Abstract

Energy Scale of the Charge Density Wave in Cuprate Superconductors †

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The cuprate high temperature superconductors develop spontaneous charge density wave (CDW) order below a temperature $T_{CDW}$ and over a wide range of hole doping ($p$). An outstanding challenge in the field is to understand whether this modulated phase is related to the more exhaustively studied pseudogap and superconducting phases [1]. To address this issue, it is important to extract the energy scale $\Delta_{CDW}$ associated with the CDW order, and to compare it with the pseudogap (PG) $\Delta_{PG}$ and with the superconducting gap $\Delta_{SC}$. However, while $T_{CDW}$ is well-characterized from earlier work, little is known about $\Delta_{CDW}$ until now. Here, we report the extraction of $\Delta_{CDW}$ for several cuprates using electronic Raman spectroscopy [2]. Crucially, we find that upon approaching the parent Mott state by lowering $p$, $\Delta_{CDW}$ increases in a manner similar to the doping dependence of $\Delta_{PG}$ and $\Delta_{SC}$ [2]. This indicates that the above three phases have a common microscopic origin [2]. In addition, we find that $\Delta_{CDW}$ and $\Delta_{SC}$ have the same magnitude over a substantial doping range, which suggests that CDW and superconducting phases are intimately related [2], as reported for example by fractionalized pair density wave [3].

References