Lunar seismology: from Apollo mission to the Farside Seismic Suite and beyond

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Project Description

Planetary science has traditionally relied on orbital or fly-by mission profiles, resulting in most of our geophysical understanding about the interior of other planets and moons being derived from indirect, remote measurements. Aside from Earth, only the Moon and Mars have been directly investigated with seismometers, courtesy of the *Apollo* and *InSight* missions, respectively. These missions have significantly contributed to our knowledge of planetary interior structure, tectonics settings, and dynamics.

New advancements are on the horizon, with upcoming lunar missions such as the Farside Seismic Suite (FSS; **Figure 1;** https://www.jpl.nasa.gov/missions/the-farside-seismic-suite), scheduled to launch in 2025-2026 and NASA's Artemis missions, as well as other exploration strategies that will use commercial partners to fly various scientific experiments to the lunar surface. These rekindling efforts on lunar exploration will allow us to address many of the unanswered questions about the structure and evolution of the Moon: <u>(i) investigating interior structures including the dichotomy of the lunar crustal thickness and internal density anomalies, global coverage of the partially-molten layer in the core-mantle boundary region, and internal structure within the lunar core, (ii) understanding global tectonics on the moon with a special focus in origin and distribution of deep lunar seismicity between near vs. farside.</u>

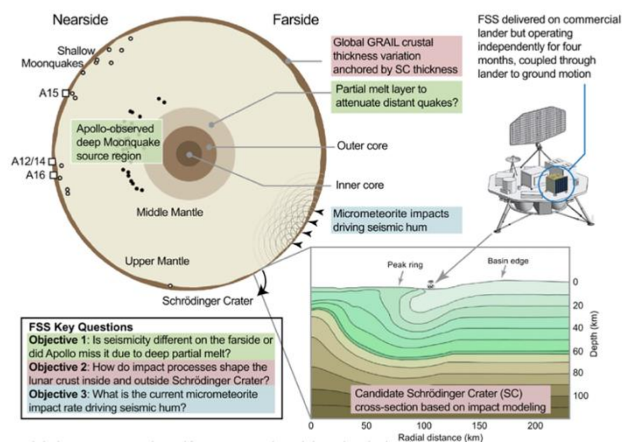

Figure 1*: Key lunar science questions and the Farside Seismic Suite (Panning et al., 2021)*

The aim of this project is to exploit seismic waveform datasets and models derived from previous Apollo missions and improve / develop available analytical tools (event location, discrimination, magnitude estimation, phase identification, modeling seismic wave propagation in highly scattering environment, structural inversion) for addressing the aforementioned scientific questions on the Moon. The development of various analytical approaches and quantitative models will also provide crucial means to further perform a more detailed study on a wide range of interesting geological targets on the moon, including ice in permanently shadowed craters, lunar void spaces, magnetic anomalies, and the omnipresent regolith. Ultimately, the expected outcome and experience from this project would be leveraged when applied to new datasets to be collected by the FSS.

The successful candidate will join, and be supported by, a vibrant and dynamic research group and would potentially collaborate with the upcoming FSS mission scientists. The candidate will have the opportunity to develop their career and profile by presenting at international conferences and publishing in high impact journals. Candidates for PhD positions should have a good mathematical background and a degree in an appropriate field such as earth science, physics, mathematics, computer science or engineering.