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Understanding temperature-dependent bulk transport in samarium hexaboride without relying on in-gap states[1] ALEXA RAKOSKI, YUN SUK EO, KAI SUN, CAGLIYAN KURDAK, Univ of Michigan - Ann Arbor —
We present a new model to explain the difference between the transport and spectroscopy gaps in samarium hexaboride (SmB_6), which has been a mystery for some time. We propose that SmB_6 can be modeled as an intrinsic semiconductor with a screening length that diverges at cryogenic temperatures. In this model, we find a self-consistent solution to Poisson's equation in the bulk, with boundary conditions based on Fermi energy pinning due to surface charges. The solution yields band banding in the bulk; this explains the difference between the two gaps because spectroscopic methods measure the gap near the surface, while transport measures the average over the bulk. We also connect the model to transport parameters, including the Hall coefficient and thermopower, using semiclassical transport theory. The divergence of the screening length additionally explains the 10-12 K feature in data for these parameters, demonstrating a crossover from bulk dominated transport above this temperature to surface-dominated transport below this temperature. We find good agreement between our model and a collection of transport data from 4-40 K. This model can also be generalized to materials with similar band structure.

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