RAPPELS

DESINTEGRATIONS ----

α $\quad {}^{A}_{Z}X_N \longrightarrow {}^{A-4}_{Z-2}Y_{N-2} + {}^{4}_{2}He$

"faible"

β^+ $\quad {}^{A}_{Z}X_N \longrightarrow {}^{A}_{Z-1}Y_{N+1} + e^+ + \nu$

β^- $\quad {}^{A}_{Z}X_N \longrightarrow {}^{A}_{Z+1}T_{N-1} + e^- + \bar{\nu}$

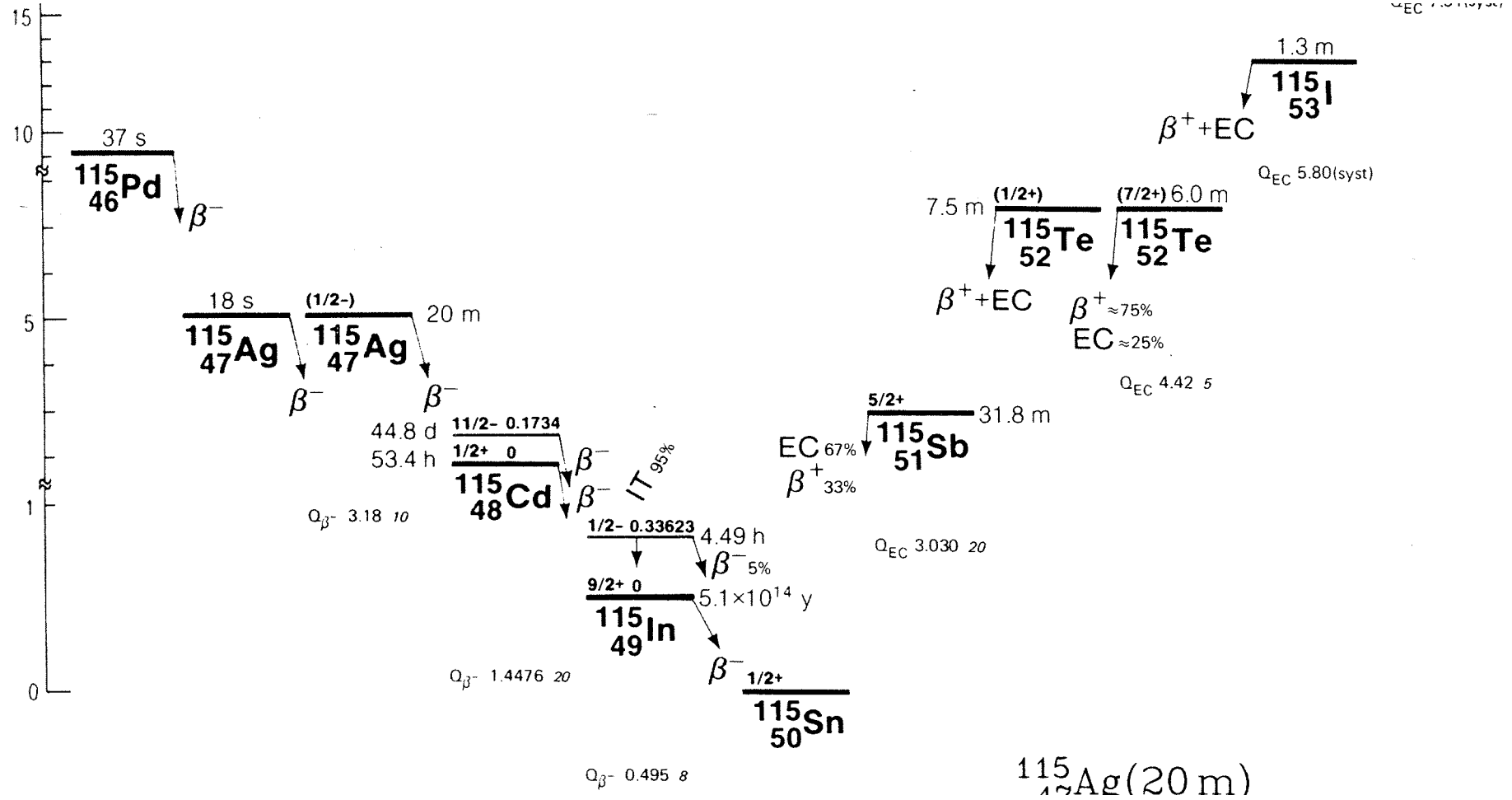
CE $\quad {}^{A}_{Z}X_N + e^- \longrightarrow {}^{A}_{Z-1}Y_{N+1} + \nu$

γ $\quad {}^{A}_{Z}X^{**}_{N} \longrightarrow {}^{A}_{Z}X^{*}_{N} + \gamma$

noyau "père" $\longrightarrow$ noyau "fils"

fission $\quad X \longrightarrow Y + Z$

"nouveautés" radioactivité par emission de ^{14}N, ...
double désintégration β


15
10
5
1
0
37 s
115 46Pd
β−
18 s
115 47Ag
β−
(1/2−)
115 47Ag
20 m
β−
44.8 d
53.4 h
11/2− 0.1734
1/2+ 0
115 48Cd
β−
β− IT 95%
Qβ− 3.18 10
1/2− 0.33623
4.49 h
β− 5%
9/2+ 0
5.1×10^14 y
115 49In
β−
1/2+
115 50Sn
Qβ− 1.4476 20
Qβ− 0.495 8
5/2+
31.8 m
EC 67%
β+ 33%
115 51Sb
QEC 3.030 20
7.5 m
(1/2+)
115 52Te
β+ +EC
(7/2+) 6.0 m
115 52Te
β+ ≈75%
EC ≈25%
QEC 4.42 5
1.3 m
115 53I
β+ +EC
QEC 5.80(syst)
115 47Ag(20 m)

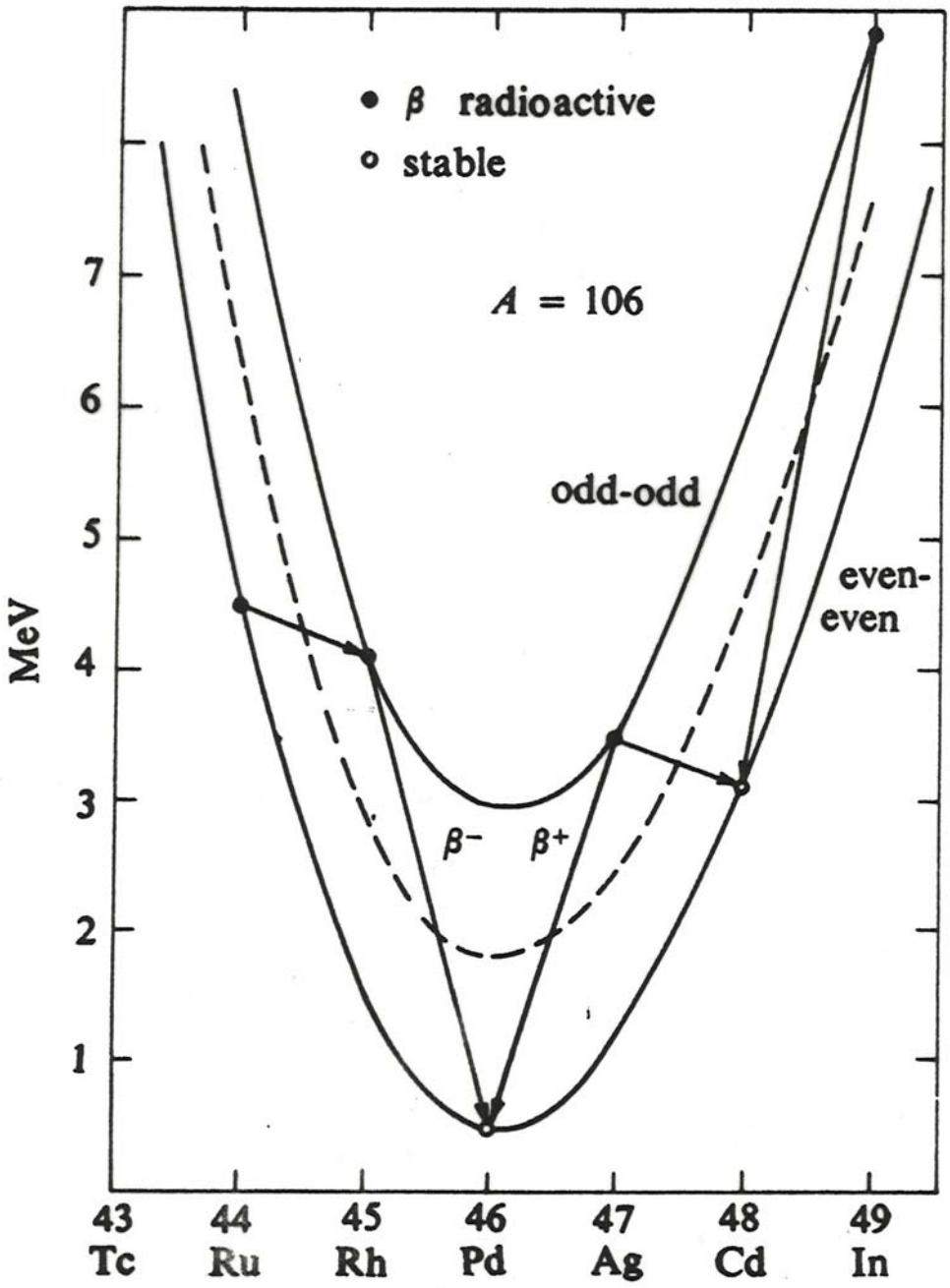


Figure 6-18 Energy (in MeV) of nuclei of mass number 106. The zero point on the energy scale is arbitrary.

Segrè p 245

Raies Gamma :

$^{26}Al^{g} \xrightarrow[T = 7.2\,10^{5}\ ans]{} {}^{26}Mg^{*} + e^{+} + \nu$ (82%)

$\hookrightarrow {}^{26}Mg + \gamma$ (1.8087 MeV)

dite raies γ du ^{26}Al (!)

autres exemples : $e^{+}e^{-}$, $^{56}Ni \rightarrow {}^{56}Co \rightarrow {}^{56}Fe$,

? ($^{7}Be \rightarrow {}^{7}Li$ (novae), $^{22}Na \rightarrow {}^{22}Ne + e^{+}$

$e^{-} + e^{+} \rightarrow \gamma\gamma$

Emission de particules retardées (α, p, ...) :

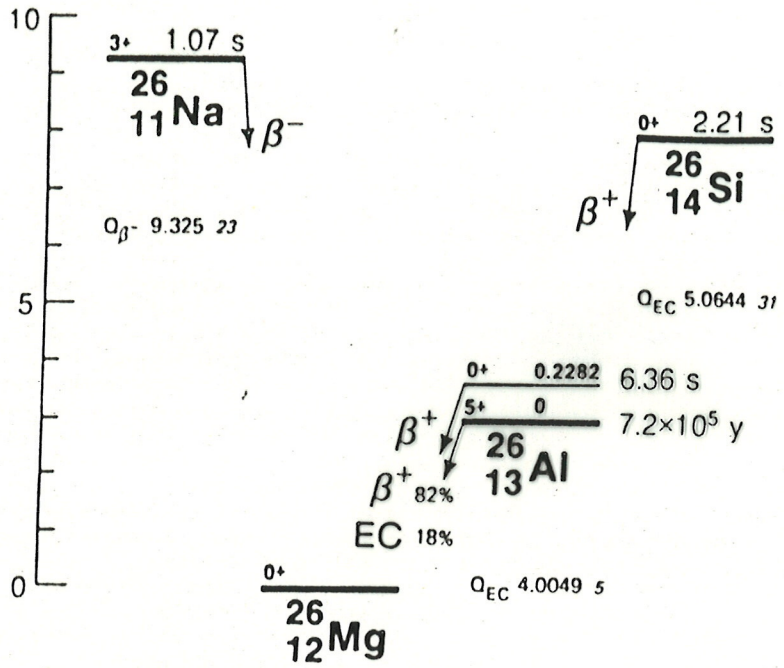
$^{21}Mg(\beta^{+}p)^{20}Ne$ (32%)

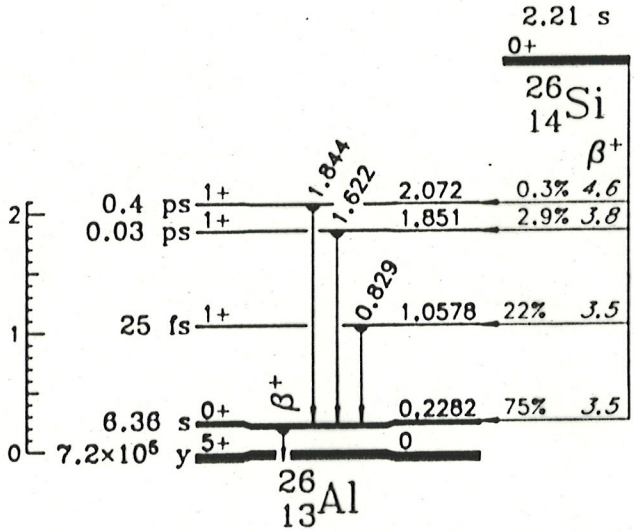
$^{25}Si(\beta^{+}p)^{24}Mg$ (100%) !!

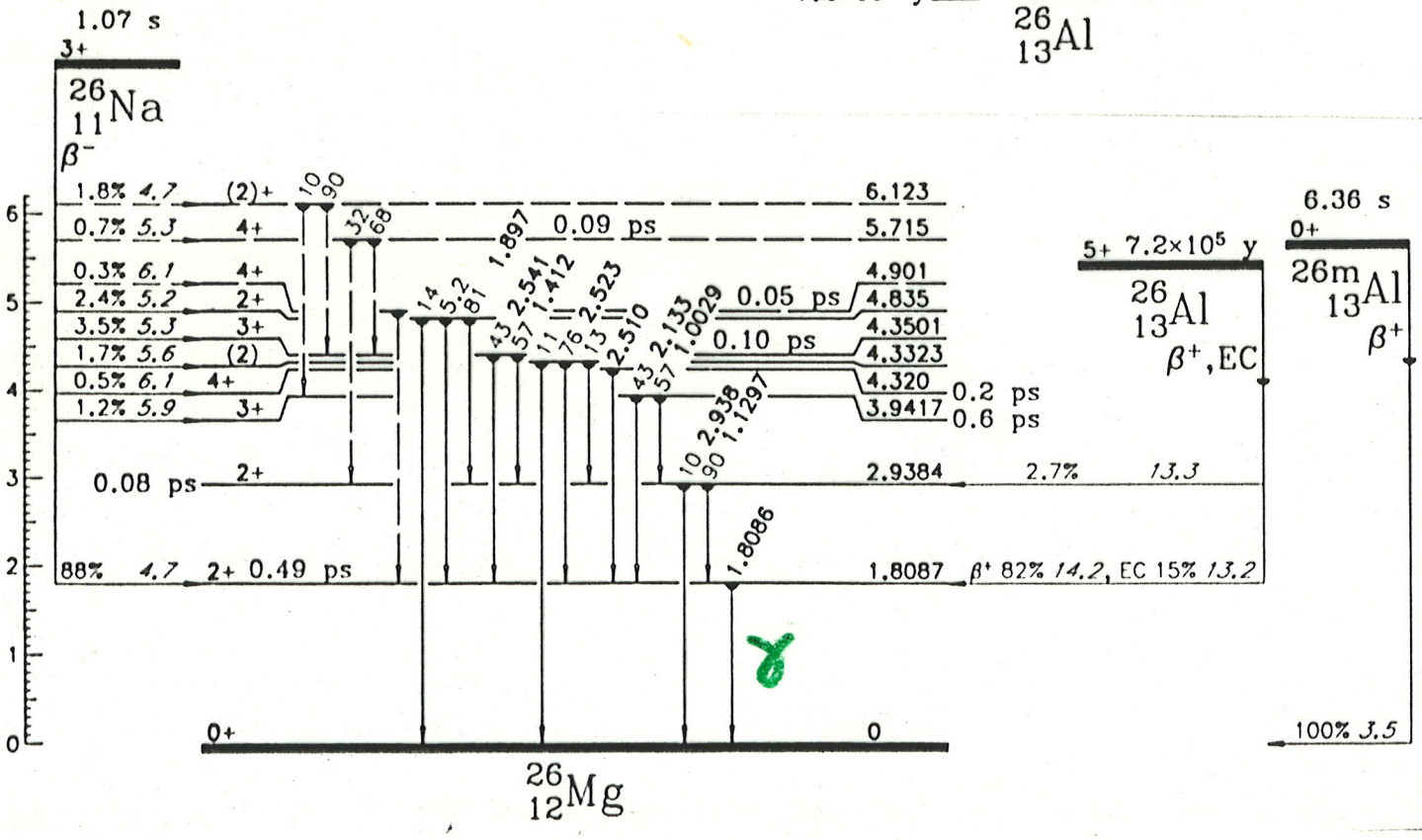
$^{20}Na(\beta^{+}\alpha)^{16}O$ (21%)

Desintégrations β^{+}, CE et β^{-} :

- Bilans energetiques Q
- particularisation à l'astrophysique $Q^{eff} = Q - \langle E_\nu \rangle$
- Spectres electroniques et neutriniques
  (application astrophysique : neutrinos solaires)
- Kurie plot, ln ft, classification des transitions (F, GT)


10
5
0
3+ 1.07 s
26 11 Na
β−
Qβ- 9.325 23
0+ 2.21 s
26 14 Si
β+
QEC 5.0644 31
0+ 0.2282 6.36 s
5+ 0 7.2×10^5 y
β+
26 13 Al
β+ 82%
EC 18%
0+
QEC 4.0049 5
26 12 Mg


2.21 s
0+
26 14 Si
β+
2
1
0
0.4 ps 1+
0.03 ps 1+
25 fs 1+
6.36 s 0+
7.2×10^5 y 5+
1.844
1.622
0.829
β+
2.072 0.3% 4.6
1.851 2.9% 3.8
1.0578 22% 3.5
0,2282 75% 3.5
0
26 13 Al


1.07 s
3+
26 11 Na
β−
6
5
4
3
2
1
0
1.8% 4.7 (2)+
0.7% 5.3 4+
0.3% 6.1 4+
2.4% 5.2 2+
3.5% 5.3 3+
1.7% 5.6 (2)
0.5% 6.1 4+
1.2% 5.9 3+
0.08 ps 2+
88% 4.7 2+ 0.49 ps
0+
6.123
5.715
4.901
4.835
4.3501
4.3323
4.320
3.9417
2.9384
1.8087
0.09 ps
0.05 ps
0.10 ps
0.2 ps
0.6 ps
2.7% 13.3
β+ 82% 14.2, EC 15% 13.2
0
26 12 Mg
5+ 7.2×10^5 y
26 13 Al
β+,EC
6.36 s
0+
26m 13 Al
β+
100% 3.5

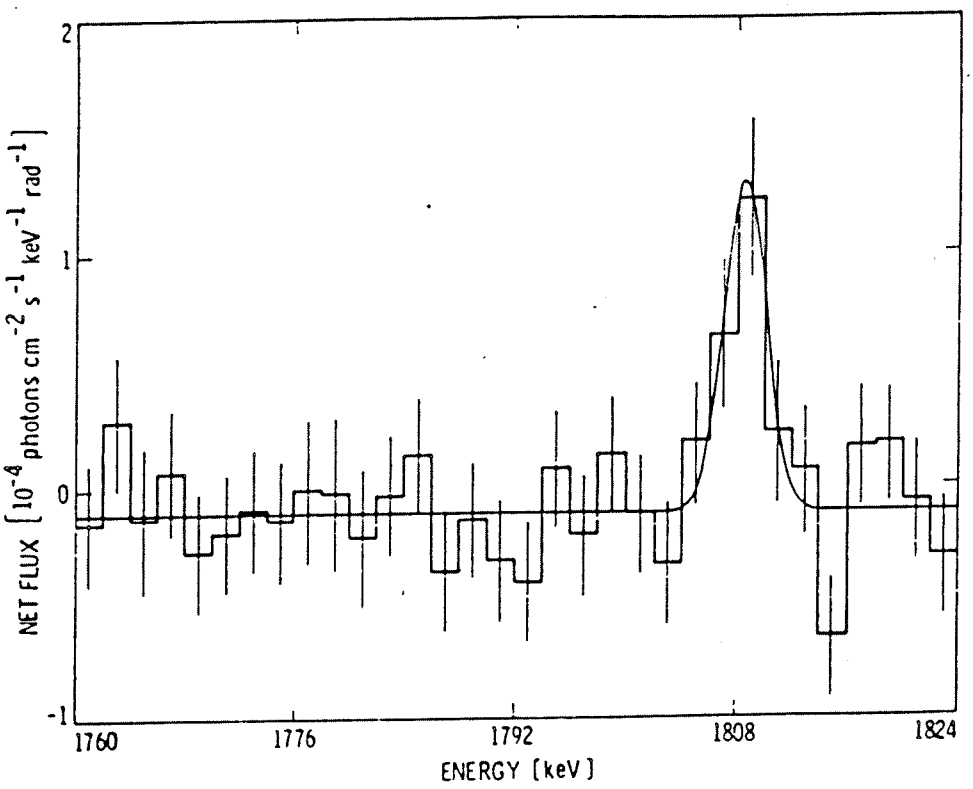
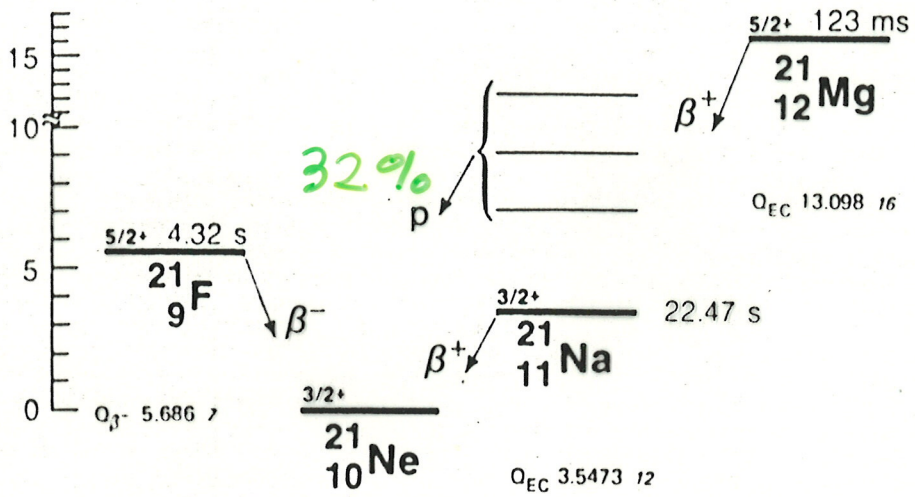


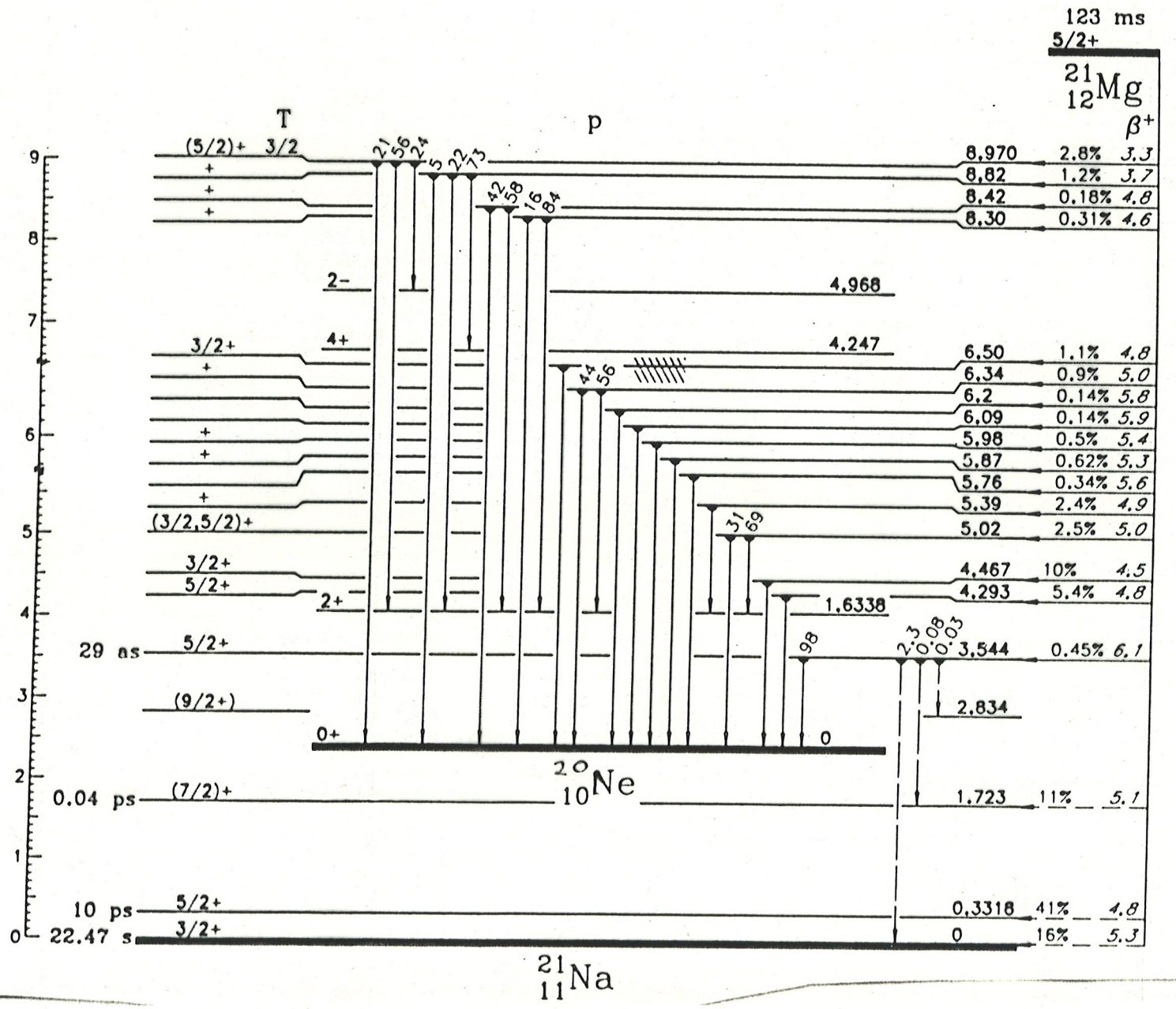
Figure 31

La raie à 1.8 Mev detectée par le satellite HEAO-3 dans la direction du centre galactique. Le flux correspondant ($F = 4.8 \pm 0.8\ 10^{-4}$ photons cm^{-2} $s-1$ rad^{-1}) est attribuée à la dec roissance de 3 $M_\odot$ de ^{26}Al environ.

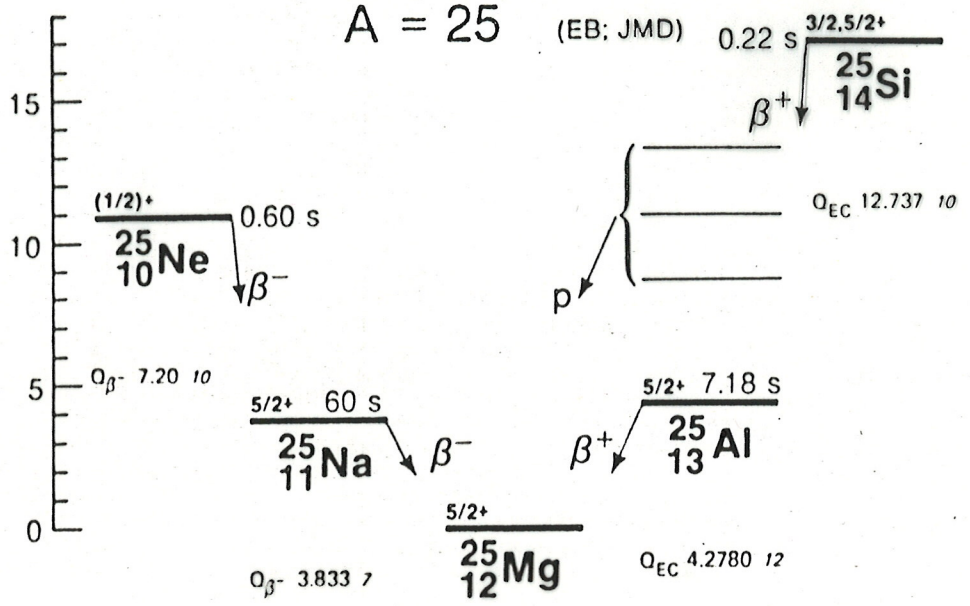
(tiré de *Mahoney et al. 1984*)

emission de particules retardées : p

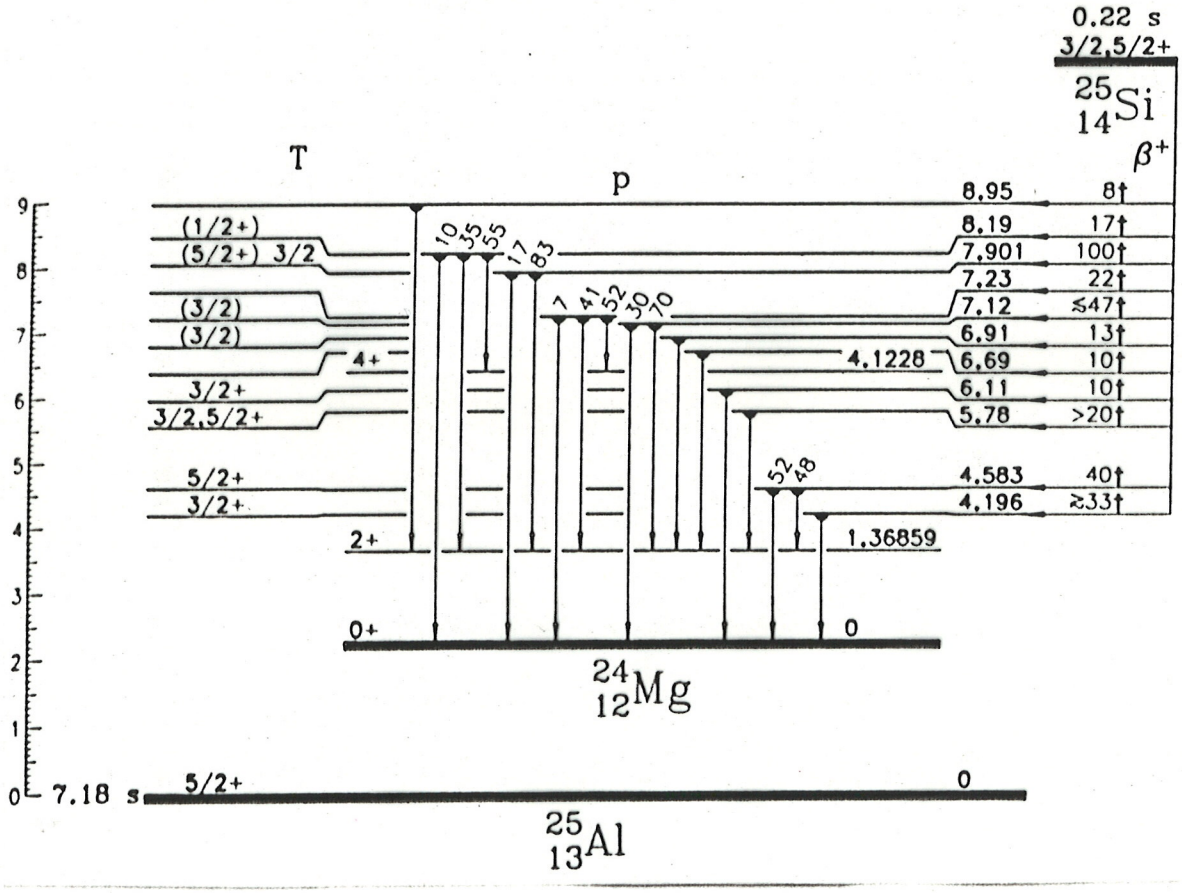




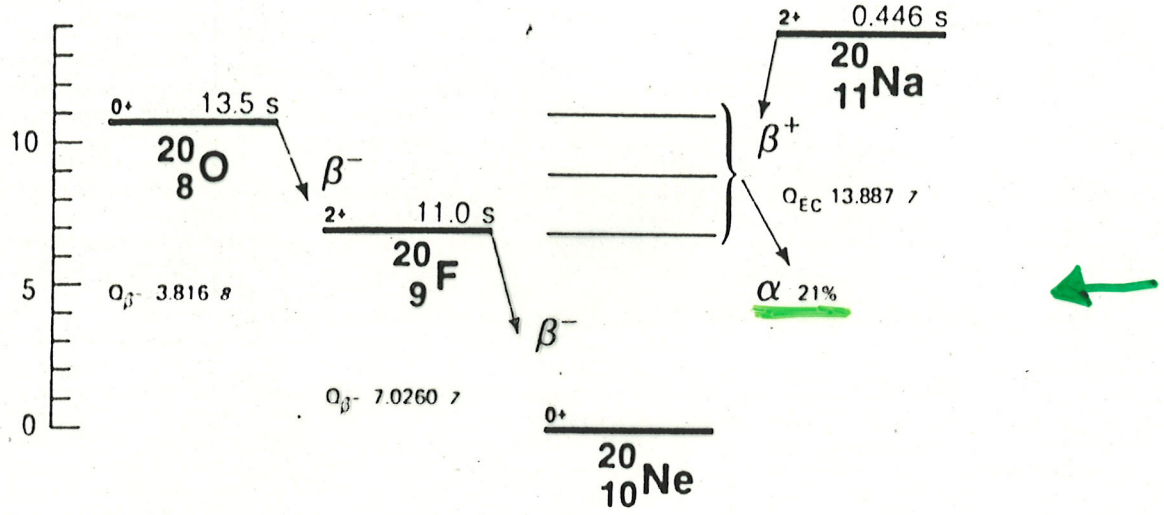
emission de particules retardées : p

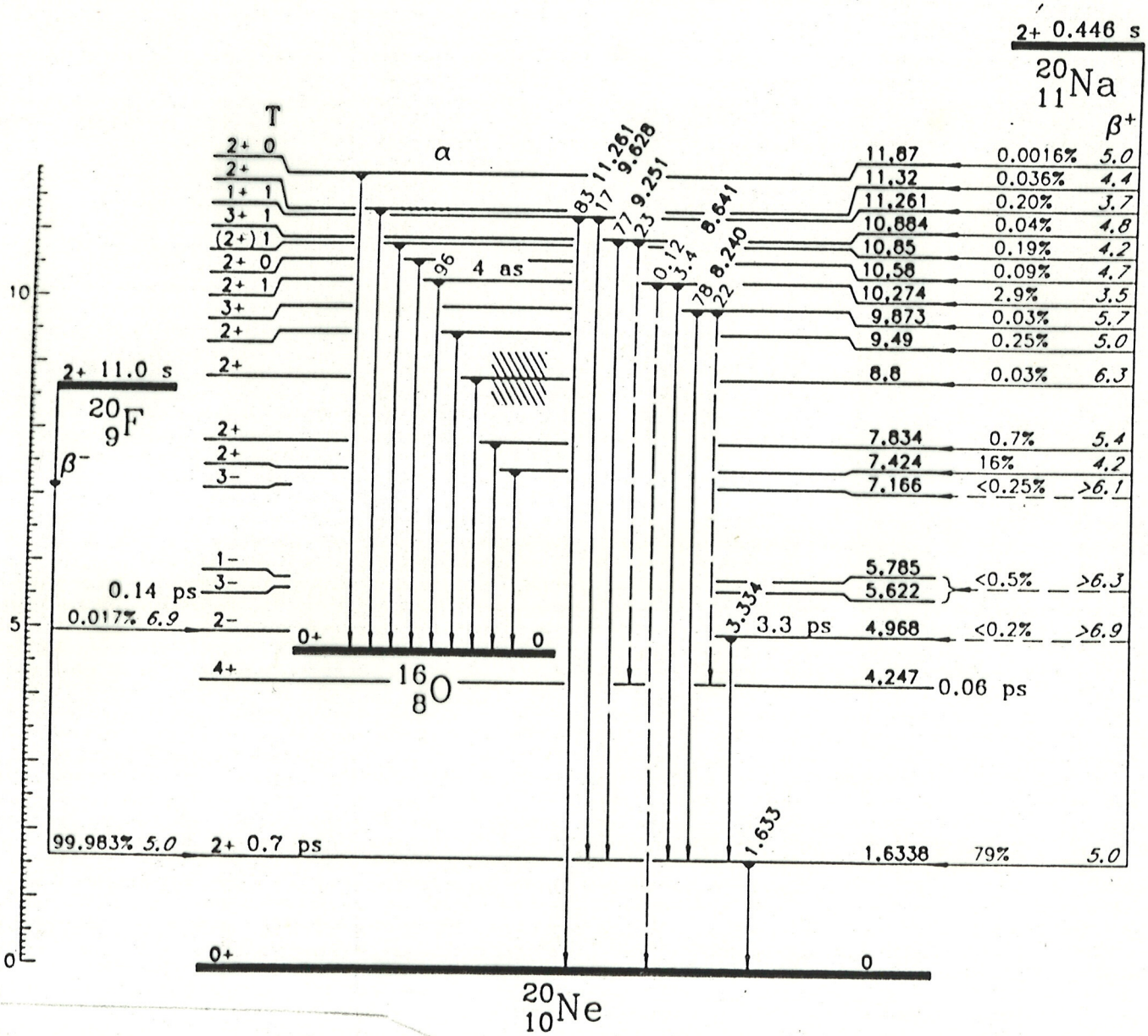


100 %

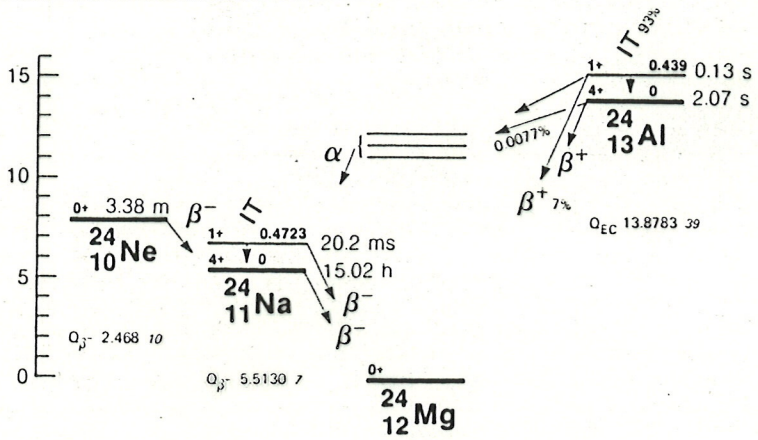


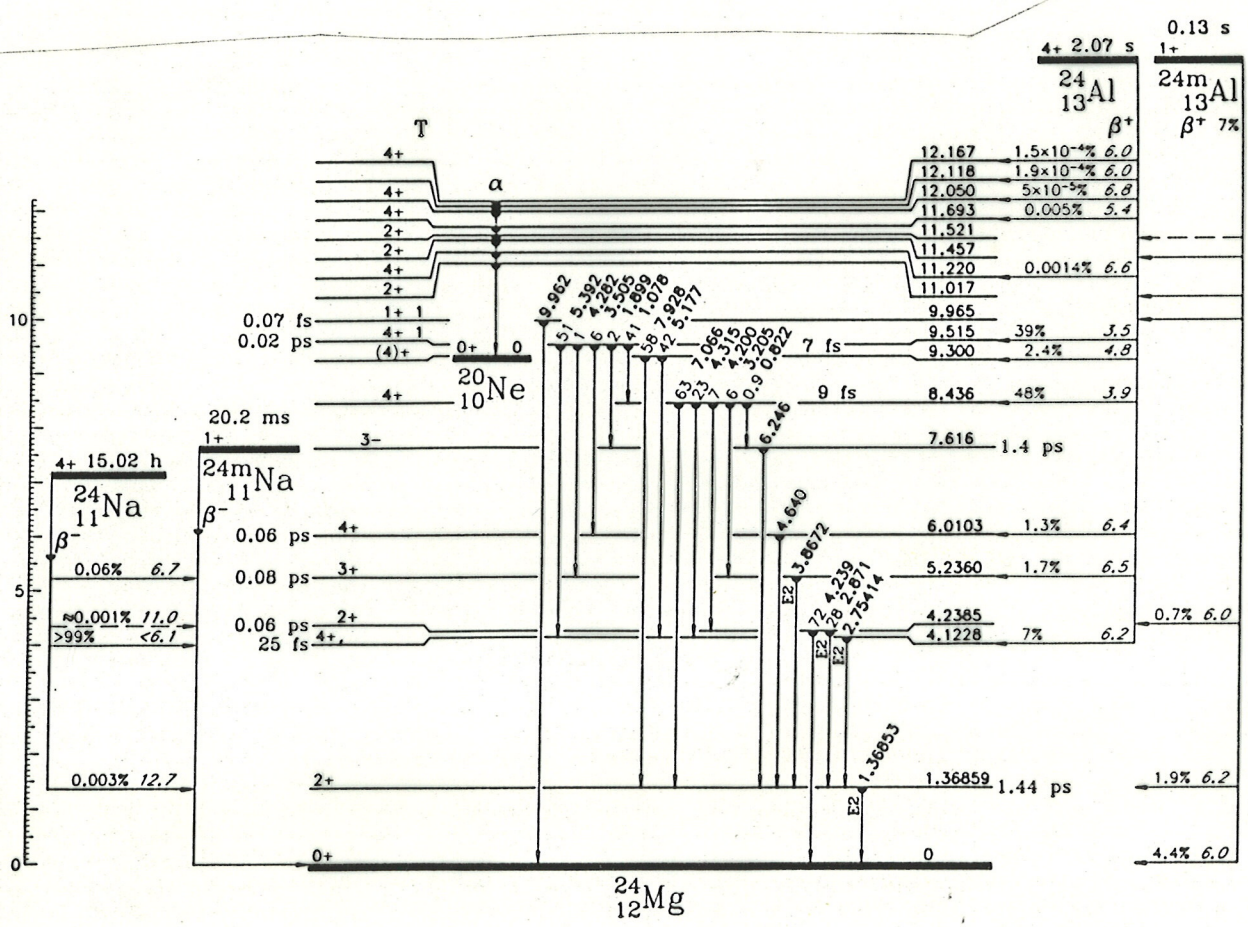
émission de particules retardées : α





emission de particules retardées : α





BILANS ENERGETIQUES

REACTIONS NUCLEAIRES :

- $X(a,b)Y$ $\quad Q = M(X) + M(a) - M(b) - M(Y)$

$= M(X) + M(a) - M(b) - M(Y)$

⇐ pas d'électrons

pour $X(p,\gamma)Y \quad Q = S_p(Y)$

$X(n,\gamma)Y \quad Q = S_n(Y)$

$X(\alpha,\gamma)Y \quad Q = -Q_\alpha(Y)$

$Q(b,a) = -Q(a,b)$

- de même pour
  - désexcitation γ $\quad Q = E^*$
  - désintégration α
  - fission