A dream becoming a reality

CUORE: a cryogenic underground observatory for rare events

E.Fiorini

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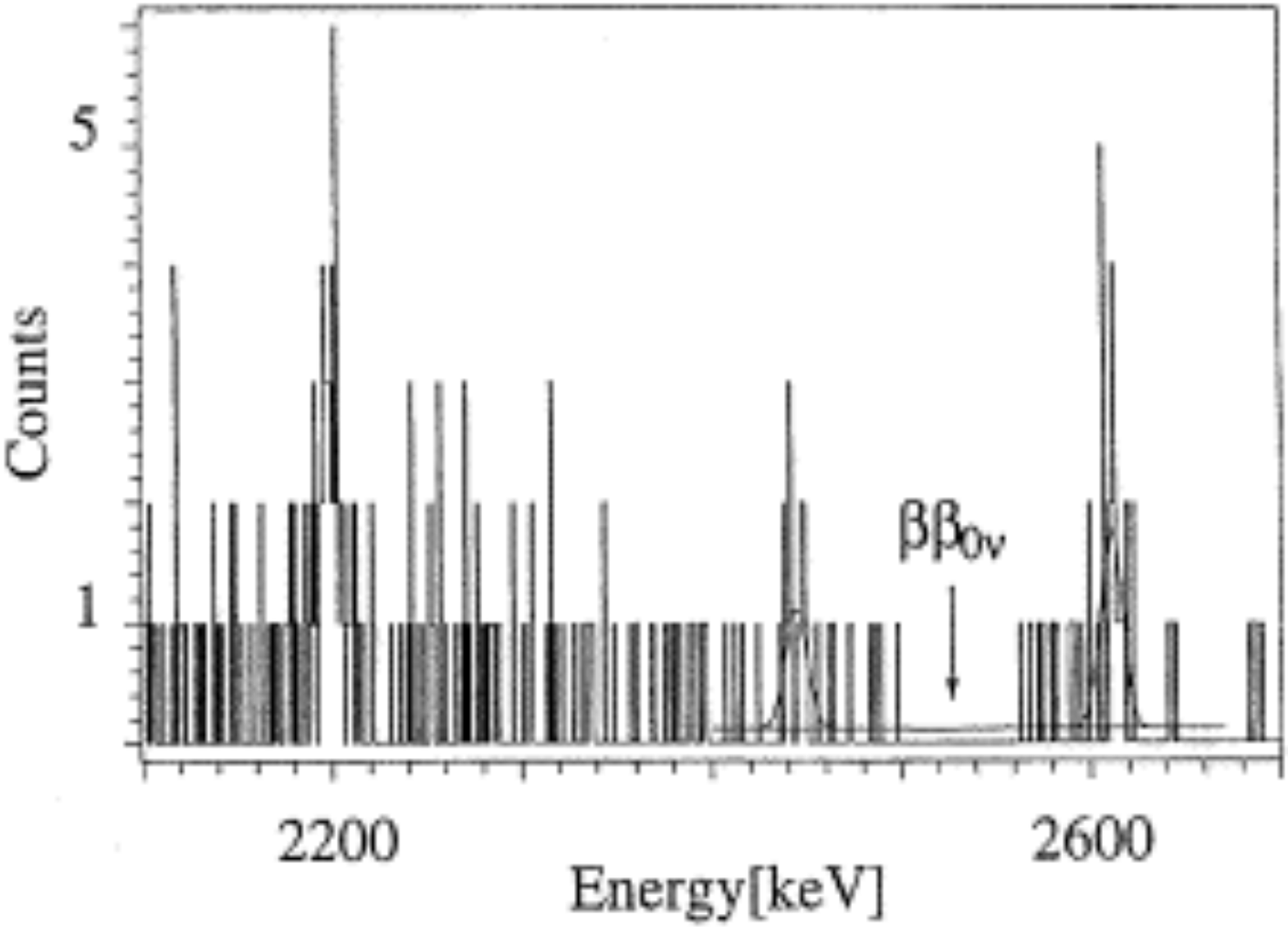
Abstract

The proposal for an array of 1000 cryogenic detectors of a mass between 0.5 and 1 kg each is presented. It would be operated underground to search for neutrinoless double beta decay, interaction of WIMPS and of solar axions and for rare events in nuclear physics. The first results of an array of 20 TeO_2 detectors totaling a mass of almost 7 kg will be also reported

the initial discussion was taken during a walk with Frank Avignone along the Volga river

- Presented to the conference on physics and astrophysics in **Venice** (California)
- Discussion of CUORE and **Genius** (H. Klapdor was absent)
- Presentation of the results from **MIBETA** – 20 crystals of 340 g each

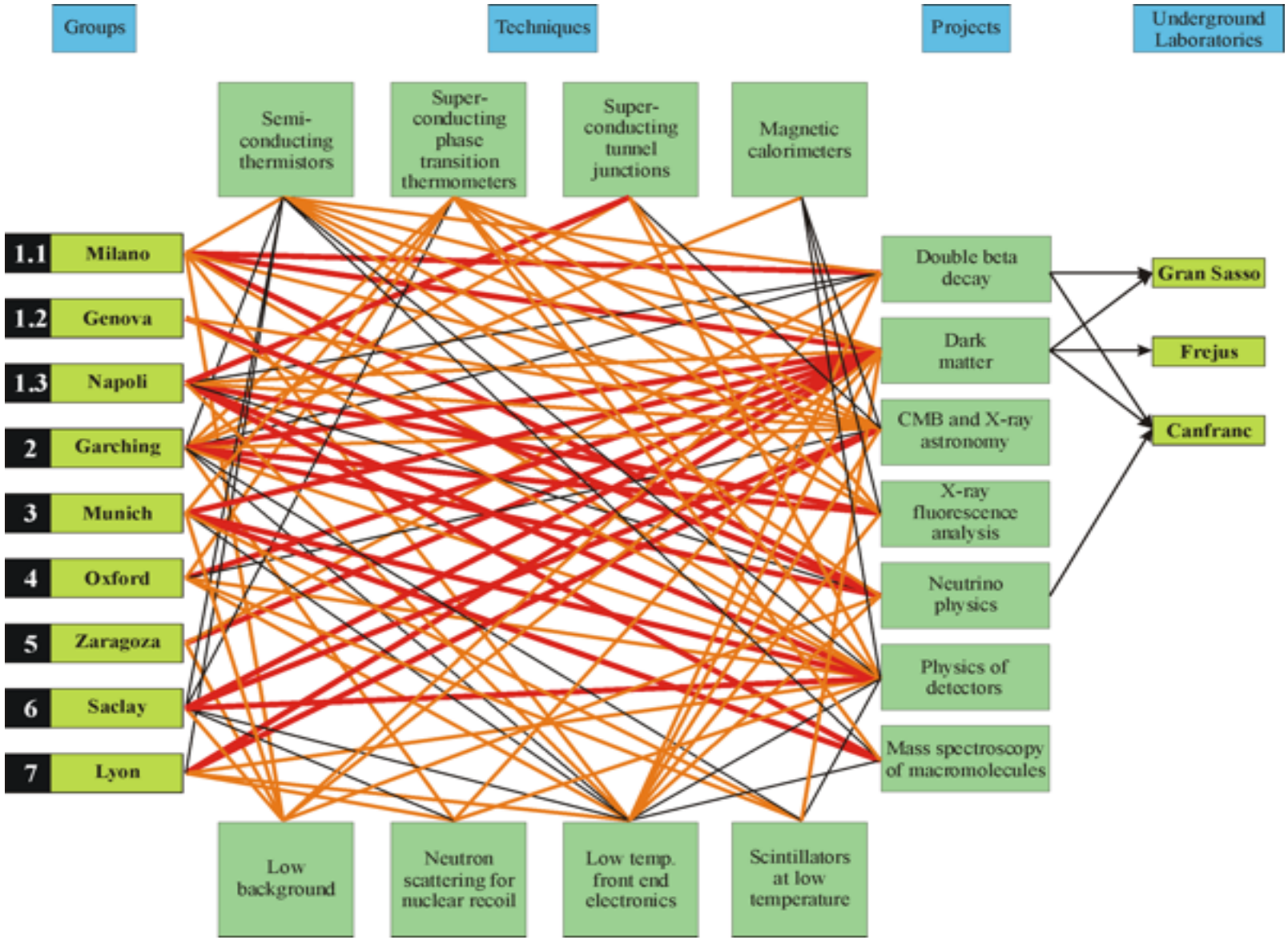


Picture by E.Iarocci (President of INFN)

Interest and application of thermal detectors in elementary particles **much before**
First mini-meeting on thermal detectors: Ringberg Castle 1986

E.Fiorini and T.Niinikosky → **Rare events** and **double beta decay**
S.H.Moseley et al → Detectors for **astrophysics** **and** **neutrino mass**
A.Drucker and L. Stodolsky → **Nuclear physics** and **Astronomy**
=> Neutrino Physics

European network on low temperatures

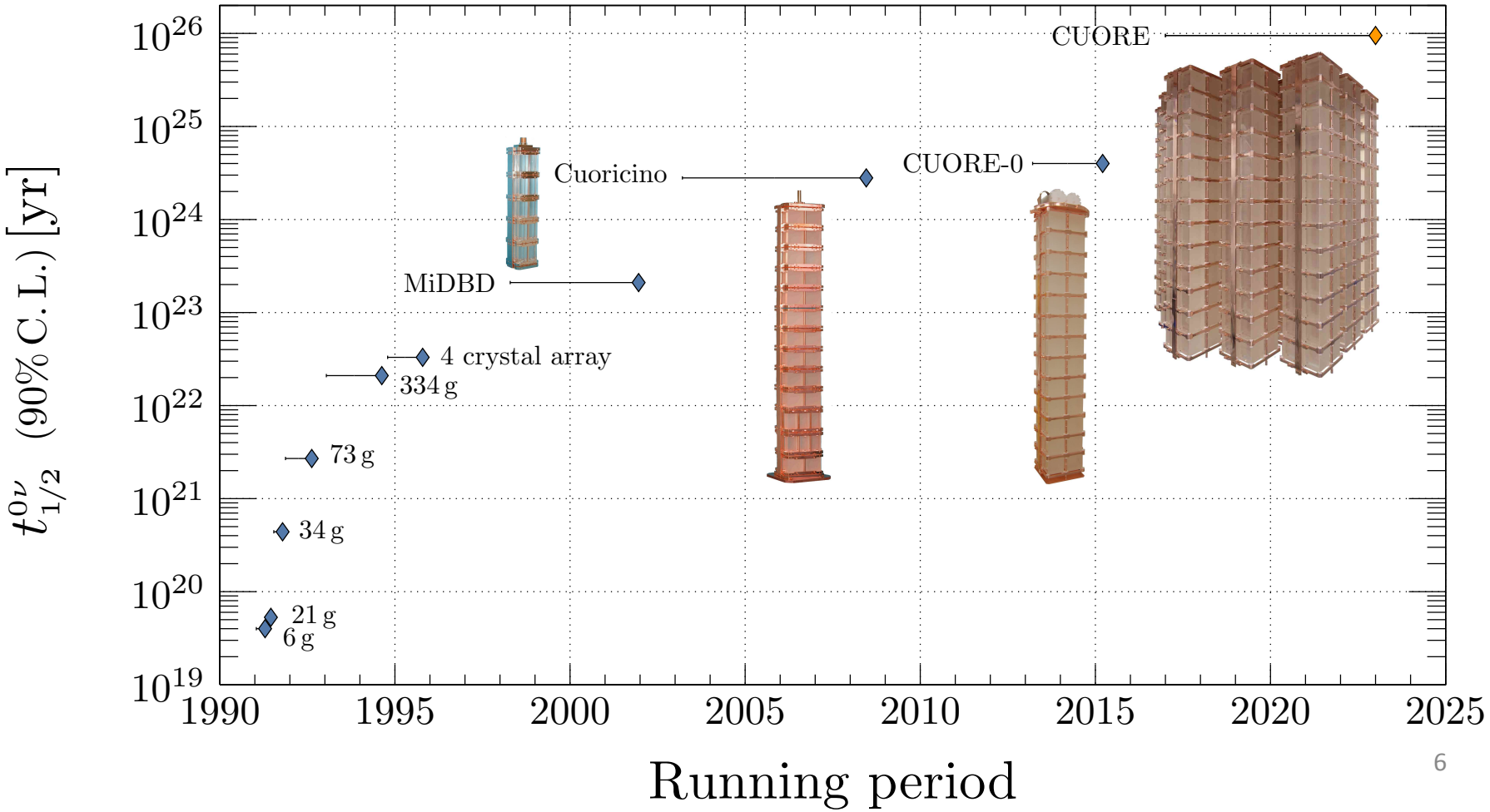


Later great interest from the United States

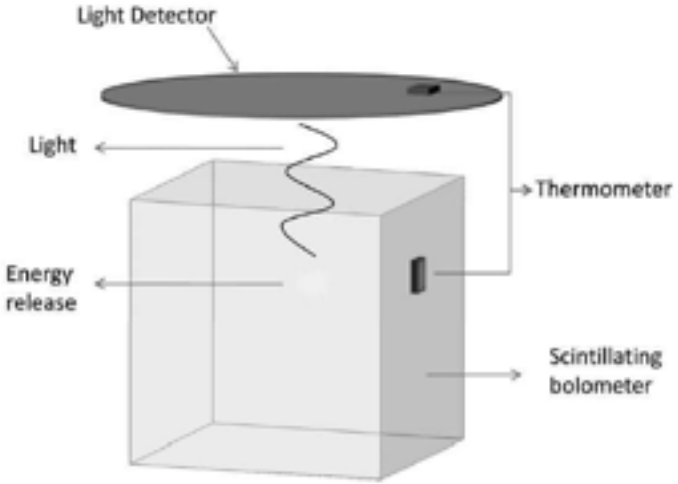
(Frank ,Rick,Stuart, Peter.,Eugene .. meeting NSF,DOE …)

- Double Beta decay => **Germanium** or **Tellurium**
- A crystal of pure tellurium => Giorgio Benedek => **TeO_2**
- Study of **solid state physics** Carlo,Angelo and Monica in Munich
- Detectors of **increasing size**

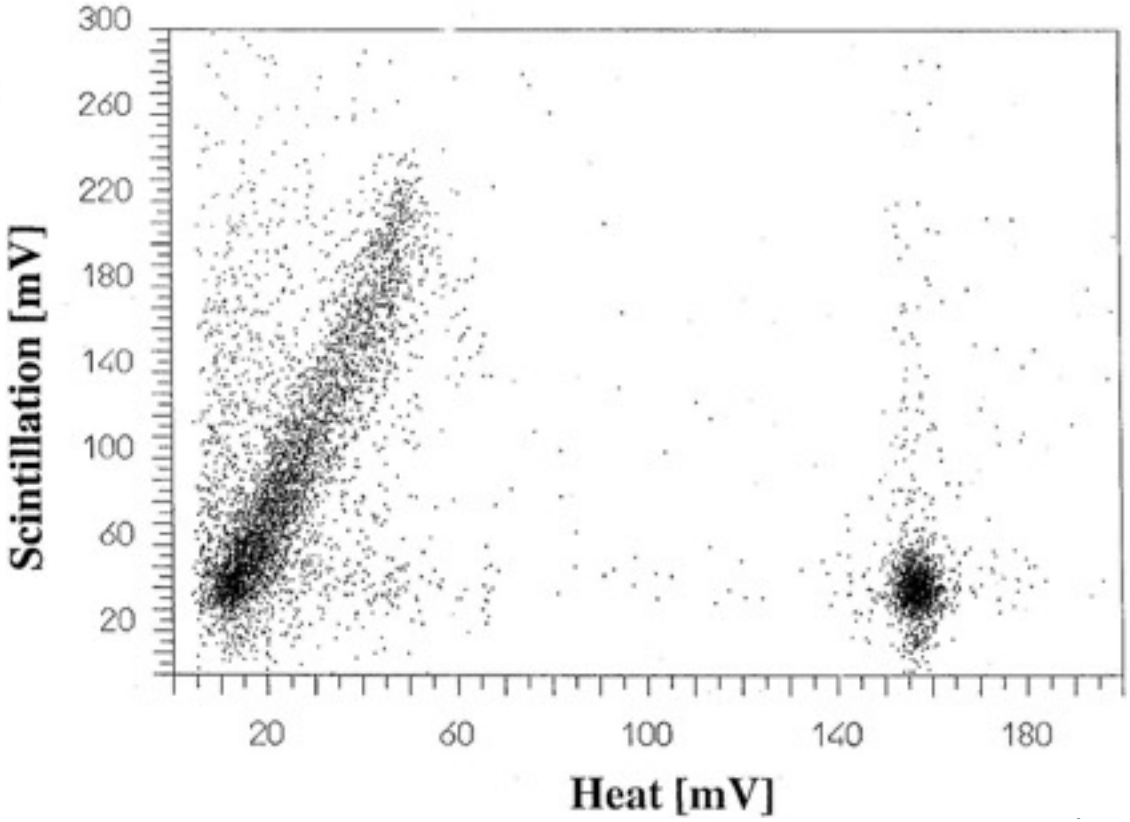
A.Alessandrello, D.V.Camin, E.Fiorini and A.Giuliani: Construction of a **massive** Germanium thermal detector for experiments on rare decays, Phys. Lett. B 202, 611 (1988)



New results and development in double beta decay of ^{130}Te and ^{48}Ca investigated with biolometric techniques



ALESSANDRELLO, A; BROFFERIO, C; CAMIN, DV; et al Edited by: Booth, NE; Salmon, GL Conference: IVth International Workshop on Low Temperature Detectors for Neutrinos and Dark Matter (LTD-4) SEP 04-07, 1991



Mutual Support of CUORE in other fields

Solid state physics and cryogenics

- CUORE is an **unique development** in **cryogenic detectors**
- Results obtained in **solid state** and **low temperature physics**
- Results reported in all international **LTD conferences** (**the next in Milano 2018)**

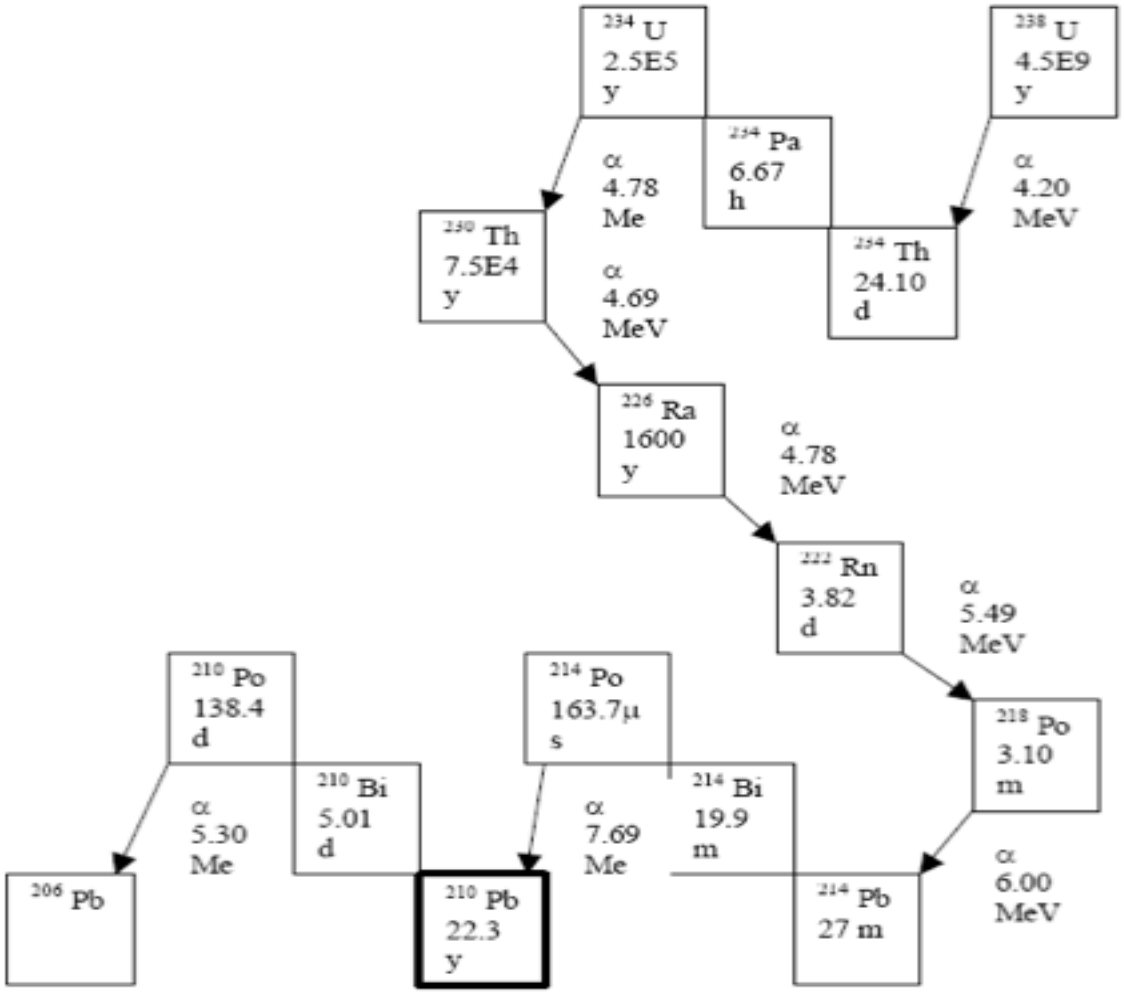
T.O.NIINIKOSKI, A.RIJLLART, A.ALESSANDRELLO, E.FIORINI and A.GIULIANI : **Heat Capacity** of a Silicon Calorimeter at low Temperatures **measured by Alpha Particles**. Europhysics Lett. 1, 499 (**1986**)

Low level radioactivity and contaminations

- Carried out with various detectors: **X , γ ray and** α spectroscopy, **ICPMS**, neutron activation, Lead Isotope analysis (LIA) and even low temperature detectors.
- Also **environmental physics** (an agreement of many ββ **groups**, including **Berkeley** and **Milano**)

Archaeometry and Roman Lead

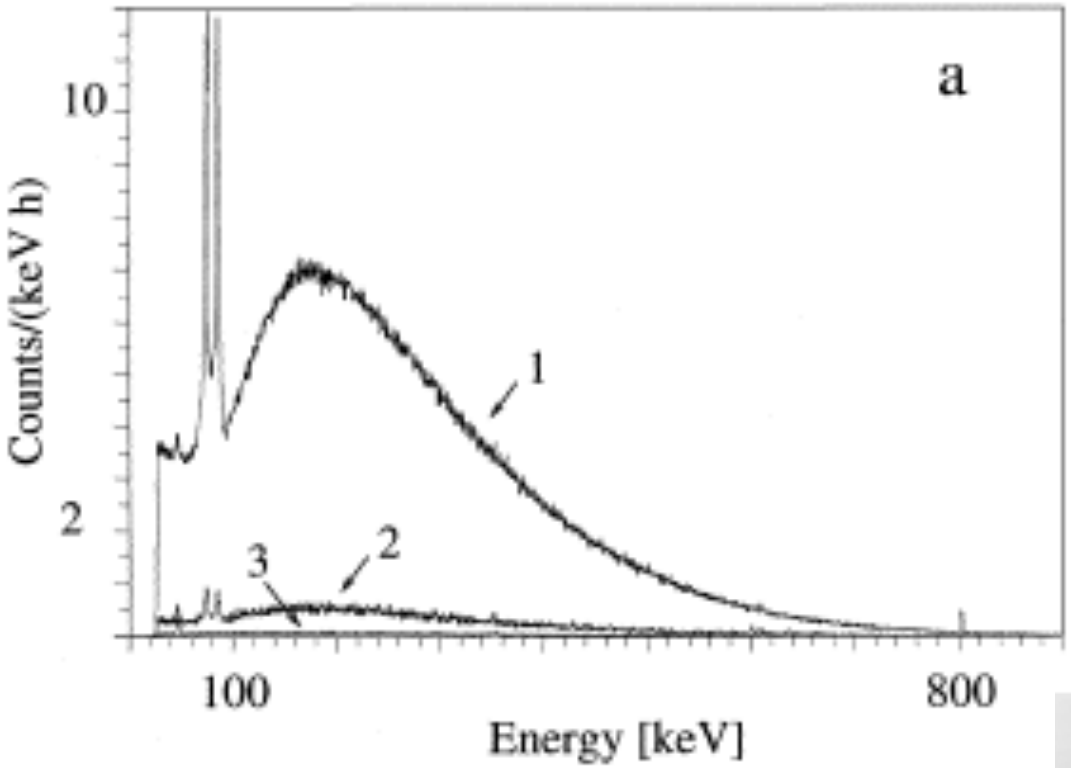
Lead as an excellent shielding material , but **^{210}Pb**




SOCMEPONTIENIORVAAVA:F

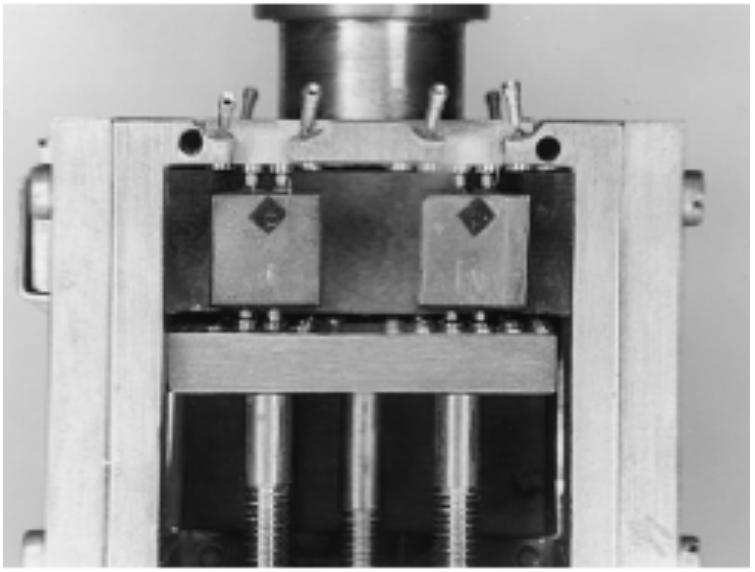

257
286
211

Spectroscopic measurement of various lead samples



Germanium measurement

Bolometric measurement

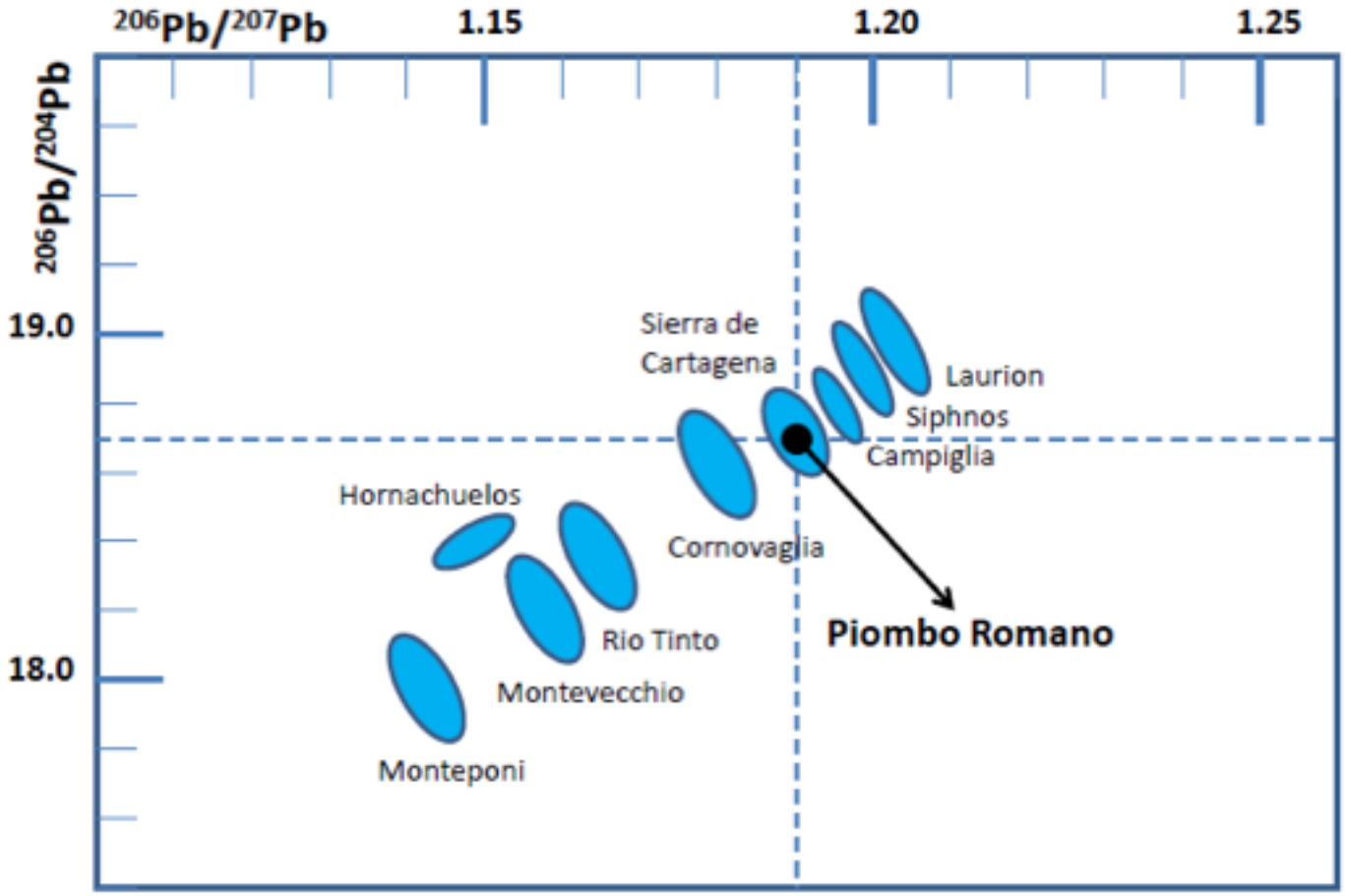


- We have to preserve the inscriptions.
- In order to strictly follow the agreement: horizontal cut of the top part
- 230 ingots were cut

Something to give in exchange to the Ministry of Cultural Affairs

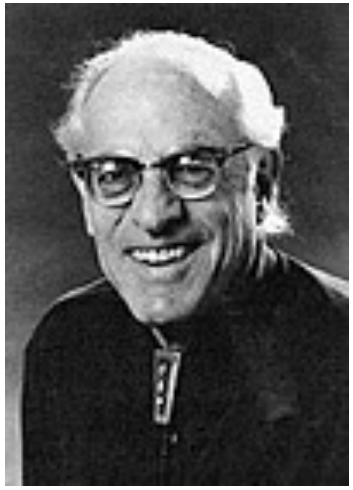
Lead Isotopic Analysis (LIA) also for Copper and Bronze (2% of Lead)

The origin of Roman Lead



Conclusions

- Ettore tu sei matto (Ettore you are crazy) => maybe , but people of **unique technical professionalism** joined CUORE.
- An example : **only four detectors lost over 988!**
- I am happy => How to contribute to this celebration ?
- A **toast** by the **american discoverer of neutrino** who honored me then very young with friendship and help



A Toast

Here's to Wolfgang Pauli
Who made a funny joke
Here's to the great Enrico
Who then of weakness spoke

Here's to all those present
To celebrate the fruits
Of all the patient workers
Who followed these astutes.

Here's to the proposition
That we shall meet again
And here's to the fond hope
The sun will shine till then.

E. Segrè
June 15, 1972

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