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The BOREXINO low-background techniques

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The BOREXINO solar neutrino experiment was a pioneer in the suppression of radioactive background. The first real-time detection of sub-MeV solar neutrinos became possible only by a strict radiopurity control program.

That started with a smart detector design, in which the mass of the scintillator-containing vessel was ultimately minimized. It continued with the selection of radiopure construction materials by means of gamma-ray spectroscopy, radon emanation screening, neutron activation analysis (NAA) and inductively coupled plasma-mass spectrometry (ICP-MS) and was supplemented by thorough surface cleaning protocols. Of course, most attention was paid to the cleanliness of the scintillator itself. Distillation, water extraction and nitrogen sparging was applied to remove radioactive traces of heavy metals and noble gases from the organic liquid. Eventually, the suppression of convective movement allowed the remaining impurities to settle.

The achieved ultra-low background level is still unmatched today and many of the applied technologies became standard in the field of low radioactivity research. In the talk I will review the most important methods developed in the framework of BOREXINO and demonstrate their impact for future low-energy astroparticle physics experiments.

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