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Mechanical properties of warped membranes ANDREJ KOSMRLJ, KECHAO XIAO, JAMES C. WEAVER, JOOST J. VLASSAK, DAVID R. NELSON, Harvard University — We explore how a frozen background metric affects the mechanical properties of solid planar membranes at zero temperature. Our focus is a special class of "warped membranes" with a preferred random height profile characterized by random Gaussian variables $h(q)$ in Fourier space with zero mean and variance $< |h(q)|^2 > \sim q^{-m}$. Using statistical physics tools to treat this quenched random disorder, we find that in the linear response regime, similar to thermally fluctuating polymerized membranes, an increasing scale-dependent effective bending rigidity, while the Young and the shear moduli are reduced. Compared to flat plates of the same thickness t, the bending rigidity of warped membranes is increased by a factor $\sim h_v/t$ while the in-plane elastic moduli are reduced by $\sim t/h_v$, where $h_v = \sqrt{< |h(x)|^2 >}$ describes the frozen height fluctuations. Interestingly, h_v is system size dependent for warped membranes characterized with $m > 2$. Numerical results show good agreement with theoretical predictions, which are now being tested experimentally, where warped membranes are prepared with 3D printers.

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