

Geometric contoured Euler springs for vertical vibration isolation in future gravitational wave detectors

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Euler buckling springs have demonstrated benefits over conventional blade springs used in Advanced LIGO suspensions and magnetic- and geometric anti-spring (GAS) filters used in Advanced Virgo. Firstly, the resonance frequency - essentially the frequency where seismic cut-off starts - is relatively low for the spring size. Secondly, the reduced spring mass increases the internal mode frequency within the spring blade, which moves them in a frequency region where the transfer function is so small that they do not pose a problem. I will present two further improvements made over the last year in the UWA gravitational wave group. One improvement reduces the blade stiffness and the effect of internal spring modes by optimising the Euler spring geometric profile. The second improvement further reduces the effective resonance frequency by using the Euler spring under an angle instead of purely vertical. Combining these two improvements will result in a novel LaCoste-like stage with a resonance frequency of below 100 mHz which can act as a vertical pre-isolation stage for future gravitational wave detectors. We will argue that, in order to measure gravitational waves from 2 Hz onwards, vertical pre-isolation is key.

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