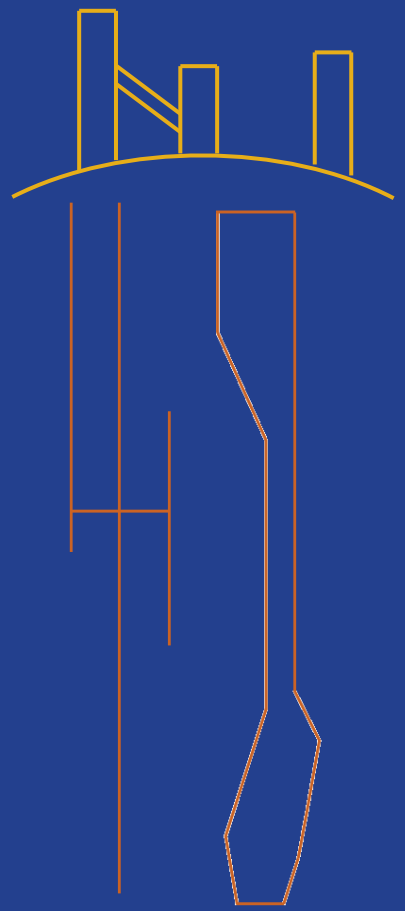
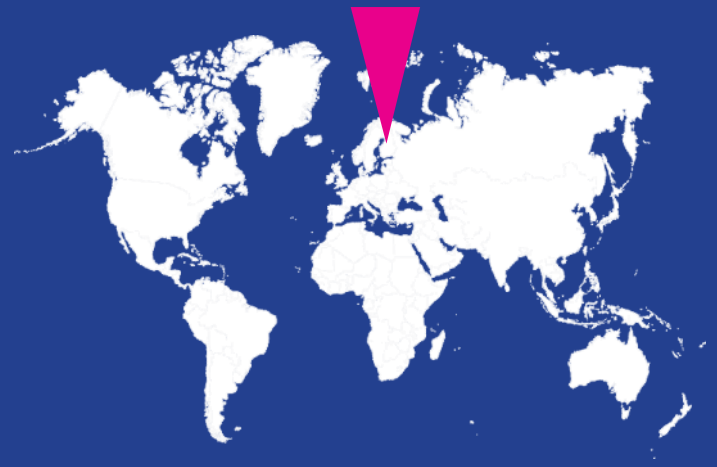
Julia Puputti
University of Oulu
Kerttu Saalasti Institute

CALLIO LAB

Underground Center for Science and R & D



#unioulu #arcticattitude



University of Oulu founded

1958

MULTIDISCIPLINARY RESEARCH AND EDUCATION

- Natural Sciences and Mathematics
- Biosciences
- Medicine and Health
- Economics and Business Administration
- Engineering and Architecture
- Information and Communication Technologies
- Education
- Humanities

60 000+
Alumni

13 500
Students

3 400
Staff

REx Regional Excellence
Alueellinen erinomaisuus

- Multidisciplinary research team lead by Dr Adj. Prof. Ossi Kotavaara
- Team expertise
  - Geoinformatics
  - Logistics, Accessibility analysis
  - Earth observations, InSAR
  - Geology, Mineral System Models
  - Chemistry: water, geopolymers
  - Underground and environmental physics
  - Circular economy
  - Mine waters
  - Mine closure and re-use
- Vast (inter)national networks
  - *ICT, AI, ML, Industry 5.0, BIM, Quantum computing, IoT, Mining, Circular Economy, Minerology, Mineral Processing, Bioleaching, Waste Management, GIS, SLO, SLE, Volcanology, Additive Manufacturing, Radiation Protection, Medicine, Architecture, Drones, Satellites, Telecommunications, Space Tech And Planetary Sciences*

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Research activities coordinated by the Kerttu Saalasti Institute, University of Oulu

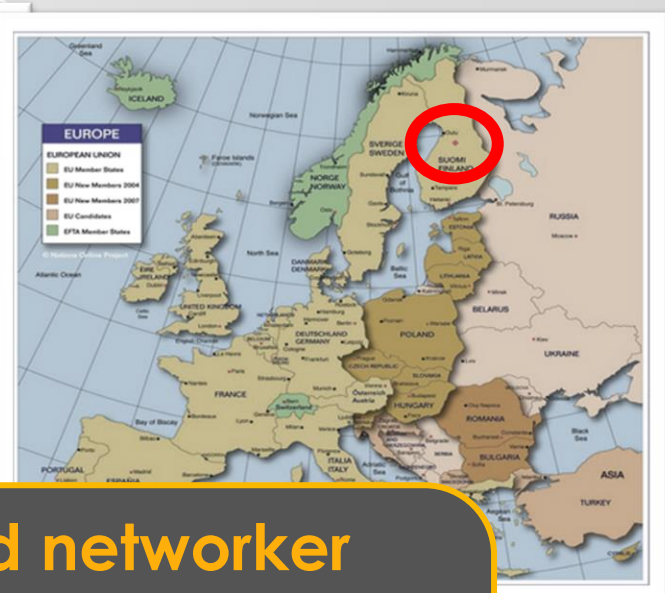
UNIQUE UNDERGROUND RESEARCH NETWORK AND INFRASTRUCTURE LOCATED AT THE 1.4 KM DEEP PYHÄSALMI MINE, PYHÄJÄRVI, FINLAND

POSTI-MINING ACTIVITIES COORDINATED BY CALLIO PYHÄJÄRVI

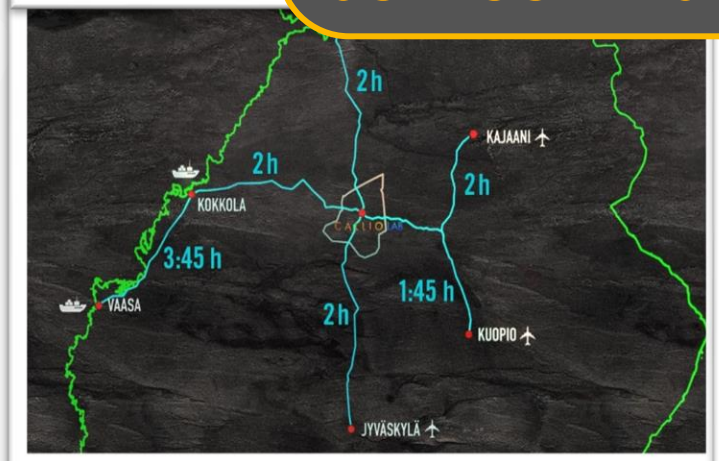
CURRENTLY SIX UNDERGROUND HALLS OR TUNNEL NETWORKS HAVE BEEN TURNED INTO MINE RE-USE FACILITIES: LABS

RESEARCH TOPICS INCLUDE:

- PARTICLE PHYSICS
- GEOTHERMAL ENERGY
- MINING & TUNNELLING
- UNDERGROUND OCCUPATIONAL SAFETY
- REMOTE SENSING AND MANY MORE



Gateway and networker between industry and research



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Multidisciplinary research infrastructure

- A 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
- PROJECTS INCLUDE E.G. H2020 GOLDENEYE, EUL, INTERREG SPIN-OFF NEMESIS (NEW EMMA EXPERIMENT SEARCHING FOR INDIRECT SIGNALS)

Education and training

Mining & tunnelling

Mine reuse

Geothermal research

Working environment

Underground H&S

Future food & Underground farming

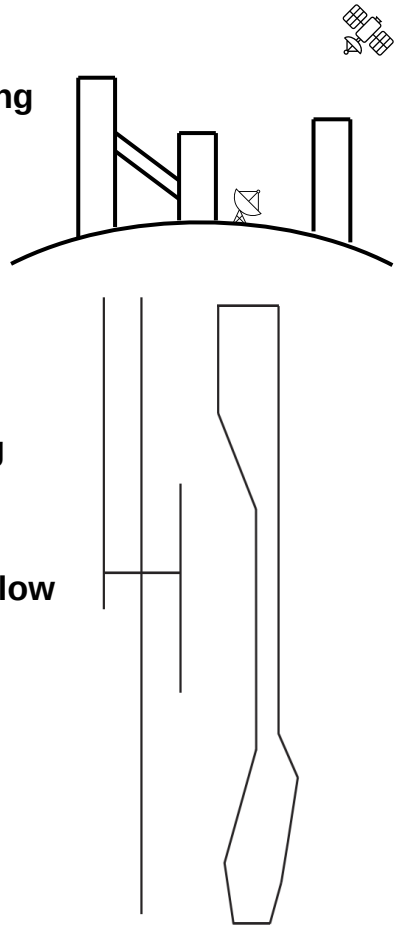
SpaceLab

Earth Observation and remote sensing

Deep underground low background facility

Particle physics & muography

Something new?



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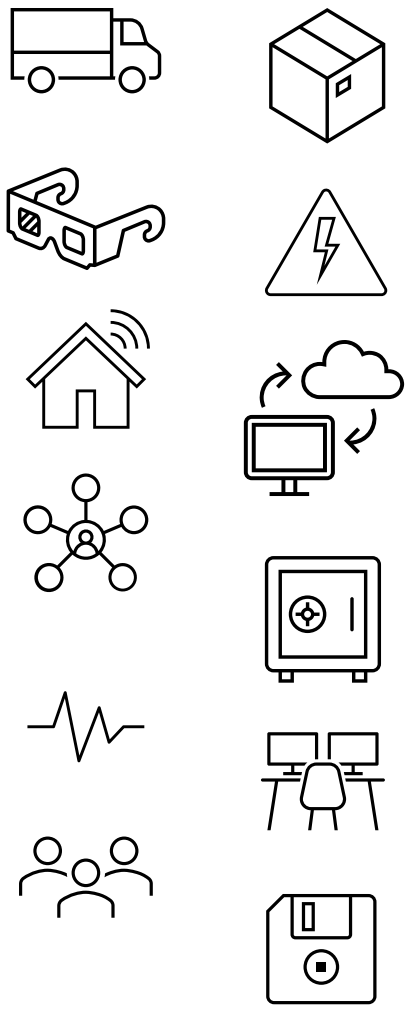
Services & Infrastructure



- 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

UNIVERSITY OF OULU

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 co-ordinated 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.***

bsuin.eu

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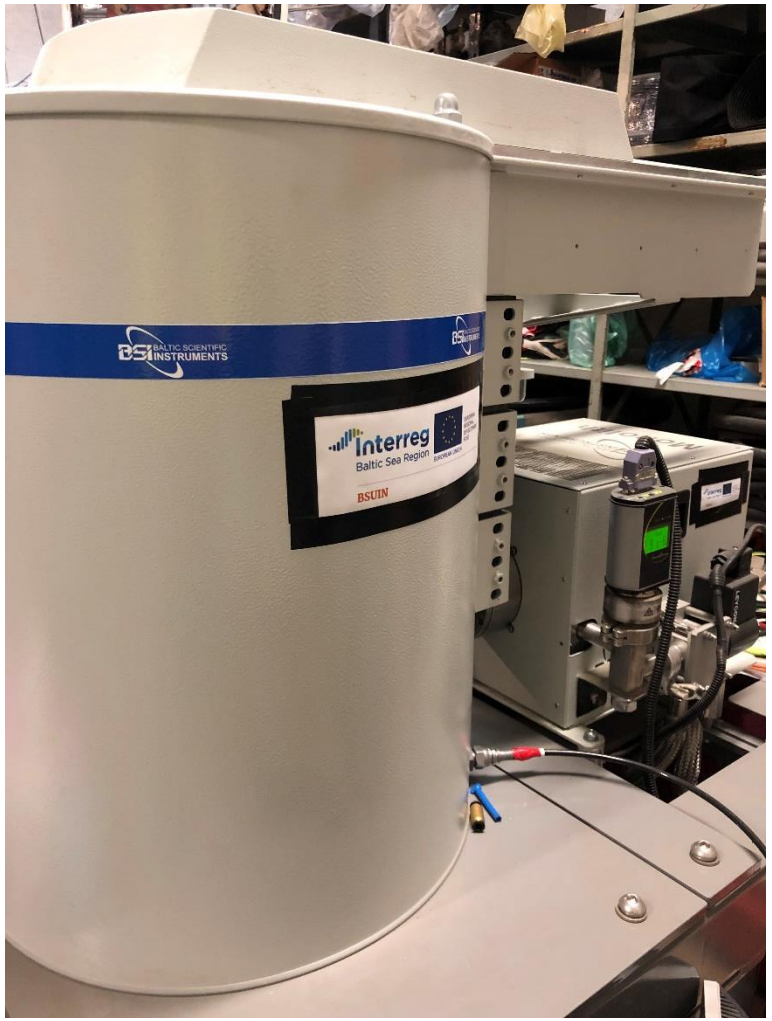
BSUIN project – continued by EUL



Pilot measurement setup and methodology

1. **Detailed description of the underground space**
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**

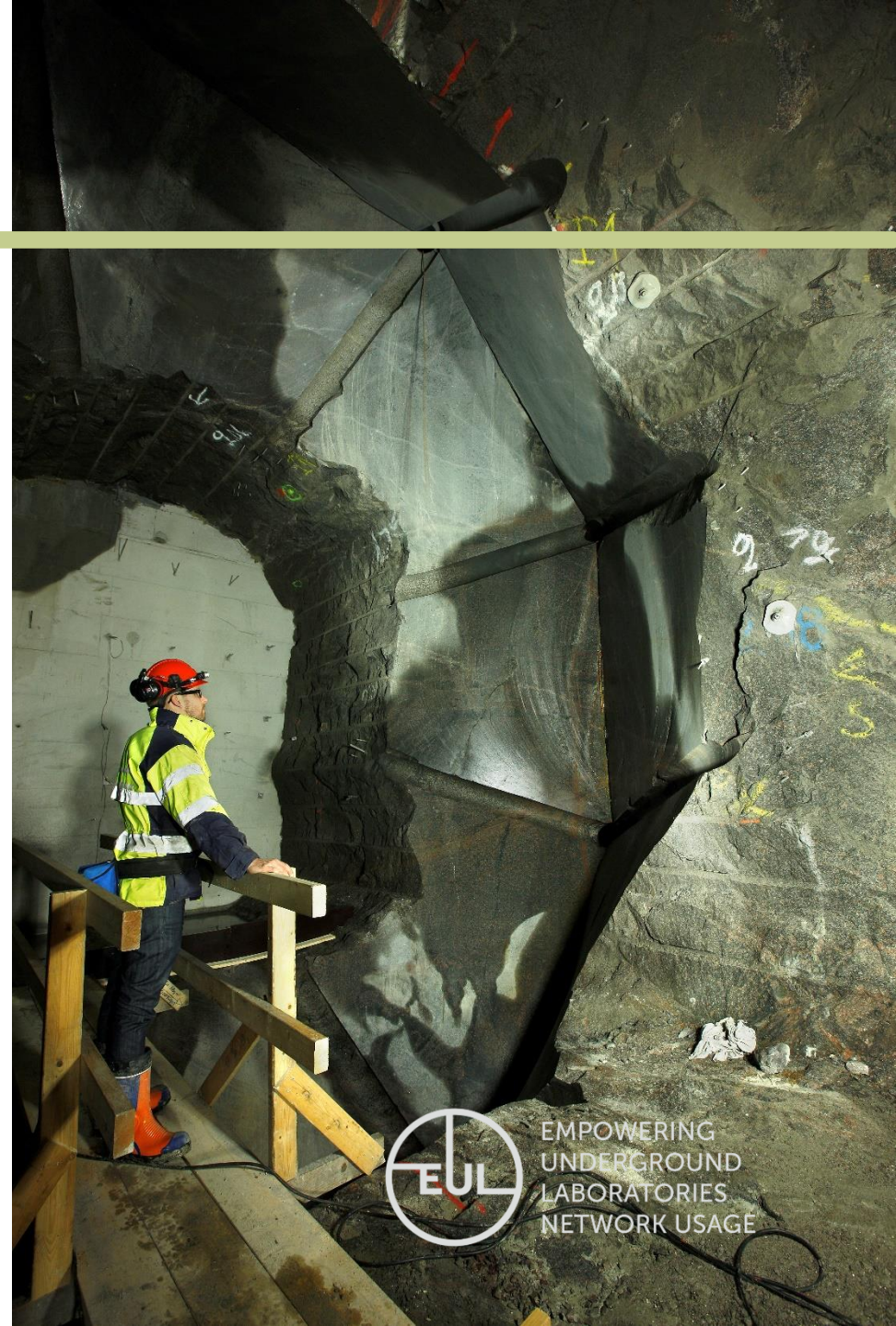
Natural background radiation at Lab 2 of Callio Lab, Pyhäsalmi mine in Finland
Measurements of gamma-ray background in Pyhäsalmi Mine
Callio Lab – the deep underground research centre in Finland, Europe
Characteristics of natural radiation background at the Callio Lab (Finland) performed within the BSUIN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

- 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.



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/

CALLIO LAB Scientific Advisory Board

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 Katowise, 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
- Henrika 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

Contacts

Mr. Jari Joutsenvaara
Callio Lab Research Coordinator
KSI, University of Oulu
Tel. +358 40 5569396
Jari.Joutsenvaara@oulu.fi
contact@calliolab.com

THANK YOU!

WWW.OULU.FI/KSI-ENG/REX

WWW.CALLIOLAB.COM

Dr. Mr. Ossi Kotavaara
Research director,
Adjunct Professor
KSI, University of Oulu
Tel.+358 50 5739124
Ossi.Kotavaara@oulu.fi

Ms. Julia Puputti
Callio Lab Project Engineer
MSc. Space Physics
KSI, University of Oulu
Tel.+358 50 467 2371
Julia.Puputti@oulu.fi

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.