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Updated background studies for the ANAIS dark matter experiment

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The ANAIS experiment is intended to search for dark matter annual modulation with ultrapure NaI(Tl) scintillators in order to provide a model-independent confirmation or refutation of the long-standing positive annual modulation signal in the low energy detection rate of the DAMA/LIBRA experiment at the Gran Sasso Underground Laboratory (Italy), using the same target and technique. ANAIS-112, consisting of nine 12.5 kg NaI(Tl) modules produced by Alpha Spectra Inc., disposed in a 3×3 matrix configuration, is taking data smoothly with excellent performance at the Canfranc Underground Laboratory (Spain) since August, 2017. Latest results corresponding to six-year exposure were compatible with the absence of modulation and incompatible with DAMA/LIBRA signal at 3.9sigma (2.9sigma) at [1-6] ([2-6]) keV; 5sigma sensitivity is expected for late 2025. Beyond ANAIS-112, the ANAIS+ project operating crystals at low temperature and replacing PMTs by SiPMs is in development.

The background model developed for all the nine ANAIS-112 detectors, based mostly on quantified activities independently estimated following several approaches, described well the measured spectra except for the very low energy region just above threshold. New filtering protocols based on machine-learning techniques have allowed to reduce the registered background in that region, but an excess over the simulation still persists. The background model also allows to predict the evolution in time of the rates in different energy windows, considered in the annual modulation analysis. An updated model is under development using 6-year exposure aiming at improving the description of some components as tritium produced cosmogenically and 210Pb contamination on crystal surface; both contributions are relevant in the low energy region and affect the time evolution of the detection rates.

Here, after the general presentation of the experiment, methodology and preliminary results of this new background studies will be discussed.

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