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A broadband xylophone configuration with sloshing Sagnac interferometers

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In high frequency band, the quantum sensitivity is ultimately limited by the optical losses in signal recycling cavity (SRC). The sensitivity limit is independent of the arm length and the squeezing level, which constraints our ability to detect signals from binary neutron star mergers. By creating a cavity with two ETMs of the arm cavities, we can form a sloshing-Sagnac interferometer. It reshapes the signal response via a triply-coupled-cavity resonance, which beats the original SRC loss limit for the Michelson interferometer. The sloshing Sagnac also turns out to be a speed-meter, which can suppress the low-frequency radiation pressure noise. By choosing two sets of parameters for the ETMs and sloshing cavity length, a broadband quantum sensitivity can be achieved from several Hz to several kHz, resulting in a xylophone configuration.

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