Rapid ^{210}Pb assay for monitornig the purification of archaeological lead for the RES-NOVA experiment

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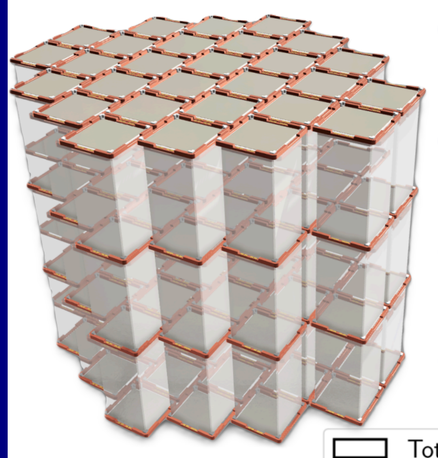
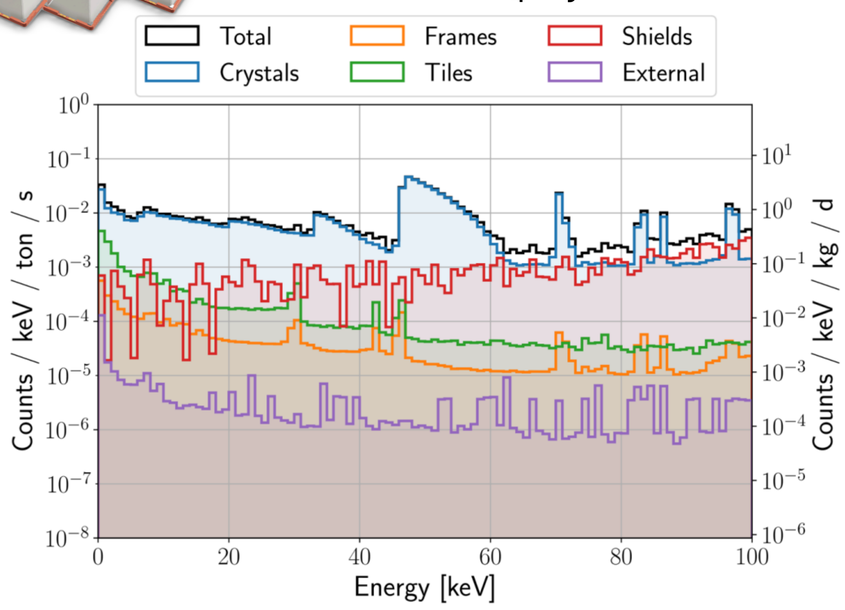
An archaeological lead based detector

The RES-NOVA experiment



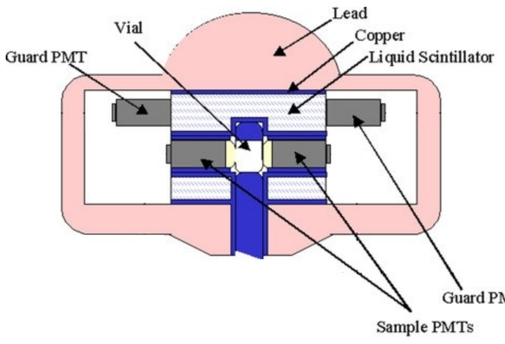
- Detection of Supernovae neutrinos (all flavours) [1]
- Detection of Dark Matter candidates (WIMPS) [2]
- Interaction channel: Coherent Elastic Neutrino Nucleous Scattering [3]
- Cryogenic detector with archaelogical lead $PbWO_4$ crystals



Main background: ^{210}Pb in $PbWO_4$ crystals

Archaeological lead grants highest radiopurity! [4]

Wallac Quantulus 1220 for Liquid Scintillation (LS) detection

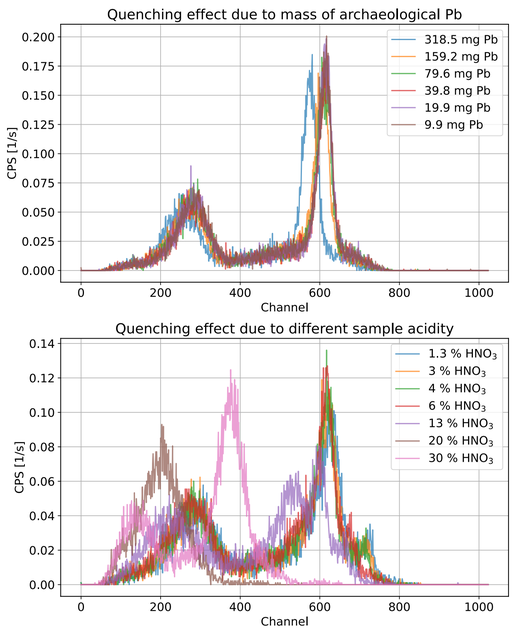


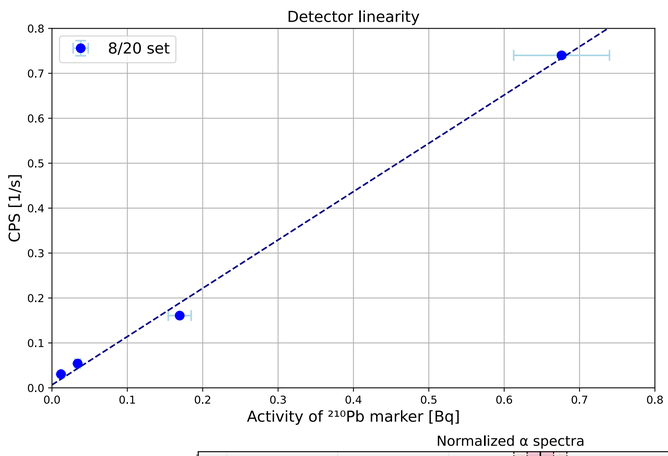
- 20 ml volume samples: 12 ml LS + 8 ml digested lead
- Detection of the whole ^{210}Pb decay chain
- Pulse Shape Analysis (PSA) for α/β particle discrimination

Optimal technique for monitoring ^{210}Pb contaminations between chemical purification processes of archaeo-lead

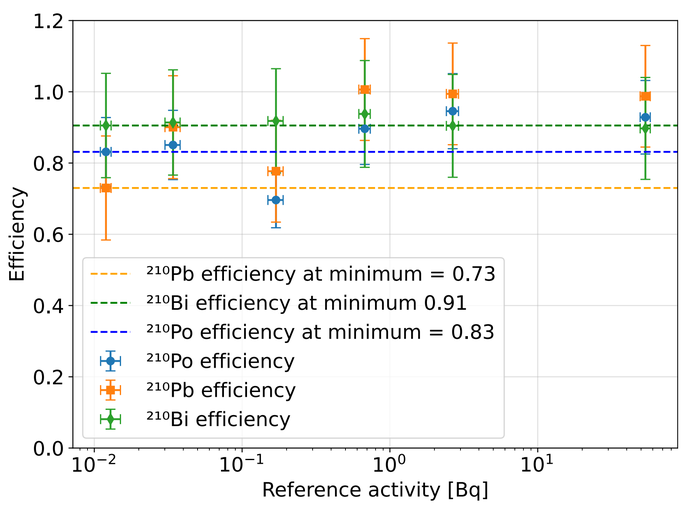
Measure optimization and results

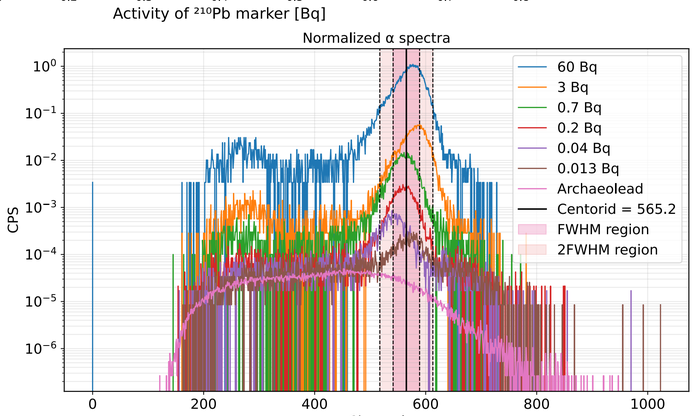
Quenching effects
Detector linearity

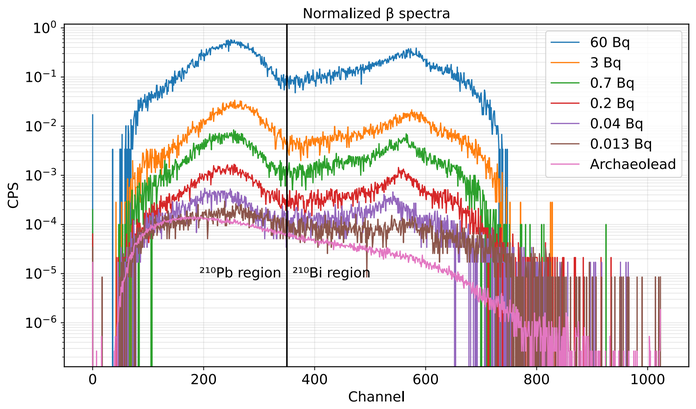


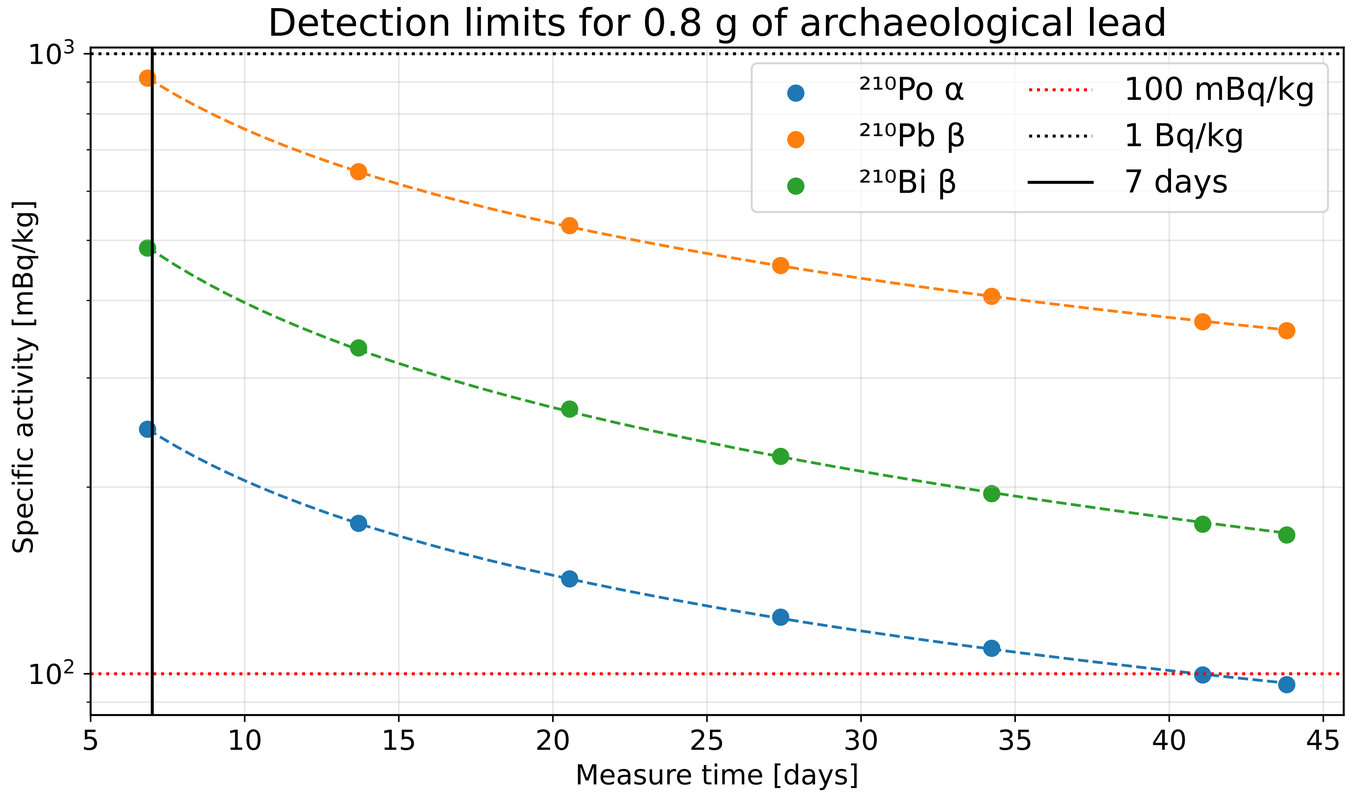


Detection efficiency
ROIs definition









FAST TECHNIQUE:
sensitivity < 300 mBq/kg in 1 week
sensitivity < 100 mBq/kg in 42 days

References

[1] Pattavina, Luca, Nahuel Ferreiro Iachellini, and Irene Tamborra. "Neutrino observatory based on archaeological lead." Physical Review D 102.6 (2020): 063001.
[2] RES-NOVA Coll. "New dark matter direct search based on archaeological Pb", Phys.Rev.D 111 (2025) 10, 103050
[3] Akimov, D., et al. "Observation of coherent elastic neutrino-nucleus scattering." Science 357.6356 (2017): 1123-1126.
[4] Pattavina, L., et al. "Radiopurity of an archaeological Roman lead cryogenic detector." The European Physical Journal A 55.8 (2019): 127.