (Spin and parity)
- J. H. Hubbell, P. N. Trehan, Nirmal Singh, B. Chand, D. Mehta, M. L. Garg, R. R. Garg, Surinder Singh, S. Puri. J. Phys. Chem. Ref. Data 23 (1994) 33
  (Mean L-shell fluorescence yield)
- E. P. Mignonsin. Appl. Radiat. Isot. 45 (1994) 17
  (Half-life)
- G .Audi, A. H. Wapstra. Nucl. Phys. A595 (1995) 409
  (Total available energy of beta- disintegration)
- R. G. Helmer, C. van der Leun. Nucl. Instrum. Methods A450 (2000) 35
  (Gamma emission energies)


4+ ; 0
14,9574 (20) h
0
24
Na
11 13
β-
γ Emission probabilities
per 100 disintegrations
0,057
0,001
99,939
0,003
3+ ; 5236,5
2+ ; 4238,3
4+ ; 4122,845
2+ ; 1368,668
1,95 ps
0+ ; 0
Stable
Mg
12 12
Q - = 5515,78 keV
% β- = 100