

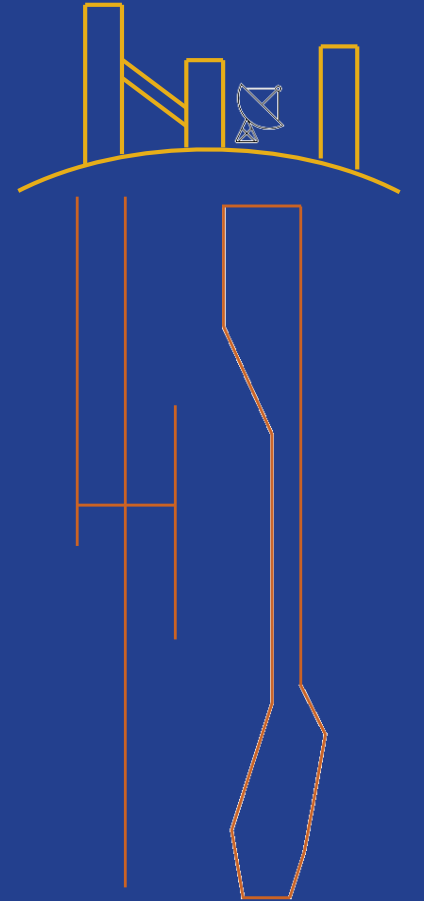


Julia Puputti
University of Oulu
Kerttu Saalasti Institute



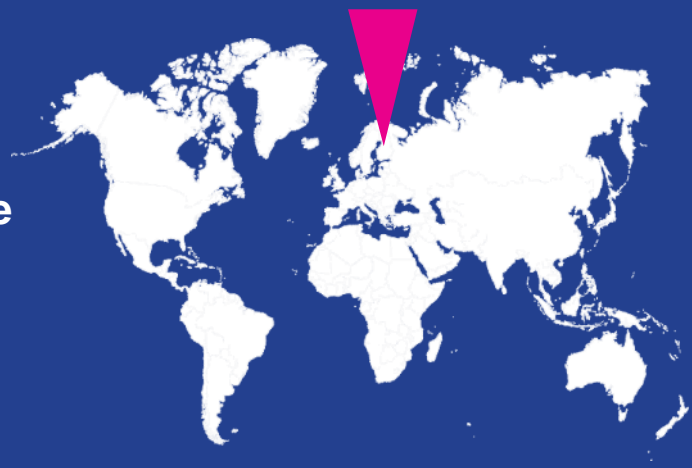
CALLIO LAB

Underground Center for Science and R & D





#unioulu #arcticattitude



Who am I?

- 8+ years working for the Pyhäsalmi Mine (owned by First Quantum Minerals)
- Since 2018 working for the University of Oulu and Callio Lab
- Regional Excellence (REx) research group
- BSc. in General Physics and MSc. in Space Physics & Astronomy
- Product of outreach (high school particle physics course)
- “Boots on the ground” Project Engineer on-site





University of Oulu

Linnanmaa campus, Oulu

Kontinkangas campus, Oulu

Sodankylä Geophysical Observatory

Oulanka Research Station, Kuusamo

Kajaani University Consortium

Kokkola University Consortium

Kerttu Saalasti Institute, Nivala

Traveling to Oulu:

- 1 hour flight from Helsinki-Vantaa International Airport
- 6 hour train ride from Helsinki to Oulu

Traveling to Pyhäjärvi & Callio Lab:

- 1 hour flight from Helsinki-Vantaa International Airport to Oulu, then 2 hour drive to Pyhäjärvi

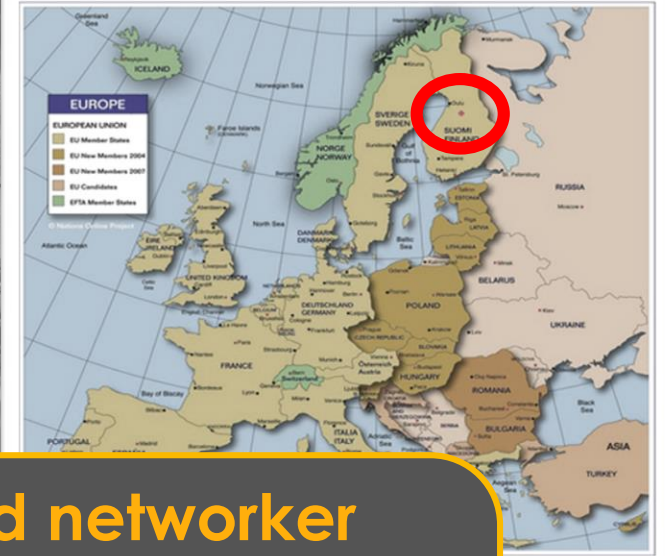
CALLIO LAB

CELLAR Community Meeting 2022

at the Pyhäsalmi Mine, in Pyhäjärvi Finland

- LOCATED AT THE 1.4 KM DEEP PYHÄSALMI MINE, IN PYHÄJÄRVI, FINLAND (~4000 M.W.E.)
- UNDERGROUND MINING 1962-2022
- POST-MINING ACTIVITIES COORDINATED BY THE PYHÄJÄRVI TOWN OWNED CALLIO PYHÄJÄRVI
- SCIENTIFIC ACTIVITIES ARE COORDINATED THROUGH CALLIO LAB

Owner of site: Pyhäsalmi Mine
Reuse coordinator: Callio Pyhäjärvi
Scientific coordination: Callio Lab



Gateway and networker
between industry and research



CALLIO LAB

Multidisciplinary research infrastructure

- AN EPOS RESEARCH INFRASTRUCTURE (ESFRI, 2020)
- A FIN-EPOS INFRASTRUCTURE (FIRI, 2020)
- A STRATEGIC RESEARCH INFRASTRUCTURE OF UNIVERSITY OF OULU
- MEMBER OF DULIA NETWORK
- FOUNDING MEMBER OF EUROPEAN UNDERGROUND LABORATORIES ASSOCIATION

We offer coordination, cooperation, networking and facilitation



Education and training



Mining & tunnelling



Mine reuse



Geothermal research



Working environment



Underground H&S



Future food & Underground farming



SpaceLab



Earth Observation and remote sensing



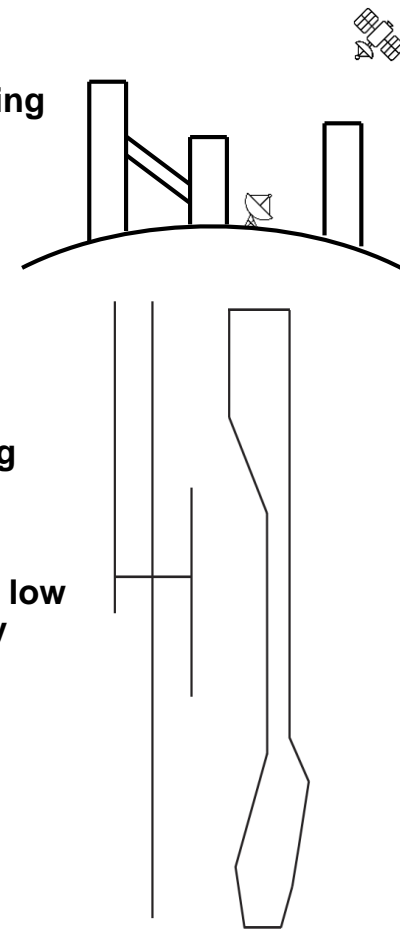
Deep underground low background facility



Particle physics & muography

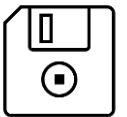
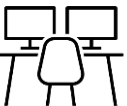
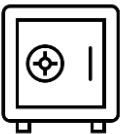
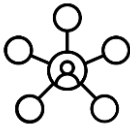
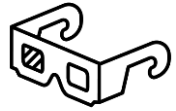
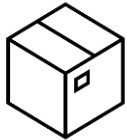


Something new?



CALLIO LAB

Services & Infrastructure



- Trucks and shipments up to 20' containers (max. width 3.5 m), can be taken through the incline
- Elevator can take 1.5 x 2.0 x 1.5 m packages
- All re-use sites have been scanned: 3D point clouds available
- Electricity easily available
- Internet access: optical base line (1+ Gb) & Wi-Fi
- HPC cloud computing services at CSC (through Finnish collaborators)
- Leaky feeder (radio phone network)
- Refuge bases (shelters) for emergencies
- Microseismic monitoring network
- Office space and meeting rooms
- Support from local team
- Extensive datasets

**Future: Globally
recognised underground
research network and
infrastructure**

Baltic Sea Underground Innovation Network (BSUIN) project 2017-2020

Aim of the BSUIN project is to **make the underground laboratories** in the Baltic Sea region **more accessible** for innovation, business development and science **by improving the information** about the underground laboratories, the operation, user experiences and safety.

PARTNER ORGANIZATIONS



Underground Laboratories in Baltic Sea Region

- ❑ Callio Lab, Pyhäsalmi mine, Finland
- ❑ Äspö Hard Rock Laboratory, Oskarshamn, Sweden
- ❑ TU-Freiberg's Research and Education mine "Reiche Zeche", Germany
- ❑ Conceptual Lab development coordinated by KGHM Cuprum R&D centre, Poland
- ❑ Ruskeala, Russia
- ❑ Underground Laboratory of Khlopin Institute, Russia

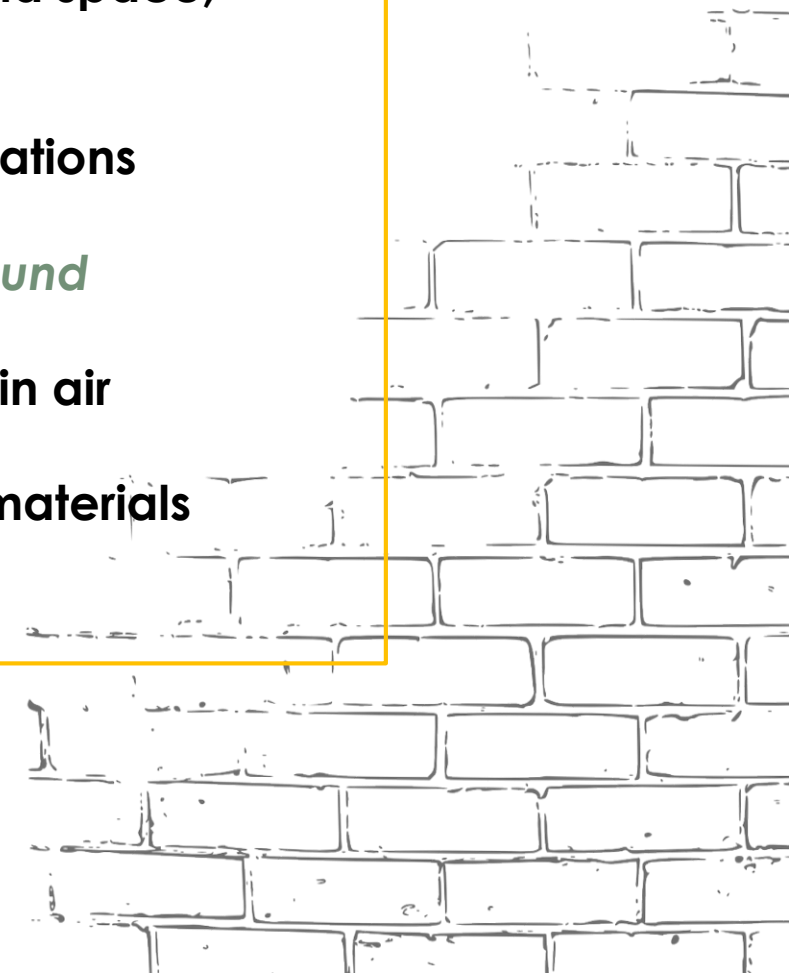
Objective: to make underground laboratories more accessible for science and innovation through methodically consistent geophysical, structural, organizational and ***natural background radiation characterization***.





Pilot measurement setup and methodology

1. Detailed description of the underground space, radiation schemes available
2. Accurate mapping of the physical locations
3. Measurement of **gamma-ray background**
4. Measurement of **radon** concentration in air
5. Radionuclide analysis of surrounding materials
6. Measurement of **neutron flux**



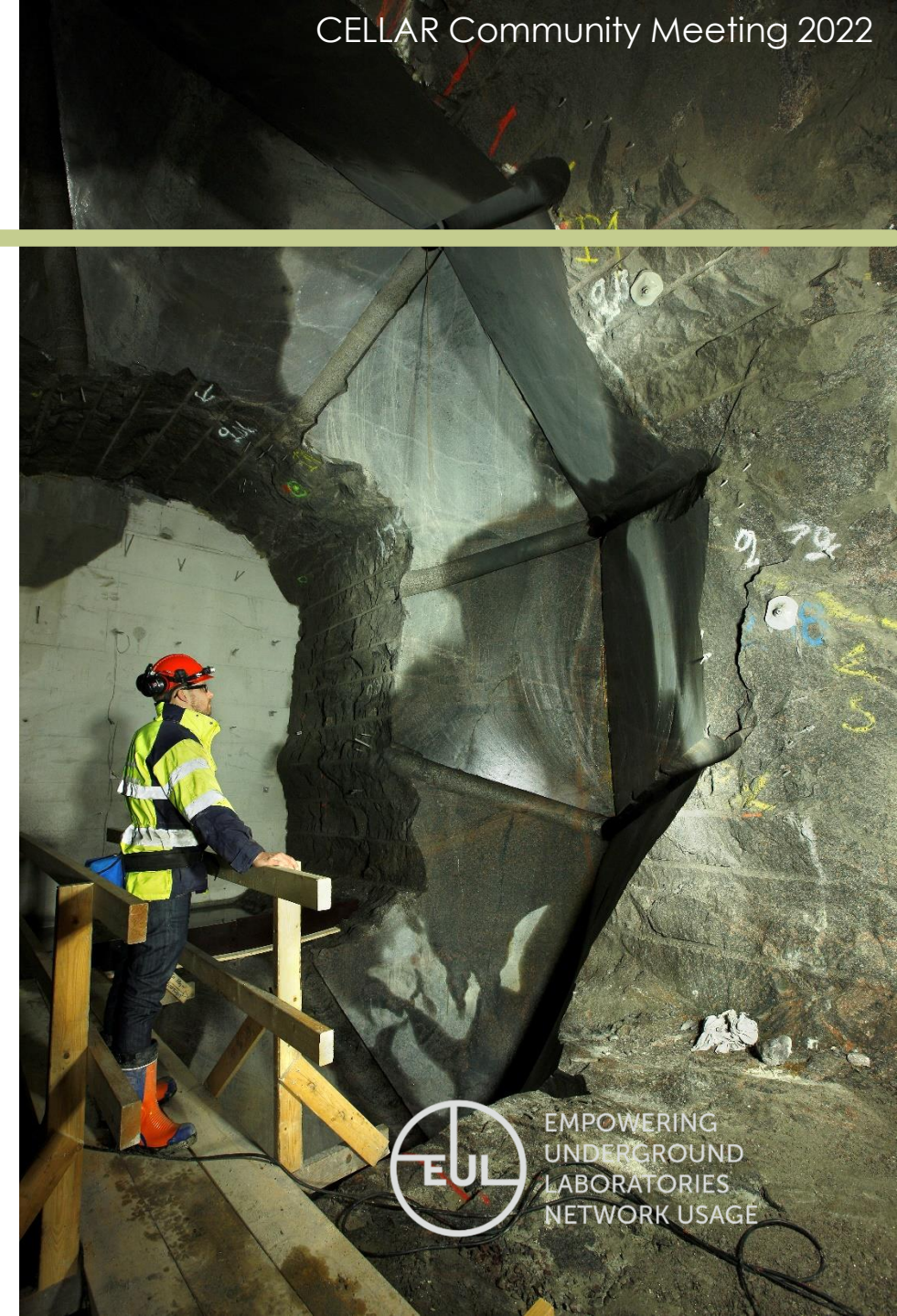
[Natural background radiation at Lab 2 of Callio Lab, Pyhäsalmi mine in Finland](#)
[Measurements of gamma-ray background in Pyhäsalmi Mine](#)
[Callio Lab – the deep underground research centre in Finland, Europe](#)
[Characteristics of natural radiation background at the Callio Lab \(Finland\) performed within the BSUIN project](#)

EMPOWERING UNDERGROUND LABORATORIES NETWORK USAGE

The European Underground Laboratories Association (EUL) is continuing work started by the Baltic Sea Underground Innovation Network (BSUIN).

[Undergroundlabs.network](https://undergroundlabs.network)

- Total applied budget 791 200 €
- Began 1.1.2021, ended 31.12.2021
- 13 partners from the BSUIN project
- Lead by University of Oulu, Kerttu Saalasti Institute
- Main goal: to enhance the markets, usage and usability of Underground Laboratories.



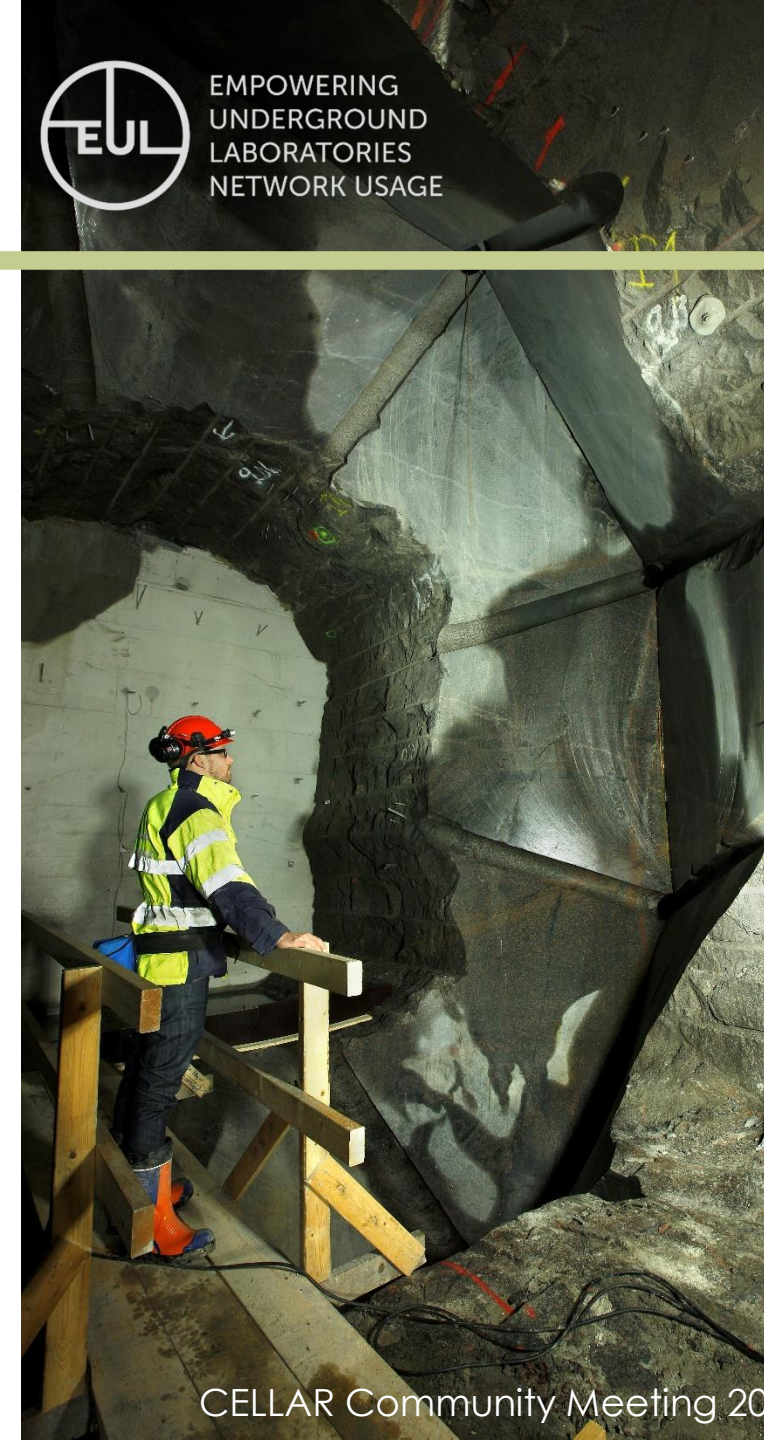
EUL
EMPOWERING
UNDERGROUND
LABORATORIES
NETWORK USAGE

BSUIN AND EUL PROJECT OUTCOMES



EMPOWERING
UNDERGROUND
LABORATORIES
NETWORK USAGE

- ❑ A database containing metadata and measured data related to the underground laboratories in the Baltic Sea region.
- ❑ A web-based EUL tool that provides access to the database and information about the underground laboratories.
- ❑ A transnational EUL network in the Baltic Sea region
- Site description and data, Callio Lab
bsuin.eu/wp-content/uploads/2022/03/A3.3_report_Site-Description-Callio-Lab_final.pdf
- Natural background radiation scheme, Callio Lab
bsuin.eu/wp-content/uploads/2022/02/A3.3_report_Scheme_Callio_Lab_final.pdf
- BSUIN end reports
bsuin.eu/2021/01/08/bsuin-final-reports/
- EUL project outcomes
bsuin.eu/eul-project/eul-results-outcomes/



- NEMESIS is fully installed and started data acquisition at 1.4 km underground
- All fourteen He-3 detectors are operational and yield good spectra with ^{252}Cf source

NEMESIS 1.4

status on November 23, 2022



GOLDENEYE:

EU H2020 funded project

- VTT coordinated 10.7 M€ H2020 Innovation Action –project
- Platform for actionable intelligence for safety, environmental monitoring and overall productivity, allowing more efficient exploration, extraction and closure
- Project duration 3 years
- Consortium of 16 partners including:
 - 3 Mining solution providers
 - 7 Sensor companies
 - 4 Mining sites
 - 3 Universities + 1 Research Institute (Coordinator)
- University of Oulu / Callio Lab is a member of the consortium
 - Validation environment for remote sensing technologies
 - Deployment and testing of an underground GNSS positioning system



PROJECT CONSORTIUM



Multi- and crossdisciplinary network of experts

- Marko Aittola, PhD in Planetary Science, Vice Chairman at Arctic Planetary Science Institute (APSI) & Director of Kokkola University Consortium Chydenius
- Marko Huttula, Professor, Head of the Nano and Molecular Systems Research Unit (NANOMO), University of Oulu
- Rauno Heikkilä, Professor of Digitalized construction and mining operations, Faculty of Technology, University of Oulu
- Jari Joutsenvaara, Project Manager, Callio Lab, Kerttu Saalasti Institute, University of Oulu
- Veiko Karu, Associative professor, Department of Geology, School of Science, Tallinn Technical University
- Jan Kisiel, Professor, Institute of Physics, University of Katowice, Silesia, Poland
- Ossi Kotavaara, Research Director, Regional Excellence, Kerttu Saalasti Institute, University of Oulu
- Bayarto Lubsandarzhiev, Doctor of Science, Leading Researcher, Experimental Physics Department, Institute of Nuclear Research, Russian Academy of Sciences, Russia
- Saija Luukkanen, Professor, Director, Oulu Mining School, University of Oulu
- Henriika Pihlajaniemi, Postdoctoral researcher, Oulu School of Architecture, University of Oulu
- Matti Muhos, Professor, Director, Kerttu Saalasti Institute, University of Oulu
- Vesa Nykänen, Research Professor, Geological Survey of Finland
- Juha Röning, Professor of Embedded System, Computer Science and Engineering, University of Oulu
- Ilya Usoskin, Professor, Head of Oulu Cosmic Ray station, Sodankylä Geophysical Observatory, University of Oulu
- Seppo Vainio, Professor in Developmental Biology, Research Unit leader Developmental Biology, Biocenter Oulu
- Marko Paavola, Senior Scientist, VTT Technical Research Centre of Finland

Open for new,
active organisations

Publications

- J. Joutsenvaara, Joutsenvaara, and Jari, “BSUIN - Baltic Sea Underground Innovation Network,” *EGUGA*, p. 11212, 2020, Accessed: Jan. 11, 2022. [Online]. Available: <https://ui.adsabs.harvard.edu/abs/2020EGUGA..2211212J/abstract>.
- E.-R. Niinikoski, “Empowering Underground Laboratories Network Usage in the Baltic Sea Region,” in *EGU General Assembly Conference Abstracts*, 2021, pp. EGU21--14791.
- M. Ohlsson *et al.*, “Six Underground Laboratories (ULs) Participating in the Baltic Sea Underground Innovation Network,” *EGUGA*, p. 22403, 2020, Accessed: Jan. 11, 2022. [Online]. Available: <https://ui.adsabs.harvard.edu/abs/2020EGUGA..2222403O/abstract>.
- P. Jalas, T. Enqvist, V. Isoherranen, J. Joutsenvaara, J. Kutuniva, and P. Kuusiniemi, “Callio Lab, a new deep Underground Laboratory in the Pyhäsalmi mine,” in *Journal of Physics: Conference Series*, 2017, vol. 888, no. 1, doi: 10.1088/1742-6596/888/1/012156.

Contacts

CELLAR Community Meeting 2022

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