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Reduction of radon in xenon-based experiments to search for rare events

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With the installation of rare event search experiments in underground laboratories, good passive and active shielding measures, careful material selection and surface treatments, radioactive isotopes in the xenon of xenon-based rare event search experiments have become the most important underground source in the search for rare events besides solar and atmospheric neutrinos. Particularly important are radioactive noble gases, especially Rn-222 because of its gamma and beta-emitting progenies Pb-214, Bi-214 and Pb-210, which cannot be removed by normal getters. In this talk, various methods for the continuous active removal of radon from xenon, in particular charcoal chromatography and cryogenic distillation, will be presented.

New records in the purity of Ar-39, Kr-85 and Rn-222 have been achieved with cryogenic “online distillation” in the dark matter experiment XENONnT. The talk will also give an outlook on how these methods can be further developed to achieve the required purity of radioactive noble gases for the next generation of experiments such as DARWIN/XLZD. In particular, the developments just started within the ERC Advanced Grant project LowRad (no. 101055063) with a target radon purity of 1 radon atom per 160 mol xenon (or 0.1 $\mu\text{Bq/kg}$) also aim at integrating the required very sensitive online diagnostic methods.

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