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Environmental radioactive background control at JUNO

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The Jiangmen Underground Neutrino Observatory (JUNO) is a 20 kt liquid scintillator detector under construction 700 m underground. It will enable studies of various neutrino physics topics, and the level of radioactive background is an essential factor in achieving the desired sensitivities. The raw materials of the JUNO detector have already been screened and met the radio purity requirements. At present, the detector is being installed in the underground experimental hall, and during these operations the radioactive control on the environment is very important. The whole underground space at JUNO site has a volume of about 300,000 m^3, including the main hall of 120,000 m^3 and a number of 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 ^{222}Rn into the air. The detector components have the risk of air exposure during the installation, so radon and its daughters can attach to their surfaces. This is particularly critical for materials that need to enter into contact with the liquid scintillator, since the radioactive contaminants could diffuse into the liquid and mimic the physics signals. Therefore, the control of radon concentration in the experimental hall is a critical issue. Moreover, dust in the air is rich in ^{238}U, ^{232}Th, ^{40}K, 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. In order to achieve an installation environment with a low radon concentration and cleanliness level, a lot of effort was put in the optimization of 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 could be stabilized at about 100 Bq/m3 after great efforts. Both the radon and the cleanliness level have now met the requirements.

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