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Impacts on Dissipative Sonic Vacuum[1] YICHAO XU, VITALI NESTERENKO, Univ of California - San Diego — We investigate the propagating compression bell shape stress waves generated by the strikers with different masses impacting the sonic vacuum – the discrete dissipative strongly nonlinear metamaterial with zero long wave sound speed. The metamaterial is composed of alternating steel disks and Nitrile O-rings. Being a solid material, it has exceptionally low speed of the investigated stress waves in the range of 50 – 74 m/s, which is a few times smaller than the speed of sound or shock waves in air generated by blast. The shape of propagating stress waves was dramatically changed by the viscous dissipation. It prevented the incoming pulses from splitting into trains of solitary waves, a phenomenon characteristic of the non-dissipative strongly nonlinear discrete systems when the striker mass is larger than the cell mass. Both high-speed camera images and numerical simulations demonstrate the unusual rattling behavior of the top disk between the striker and the rest of the system. The linear momentum and energy from the striker were completely transferred to the metamaterial. This strongly nonlinear dissipative metamaterial can be designed for the optimal attenuation of dynamic loads generated by impact or contact explosion.

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