Buckling properties of the linear chain of particles

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Abstract

A linear chain of spheres confined by a transverse harmonic potential experiences localized buckling under compression. First, we present simple experiments using gas bubbles in a liquid-filled tube to demonstrate this phenomenon. Our findings are supported semi-quantitatively by numerical simulations. In particular, we demonstrate the existence of a critical value of compression for the onset of buckling [1].

Second, we extend the previous analysis. Two regimes are distinguished. Low compression, for which the entire chain buckles, and higher compression, for which there is localized buckling. With further increase of compression, second-neighbor contacts occur; beyond this compression the structure is no longer planar, and is not treated here. A continuous model is developed which is amenable to analytical solution in the low compression regime for an infinite chain [2].

[1]. Weaire, D., Irannezhad, A., Mughal, A., & Hutzler, S. (2020). A simple experimental system to illustrate the nonlinear properties of a linear chain under compression. American Journal of Physics, 88(5), 347-352.

[2]. Hutzler, S, , Mughal, A.,Ryan-Purcell, J., Irannezhad, A. & Weaire, D. (2020). Buckling of a linear chain of hard spheres in a harmonic confining potential: numerical and analytical results for low and high compression. Physical Review E, Submitted.

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