Electronic Structure Determination from Silicon to Uranium

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The synergistic relationship between light source instrumentation and condensed matter materials problems will be discussed with an emphasis on *f*-electron materials through the decades.[1,2] A revolution from angle-integrated photoemission at 300 meV energy resolution and 300K temperature to 10 meV and 10K angle-resolved photoemission (ARPES) has driven new understanding in long-standing condensed matter problems. While covering a broad range of materials including semiconductors and transition metals, we will focus on *f*-electron systems involving Ce, Yb and U with recent highlights from SRC research into uranium compounds.

The 5*f* electrons in uranium compounds are central to understanding the electronic properties of these materials so we exploit both resonance photoemission and ARPES data at photon energies which enhance 5*f* character. In Figure 1 we show the ARPES data for $UCoGa_5$ which is a member of the broader 115 family of materials that spans across Ce, Yb, U and Pu compounds and exhibit properties of magnetism, enhanced mass, and superconductivity. The ARPES data is used to determine the self-energy of the material which encompasses all of the interactions beyond an independent particle description of the system. In addition, we will present results for UO_2 as a Mott insulator, UTe as an itinerant ferromagnet, USb_2 as a multigap antiferromagnet, and a continuing effort to understand the hidden order phase in URu_2Si_2. Many of these uranium materials have analogs in the rare-earth materials and we will make connections to the 4*f* materials where appropriate.

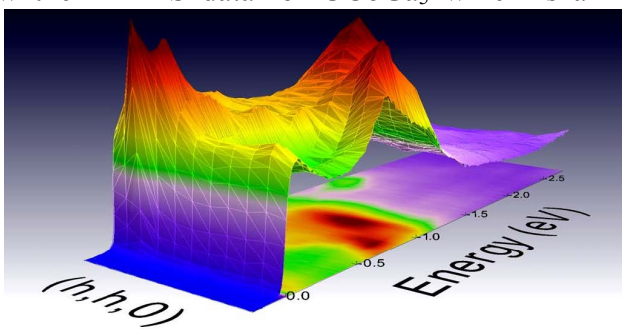

Fig. 1 ARPES data for $UCoGa_5$ used to determine the band structure and self-energy.

Work supported by the DOE Office of Science, BES, Division of Materials Science & Engineering.

References:

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