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Environmental radioactivity background control at JUNO

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The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator detector under construction at 700 m underground. It will enable studies of various neutrino physics topics, and the level of radioactive background is an essential factor for achieving the desired sensitivities. The raw materials of the JUNO detector have already been screened and met the radio purity requirements. The detector is presently being installed in the underground experimental hall, and during these operations the radioactive control of the environment is crucial. The whole underground space at the JUNO site is about 300,000 m³, including the 120,000 m³ main hall and several attached halls and tunnels, such as the liquid scintillator room and the liquid scintillator filling room, making it the largest underground laboratory in the world. As in every underground laboratory, the rocks and water will release large amounts of ²²²Rn into the air. The detector components are exposed to air during the installation, so radon and its daughters can attach to their surfaces. This is particularly critical for materials directly contacted with the liquid scintillator since the radioactive contaminants could leach into the liquid and mimic the physics signals. Therefore, the controlling the radon concentration in the experimental hall is a critical issue. Moreover, dust in the air is rich in ²³⁸U, ²³²Th and ⁴⁰K, so the residual dust is another source of radioactive background. The cleanliness inside the experimental hall should reach the level of Class 100,000 or better. To achieve an installation environment with a low radon concentration and cleanliness level, a lot of effort was put into optimizing the ventilation system in the experimental hall. Additionally, the sources of radon in the underground air have been carefully studied. The radon concentration in the experimental hall has been stabilized at about 180 Bq/m³ after great efforts. Both the radon and the cleanliness level have now met the requirements.

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