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The XENONnT Radon Removal System

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The XENONnT experiment, located underground at the Laboratori Nazionali del Gran Sasso, uses a total of 8.6t of high-purity liquid xenon to directly search for WIMP (weakly interacting massive particle) dark matter using a dual phase time projection chamber. Most of the low-energy electronic recoil background is caused by intrinsic contamination of the xenon by Rn-222 with a half-life of 3.8d, which is continuously emanating from the detector materials.
For the reduction of this background, a high-flow online radon removal system was designed and constructed (M. Murra et al, Eur. Phys. J. C 82 (2022) 1104), which uses cryogenic distillation based on the difference in vapor pressure between radon and xenon. The system can be operated in parallel in two modes: At a flow rate of 200 slpm, liquid xenon is extracted from the detector and passed through the system. The cleaning time constant, which only corresponds to one mean lifetime of Rn-222 (5.5d), results in a reduction in radon concentration by a factor of two. An additional extraction of 25 slpm of gaseous xenon provides another reduction factor of about two. With the combined operation of both modes, an extremely low Rn-222 activity concentration of < 1 μBq/kg is achieved, the lowest of any xenon dark matter experiment.
This contribution shows the basic concept of the XENONnT radon removal system and the performance of the system in the XENONnT experiment.
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Submitted on behalf of a Collaboration?

Yes

Authors: KOKE, David (Institut für Kernphysik, Universität Münster); ALTHÜSER, Lutz (Institut für Kernphysik, Universität Münster); HUHMANN, Christian (Institut für Kernphysik, Universität Münster); JAKOB, Johanna (Institut für Kernphysik, Universität Münster); MICHAEL, Andria (Institut für Kernphysik, Universität Münster); MURRA, Michael (Columbia University, New York, USA; Institut für Kernphysik, Universität Münster); SCHULTE, Philipp (Institut für Kernphysik, Universität Münster); SCHULZE EISSING, Henning (Institut für Kernphysik, Universität Münster); WEINHEIMER, Christian (Institut für Kernphysik, Universität Münster)

Presenter: KOKE, David (Institut für Kernphysik, Universität Münster)

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