

The BetaCage, an Ultra-sensitive Screener for Surface Contamination

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Material screening for identifying low-energy electron emitters and alpha-decaying isotopes is now a prerequisite for rare-event searches (e.g., dark-matter direct detection and neutrinoless double-beta decay) for which surface radiocontamination has become an increasingly important background. The BetaCage, a gaseous neon time-projection chamber, is a proposed ultra-sensitive (and nondestructive) screener for alpha- and beta-emitting surface contaminants to which existing screening facilities are insufficiently sensitive. The expected sensitivity is 0.1 betas (per keV-m²-day) and 0.1 alphas (per m²-day), where the former will be limited by Compton scattering of external photons in the screening samples and (thanks to tracking) the latter is expected to be signal-limited; radioassays and simulations indicate backgrounds from detector materials and radon daughters should be subdominant. We will report on details of the background simulations and detector design that provide the discrimination, shielding, and radiopurity necessary to reach our sensitivity goals for a chamber with a 95x95 cm² sample area positioned below a 40 cm drift region and monitored by crisscrossed anode and cathode planes consisting of 151 wires each.

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