

What is the difference between a graphene mechanical resonator and a music drum?

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When a graphene layer is suspended and clamped over a circular trench, the graphene acts as a drum. Likewise, a suspended nanotube vibrates in way similar to a guitar string. However, one difference is the mass, since graphene is only one atom thick, and the diameter of nanotubes is about 1 nm. Another difference is that the quality factor Q becomes extremely large at cryogenic temperature, up to 5 million [1]. This large Q -factor reflects the high crystallinity of graphene and nanotubes and their lack of dangling bonds at the surface. Because of this combination of low mass and high quality factor, the motion is enormously sensitive to the environment - the mechanical eigenstates are extremely fragile and easily perturbed by the measurement. But, if graphene and nanotube resonators can be properly harnessed, they become incomparable sensors of mass [2] and force [3].

References

- [1] J. Moser, A. Eichler, J. Güttinger, M. I. Dykman, A. Bachtold, *Nature Nanotechnology* 9, 1007 (2014).
- [2] J. Chaste, A. Eichler, J. Moser, G. Ceballos, R. Rurali, A. Bachtold, *Nature Nanotechnology* 7, 301 (2012).
- [3] J. Moser, J. Güttinger, A. Eichler, M. J. Esplandiu, D. E. Liu, M. I. Dykman, A. Bachtold, *Nature Nanotechnology* 8, 493 (2013).