

Callio Lab – the deep underground research centre in Finland, Europe

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Located just below the Polar circle, Callio Lab is one of the northernmost underground laboratories in Europe [1,2]. The underground research centre has developed from underground physics (formerly known as the Centre for Underground Physics in Pyhäsalmi, CUPP [3]). Over the years, its strategy has been shifted to a multi-and transdisciplinary research centre, now known as Callio Lab.

The Callio Lab is physically located at the 1.44 km deep Pyhäsalmi mine, Pyhäjärvi, Finland. The mine has produced copper, zinc and pyrite since its opening in 1962. The deposit is geologically located within a 1.9 bn-year-old seafloor and belongs to the class of volcanic massive sulphide (VMS) deposits [4]. Seismically the bedrock is stable and tremors are mainly induced by the mining activities. The mine has a flat overburden, and access to the mine is through an 11 km incline or the 1.4 km deep elevator shaft. The travel times are 30 minutes and 2.5 minutes, respectively [5].

The development of underground research facilities in the Pyhäsalmi mine started in the late 1990s at the margin of the then known ore resources. However, with the discovery of a new deposit below the old one, the life span of the underground mining was extended year by year. However, it is expected that mining will cease at the later part of 2021. The eventual end of underground extraction will give more room and possibilities for science, research and business. The latter is governed by the Callio – Mine for business [6], governed by the local town. The scientific activities of Callio Lab are coordinated by the University of Oulu, Finland.

Throughout the years the various scientific activities and research initiatives have been started at the Callio Lab. The characterisation of underground halls (i.e., Labs in the facility) has included the on-site natural background radiation measurements (gamma, neutron, radon) and sample analysis of the building materials used and samples of the surrounding bedrock [7–12]. The muon background measurements were done in 2005 [13]. The rock overburden at a depth of 1390 has been measured to be 4000 m.w.e., and at Lab 2, located at a depth of 1436m, it is estimated around 4100 m.w.e [5].

The scientific activities at utilising the Callio lab research infrastructure range from mining and mining-related training to geothermal concept and technology testing, underground food production, working environment research, and particle physics. The low-background facility, using the low background HPGe detector from Baltic Scientific Instruments, is located at Lab 5 at a depth of 1410 m. [14]. The facility provides sample analysis services for the EUL project laboratories [15], but other scientific institutions benefit from the facility too.

Callio Lab is part of the DULIA network, a founding member of the European Underground Laboratories association [15], a candidate as a thematic core service for the European Plate Observation System, EPOS [16], member of Nordic and Finnish EPOS research infrastructures, and is a strategic research infrastructure of the University of Oulu. EPOS is on the European and Finnish research infrastructure roadmaps.

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References

1. Puputti J, Joutsenvaara J, Kotavaara O, Niinikoski E-R. 2021 From Earth and beyond - Callio Lab underground centre for Science and R&D. In EGU General Assembly Conference Abstracts, pp. EGU21-14229.
2. 2021 Callio Lab. See <https://calliolab.com/facilities-2/facilities/> (accessed on 20 April 2021).
3. Enqvist T et al. 2005 Research options in the pyhäsalmi underground facility. Nucl. Phys. B - Proc. Suppl. 143, 561. (doi:10.1016/j.nuclphysbps.2005.01.226)
4. Mäki T, Kousa J, Luukas J. 2015 The Vihanti-Pyhäsalmi VMS Belt. In Mineral Deposits of Finland, pp. 507–530. Elsevier Inc. (doi:10.1016/B978-0-12-410438-9.00020-0)
5. Joutsenvaara J (Jari). 2016 Deeper understanding at Lab 2:the new experimental hall at Callio Lab underground centre for science and R & D in the Pyhäsalmi Mine, Finland. University of Oulu. See <http://urn.fi/URN:NBN:fi:oulu-201606042350>.
6. 2021 Callio - Mine for Business. See <https://callio.info>.
7. Debicki Z, Jedrzejczak K, Kasztelan M, Marszał W, Orzechowski J, Szabelski J, Tokarski P. 2019 Measurements of thermal neutron flux in underground laboratories, a standard proposal for the BSUIN project. In The multi-messenger astronomy: gamma-ray bursts, search for electromagnetic counterparts to neutrino events and gravitational waves, pp. 48–54.

8. Jędrzejczak K, Kasztelan M, Szabelski J, Tokarski P, Orzechowski J, Marszał W, Przybylak M. 2020 Characteristics of natural neutron radiation background performed within the BSUIN project. In EGU General Assembly Conference Abstracts, p. 3353.
9. Polaczek-Grelak K et al. 2020 Natural background radiation at Lab 2 of Callio Lab, Pyhäsalmi mine in Finland. Nucl. Instruments Methods Phys. Res. Sect. A Accel. Spectrometers, Detect. Assoc. Equip. 969, 164015. (doi:10.1016/j.nima.2020.164015)
10. Gostilo V, Sokolov A, Pohuliai S, Joutsenvaara J. 2020 Characterisation of the natural gamma-ray background in the underground Callio Lab facility. Appl. Radiat. Isot. 156, 108987. (doi:10.1016/j.apradiso.2019.108987)
11. Abdurashitov J. N. GVNMLSAAYVEPJKT. 2006 Measurement of Neutron Background at the Pyhasalmi mine for CUPP Project, Finland. arXiv:nucl-ex
12. Pohuliai S, Sokolov A, Gostilo V, Joutsenvaara J, Puputti J. 2020 Measurements of gamma-ray background radiation in Pyhäsalmi mine. Appl. Radiat. Isot. 161. (doi:10.1016/j.apradiso.2020.109166)
13. Enqvist T et al. 2005 Measurements of muon flux in the Pyhäsalmi underground laboratory. Nucl. Instruments Methods Phys. Res. Sect. A Accel. Spectrometers, Detect. Assoc. Equip. 554, 286–290. (doi:10.1016/j.nima.2005.08.065)
14. Pohuliai S, Sokolov A, Gostilo V, Joutsenvaara J, Puputti J. 2020 Measurements of gamma-ray background radiation in Pyhäsalmi mine. Appl. Radiat. Isot. 161, 109166. (doi:10.1016/j.apradiso.2020.109166)
15. Mischo H, Fuławka K, Joutsenvaara J. 2021 European Underground Laboratories Association EUL-An International Partner for Underground Research Opportunities. In EGU General Assembly Conference Abstracts, pp. EGU21–7730.
16. Elger K, Lauterjung J, Ulbricht D, Cocco M, Atakan K, Bailo D, Graves H, Jeffrey K. 2016 Implementation of the European Plate Observing System (EPOS) Infrastructure.

Reference to paper (DOI or arXiv)

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