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Internal friction of silica membranes at high frequencies

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Knowledge of the frequency-dependence of the acoustic attenuation in structural glasses is necessary to understand their universal low temperature thermal properties. However, very little experimental information is currently available on the vibrational properties of glasses in the frequency range between 100 GHz and 1 THz, corresponding to the temperature range relevant for these thermal anomalies. I will present recent results on the sound attenuation of vitreous silica probed by the extreme ultraviolet transient grating technique now available at the Fermi free electron laser [1]. The recently developed method is based on a four-wave mixing scheme, where two pump beams generate a transient grating, whose decay is detected by the appropriately delayed probe pulse. The technique allowed us to investigate the propagation and damping of sound waves in silica membranes 100 nm thick, in a large frequency interval between 50 and 400 GHz [2]. The method can be applied to other thin films of interest for gravitational wave detectors, both in the form of freestanding membranes or deposited on a substrate. We will show some preliminary results on films of pure tantala and present ideas for future developments.

[1] L. Foglia *et al.*, Photoacoustics **29**, 100453 (2023).
[2] D. Fainozzi *et al.*, APL Mater. **12**, 051122 (2024).

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