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## Ancient Romans join neutrino hunt

Apr 23, 2010 [7 comments](#)

Sunken treasure

Ever on the look-out for ultra-low radioactive materials to shield their sensitive experiments, nuclear physicists have struck gold with a consignment of lead that lay on the floor of the Mediterranean Sea for 2000 years. The almost completely inert ancient lead will be used to line the CUORE neutrino experiment located under the Gran Sasso mountain in central Italy.

Experiments designed to study extremely rare nuclear processes must be shielded from all possible sources of radioactive contamination, which will swamp sensitive detectors with spurious signals. The sources of interference include cosmic rays from space and radioactivity naturally present in rocks. But there is also radioactivity in the very materials used to provide the shielding, such as lead or copper. And it is here that the ancient lead comes into its own.

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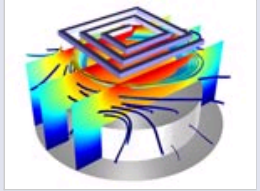
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## Sunk off Sardinia

The sunken metal comprises about 2000 ingots each weighing approximately 33 kg, and was on board a ship heading from Spain towards Italy around the year 50 BC. After going down off the coast of Sardinia, the 36 m long ship and its contents lay on the seabed for over two millennia until they were discovered about 20 years ago. This vast stretch of time means that the tiny amount of the radioactive isotope lead-210 originally present in the ingots, just as it exists in any normal lead object, has by now almost completely disappeared.

When nuclear physicist Ettore Fiorini at the University of Milan-Bicocca read about the find in a newspaper he went to Cagliari to offer the financial support of the Italian National Institute for Nuclear Physics (INFN) in excavating the vessel and its precious cargo. Accepting the offer, archaeologists in Cagliari at the time gave the INFN 150 ingots in return, and they recently sent off a second batch of 120 ingots, which reached the Gran Sasso laboratory last week. These will now be stripped of their historically interesting manufacturers' names, cleaned of any incrustations and then melted to provide a shield for the CUORE experiment.

CUORE, which should be ready in about two or three years time, will use 750 kg of tellurium dioxide to try and discover an extremely rare nuclear process predicted by theory and known as neutrinoless double beta decay. Involving the transformation of two neutrons into protons and electrons but no neutrinos, this decay would imply that neutrinos are, uniquely, their own antiparticle. Observing the decay would also provide physicists with a way of directly calculating the mass of the neutrino, something that to date can only be done indirectly.

### Important commodity

CUORE is not the first nuclear physics experiment to have benefited from ageing lead. Researchers in the US used 450-year old lead from the hull of a sunken Spanish galleon to line their IGEX experiment. What is different about CUORE, however, is the sheer quantity, as well as the quality, of the ancient material. Rather than simply being lined with lead, the ship that sank off the coast of Sardinia had lead as its cargo, lead being an important commodity in ancient Rome since it was used for all sorts of objects, from water ducts and urns to coins and bullets for slings. "This ship was specialized to transport lead so it is a treasure," says Fiorini, who is CUORE spokesperson. "It multiplies by many times the quantity of ancient lead available in the world."

It is not known why the ship sank, but the fact that the vessel was anchored and the lead ingots were found still partly stacked suggests that it did not come to a violent end. Archaeologists have speculated that it was deliberately sunk by the ship's captain in order to prevent the lead from falling into enemy hands.

### About the author

Edwin Cartlidge is a science writer based in Rome

**This ship was specialized to transport lead so it is a treasure. It multiplies by many times the quantity of ancient lead available in the world.**

**Ettore Fiorini,  
University of Milan-Bicocca**

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### 7 comments

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1

**gunslinger**  
Apr 26, 2010 7:59 PM  
United States

**I don't get it**

If the undesirable isotope in the lead decays after only 2000 years, then wouldn't all lead in the mines also not have this isotope?

I don't understand the significance of using lead sitting on the ocean floor for 2000 years as opposed to lead sitting in a mine for 4 billion years.

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2

**kwamba**

Apr 26, 2010 11:41 PM  
Menlo Park, United States

Quote:

*Originally posted by **gunslingor***

If the undesirable isotope in the lead decays after only 2000 years, then wouldn't all lead in the mines also not have this isotope?

I don't understand the significance of using lead sitting on the ocean floor for 2000 years as opposed to lead sitting in a mine for 4 billion years.

Pb-210 is part of the U-238 decay chain. I think what's happening is that U-238, with its 1-billion (or so) year half-life acts as an essentially constant source of Pb-210. So if you had any trace contamination of U-238 in your sample of freshly mined Pb, it'll automatically have Pb-210. I'm not sure about this, but I think you can remove the U-238 from a sample of mined lead by chemical means, but then you are still left with whatever Pb-210 was in your sample afterwards.

Then again, even if your Pb is sitting in the mine and is free of U-238 contamination, you still have the problem of Rn-222 which is an intermediate step in the U-238 decay chain. Rn-222, when it forms, can drift around as a gas, so it's easy to imagine some Pb-ore sitting in the ground, coming into contact with the radon, and picking up a tiny amount of Pb-210 as a result. Remember, experiments like CUORE care about even miniscule levels of radioactivity so even a small relative Pb-210 contamination could be disastrous.

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3

**gunslingor**

Apr 27, 2010 3:44 PM  
United States

Quote:

*Originally posted by **kwamba***

Quote:

*Originally posted by **gunslingor***

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Perfectly good explanation, I understand.

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4

**kwamba**

Apr 27, 2010 7:18 PM  
Menlo Park, United States

Quote:

*Originally posted by **gunslingor***

Perfectly good explanation, I understand.

I am glad I could help, and I am glad you raised the question! The article, though well-written, well-reported, and very well put together overall, was more than a little deficient in getting across this important point!

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5

**kobychev**

Apr 30, 2010 8:42 AM  
Ukraine

Ancient lead (of more than 2000 yrs old) was also found in a sunken Greek ship in Ukraine and used by physicists in low-background nuclear experiments; see [dx.doi.org...j.nima.2009.02.018](https://doi.org/10.1102/j.nima.2009.02.018).

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6

**jchjchha**

May 13, 2010 7:02 AM

**jordan**

great! I'd like wear the <a

href="[www.mydiscountjordan...](http://www.mydiscountjordan...)">air jordan shoes</a>

7

**jchjchha**

**13123**

May 13, 2010 7:03 AM

great! I'd like wear the <a

href="www.mydiscountjordan...">air jordan shoes</a>

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