GRAN SASSO SUMMER INSTITUTE 2014

HANDS-ON EXPERIMENTAL UNDERGROUND PHYSICS AT LNGS

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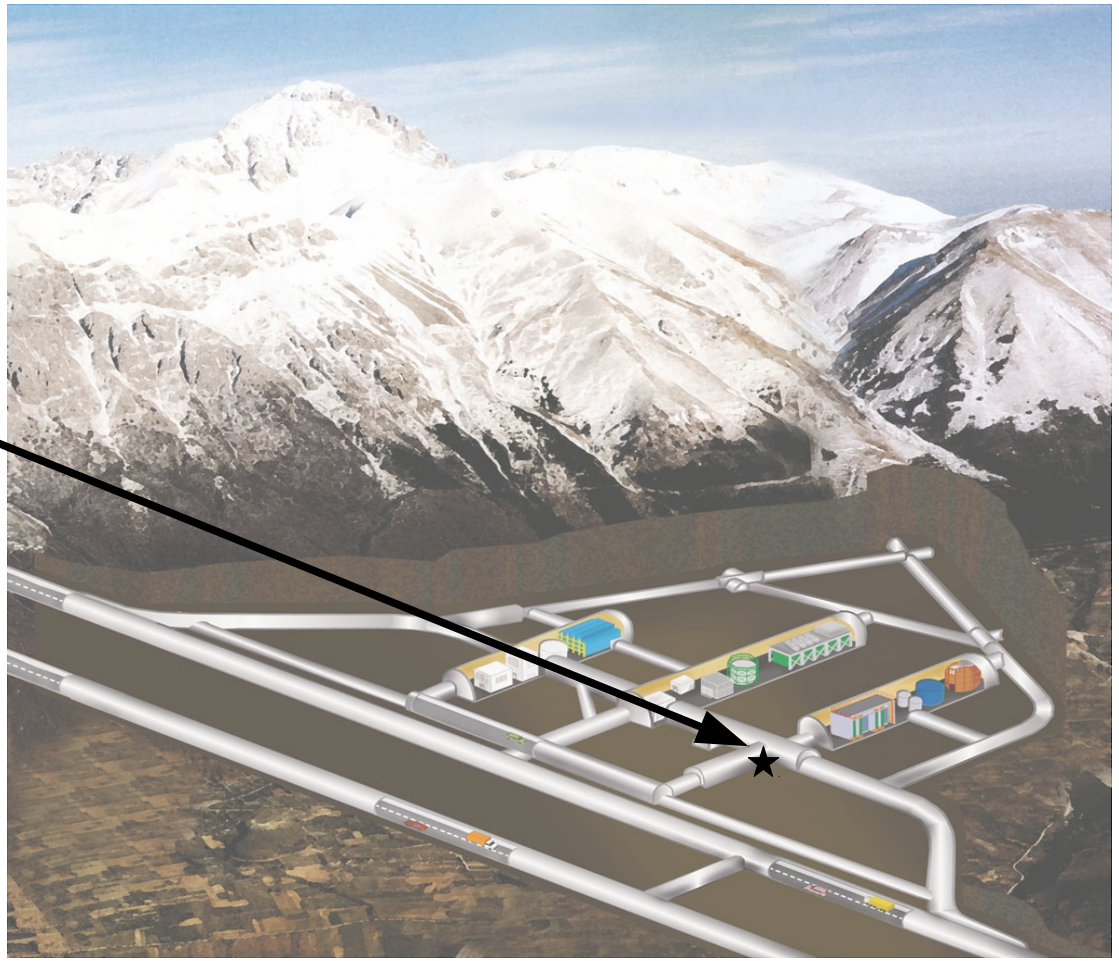
October, 3rd 2014

Rare decay search with STELLA

The LNGS low background counting facility

STELLA

(**S**ub**TE**rranean **L**ow **L**evel **A**ssay)



Rare decay search: ^{180m}Ta

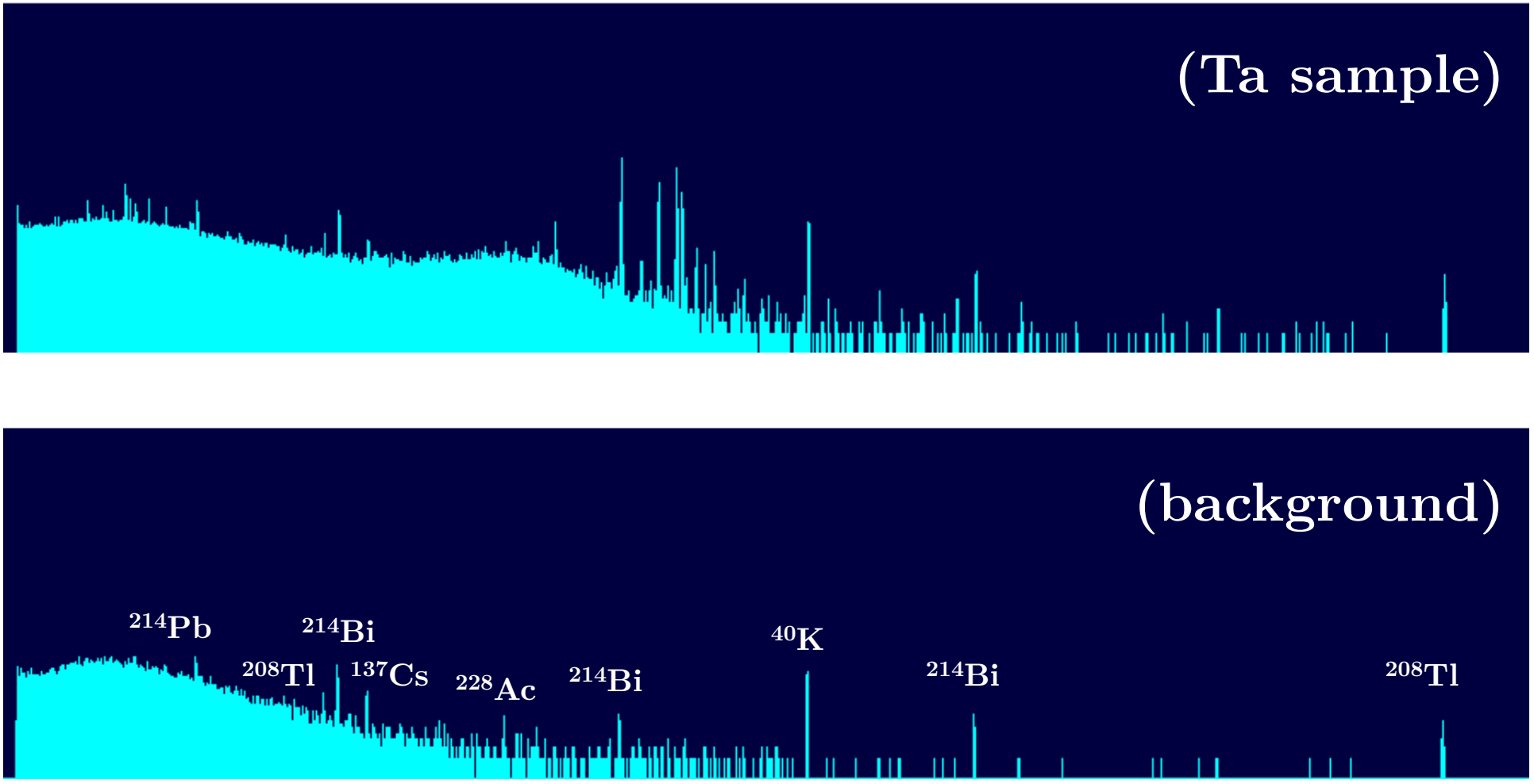
- the ground state of ^{180}Ta has a short half-life of only 8.1 h
- Tantalum-180 is the rarest isotope of nature's rarest element

  → Solar System abundance of ^{180m}Ta of $2.49 \cdot 10^{-12}$ (Si=1)

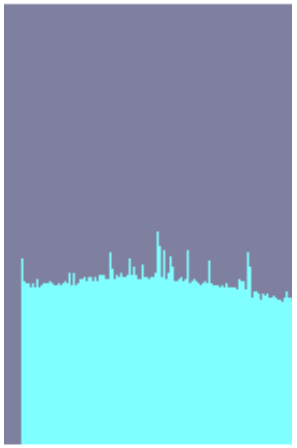
obs. CR activation → production of ^{182}Ta

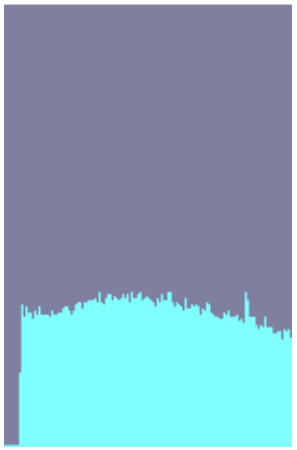
M. Hult et al. *Appl. Rad. Iso.* **67 (2009) 918–921**

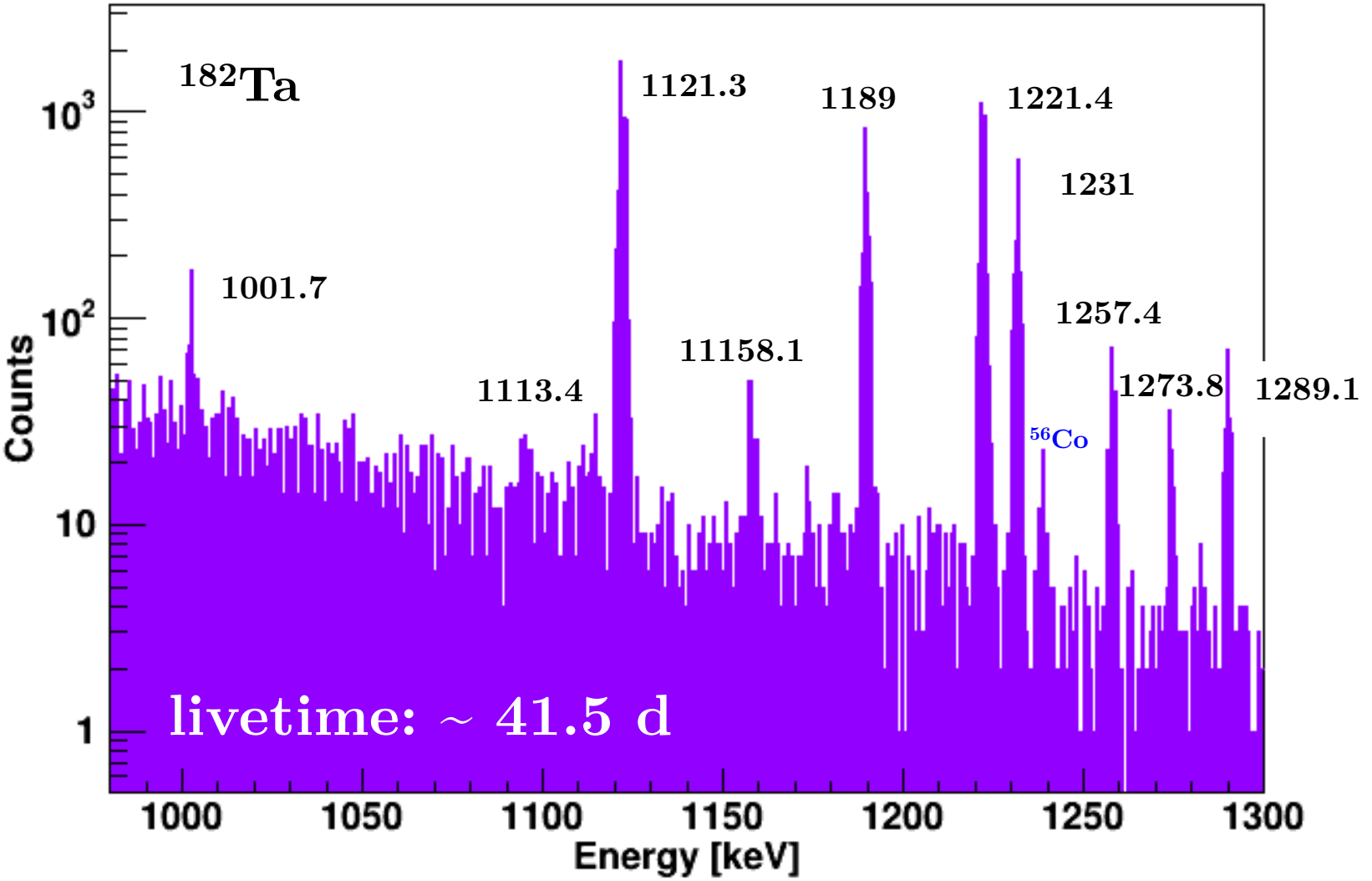
Gamma spectrum



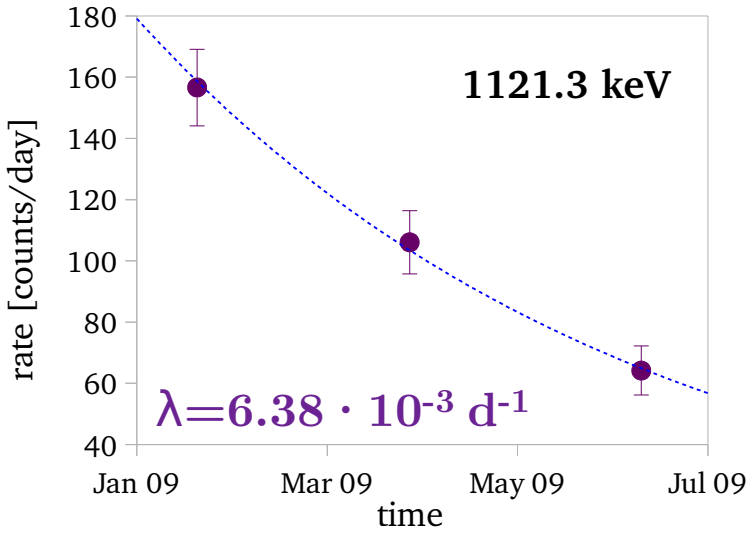
Gamma spectrum

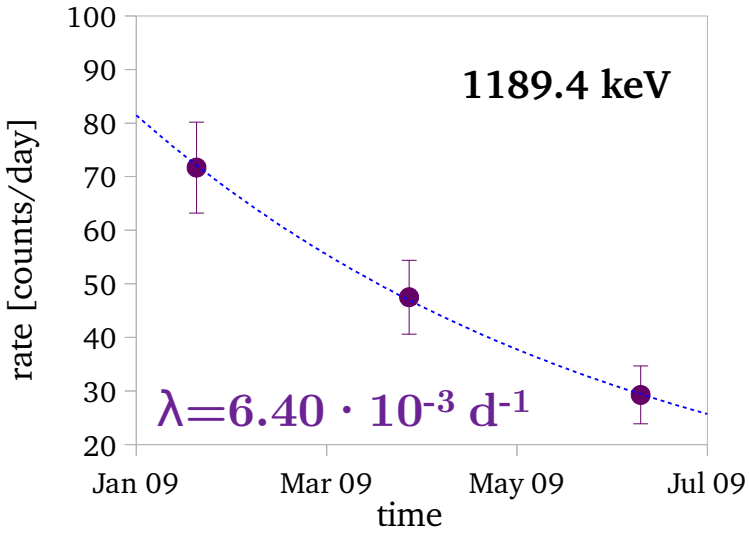






^{182}Ta half-life

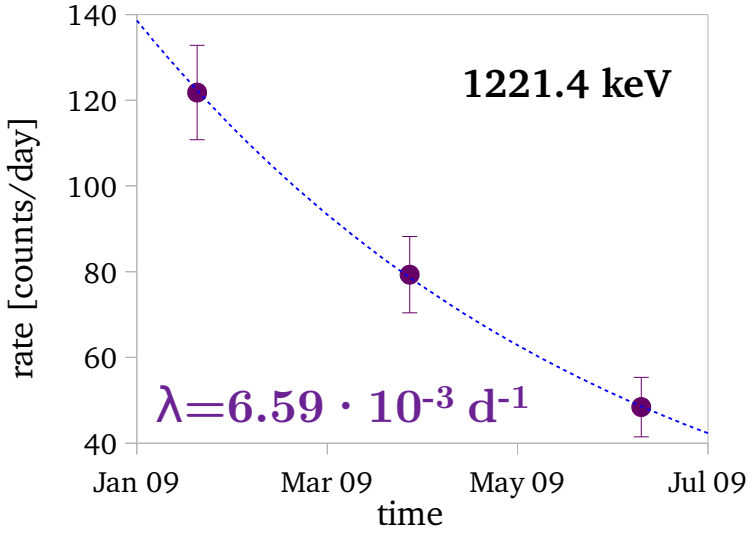


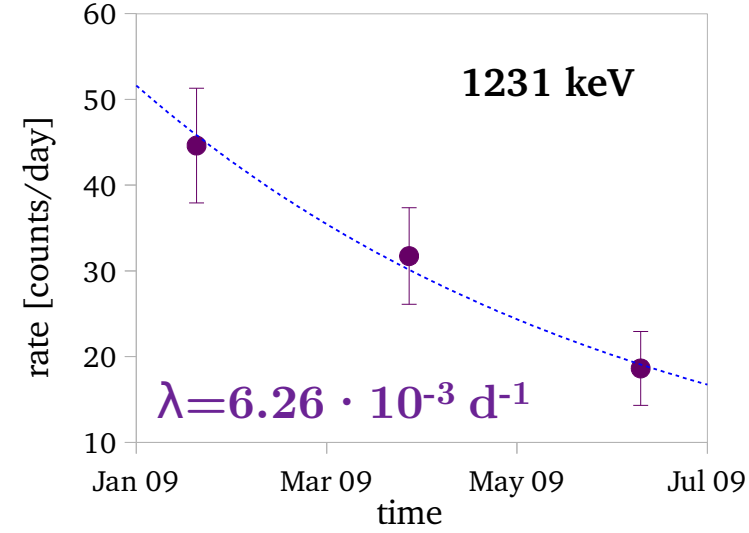


$$dN/dt \sim e^{-\lambda t},\ \lambda = \ln 2/t_{1/2}$$

$$t_{1/2}(^{182}\mathrm{Ta}) = 114.43\ \mathrm{d} \rightarrow \lambda = 6.06 \cdot 10^{-3}\ \mathrm{d}^{-1}$$

$$\lambda(\mathrm{exp.}) = 6.41 \cdot 10^{-3}\ \mathrm{d}^{-1}$$





Outlook & perspectives

- **the analysis on ^{182}Ta briefly performed during these days has to be improved (better fits, error propagation, consideration of efficiencies, ...)**
- **a long measurement (> 1 month) will be needed to search for the decay of ^{180m}Ta**
- **an upper limit or (let's hope!) a constraint on the half-life will be placed**