



Pan-European network FuSe: a new frontier in exploring seismic phenomena and earthquake precursors

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Investigating the complex coupling between the lithosphere, atmosphere, and ionosphere (LAI) requires a fundamental understanding of the physical forces governing tectonic processes and their electromagnetic manifestations. While various pre-seismic signals have been successfully identified, a persistent gap remains between the empirical observation of these phenomena and the fundamental physical laws that describe nature across all scales, from the subatomic realm to cosmic expansion. Exploring these interrelations presents significant challenges due to divergent scientific languages, specialized expertise, and unique terminologies across fields. The recently approved **COST Action CA24101 "Testing Fundamental Physics with Seismology" (FuSe)** aims to bridge this gap by exploring how seismic phenomena and earthquake precursors can serve as a "multi-messenger" window into fundamental interactions.

At the heart of FuSe is the belief that imprints of non-standard physics, such as scalar fields or "fifth forces", may be embedded within seismic and geomagnetic data. Conversely, theoretical insights from fundamental physics can refine our understanding of Earth's interior by improving models of density and thermodynamic parameters like elasticity and bulk modulus. This refined modeling is essential for accurately interpreting the electromagnetic and gravitational

perturbations that occur within the complex Earth-atmosphere-space system.

To ensure these breakthroughs translate into practical advancements, FuSe focuses on several strategic pillars:

- **Building a common language:** developing a shared methodology to equip the next generation of scientists with cross-disciplinary skills.
- **Interfacing communities:** creating dynamic research groups that unite scientists from particle physics, gravity, planetary science, and seismology.
- **Cross-disciplinary data integration:** consolidating seismic data from the Earth and Moon with particle physics and geomagnetic data into AI-ready, FAIR-compliant streams.
- **SME collaboration:** partnering with small and medium-sized enterprises (SME) to advance sensor networks, AI algorithms, and real-time natural catastrophe alert systems.

In this presentation, we outline the roadmap of the FuSe Action. We invite researchers with a background in electromagnetic precursors and LAI coupling to join this collaborative environment, where the synergy between geosciences and fundamental physics promises to drive innovative breakthroughs and unlock new paradigms in our comprehension of the Earth and the Universe.

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