Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

An Artificial Ising System with Phononic Excitations HAMED GHAFFARI, W.ASHLEY GRIFFITH, University of Texas, PHILIP BENSON , School of Earth Environmental Sciences, Burnaby Building, Burnaby Road, Portsmouth, M.H.B NASSERI, R.PAUL YOUNG, University of Toronto — Many intractable systems and problems can be reduced to a system of interacting spins. Here, we report mapping collective phononic excitations from different sources of crystal vibrations to spin systems. The phononic excitations in our experiments are due to micro and nano cracking (yielding crackling noises due to lattice distortion). We develop real time mapping of the multi-array senores to a network-space and then mapping the excitation- networks to spin-like systems. We show that new mapped system satisfies the quench (impulsive) characteristics of the Ising model in 2D classical spin systems. In particular, we show that our artificial Ising system transits between two ground states and approaching the critical point accompanies with a very short time frozen regime, inducing formation of domains separated by kinks. For a cubic-test under a true triaxial test (3D case), we map the system to a 6-spin ring under a transversal-driving field where using functional multiplex networks, the vector components of the spin are inferred (i.e., XY model). By visualization of spin patterns of the ring per each event, we demonstrate that "kinks" (as defects) proliferate when system approach from above to its critical point. We support our observations with employing recorded acoustic excitations during distortion of crystal lattices in nano-indentation tests on different crystals (silicon and graphite), triaxial loading test on rock (poly-crystal) samples and a true 3D triaxial test.

Hamed Ghaffari
University of Texas

Date submitted: 03 Nov 2015 Electronic form version 1.4