Coupling of fully symmetric As phonon to magnetism in iron based superconductors

SHANGFEI WU, Rutgers University, WEILU ZHANG, Sophia University, LI LI, HUIBO CAO, ATHENA SEFAT, Oak Ridge National Laboratory, HSIANG-HSI KUNG, University of British Columbia, HONG DING, IOP,CAS, PIERRE RICHARD, Universite de Sherbrooke, GIRSH BLUMBERG, Rutgers University — Raman coupling to the fully symmetric As phonon $A_g$(As) in iron based superconductors is forbidden for the XY scattering geometry with cross-polarized light along the Fe-As directions in the tetragonal phase, whereas it becomes allowed in the orthorhombic phase: The emerging modes intensity indicates the lattice orthorhombicity, which is expected to be small. However, in the orthorhombic phase of several families of parent compounds of Fe-based superconductors (BaFe$_2$As$_2$, NaFeAs, FeSe, and LaFeAsO) [1], as well as in the gold doped compounds Ba(Fe$_{1-x}$Au$_x$)$_2$As$_2$ [2], we find that the $A_g$(As) phonon intensity is significantly enhanced when the magnetic order sets in below the Neel temperature $T_N$. The $A_g$(As) phonon also shows an asymmetric line shape below $T_N$ and an anomalous linewidth broadening upon Au doping. By the Fano model analysis, we conclude the temperature dependence of light coupling amplitude to the $A_g$(As) phonon follows the evolution of the magnetic order parameter. We propose that the intensity enhancement of the $A_g$(As) phonon is due to electronic anisotropy induced by the collinear spin density wave order. [1]Phys.Rev.Research 2, 033140 (2020) [2]Phys.Rev B 102, 014501 (2020)

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