NAA
NEUTRON ACTIVATION ANALYSIS
(ANALISI PER ATTIVAZIONE NEUTRONICA)

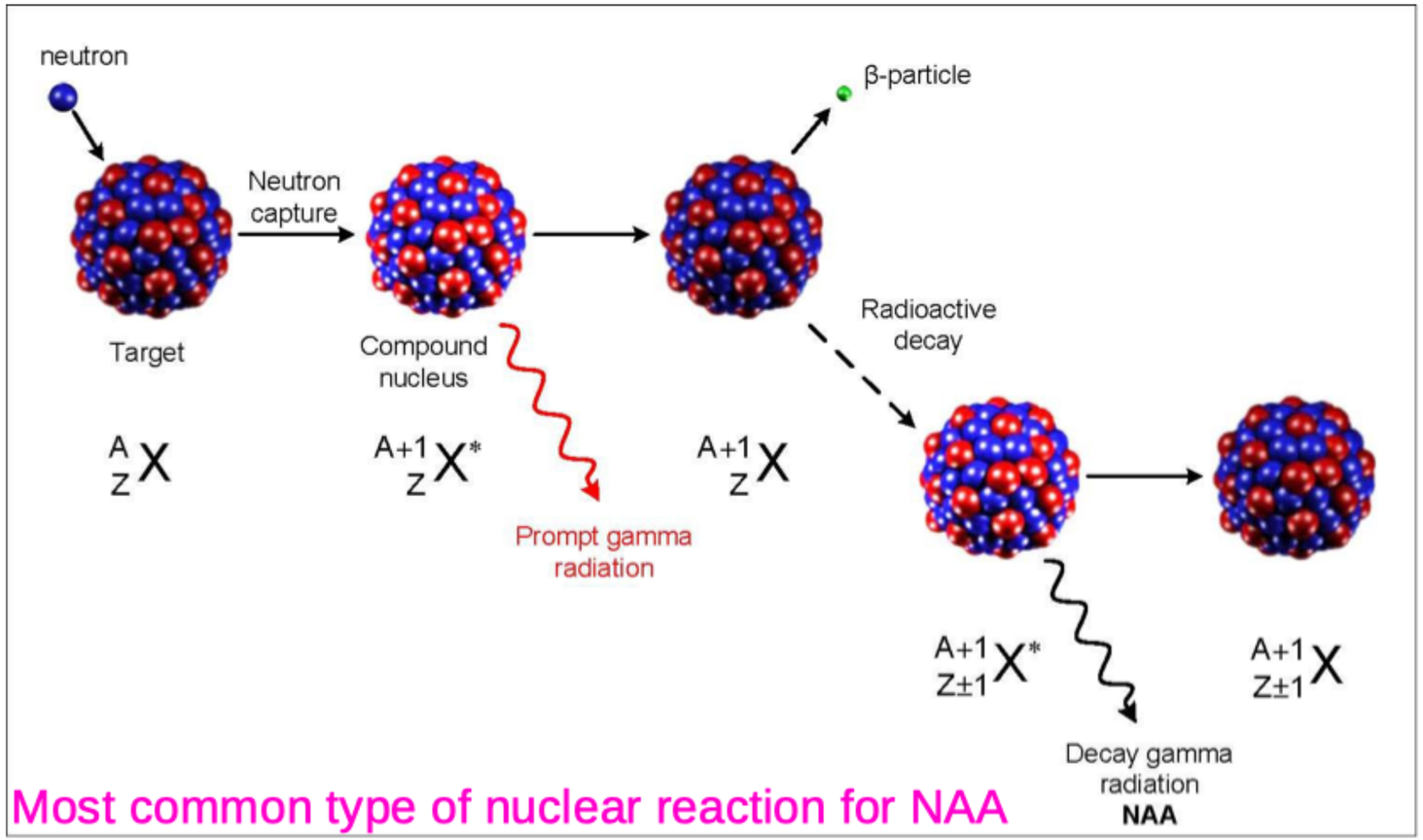
La tecnica

$$\mathrm{A}^{x} + \mathrm{n}^{1} \rightarrow \mathrm{A}^{1+x}$$

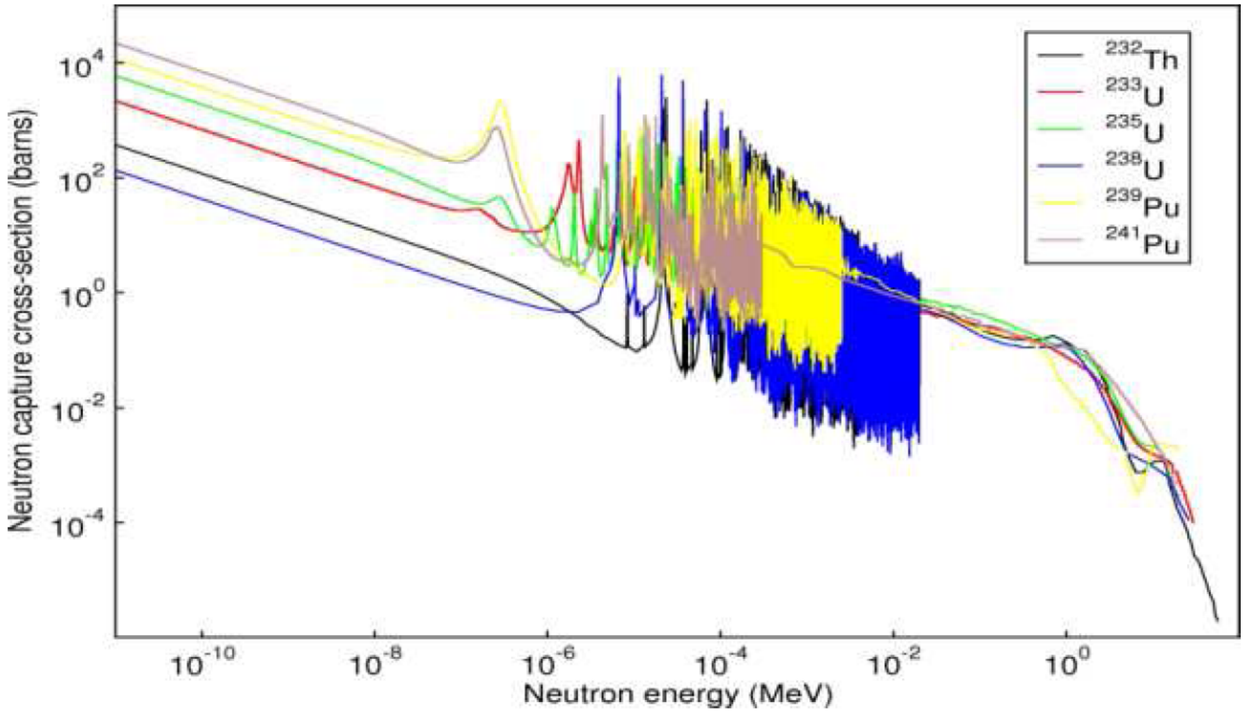
$$\mathrm{A}^{1+x} \rightarrow \mathrm{B} + \mathrm{radiation}$$

to be measured

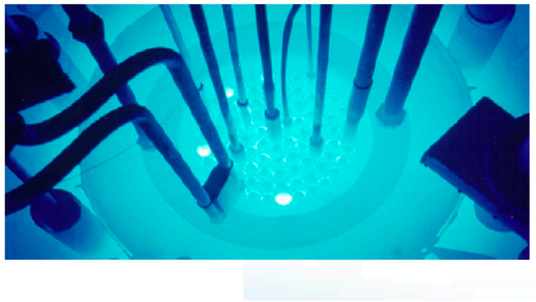
Principio base di NAA

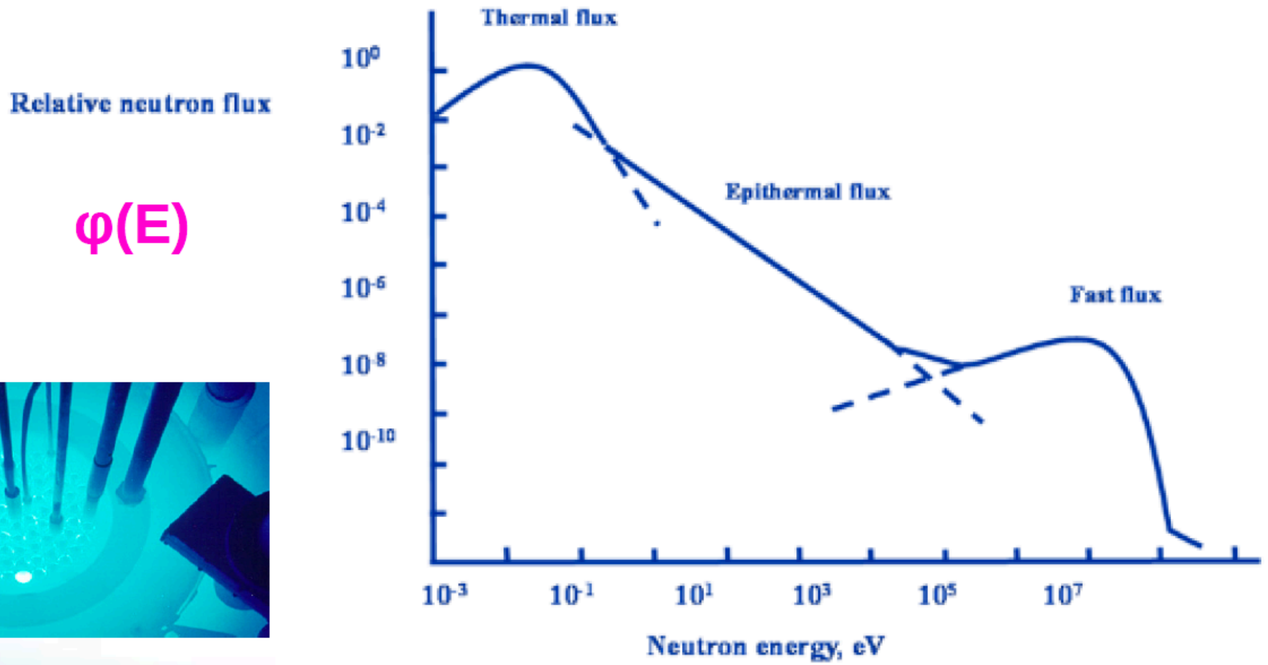


Sorgenti di neutroni



Reattori nucleari





Ingredienti chiave per NAA

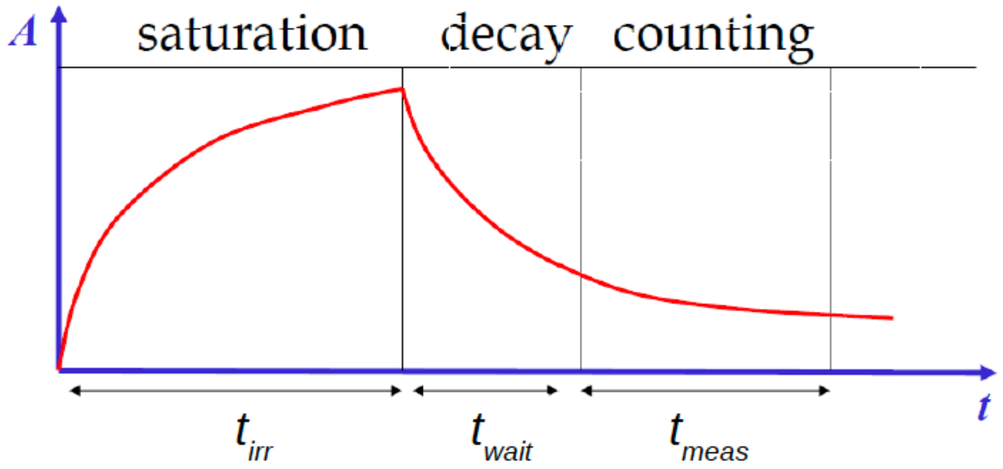
$$^{A}X + n \longrightarrow {}^{A+1}X \xrightarrow{\beta^-} {}^{A+1}_{Z+1}Y + \gamma_{cascade}$$

Three key ingredients:

- High neutron flux
- High enough neutron capture cross section
- “Convenient” daughter nucleus (γ emission, half-life time)

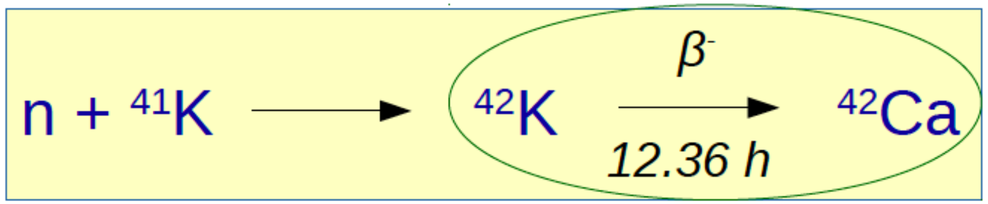
Sensitivity depends on:

- type pf material (short-lived activation products)
- neutron exposure time
- interferences in the matrix
- background in the region of the gamma emission



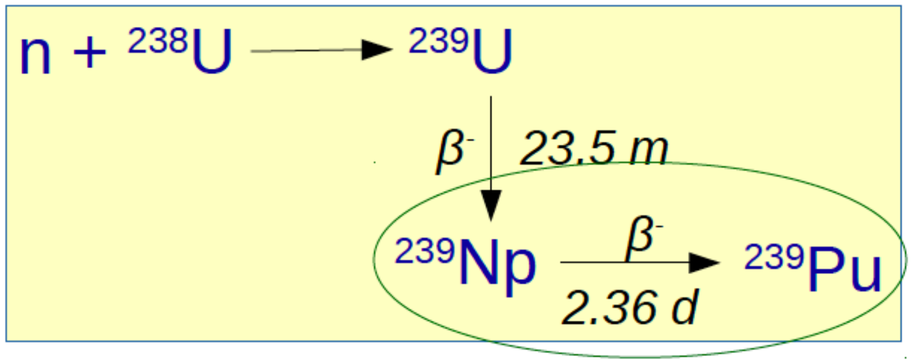
- care in the sample preparation is extremely important!
- the radiopurity of the sample container is also of concern!

NAA per contaminanti naturali

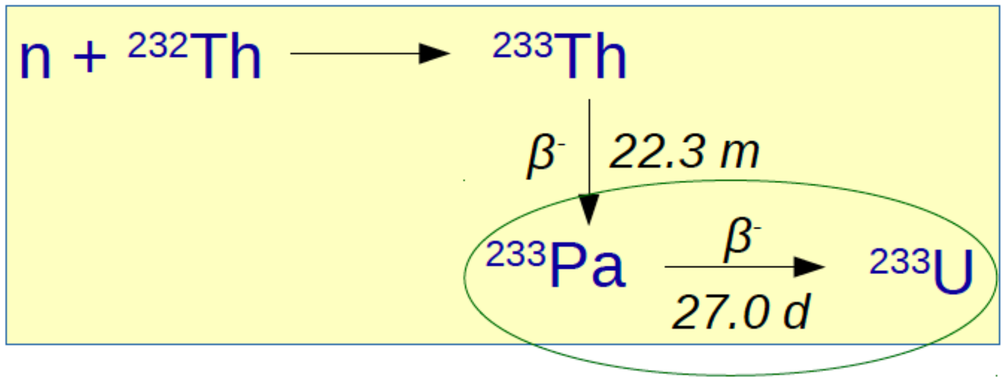


- ^{41}K isotopic abundance is 6.7%
- ^{40}K isotopic abundance is 0.01%

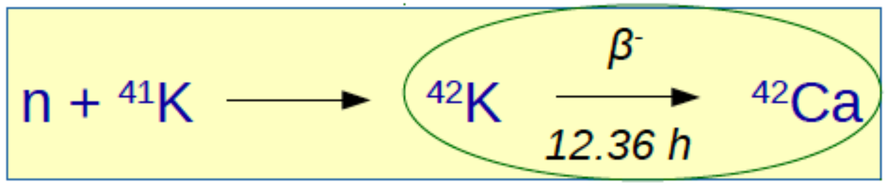
^{40}K contamination is calculated from ^{41}K one



The material of the sample container should not form long-lived radioisotopes during neutron irradiation: too long cooling times after the irradiation may prevent measuring shorter living nuclides, like ^{42}K.



NAA per 40K



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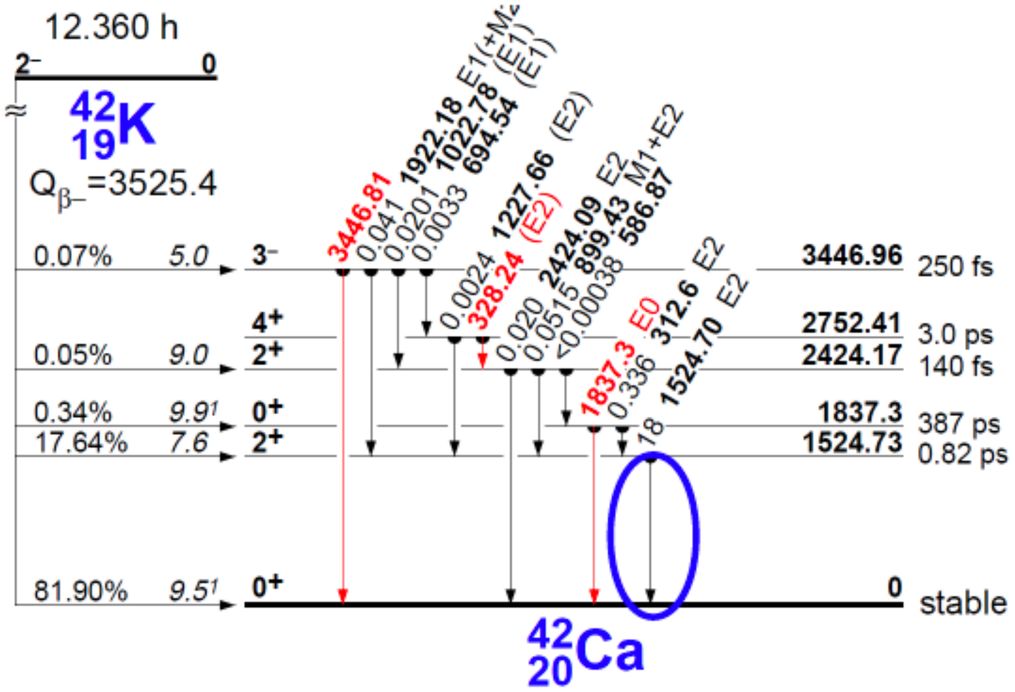
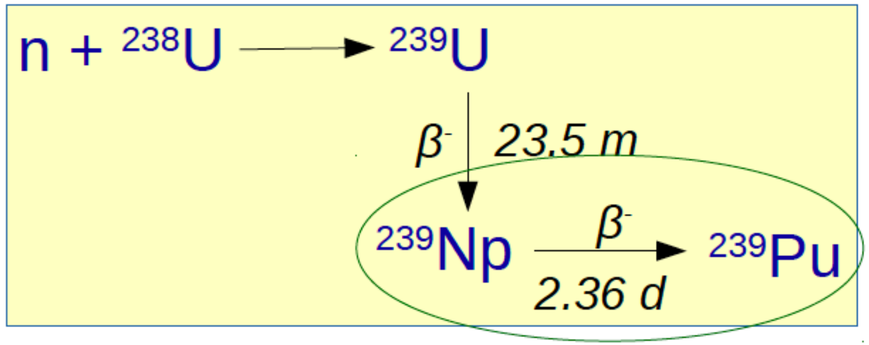
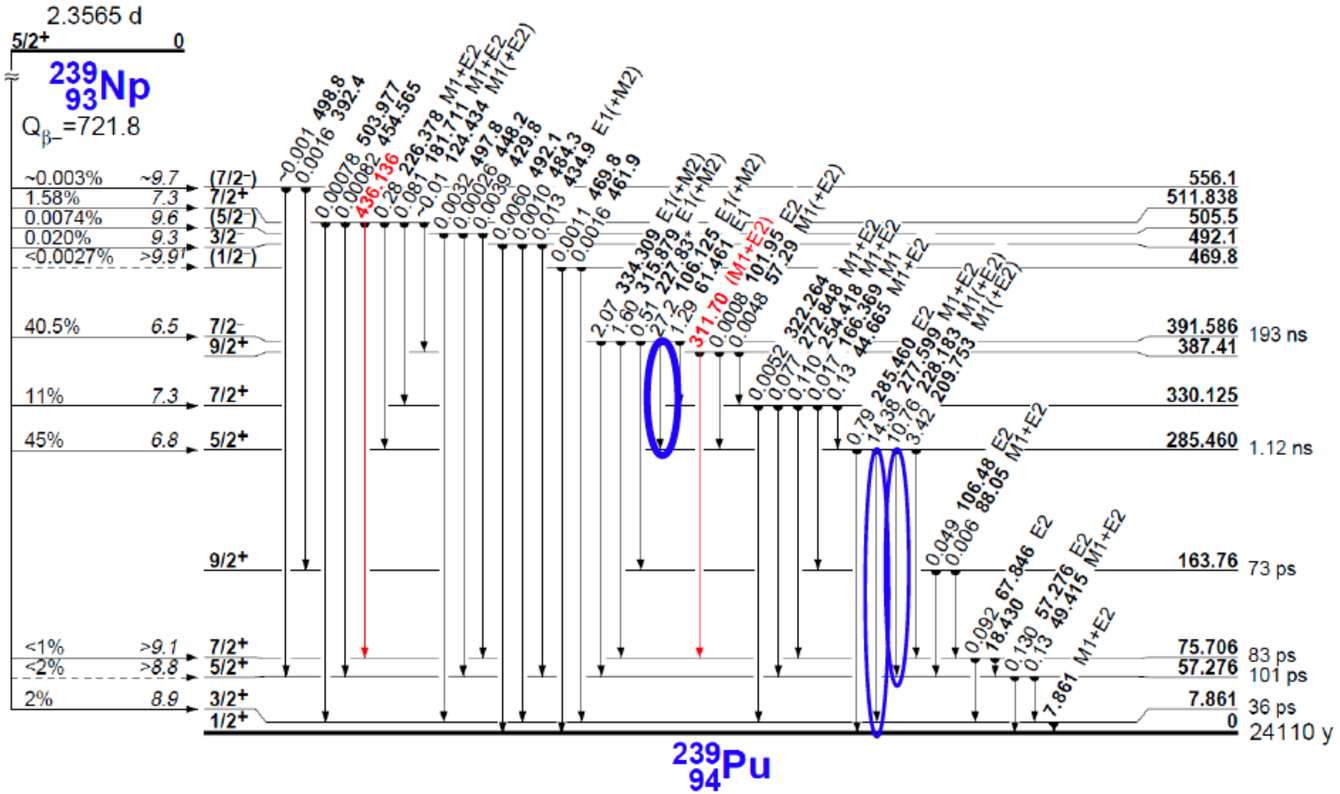


NAA per 238U


n + 238U
239U
β-
23.5 m
239Np
β-
2.36 d
239Pu


2.3565 d
5/2+
0
239 93 Np
Q β−=721.8
239 94 Pu
24110 y
556.1
511.838
505.5
492.1
469.8
391.586
387.41
193 ns
330.125
285.460
1.12 ns
163.76
73 ps
75.706
83 ps
57.276
101 ps
7.861
36 ps
0

NAA per 232Th