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**Momentum-Resolved Thermodynamic: Key Effects of Self-Energies on the Entropy in Underdoped Cuprate Superconductors** XIAOQING ZHOU, HAOXIANG LI, STEPHEN PARHAM, JUSTIN WAUGH, TOM NUMMY, JUSTIN GRIFFITH, Univ of Colorado - Boulder, JAMES SCHNEELOCH, RUIDAN ZHONG, GENDA GU, Brookhaven National Lab, GERALD ARNOLD, Univ of Colorado - Boulder, HELMUTH BERGER, Department de Physique, Ecole Polytechnique F ed erale de Lausanne, DANIEL DESSAU, Univ of Colorado - Boulder, BERGER GROUP TEAM, GU GROUP TEAM, DESSAU GROUP TEAM — We demonstrate that the distribution of electronic entropy over momentum and energy space can be directly probed using Angle Resolved Photoemission Spectroscopy (ARPES). On slightly underdoped $Bi_2Sr_2CaCu_2O_{8+\delta}$, we investigated their detailed entropy evolutions as a function of momentum and temperature. We found our momentum resolved entropy to be qualitatively consistent with the bulk measurements, establishing ARPES as an alternative and complementary probe of thermodynamic properties to conventional methods. Furthermore, we reduce the entropy into temperature dependent density of states, and revisit the concepts of pseudogap and superconducting phase from a thermodynamic point-of-view. We conclude that the dynamics of self-energy is more relevant than the evolution of gaps in governing thermodynamic properties of cuprates.

Xiaoqing Zhou
Univ of Colorado - Boulder

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