Valley contrasting chiral phonons in monolayer hexagonal systems[1] LIFA ZHANG, QIAN NIU, Univ of Texas, Austin — In monolayer haxagonal lattice systems, two inequivalent valleys appear in the reciprocal lattice space. With inversion symmetry breaking, we find valley dependent chiral phonons which are circularly polarized with carrying spin angular momentum and ionic magnetic moment. At valleys, light and heavy phonons are found and evolve in intervalley electronic scattering. Under three-fold rotation operation, phonons have pseudo angular momentum, which include spin and orbital parts. From conservation of pseudo angular momentum, momentum and energy, the selection rules in valleytronics are obtained. Due to chiral valley phonons, one can observe polarized infrared photoluminescence and phonon valley coherence by infrared excitation. There is also a valley dependent phonon Berry curvature which can result a valley phonon Hall effect. The valley-dependent chiral phonon, together with its spin angular momentum, pseudo angular momentum, infrared polarized photoluminescence, phonon valley coherence and valley Hall effect, will form a basis for valley-based phononics applications.

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