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Measurement of a phase of a radio wave reflected from rock salt and ice irradiated by an electron beam for detection of ultra-high-energy neutrinos

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We had reported a reflection effect of a radio wave from rock salt irradiated by an X-ray or a 2MeV-electron beam. The beam irradiation had given rise to increases in temperature and consequently permittivity in the rock salt. The radio wave had been reflected due to the irregularity of the permittivity in the rock salt. In this conference we report measurements of phase changes as well as amplitude changes of a radio wave reflected from not only rock salt but also ice. A coaxial tube was filled with rock salt or ice and an open end was irradiated by the 2MeV-electron beam. We found that the amount of the phase change was in accord with the propagation delay of the radio wave due to the increase of the permittivity in the media. The reflection effect is expected in all dielectrics whose permittivities depend on their temperatures. When a GZK neutrino interacts with the detection media, the energy is dissipated to the location to rise the temperature. The radio-wave-reflection effect would be applicable to detect ultra-high-energy neutrinos in all kinds of detection media made of solid dielectrics with a gigantic mass and a long attenuation length for a radio wave such as an ice sheet at Antarctica as well as a huge rock salt dome, and in the future at the moon's crust. A phased-array radar with a peak power of 1 GW (Equivalent Isotropic Radiation Power) could detect around10 GZK neutrinos per year within the fiducial mass of 50 Gt.

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