ANAIAS dark matter project


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SUMMARY:

- A complete background model was developed for a 9.6 kg detector (ANAIS-0 prototype) after months of data taking in Canfranc based on radiopurity input data and MC simulation, indicating that the NaI(Tl) crystal was the main contributor to the measured background.
- First background data of two new 12.5 kg detectors have been analyzed, showing an excellent light collection and a much lower 40K content.

REFERENCES:


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ANAIAS project: Annual modulation with NaI Scintillators

- Set-up
  - Two 12.5 kg NaI(Tl) detectors built by Alpha Spectra in USA using screened powder (<90 ppb at 95% CL by GeGe spectrometry at LSC) and OFHC copper
  - Arrived at Canfranc in December 2012 and coupled to Ham ULB and Hamamatsu R12669 SEL2 PMTs

- Cosmogenic activation
  - Emissions from several cosmogenic isotopes identified and decay observed
  - Preliminary production rates (kg⁻¹ d⁻¹) derived

- Low energy background
  - Preliminary assessment of 40K activity in crystals using the same coincidence technique
  - Although cosmogenic activation is still decaying, complete understanding of background is underway to further reduce it


- Set-up
  - Two 12.5 kg NaI(Tl) crystals (4”x4”x10”) produced by Saint-Gobain and encapsulated using ETP copper at University of Zaragoza
  - Operated at hall B in LSC from February 2011 to December 2012

- Radioactive contaminations in external components determined by HPGe spectrometry performed at LSC

- High energy spectrum: most of the measured background is nicely reproduced
- Low energy spectrum: some non-explained components are still present (plausible background sources analyzed)

Data vs simulated contributions

ANAIAS-0 prototype: Background model [1,2]

- A 9.6 kg NaI(Tl) crystal (4”x4”x10”) produced by Saint-Gobain and encapsulated using ETP copper at University of Zaragoza
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- Preliminary production rates (kg⁻¹ d⁻¹) derived

- External contaminants
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- Monte Carlo simulation
  - MC simulations using Geant4 package carried out to evaluate contribution from each measured contaminant
  - Some hypotheses added (no fitting of the experimental data to a combination of these contributions has been attempted): some values below upper limits, 210Pb surface emissions on crystal and copper vessel, cosmogenic 3H and 129I in crystal, extra 210Pb in lead

- Data vs simulated contributions
  - High energy spectrum: most of the measured background is nicely reproduced
  - Low energy spectrum: some non-explained components are still present (plausible background sources analyzed)

- Low energy background
  - Cosmogenic activation
    - Emissions from several cosmogenic isotopes identified and decay observed
    - Difference between first data underground and data taken 75 days later
    - Preliminary production rates (kg⁻¹ d⁻¹) derived