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Research opportunities with MaQuIS - updates and continuation of a dedicated consortium

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Mars was long thought to be in a quiescent state with minimal geodynamic processes taking place at present. However, NASA's InSight mission shed light on the planet's present-day tectonic activity, part of which is likely related to mantle plumes and associated magmatic that, in the recent past, might have contributed to building up the Martian atmosphere through mantle outgassing. We propose a dedicated gravimetric satellite mission for Mars: the Mars Quantum gravity sensing of Interior Structure and atmosphere mission (MaQuIS) to understand these intricate dynamic processes and use gravity observations to constrain the interior structure and geologic evolution of the red planet. The mission will enable us to decipher Mars' ongoing geodynamic activity, the structure of its lithosphere, as well as to probe for subsurface water reservoirs and to characterise the temporal dynamics of the atmosphere. MaQuIS follows a well-crafted mission scenario, inherited from the successful Gravity Recovery and Climate Experiment (GRACE) and Gravity Recovery and Interior Laboratory (GRAIL) missions deployed around Earth and the Moon, respectively. Compared to its predecessors, MaQuIS will include state-of-the-art quantum sensing technologies to improve the detection of fine variations in Mars' gravitational field and maximize the mission's scientific return. MaQuIS will contribute to the following main science objectives:

1. Uncover the evolution of Mars by studying interior dynamics, detailed structure and composition of the planet's lithosphere and deep mantle.

2. Capture Mars' climate history by monitoring the density of the planet's upper atmosphere and uncover the monthly, seasonal, and long-term changes.

3. Explore potential scenarios for the fate and sequestration pathways of Mars' surface liquid water.

These primary mission goals will have profound and long-lasting impacts on the study of Mars, shedding new light on Mars' geologic evolution and ongoing interior and atmosphere activity.

Activities are ongoing to increase the TRL-level of the instrument technology. Both improved systems for the main instruments are being developed. LRI link acquisition is being developed to improve the initialisation phases. Also, other laser frequencies are being looked at to be able to share laser sources for the LRI and CAI accelerometers. Improvements of the internal layout of the CAI instrumentation help in detecting bottlenecks in the new technology. Mission design studies are improving the understanding of the impact of certain orbit choices to the precission and coverage of the observations. Finally we will also present some preliminary CFD studies performed on the whole mission design, highlighting that the mission is technological feasible and will provide excellent data to improve our understanding of Mars.

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