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Astroparticle physics obtaining more attention from a new type of audience

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The high-energy physics is experiencing an interesting twist of events as some basic principles related to cosmic-rays and atmospheric production of cascading earthbound particles appear becoming more mainstream, at least in other sciences. We offer a few examples to support the point. First, the corresponding author of this work is a geologist by education and yet in the process to cross the barrier between two branches of science that have not traditionally crossed the paths too often (the radionuclide dating been one of the major exceptions). This particular personal journey may not yet be a tip of an iceberg, but it is, at the very least, an example of a new tendency of cross-pollination between disciplines. In this case, the driving force is muons and muography, the rapidly evolving application of muons in as wide range of disciplines as archaeology, engineering, and earth sciences (including planetology and research of asteroids).

Muography is a novel geophysical imaging and monitoring method for density contrasts and temporal density changes in solid and liquid materials. It is based on the differential attenuation of atmospheric muons in various directions in the material between the radiation source (air showers in the atmosphere) and the detector. The latter can be installed on ground or underground. Characterization of material densities can obtain many forms and it can be carried out with many types of gaseous, scintillation, and nuclear emulsion detectors. These include drift chambers, micro-mesh gaseous structures, resistive plate chambers, multi-wire proportional chambers, scintillation detectors, and Cherenkov telescopes. Some detectors are mobile, some transportable, and some stationary. Some detectors are used in stable conditions, whereas in some cases the application dictates that the detector must be robust and of high endurance. The latter is especially true for the long-term open-air or underground monitoring campaigns. Most of the varied detector types can be deployed in multiple environments (e.g., within buildings, on the surface of the earth, caves, and tunnels), some even underwater (e.g., borehole detectors). The materials, too, can be of many types and origins (e.g., a pyramid, historical building, engineered structure, an active, dormant or fossil volcano, karst cave, a soil bed or bedrock formation, and an open pit or underground mine). Most importantly, at least regarding the current topic, the researchers themselves can have backgrounds that differ from one another drastically (an archaeologist, volcanologist, architect, geologist, geophysicist, mineral explorationist, mining engineer, etc.).

It is the above cross-pollination between the different disciplines that establishes muography not only a highly multidisciplinary but also a cross-disciplinary field of research. It also aids to enlarge and widen the audience base of astroparticle physics. Even if this new research may not automatically be of great interest to astroparticle physicists, it is likely fruitful in the long run as some research topics are hard to carry out without specialized skills and expertise in these other disciplines (e.g., muon propagation and energy loss in real-world rocks). In the short term, however, the best value proposition for the astroparticle physicists is that their own research is becoming increasingly referenced by authors who are non-physicists and in journals that are not necessarily followed by astroparticle physicists. It is also likely that this new pool of researchers increases the total reference counts of some astroparticle physics publications.

We will provide more examples of the development of muography and the expanding distribution of astroparticle physics amongst the other disciplines in our longer, follow-up work.

Reference to paper (DOI or arXiv)

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Primary author(s) : HOLMA, Marko (Muon Solutions Oy, Finland); Mr. JOUTSENVAARA, Jari (Kerttu Saalasti Institute, University of Oulu, Finland); Dr. KUUSINIEMI, Pasi (Muon Solutions Oy, Finland)

Presenter(s) : HOLMA, Marko (Muon Solutions Oy, Finland)

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