Using collective excitations in a BEC to detect gravitational waves

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We show that gravitational waves create phonons in a Bose–Einstein condensate (BEC). A traveling spacetime distortion produces particle creation resonances that correspond to the dynamical Casimir effect in a BEC phononic field contained in a cavity-type trap. We propose to use this effect to detect gravitational waves. The amplitude of the wave can be estimated applying recently developed relativistic quantum metrology techniques. We provide the optimal precision bound on the estimation of the wave's amplitude. Finally, we show that the parameter regime required to detect gravitational waves with this technique could be, in principle, within experimental reach in a medium-term timescale.