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Simulating the passive seismic investigation of Didymoon

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The understanding of the internal structure of an asteroid constraints the interpretation of its evolutionary history, and is one of the first steps towards preparing possible asteroid deflection manouvers, or utilising asteroids as in-situ space resources. Given the strong evidence that asteroids are seismically active, an in-situ passive seismic experiment could provide information about the asteroid surface and interior properties. Here we simulate the seismic wave propagation in Didymoon, the secondary component of asteroid (65803) Didymos. Seismic simulations show that even small meteoroid impacts can generate clearly observable body and surface waves if the internal structure is homogeneous. The presence of a regolith layer over a consolidated core can result in the seismic energy becoming trapped in the regolith due to the strong impedance contrast at the regolith-core boundary. The inclusion of macro-porosity (voids) further increases the complexity of the wavefield due to scattering. The most prominent seismic waves are always found to be those traveling along the surface of the asteroid and those focusing in the antipodal point of the seismic source. We show that one single seismic station deployed by a space mission can already vastly improve our knowledge about the seismic environment and sub-surface structure of an asteroid.