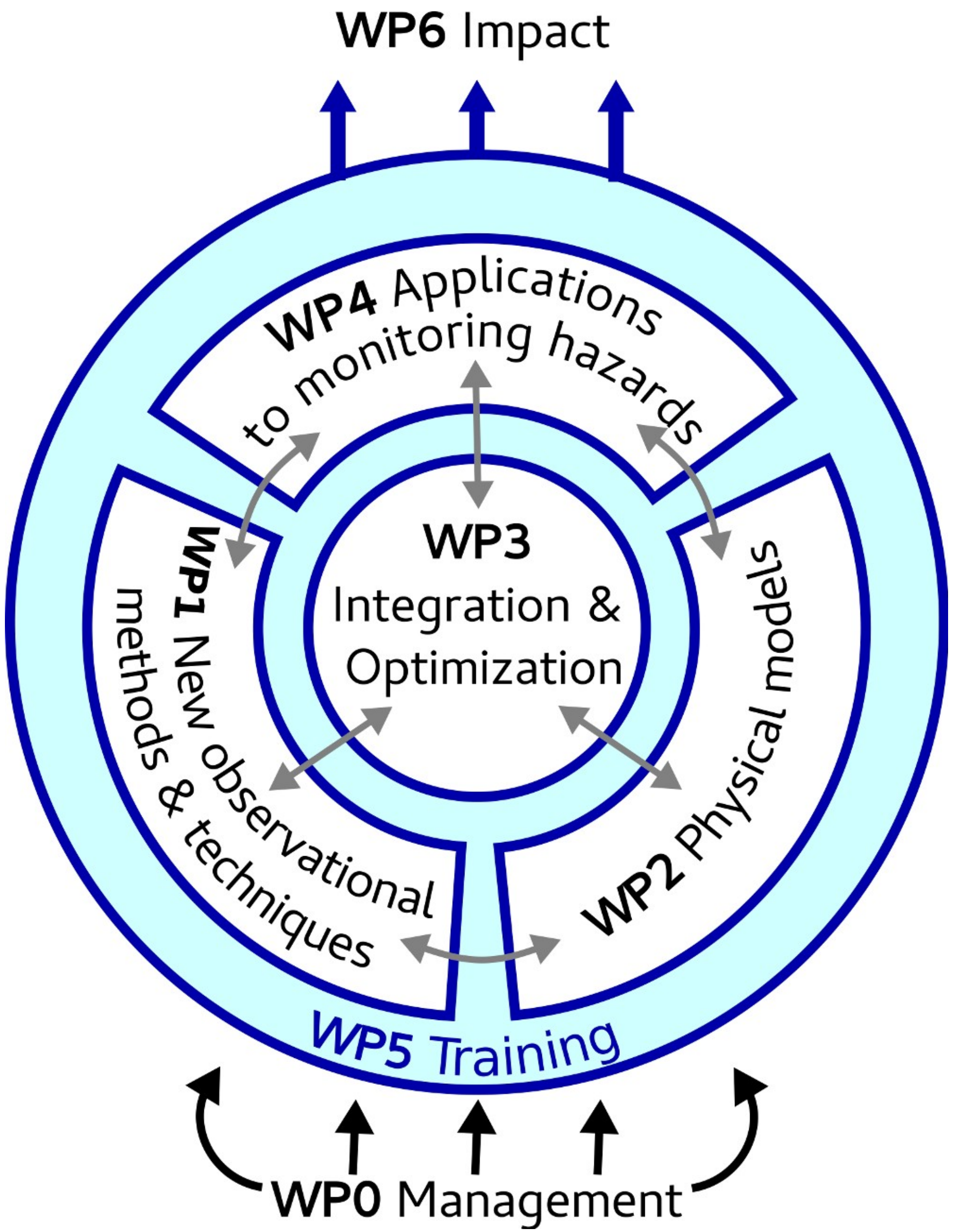
WP1 – Observational Methods and Techniques



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WP1 – Observational Methods and Techniques

- What additional information do **6+ degree-of-freedom** point measurements provide about the wavefield and local structure (ESR1.1)?

- How do networks with a **combination of sensor types** help us understand the observations from a **wave physics** point of view? What are the **advantages and limitations** of each sensor type? How should we combine and process multi-sensor ground motion observations in **dense arrays** (ESR1.3)?

- How can **6+ degree-of-freedom** point measurements improve spatially sparse measurements (OBS, ESR1.4)

- How can **distributed acoustic sensing (DAS)** - extremely dense measurements - best be exploited (ESR1.2)?

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WP1 thus serves as the **instrumentation backbone** of SPIN, providing
a new generation of 'telescopes' with which to observe Earth's interior processes.

WP1 – ESR Projects 1/4

SPIN ESR 1.1: Harnessing wavefield gradients: theory, experiment, applications (LMU, co- supervisor ETH)

ESR: Le Tang

Expected results:
- Open source synthetic **6 DoF benchmark** data for processing, data analysis, and inverse problems
- **Processing toolbox** (Full 6 DoF) with documentation, embedded in Jupyter notebooks
- Case studies on **field and laboratory data**, demonstrate improvement in inverse problem resolution

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WP1 – ESR Projects 2/4

SPIN ESR 1.2: Distributed acoustic sensing for natural hazard assessment (ETH)

ESR: Sebastian Noe

Expected results:

- **Monitoring of glaciers**, potentially unstable **slopes**, and **earthquake-induced ground motion i**n densely populated urban areas.
- properly quantify observational **uncertainties** of DAS waveforms
- to integrate them into the design of suitable misfit functionals
- DAS-based **full waveform inversion methods**
- Applications for both earthquake source properties and 3D Earth structure.

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WP1 – ESR Projects 3/4

SPIN ESR 1.3: Wavefield gradient methods to monitor the Earth’s crust
(ISTERRE, co-supervisor LMU)

ESR: Mirko Bracale

Expected results:

- Evaluate the possibilities offered by **wave field gradient measurements** in addition to traditional local measurements for monitoring **temporal variations of elastic properties** (mean velocities, structural changes) in the Earth’s crust.
- Focus on a **volcanic area** where such changes are already reported but not precisely characterized.
- Test ability to image changes in the environment associated with for example **localized velocity changes** or appearance of filled cracks.
- Application to field data with a noise based monitoring approach. The processing of the field data will include a stage of characterization and classification of the ambient wavefield.

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WP1 – ESR Projects 4/4

SPIN ESR 3.4: Ambient signals as a tool to characterize material properties (UHH, co-supervisor IPG)

ESR: Mohammad Aminian

Expected results:

- Characterize the **time-dependent distribution of noise sources** at different frequencies and scales (e.g. urban noise, local environmental noise, ocean noise on the global scale).
- What can the inclusion of additional ground motion observables tell us about how the **noise sources** work?
- How do the noise field characteristics affect the **accuracy of noise cross-correlation signals**? What about **seismic noise interferometry** with new observables?

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WP1 – Questions for this workshop

- **How can WP1 support the other SPIN Work Packages?**
- What is the **instrumentation pool** that we have in our network? Let us make an inventory (PADLET)!
- What are the most **exciting experiments** that we can do to demonstrate the potential of gradient observations?
- **Where** should we go? Where are potential sites with prior knowledge (**tomography**)? Where are sites with substantial seismic activity (**source inversion**)?
- Should we aim for a **3D subsurface array** multicomponent installation (e.g., LSBB)
- What are **technological developments** on the rotation and strain sensing front that we should monitor?
- Should we bridge to **other communitites** (gravitational wave detection, structural engineering)?

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