The Mesoscopic X-ray Edge Problem

Martine Hentschel*

Department of Physics, Duke University,Box 90305, Durham, NC 27708-0305, U.S.A.

Due to a phenomenon called Anderson orthogonality catastrophe, the overlap between the ground states of a system before and after the application of a perturbation vanishes in the limit of infinite particle number. One example is the sudden perturbation caused by an x-ray photon exciting a core electron into the conduction band. The interaction with the core hole left behind modifies the one particle energies and wavefunctions of the conduction electrons, giving rise to such an orthogonality between the many-body ground states. The photoabsorption cross section depends furthermore on other processes beyond the naive classical picture, leading to what is known as the x-ray edge problem of metals. Here, we study the same phenomena, but for mesoscopic objects like nanoparticles where the energy levels obey random matrix statistics rather than being equally spaced. We study the effects of the resulting mesoscopic fluctuations on the ground state overlap and on the photoabsorption spectrum.

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