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POS-F51 – Non-linear elastic wave interactions: pump-probe experiments in rocks

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During earthquakes, the travelling speeds of seismic waves can change due to the heterogeneous nature of the earth's crust. However, it remains an open question which factors most influence seismic wave speed changes. In this context, we use lab-scale experiments to study how heterogeneities such as cracks and ambient humidity affect the way that elastic waves interact in porous sandstone. We focus on non-linear wave interactions that allow us to track changes in wave travelling speeds, which can indicate changes in material (rock) properties. We demonstrate that strong pump wave pulses soften sandstone more in humidified conditions than they do in dry conditions, and that this effect is repeatable and reversible.[1] Furthermore, our pump-probe experiments detect rock softening changes easily and repeatably using an experimental design that does not rely on resonance conditions. Building on previous simulations [2], we assess wave speed differences between resonant and non-resonant pumping conditions.

[1] Somayeh Khajehpour Tadavani, Kristin M. Poduska, Alison E. Malcolm, and Andrey Melnikov. A nonlinear elastic approach to study the effect of ambient humidity on sandstone. J. Appl. Phys. 128, 244902 (2020). DOI: 10.1063/5.0025936

[2] Heru Rusmanugroho, Alison E. Malcolm, Meghdad Darijani, A numerical model for the nonlinear interaction of elastic waves with cracks. Wave Motion 92, 102444 (2020). DOI: 10.1016/j.wavemoti.2019.102444

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