Fracton oscillations in the net fractals

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The concept of fractal has become a powerful tool in analysis of common aspects of many complex processes observed in physics, biology, chemistry or earth sciences. Brownian motion, turbulence, colloid aggregation or biological pattern formation can be fully understood only when the idea of self-similarity or fractal structures is applied. The hallmark of a fractality is a hierarchical organization of its elements, described by discrete scaling laws which makes the fractal, regardless on magnification or contraction scale, looks the same. This property of fractals is called self-similarity, self-affinity or self-replicability. We prove that some fractals, the net fractals, presented in the logarithmic scale are isomorphic with the conventional crystal lattices. Assuming that the force constants scale as $\sigma(\lambda x)= \lambda^{-\alpha} \sigma(x)$ we construct the model of elastic (linear) vibrations on a fractal (fractons [1]). Further, we show that the fractons on the "net fractals "can be assumed as the log-scale phonons. Although our study is restricted to a special class of "net fractals", the results obtained are of importance to a wider class of fractals. We indicate, that in real dendritic fractals, such type of vibrational eigenmodes can be can be associated with the fractal backbone oscillations. It is evident that basing on our model some conclusions concerning non-linear excitations of fractal systems like solitons, dromions and instantons can be drawn. We believe that the presented model of fractal excitations provides a guideline for analysis of other phenomena on mesoscopic fractal systems like resonant transmission/absorption through fractal slits [2], fractal plasmons or fractal antennas (fractal electrodynamics). Finally, basing on the results obtained we give support to the idea of fracton paring superconductivity raised in [3]. We show that unconventional dispersion of the Cooper pairs can lead to enhancement of the critical temperature [4].

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