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Double Super-Exchange in Silicon Quantum Dots Connected by Short-Bridged Networks[1] HUASHAN LI, ZHIGANG WU, MARK LUSK, Colorado School of Mines — Silicon quantum dots (QDs) with diameters in the range of 1-2 nm are attractive for photovoltaic applications. They absorb photons more readily, transport excitons with greater efficiency, and show greater promise in multiple-exciton generation and hot carrier collection paradigms. However, their high excitonic binding energy makes it difficult to dissociate excitons into separate charge carriers. One possible remedy is to create dot assemblies in which a second material creates a Type-II heterojunction with the dot so that exciton dissociation occurs locally. This talk will focus on such a Type-II heterojunction paradigm in which QDs are connected via covalently bonded, short-bridge molecules. For such interpenetrating networks of dots and molecules, our first principles computational investigation shows that it is possible to rapidly and efficiently separate electrons to QDs and holes to bridge units. The bridge network serves as an efficient mediator of electron superexchange between QDs while the dots themselves play the complimentary role of efficient hole superexchange mediators. Dissociation, photoluminescence and carrier transport rates will be presented for bridge networks of silicon QDs that exhibit such double superexchange.

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Huashan Li
Colorado School of Mines

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