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Muon radiography of Stromboli volcano by using nuclear emulsion

Valeri Tioukov (1), Andrey Alexandrov (1), Cristiano Bozza (4), Lucia Consiglio (1), Nicola D'Ambrosio (7), Giovanni De Lellis (1,2), Flora Giudicepietro (5), Giovanni Macedonio (5), Seigo Miyamoto (3), Ryuichi Nishiyama (3), Massimo Orazi (5), Rosario Peluso (5), Andrey Sheshukov (8), Chiara De Sio (4), Chiara Sirignano (6), Simona Maria Stellacci (4), Paolo Strolin (1,2), and Hiroyuki K. M. Tanaka (3)

(1) Istituto Nazionale di Fisica Nucleare, Sezione di Napoli, Italy, (2) Dipartimento di Fisica Università "Federico II" Napoli, Italy, (3) Earthquake Research Institute, The University of Tokyo, Japan, (4) Dipartimento di Fisica Università di Salerno, Italy, (5) Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Vesuviano, Napoli, Italy, (6) Dipartimento di Fisica e Astronomia Università di Padova, (7) Istituto Nazionale di Fisica Nucleare, LNGS, Italy, (8) Joint Institute for Nuclear Research, Dubna, Russia

We present the results of the first muon radiography (muography) of the Stromboli volcano experiment conducted with a detector based on a special photographic technique, using the so-called nuclear emulsion. The experiment was realized as part of a collaboration between research Institutions of different Countries (Italy, Russia, Japan). Muography consists in observing the differential absorption of muons - elementary particles produced through cosmic-ray interactions in the Earth atmosphere - going through the volcano and can attain a spatial resolution of tens of meters. Possible limitations of the method come from the low intensity of the muon flux surviving the traversal of a rock thickness of the order of 1 km or more. The emulsion films were prepared at the Gran Sasso Underground laboratory and were analyzed at Napoli, Salerno and Tokyo scanning laboratories. The analysis of the data acquired over a period of five months provided an image of the shallow structure of the summit area of Stromboli volcano with a resolution of about 10 meters. This image shows that the crater zone is characterized by a low-density zone corresponding to the NE crater. The density anomaly also includes the crater valley at the top of the volcano. We estimate a density of 1.7 g/cm3 in the anomaly region where we record a muon flux in excess of 30-40%, to be compared with the standard rock density that we assume of 2.65 g/cm3.