Shape from sound: New methods to probe the universe

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(Phys.org) —As the universe expands, it is continually subjected to energy shifts, or "quantum fluctuations," that send out little pulses of "sound" into the fabric of spacetime. In fact, the universe is thought to have sprung from just such an energy shift.

A recent paper in the journal *Physical Review Letters* reports a new mathematical tool that should allow one to use these sounds to help reveal the shape of the universe. The authors reconsider an old question in spectral geometry that asks, roughly, to what extent can the shape of a thing be known from the sound of its acoustic vibrations? The researchers approached this problem by breaking it down into small workable pieces, according to author Tejal Bhamre, a Princeton University graduate student in physics.

To understand the authors' method, consider a vase. If one taps a vase with a spoon, it will make a sound that is characteristic of its shape. Similarly, the technique Bhamre and her coauthors developed could, in principle, determine the shape of spacetime from the perpetual ringing caused by quantum fluctuations.

The researchers' technique also provides a unique connection between the two pillars of modern physics—quantum theory and general relativity—by using vibrational wavelengths to define the geometric property that is spacetime.

Bhamre worked with coauthors David Aasen, a physics graduate student

at Caltech, and Achim Kempf, a Waterloo University professor of physics of information.

More information: David Aasen, Tejal Bhamre and Achim Kempf. 2013. Shape from Sound: Toward New Tools for Quantum Gravity. *Physical Review Letters*. Article first published online: March 18, 2013. DOI: 10.1103/PhysRevLett.110.121301. prl.aps.org/abstract/PRL/v110/i12/e121301

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