Nematic magnetoelastic effect contrasted between Ba(Fe$_{1-x}$Co$_x$)$_2$As$_2$ and FeSe

YUWEN HU$^1$, XIAO REN, Peking University, China, RUI ZHANG, Rice University, USA, HUIQIAN LUO, Chinese Academy of Sciences, China, SHIGERU KASAHARA, TATSUYA WATASHIGE, Kyoto University, Japan, TAKASADA SHIBAUCHI, University of Tokyo, Japan, PENGCHENG DAI, Rice University, USA, YAN ZHANG, Peking University, China; Collaborative Innovation Center of Quantum Matter, China, YUJI MATSUDA, Kyoto University, Japan, YUAN LI, Peking University, China; Collaborative Innovation Center of Quantum Matter, China — Whether the nematic order ubiquitously found in Fe-based superconductors is driven by the spin or the charge or orbital degree of freedom is currently under heated debate. To elucidate its microscopic origin, we report a Raman scattering study of lattice dynamics, which quantify the extent of $C_4$-symmetry breaking, in BaFe$_2$As$_2$ and FeSe. FeSe possesses a nematic ordering temperature $T_s$ and orbital-related band-energy split below $T_s$ that are similar to those in BaFe$_2$As$_2$, but unlike BaFe$_2$As$_2$ it has no long-range magnetic order. We find that the $E_g$ phonon-energy split in FeSe sets in only well below $T_s$, and its saturated value is substantially smaller than that in BaFe$_2$As$_2$. Together with reported results for the Ba(Fe$_{1-x}$Co$_x$)$_2$As$_2$ family, the data suggest that magnetism exerts a major influence on the lattice.

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