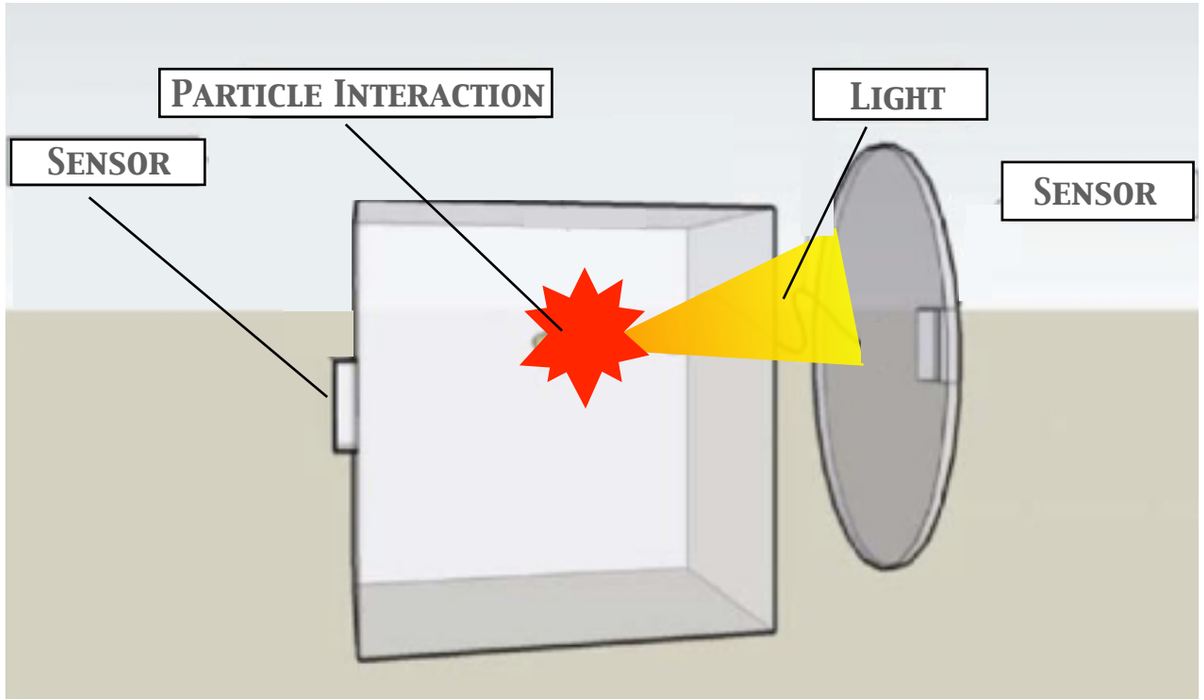
Study of Rare Alpha Decays with Scintillating Bolometers

Laura Cardani
Sapienza, University of Roma and INFN Roma

Standard detectors (gas counters, semiconductors..) do not achieve the necessary sensitivity to study rare α decays
New detection technique: scintillating bolometers



Double read-out

Heat released by an interaction

Scintillation light emitted by the same interaction

- Excellent energy resolution
- Very high efficiency

Recognition of the nature of the interaction (α, electrons) through the scintillation yield

Rejection of the background due to electrons, muons, γ's..

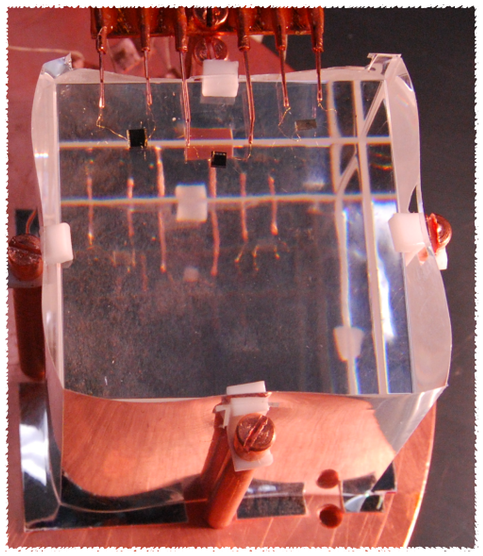
Thanks to this technique we could study the rare α decays of several isotopes
We operated a $PbWO_4$ bolometer in order to study the lead isotopes, achieving an unprecedented sensitivity on their decays.

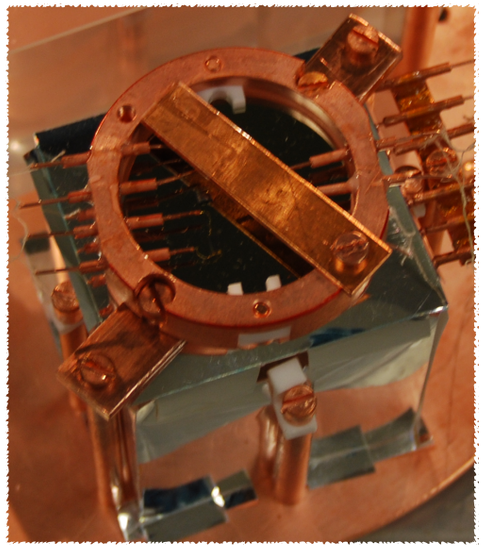
Isotope	Energy of emitted α	Sensitivity on α decay
^{204}Pb	1971.8 keV	~ 10^{20} years
^{206}Pb	1136.6 keV	~ 10^{21} years
^{208}Pb	391.5 keV	~ 10^{20} years
^{207}Pb	518.8 keV	~ 10^{19} years

Study of Rare Alpha Decays with Scintillating Bolometers

Laura Cardani
Sapienza, University of Roma and INFN Roma

We used the same technological approach to study the rare decay of ^{209}Bi





^{209}Bi was considered as the heaviest stable isotope, until its α decay on the ground state of ^{205}Tl was observed.

We operated a 889 g BGO scintillating crystal in a cryostat in the Laboratori Nazionali del Gran Sasso (L'Aquila, Italy) in order to detect the decay on the first excited state.

First evidence of the excited state decay of ^{209}Bi:

- the background due to electrons (β/γ band) is fully disentangled thanks to the read-out of the light
- $T_{1/2}(^{209}Bi) = (2.01 \pm 0.08) \times 10^{19}$ years
- Branching ground/excited level transitions = (98.8 ± 0.3) %

Phys. Rev. Lett. 108 (2012) 062501