NEXUS - WP 2
Muography and Radiation Measurements

NEXUS Kick-off meeting – 22-1-2026

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WP 2 – Description

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- Use of the cosmic ray muons properties to better understanding the sources of background for extremely sensitive measurements such as Dark Mater search.
- Neutron spectral and flux characterization one of the most important measurements to be performed to understand the background of any rare event detector installed in UL's.
- For complete characterization of UL's, measuremets of radioactivity (gamma rays'emission), radon exhalation and concentration will be performed.
- Muons and neutrons measurement will be performed in the Huguenot tunnel where the future PAUL facility will be built using both electronic detectors and nuclear emulsion
- These activities will also give the possibility to consolidate a framework of groups involved in muography by offering common reference tools (like common data formats, benchmark datasets,common methodologies, etc…).

WP 2 – Institutes

- CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS (CNRS)
- ISTITUTO NAZIONALE DI FISICA NUCLEARE (INFN)
- CONSORCIO PARA EL EQUIPAMIENTO Y EXPLOTACION DEL LABORATORIO SUBTERRANEO DE CANFRANC (LSC)
- QUEEN'S UNIVERSITY AT KINGSTON (SNOLAB)
- THE SQUARE KILOMETRE ARRAY OBSERVATORY (SKAO)
- SOUTH DAKOTA SCIENCE & TECHNOLOGY AUTHORITY (SURF)
- STELLENBOSCH UNIVERSITY (SU)
- UNITED KINGDOM RESEARCH AND INNOVATION (UKRI)
- UNIVERSITY OF THE WESTERN CAPE (UWC)

WP 2 - Objectives

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- Characterization of Underground Laboratories (Uls) using muography techniques.
- Monitor the environmental radioactivity (gamma rays' emission) and radon exhalation and concentration inside underground tunnels
- Neutron spectral and flux characterization
- Technological transfer and characterization of the PAUL facility.

WP 2 – Objectives ….

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- Underground Muons and Neutrons Measurements with electronic detectors and nuclear emulsion
- Measurement of a precise angular muon's spectrum. Simultaneous measurements by several detectors located in different positions are possible in the tunnel where the future South African laboratory (PAUL) will be located. (INFN, UWC, SU), Similar measurements could be performed in other ULs
- Underground Radon measurements and Gamma Rays measurement (UWC, SU, CNRS, INFN, LSC, UKRI)

WP 2 – Objectives…

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- Geophysical measurements with permanent muon monitoring station to characterize Huguenot tunnel (PAUL facility) (CNRS, UWC, SU)
- Development of a local muons detector system in South Africa, opportunity to train students and knowledge and skills transfer. UWC, SU, CNRS, INFN, LSC, UKRI)
- Technological transfer and characterization of the PAUL facility.
- Staff exchange visits

WP 2 – Milestones

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Milestones definition	due date (months)
• Neutrons measurements	12
• Measurements with nuclear emulsions	18
• Radon levels and Gamma background measurement	24
• Geophysical measurements in the Huguenot Tunnel	36
• Realization of density distribution map and the joined inversion with gravimetry	48

Deliverables

- Characterization of the ULs background environment (Document report)
- Best practices for the concept and design of Uls (Document report)