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Role of multiple subband renormalization in the electronic transport of correlated oxide superlattices

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Metallic behavior of band-insulator/ Mott-insulator interfaces was observed in artificial perovskite superlattices such as in nanoscale $SrTiO_3/LaTiO_3$ multilayers [1]. For the theoretical description of the parallel transport at low temperatures we identify two major ingredients relevant for such systems: a) the quantum confinement of the conduction electrons leads to a complex, quasi-two dimensional subband structure with both hole- and electron-like Fermi surfaces. b) strong electron-electron interaction answers for a substantial renormalization of the quasi-particle dispersion. Both aspects are well captured in the finite-U slave-boson mean-field description of an extended Hubbard model for the band-insulator/Mott-insulator heterostructure [2].

In our study we focus on the optical conductivity and on the Seebeck coefficient [3]. The results for the optical conductivity can be compared with recent experiments [4] to estimate key parameters. On the other hand, the Seebeck coefficient is sensitive to details of the dominant scattering mechanism. As an example, we study the s-wave impurity scattering in the Born and the unitary limit. Since the subband contributions are weighted differently in the two limits, the Seebeck coefficient is either dominated by the weakly or the strongly renormalized subbands leading to different characteristic behavior.

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