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# TRENDS IN PUBLISHING MUOGRAPHY RELATED RESEARCH RESULTS. THE SITUATION AT THE END OF 2020

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### Basics

Muography: Muography: A group of density imaging techniques based on the detection of cosmic-ray induced muons

Applications: Archaeology, architecture, border control, tunnels, caves, containers, nuclear waste imaging, volcanology, hydrology, geology, mineral exploration, mining, oceanography, etc.

## Current trends

- 1. The term 'muography' is stabilising
- 2. Applications spreading out
  - First-wave applications (e.g., border control, volcanoes) reaching early-stage maturity (i.e., recognition)
  - Second-wave applications (e.g., civil engineering, caves, mining) gaining momentum
- Third-wave applications under piloting (e.g., oceanography)
- Future applications proposed in the literature (e.g., planetary research)
- 3. Cross-pollination between different disciplines continues to intensify as muography is developing from multidisciplinary research to a truly transdisciplinary research field







NUCLEAR SCIENCE TECHNOLOG` PHYSICS PARTICLES FIELDS MULTIDISCIPLINARY SCIENCES GEOCHEMISTRY GEOPHYSICS ASTRONOMY ASTROPHYSICS OPTICS PHYSICS CONDENSED MATTER

### An analysis based on Web of Sciences

- Search words: muograph\* OR muon radiograph\* OR muon tomograph\* OR muon scattering tomograph\*
- 556 publications found
- Oldest paper from 1987 (in Russian), but the earliest papers were not found (e.g., George, 1955)
- Every year after 2001 is represented by more than one publication
- Peak year so far: 2019 (68 counts)

**ENGINEERING ELECTRICAL ELECTRONIC** GEOSCIENCES MULTIDISCIPLINARY MATERIALS SCIENCE MULTIDISCIPLINARY MAGING SCIENCE PHOTOGRAPHIC TECHNOLOGY METALLURGY METALLURGICAL ENGINEERING COMPUTER SCIENCE INTERDISCIPLINARY APPLICATIONS ENGINEERING MULTIDISCIPLINARY COMPUTER SCIENCE ARTIFICIAL INTELLIGENCE

MATERIALS SCIENCE CHARACTERIZATION TESTING ENGINEERING CHEMICAL

CHEMISTRY PHYSICAL NANOSCIENCE NANOTECHNOLOGY PHYSICS MATHEMATICAL ENERGY FUELS TELECOMMUNICATIONS

SPECTROSCOPY OPERATIONS RESEARCH MANAGEMENT SCIENCE MINING MINERAL PROCESSING ENGINEERING MECHANICAL ENGINEERING ENVIRONMENTAL EDUCATION SCIENTIFIC DISCIPLINES REMOTE SENSING PHYSICS ATOMIC MOLECULAR CHEMICAL

MICROSCOPY GREEN SUSTAINABLE SCIENCE TECHNOLOGY ENVIRONMENTAL SCIENCES COMPUTER SCIENCE HARDWARE ARCHITECTURE CHEMISTRY MULTIDISCIPLINARY CHEMISTRY INORGANIC NUCLEAR

> CHEMISTRY APPLIED CHEMISTRY ANALYTICAL ARCHAEOLOGY WATER RESOURCES

THERMODYNAMICS QUANTUM SCIENCE TECHNOLOGY POLYMER SCIENCE

PHYSICS FLUIDS PLASMAS MATHEMATICS APPLIED MATERIALS SCIENCE COATINGS FILMS INTERNATIONAL RELATIONS ENGINEERING INDUSTRIAL ENGINEERING GEOLOGICAL ENGINEERING BIOMEDICAL COMPUTER SCIENCE INFORMATION SYSTEMS AUTOMATION CONTROL SYSTEMS ART





### **MUOGRAPHY PUBLICATIONS**

ARCHITECTURE