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Simulation Analysis of Cosmic Ray Muon Penetrating Subsurface of Huge Mountain/巨大山体の表層を透過する宇宙線ミュオンの挙動解析シミュレーション

We conducted a simulation analysis of the behavior of cosmic-ray muons (CRM) passing through a huge mountain using the newly established cosmic-ray muon mode in PHITS. In this analysis, we investigated various aspects, including the altitude and angle dependence of incident and transmitted muons, further attenuation of decelerated muons after transmission of massive mountain by atmosphere, and asymmetry of multiple scattering.

The phreatic eruption at Mt. Ontake in 2014, which is the worst volcanic disaster causing the largest postwar victims, had taken place abruptly without any precursor. The goal of this study is to explore a new approach to catch a sign of anomaly preceding such eruption at Mt. Fuji by using CRM. The CRM radiography is a unique method to provide transmission image of internal structure inside of active volcano[1]. Mt. Fuji, however, is too large even for high-energy CRMs to probe dynamics of magma directly. Motivated by the seasonal variation

observed in CRM intensity after passing through Mt. Kurokura in West Iwate mountains and its correlation with frequency of steam explosion[2], we focused on subsurface structure of Mt. Fuji where hidden underground streams must be running to supply spring water of over 5 million m^3/day around the foot of the mountain.

In this study, we investigate attenuation and scattering behavior of CRM passing through Mt. Fuji with the position sensitive detector which set up at the Gotemba Tarobo at 1290m in altitude nearby the Fuji Skyline Roadway. From here, Mt. Fuji is an object with wide dynamic range of elevation angles from 0 to 20 deg, altitudes from 1300 to 3776 m, and path lengths from zero to several kilometers, even limited to subsurface and near the summit. After transmission through mountain, CRMs travel long distance from dozens of meters to several kilometers to the detector in atmosphere.

Intensity of the incident CRM at h=3776 m is 1.8 times larger than at 0 m, in θ=15~20 deg, while it is almost same at h=0 and 1300m. After transmission through standard rock, it was found that the ratio decreases down toward unity up to 200 m.w.e. , then increases again, resulting in 1.2 to 1.3 times at 2000 to 5000 m.w.e. On the other hand, we confirmed that the further attenuation by atmosphere during the flight to the detector is negligible. Multiple scattering will be discussed in comparison with Moliere's approximation.

References

[1] T. Kusagaya and H. K. M. Tanaka, "Development of the very long-range cosmic-ray muon radiographic imaging technique to explore the internal structure of an erupting volcano, Shinmoe-dake, Japan",Geosic. Instrum. Method. Data Syst., 4, (2015) pp.215-226.

[2] H.K.M. Tanaka, K. Nagamine, et al., "Radiographic measurements of the internal structure of Mt. West Iwate with near-horizontal cosmic-ray muons and future developments", J. Nucl. Inst. Metth. Phys. Res. A555, (2005), pp. 164-172, and Iwate Prefectural Office, private communications.

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