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Long-term recordings at the FSU Jena Geodynamic Observatory Moxa (Thuringia, central Germany)

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The remote location of the Geodynamic Observatory Moxa of Friedrich-Schiller University Jena, about 30 km south of Jena in the Thuringian slate mountains, results in very low ambient noise and thus very good conditions for long-term geophysical observations, which are further improved, as many sensors are installed in the subsurface in galleries or in boreholes.

So far, the focus of Moxa observatory has been on observing transients signals of deformation and fluid movements in the subsurface. This is accomplished by sensors like a superconducting gravimeter CD-034, three laser strain meters measuring nano-strain along three galleries in north-south, east-west and NW-SE directions, or borehole tiltmeters. Further, information on fluid flow is gained from downhole temperature measurements employing an optical fiber. These sensors are complemented by a climate station and two shallow drill-holes, one of which has been fully cored, which in addition to the temperature times series provide information on water level and rock physical properties. Near surface geophysical profiling using e.g. electrical resistivity tomography has led to a good knowledge of the structurally complex subsurface of the observatory.

Recently, a node for the Global Network of Optical Magnetometers for Exotic physics (GNOME) has been installed in the temperature-stabilized room at Moxa observatory close to the superconducting gravimeter. The GNOME is a world-spanning collaboration employing optically pumped magnetometers (OPM) to search for space-time correlated transient signatures heralding exotic physics beyond the Standard Model. GNOME is sensitive to prominent classes of dark-matter scenarios, e.g., axion or axion-like particles forming macroscopic structures in the Universe. The installation in close vicinity to the superconducting gravimeter ensures well-controlled and -monitored ambient conditions such as temperature, air pressure and especially vibrations, allowing improved vetoing of false-positive detection events in the Moxa GNOME node.

Here, we focus on introducing Moxa Observatory's sensor systems with an emphasis of actual sensor configurations and further on highlighting how various information on fluid flow coming from the specific sensors lead to an improved understanding of the direction and magnitude of subsurface fluid flow.