**Introduction:** We aim at technological advances and innovations in 3D subsurface imaging with the presence of signal sparsity [1,2,3]. Our goal is to enable detection and classification of valuable mineral and metal resources contained by a small planetary object which is vital for future asteroid mining prospects [4]. Due to strict limitations of space missions it is necessary to innovate new energy and payload efficient technologies to fill the role of seismic blasts, deep boreholes and high-energy radars utilized in terrestrial land surveys. It is also essential to develop computational methods and algorithms that enable robust recovery of subsurface structures from a minimal set of sparse data. The key feature for successful results is a careful mission design phase [4] in which the applied signaling scenario and inversion procedure will have to be thoroughly studied and tested. Our research with our partners deals with these essential aspects including numerical simulations [1,3], sparse transmitter and receiver placement [1,2,3], advanced forward and inverse methodology [1,3], tests with laboratory targets [2], and scientific benchmark model development.

**Signaling scenarios:** We study both seismic [2] and radio frequency signaling [1,3] methods. In both cases, the number of signal sources will have to be relatively low leading to a sparse signal structure. A radio signal can be transmitted and received using a (i) orbiterto-orbiter (ii) lander-to-orbiter (iii) lander-to-lander or approach. A seismic transmitter (transducer) requires a direct surface contact, but the signal can be recorded, e.g., via laser, meaning that scenarios (ii) and (iii) suit for seismic imaging.

**Regolith models and data sets:** Asteroid regolith can have a very complex structure featuring internal voids, porosity, cracks, and boulders. It can also contain extraordinary amounts of metals and minerals with high permittivity. Because of this diversity, we use both numerical [1,3] and laboratory experiments [2] to ensure the best possible result reliability. We record complete data sets of the target objects utilizing advanced measurement technologies including 3D laser point cloud and vibration surveys as well as computerized tomography (CT scan). Consequently, both surface and subsurface structures together with important signal characteristics can be reproduced with high accuracy.