Strongly Nonlinear Waves in Polymer-Based Phononic Crystals

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University of California, San Diego — “Sonic vacuum” type phononic crystals were
assembled from chains of polytetrafluoroethylene (PTFE) beads and Parylene coated
steel spheres. It was demonstrated for the first time that these polymer-based “sonic
vacui,” with exceptionally low elastic modulus of particles, support propagation of
strongly nonlinear solitary waves (and their trains) with a speed below 100 m/s
for small amplitudes in reasonable agreement with numerical calculations. These
solitary waves can be described using classical nonlinear Hertz law despite the vis-
coelastic nature of the polymers and the high strain rate deformation of the contact
area. Elastic modulus for PTFE taken from extrapolated Hugoniot data results in
a good agreement with experimentally measured parameters of solitary waves. Tun-
ability of signal shape and velocity was achieved through a non-contact magnetically
induced precompression of the chains. This prestress allowed an increase up to two
times of the solitary waves speed and a significant delay in signal splitting. This
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