

VBB on the Moon: Expected performances and science return

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The SEIS VBB, InSight's Very Broad band seismometer, is monitoring Mars' seismic activity and noise since January 2019 and its installation with a Wind Shield protection has been completed in early February, 2019. During the first part of the night ground velocity below 10^{-10} m/s/Hz^{1/2} at 2.5 seconds have been shown, about one order of magnitude below the self-noise of the companion SP instrument, showing the importance of low self-noise and well installed instruments in planetary seismology.

By using the VBB technology, we show that different configuration of instrument can be proposed. The more simple will be a vertical VBB, which can be used from the spare units of the InSight SEIS experiment, and can be available for very early opportunities prior 2025. Much better will be oblique, 3 axis VBB, designed for the lunar gravity. We detail here the expected performances of these Lunar version of the VBB ($3 \cdot 10^{-11}$ m/s²/Hz^{1/2} between 0.02Hz and 1Hz), which can be considered for near future Lunar investigations, either deployed by robotic missions or by human deployed Autonomous surface package.

These performances are about 10 times better than Apollo and will allow addressing several seismic investigations never performed on the Moon. We focus on the detection capabilities of Deep Moon Quakes, Impacts and Shallow Moonquakes, including for surface waves and address what could be observed, including core phases, lunar seismic noise and impacts signals.

We finally conclude by discussing expectations at very long periods, for the detection of free oscillations excited by the largest events and discuss possible improvements made with optical sensing.

Keywords: Moon seismology, Apollo, InSight, Deep Moonquakes, Lunar seismic noise, Optical sensor