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The Monte Carlo simulation of the Borexino detector

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Borexino is a 300 tons sub-MeV liquid scintillator solar neutrino detector
which has been running at the Laboratori Nazionali del Gran Sasso (Italy) since 2007.
Thanks to its unprecedented radiopurity, it was able to measure the
flux of 7Be, 8B, pp, and pep solar neutrinos and to detect geo-neutrinos. A reliable simulation of the detector is an invaluable tool for all the Borexino physics analyses.
The measurement of the solar neutrino interaction rates requires the highest level of accuracy from the simulation, which is used to generate the energy spectra of all the components used in the final fit of the recorded energy spectrum. The simulation accounts for the energy loss of particles in all the detector components, the generation of the scintillation photons, and their propagation within the liquid scintillator volume. Moreover, each
time a photomultiplier detects a photon, the algorithm proceeds with a detailed simulation of the electronics chain.
Finally, a novel efficient method for simulating the external background which survives the Borexino passive shield has been developed. This technique allows to reliably predict the effect of the contamination in the peripheral construction materials.
The techniques developed to simulate the Borexino detector and their level of refinement are of possible interest to the neutrino community, especially for current and future large-volume liquid scintillator experiments, and for dark matter community, given the wide use of veto systems made of liquid scintillators. The contribution will show the level of accuracy of the simulation and will highlight the fundamental aspects to implement a high precision simulation of a liquid scintillator detector.

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