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A telescope for rock mass density imaging based on muon TPC* with Micromegas-bulk detector

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In the framework of the realization of field telescopes dedicated to the tomography of geological objects, the choice of proportional detectors parallel plate type MICROMEGAS-Bulk, compared to scintillating plastic, was motivated by reasons of robustness, lightness and adaptability to various configurations of measurements. The choice of MICROMEGAS-Bulk was also necessary for its intrinsic qualities:

- The rise and fall times of the pulse measured lower than 1 ns is sufficiently rapid to allow determining the direction (azimuths and zeniths) of muons by temporal discrimination,
- The ability to build compact detectors, dedicated to karst galleries and small section tunnels since only one detector is required to measure the direction of the muons,
- The stability of the gain, adjustable from 1 to about 10^5,
- The printed circuit technique that allows facilitating future developments and valorizations.

We present the progress of the project T2DM2 (*Temporal Tomography of Density by Muons Measurements*) developed by GEOAZUR Lab (http://geoazur.oca.eu) in order to investigate the properties of the carbonate reservoir surrounding the LSBB underground lab (http://lsbb.oca.eu).

The aim is to proceed a continuous survey in order quantifying changes in the density of the carbonate reservoir surrounding the LSBB underground lab (http://lsbb.oca.eu). The goal is to reach an accuracy of 10^{-3} for the muon flux that will be sufficient to characterize the temporal variations of the density associated with the water flow into the massif for depth ranging from 10 m to 500 m depth. The expected changes are greater than 3 % for the Urgonian facies of the reservoir whose porosity varies between 10 % and 20 %. The technological configuration of the muon telescope must meet the observational constraints of exposure duration, angular resolution and surface available to deploy the telescope, these constraints determining the temporal and spatial resolution of hydrodynamic processes.

Thus, an angular resolution of 10° for a 3 m^2 telescope achieves a well adapted statistical counting of muons ($\sim$ 1000 muons) in 40 days at 500 m depth for vertical flow (Φ_v = 3.10^{-3} μ m^{-2} s^{-1} sr^{-1} after PDG standard http://pdg.lbl.gov). To a depth of 200 m, it suffices to deploy a telescope of 1 m^2 to obtain the same accuracy with the same angular resolution.

TPC *: Time Projection Chamber 3D