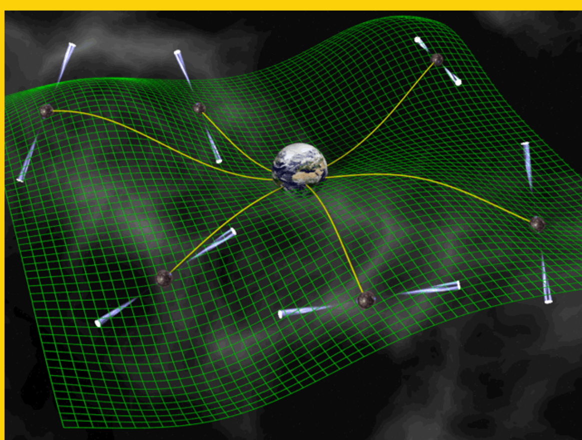
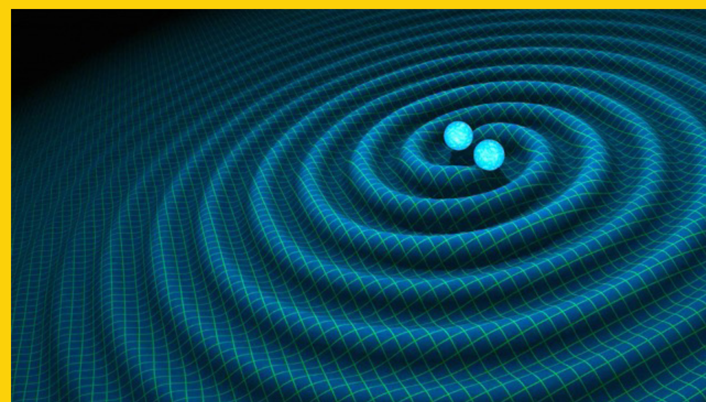
PULSAR MOBILE

What is a "Pulsar Timing Array?"
This model illustrates the method by which we hope to detect low frequency gravitational waves, using a Pulsar Timing Array (PTA). The white, 3D-printed pulsars include loops, showing their strong magnetic fields and narrow, conical emission regions emanating from each sphere. In order to detect small ripples in spacetime, PTAs are made up of the most rapid rotators, millisecond pulsars, which spin hundreds of times per second. Millisecond pulsars can be timed to incredible precision and in some cases, we can predict pulse arrival times to within hundreds of nanoseconds (0.0000001 seconds). Made up of millisecond pulsars found all over the Galaxy – essentially very accurate clocks beaming towards the Earth, a PTA is a Galactic-scale gravitational wave detector.



What makes "low-frequency" gravitational waves?
When galaxies like the Milky Way interact gravitationally and eventually collide, supermassive black holes in their centers orbit around one another and generate ripples in spacetime called gravitational waves that move out in all directions like ripples on a pond. Gravitational waves produced in this manner have lightyear wavelengths and therefore very low frequencies – one wave per year, or nanohertz! Since the Universe is a big place, full of supermassive black holes and colliding galaxies, signals from all these sources combined make up a "stochastic" background of gravitational waves (picture choppy water on a windy day). The motor shaking our apparatus illustrates this stochastic background, stretching and squeezing spacetime and causing slight variations in distances between PTA pulsars and the Earth.



What would a detection look like?
Since millisecond pulsars in our PTA are so predictable, we expect to detect slight distance perturbations (~10 meters) for pulsars trillions of kilometers away, indicating passing gravitational waves. Researchers at UW-Milwaukee work for a collaboration called NANOGrav (the North American Nanohertz Observatory for Gravitational Waves), a PTA regularly monitoring over 50 millisecond pulsars with two of the most sensitive radio telescopes in the world in Green Bank, WV and Arecibo, Puerto Rico. They expect to make a detection within the next five years.

Scan for more information!

http://www.cgca.uwm.edu/outreach/maker.html

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