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Perspectives for the Radiography of Vesuvius by Cosmic Ray Muons

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Following the pioneering work done in Japan for the radiography of volcanoes by using cosmic ray muons, we have initiated a perspective study for a muon radiography of the edifice of the volcanic complex Mt. Somma-Vesuvius. The Vesuvius is a cone, 1280 m high above the sea level, which has grown within the ancient caldera of Mt. Somma, formed about 19000 years ago and whose original height has been estimated to about 2000 m. Only the northern ridge of the Mt. Somma caldera is actually left as a part of the ancient structure, whose collapse started during two large eruptions occurring about 18000 and 16000 years ago. Although at present the monitoring system does not reveal signs of notable activity, the history of the volcano has been characterized by dramatic plinian and sub-plinian eruptions, the most famous of which caused the destruction of the towns of Pompei and Ercolano in 79 AD as reported by Pliny. The most recent eruption occurred in 1944.

Particularly in recent years, the population living at the base and along the slopes of the volcano has greatly grown, reaching about 600,000 people in an area which has been consequently classified at the highest volcanic risk in Europe. The knowledge of the inner structure of the volcano edifice and subsoil structure is therefore of the greatest importance, to build realistic scenarios of the next eruption through accurate simulations of the magma upraising mechanism and eruption.

We investigate the feasibility of using cosmic ray muons to perform the radiography of the Mt. Somma - Vesuvius edifice with the aim to design a system of muon detectors and to evaluate its performance for muon radiography. The muon flux at potential detector locations is computed accounting for the strong attenuation due to the properties of rock volumes encompassed by nearly horizontal muons. The final aim is to estimate the sensitivity to the heterogeneous density distribution within the volcano edifice and relate it to the presence of lava conduits. A structural model of the volcano down to a depth of

10 km, was derived by seismic reflection and tomography. It can be used as a reference model for the interpretation of muon data.

For muon detection, we envisage the use inner of electronic devices developed for particle physics, such as the Resistive Plate Chambers. Their use is made possible by the availability of power supply at potential detector sites. Using the same basic computational tools, we are performing a study on Earth radiography by means of high energy neutrinos generated by cosmic rays (see the talk by G. Miele).