Nuclear structure studies @ gas-filled separators

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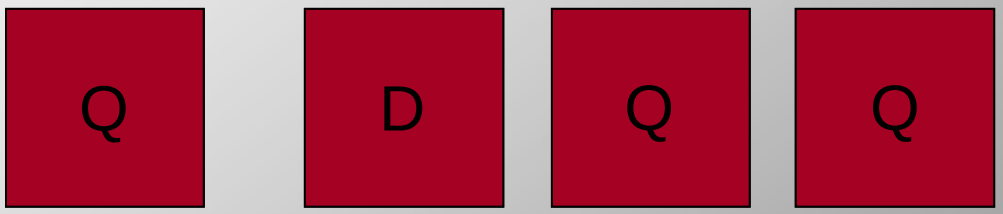
Gas-filled recoil separators

-simple, “cheap“ and clean
-good transmission
    -symmetric reactions
    -asymmetric ones (e.g. O on Pb ~ 10% for xn)
-filling gas & chemistry
    -He no problem
    -H_2 might be...

Spectroscopy

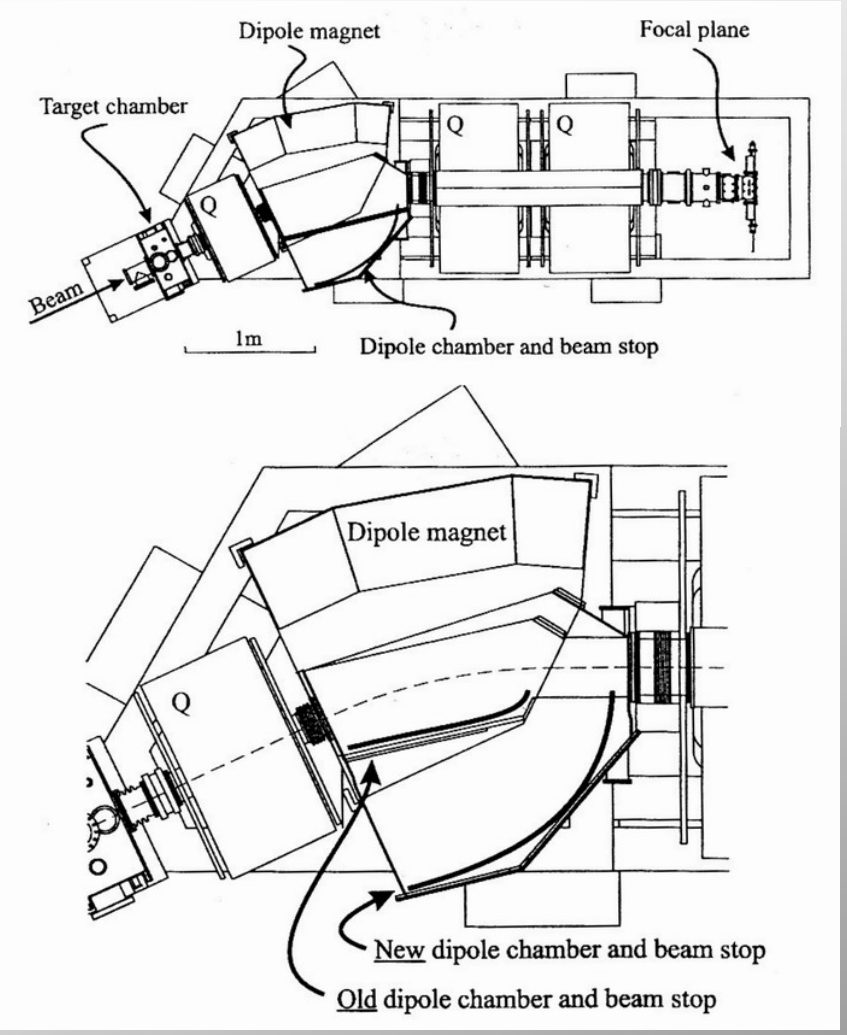
-examples at the focal plane

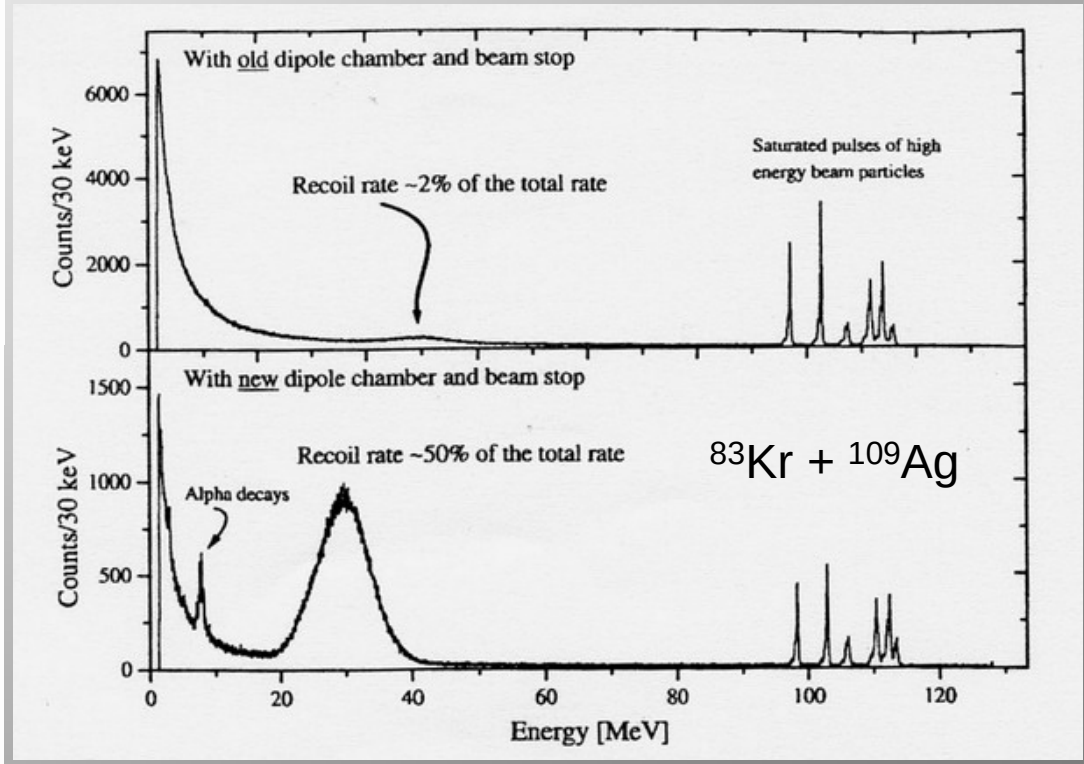
Gas-filled recoil separators: Magnetic configuration



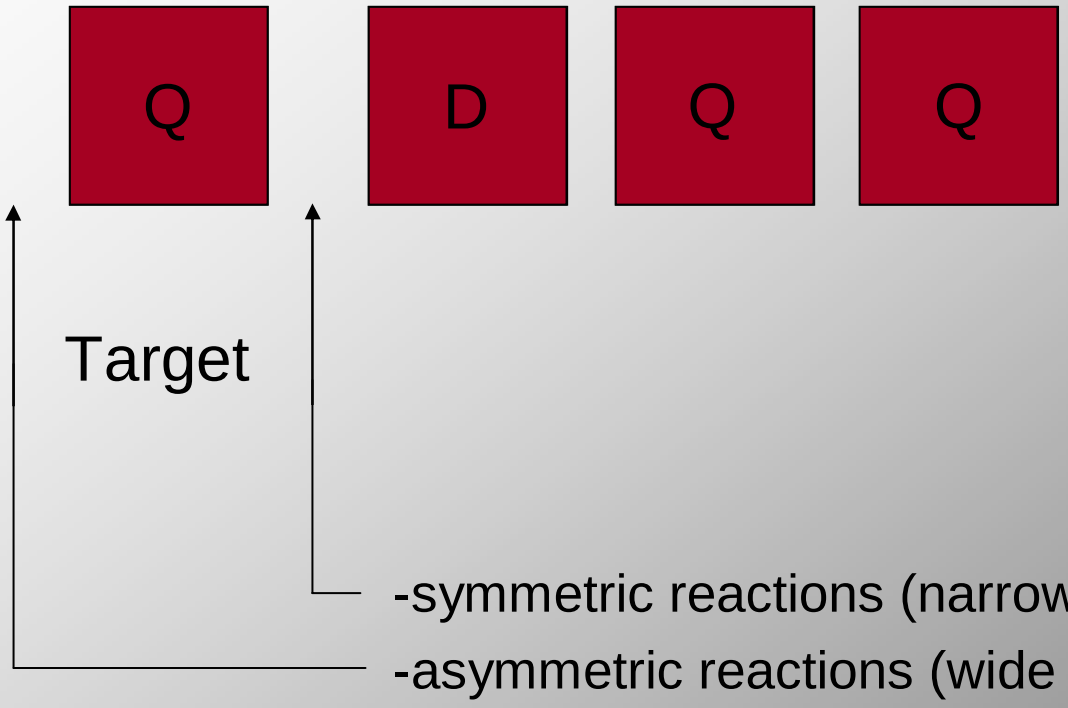
Gas-filled recoil separators: RITU

H. Kettunen, Ph.D. thesis





Gas-filled recoil separators: transmission



Generally for asymmetric reactions:

-target $\Rightarrow$ large angular spread of recoils

-the thinner the target the better the transmission

but: yield $\Leftrightarrow$ target thickness.

Gas-filled recoil separators: He vs. H_2

P. Armbruster et al., Proc. of the Int. Conf. on Mass Spectroscopy, Univ. of Tokio Press 1970

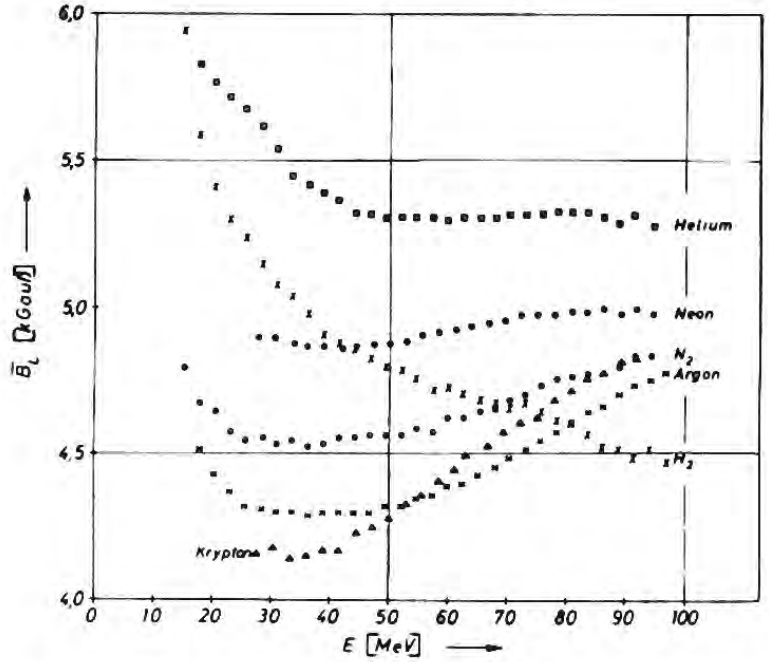
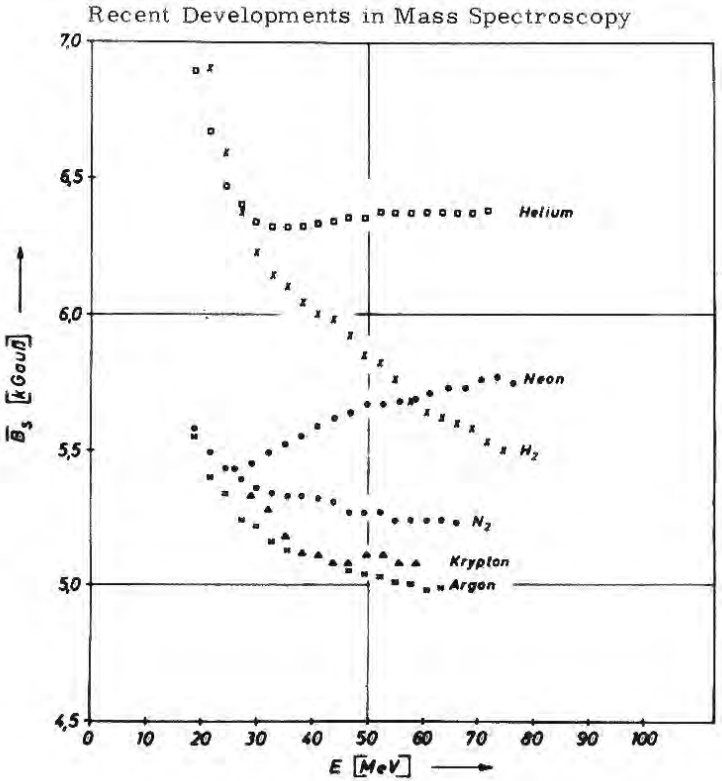
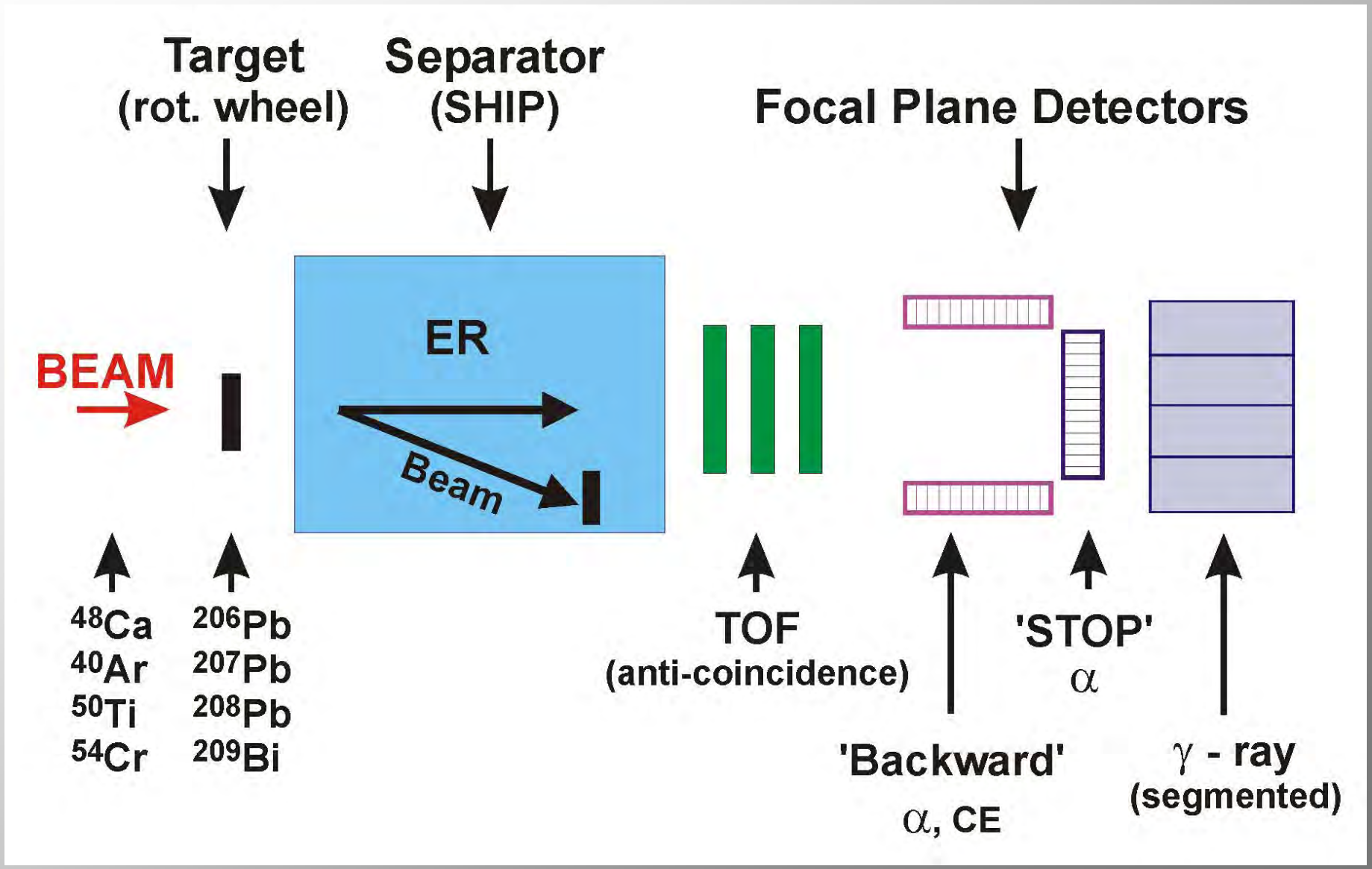


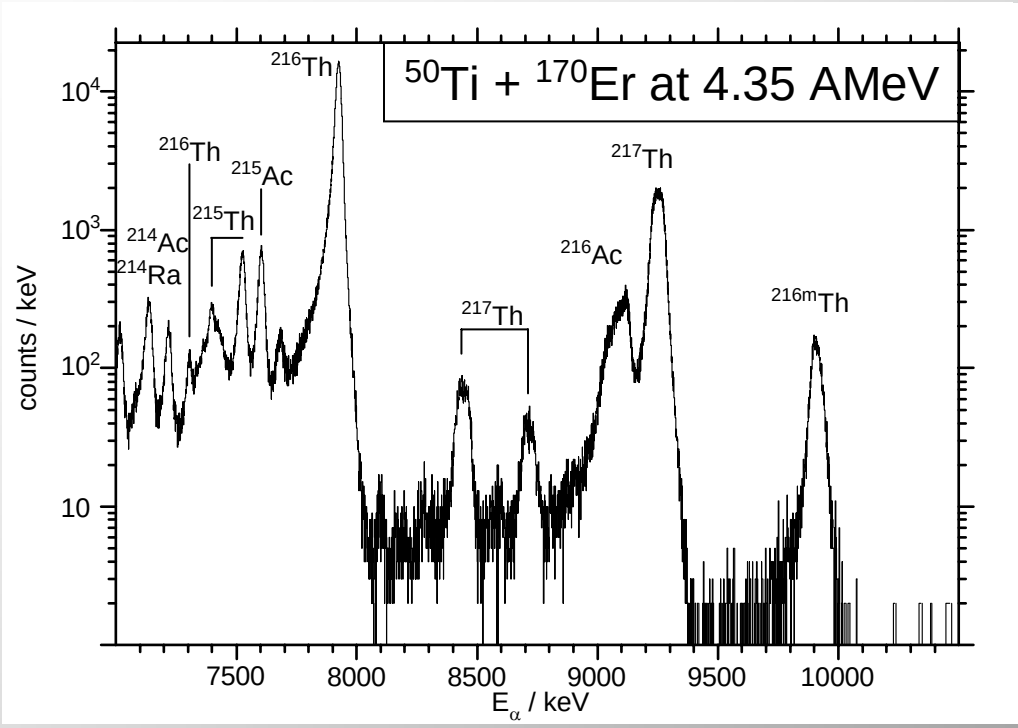
Fig 10 Magnetic field strength to hold light and heavy fission products on a radius of curvature of ρ = 200 cm The independence of the Bρ -values from the energy is fulfilled best in the minima of the curves

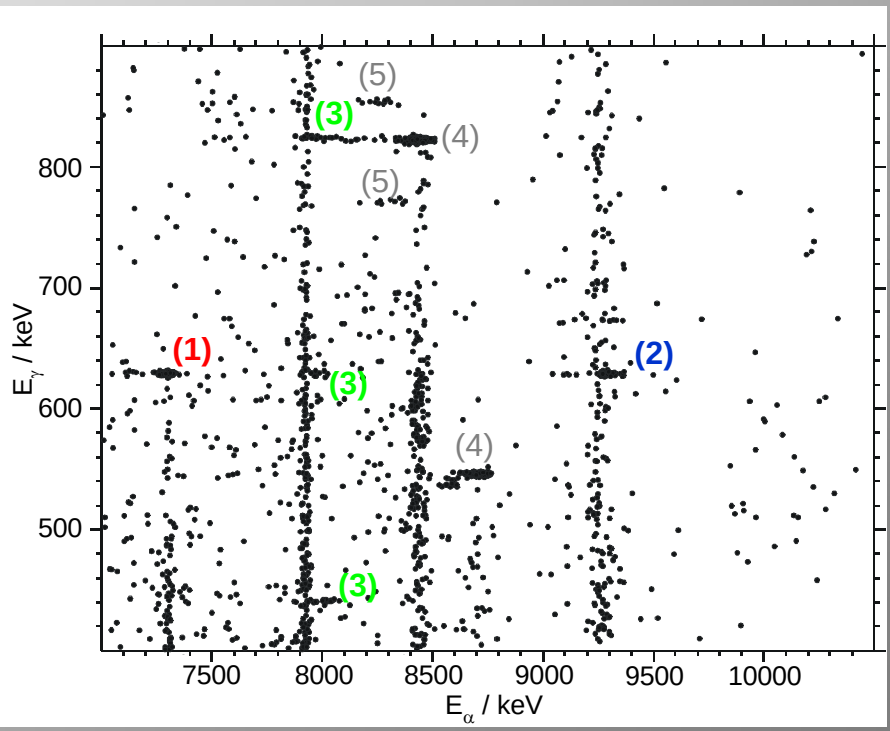


ER(γ) - α(γ) - ... spectroscopy

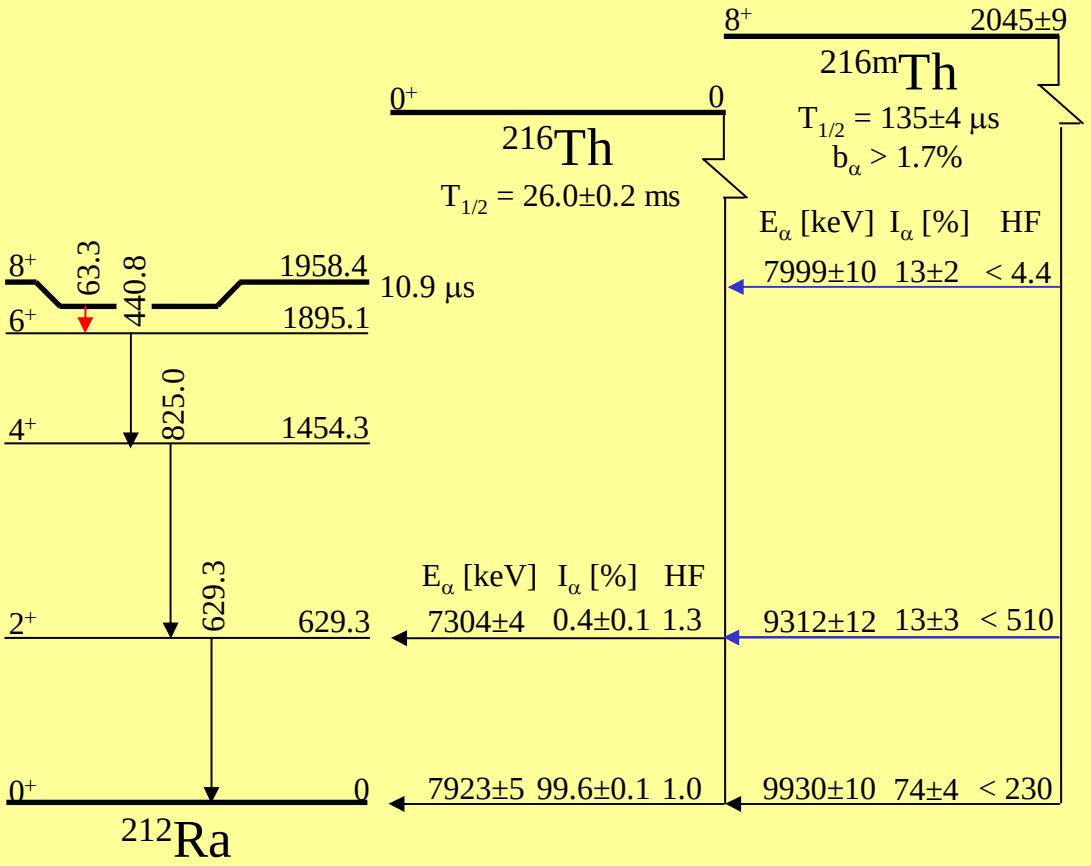


SHIP example: ^{216g,m}Th



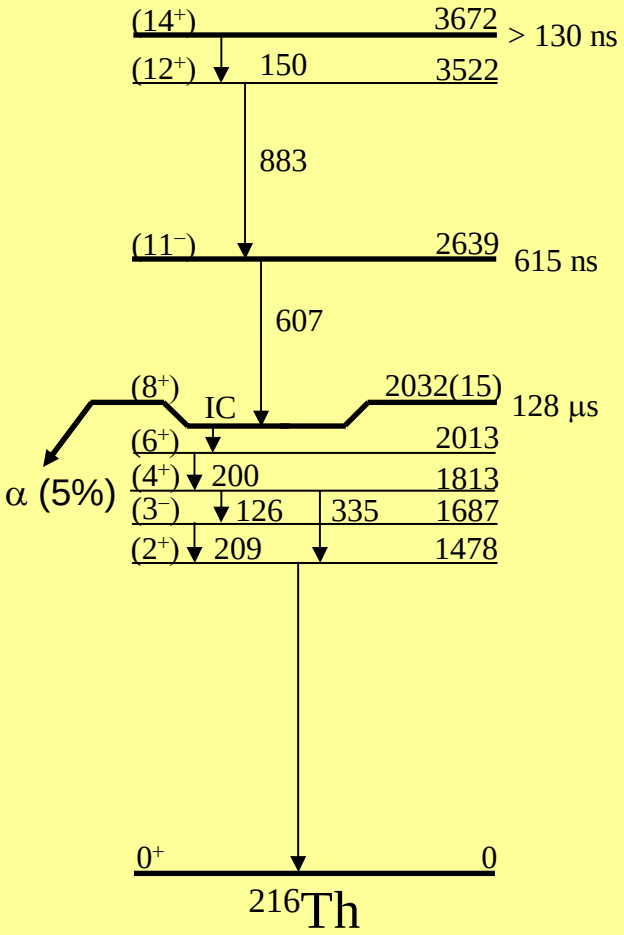


^{216g,m}Th decay schemes

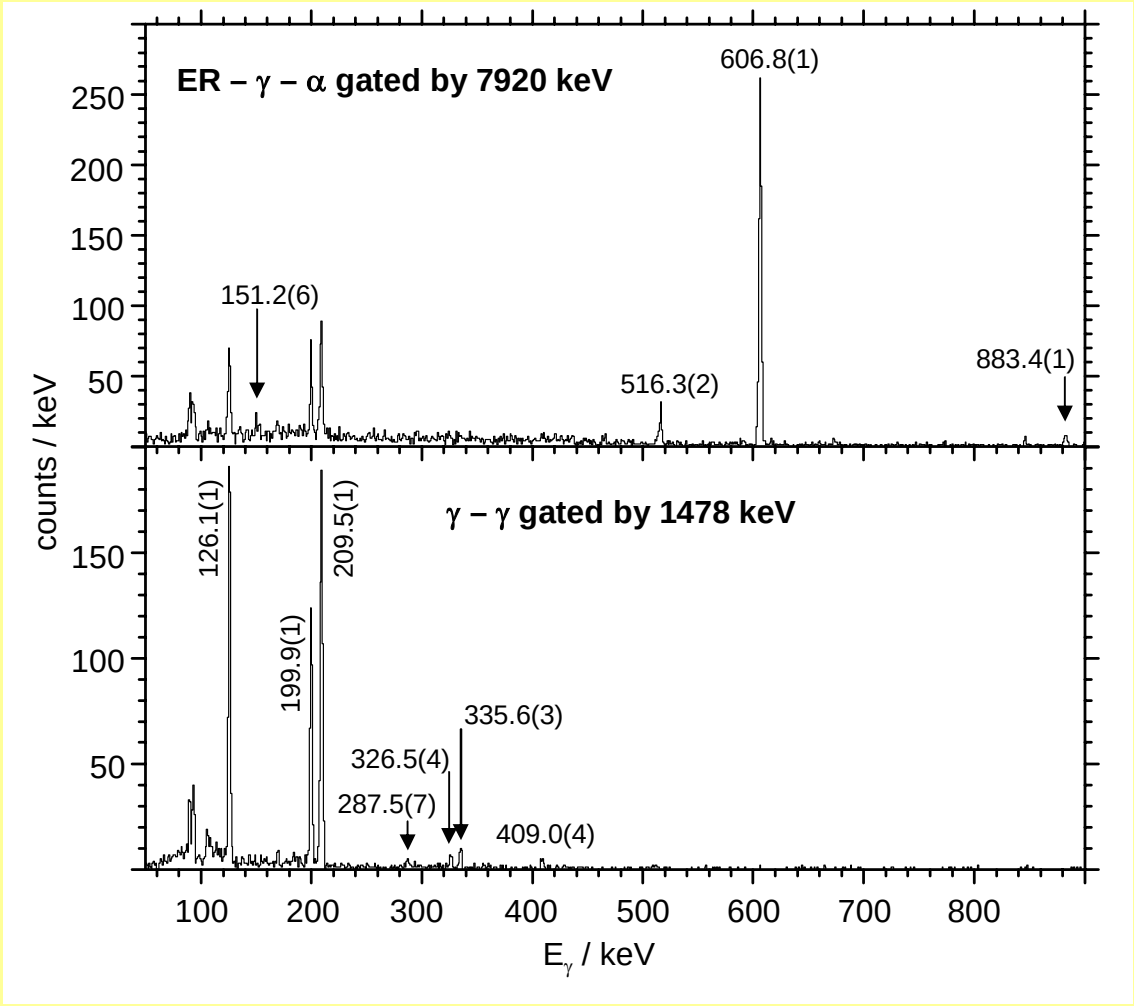


In-beam Kohno et al.
Phys. Rev. C 33, 392 (1986)

^{216}Th level scheme



RDT Hauschild et al.
Phys. Rev. Lett. 87, 072501 (2001)



SHIP example 2: ^{214,216}Ac (^{12}C + ^{209}Bi)

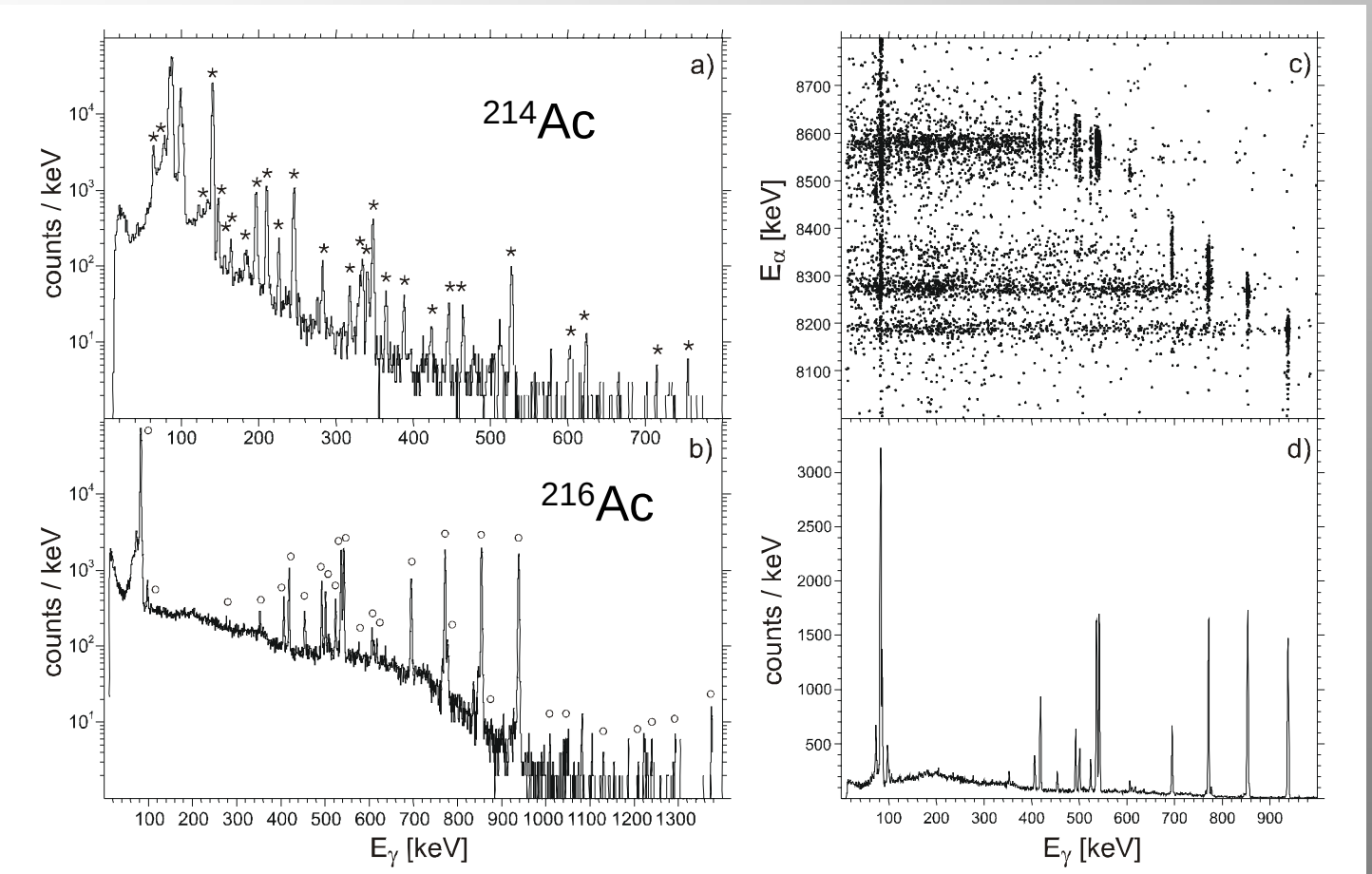
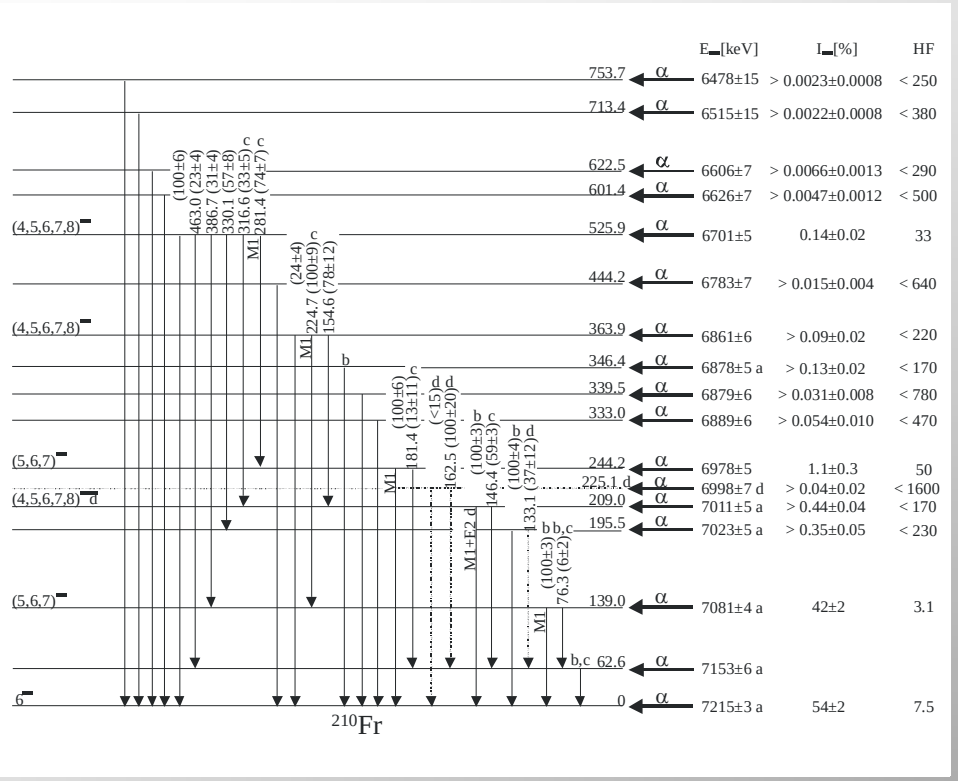
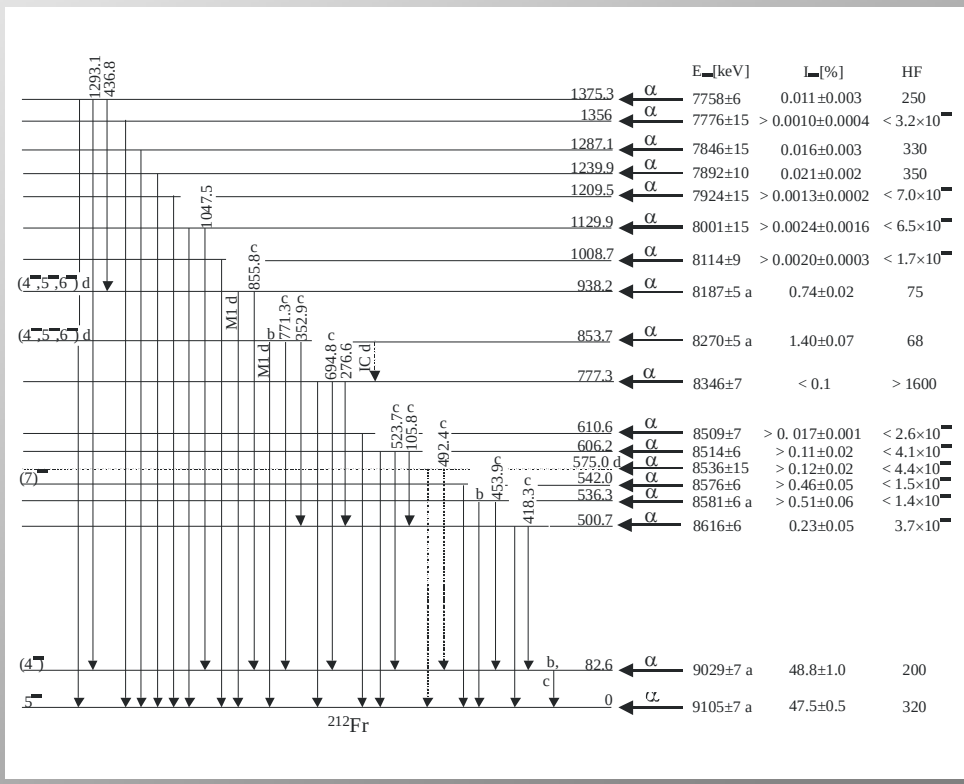


Fig. 2: γ-rays observed in coincidence with α-decays of ^{214}Ac (a) and ^{216}Ac (b). γ-rays assigned to the decay of ^{214}Ac measured at 9.1 AMeV and ^{216}Ac at 7.1 AMeV are denoted by * and o, respectively.
c) α-γ-coincidences observed in α-decay of ^{216}Ac (the scatter plot shows ≈ 5% of total data).
d) Projection of all α-γ-coincidences on the γ-energy axis.

^{214,216}Ac decay schemes





-towards SHEs level densities are increasing ⇒ IC becomes dominating
⇒ summing effects ($\alpha + e^-$) ⇒ α - γ - and/or α - e^- - coincidences needed

Conclusions

Gas-filled separators

+simple, cheap and clean
+high efficiency
+short $\Rightarrow$ short flight times $\Rightarrow$ short living nuclei&isomers
–Bρ, e.g. new elements?

To compare, e.g. SHIP

+velocity filter with high efficiency $\Rightarrow$ nice feature for new elements
+UNILAC provides pulsed beams with very high intensities $\Rightarrow$ RDT?
+superb in (decay) studies at the focal plane
–transmission for very asymmetric reactions? $\Leftarrow$ UNILAC
–length $\Rightarrow$ flight time $\Rightarrow$ short living nuclei&isomers? $\Leftarrow$ UNILAC

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