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Thermally-driven Isotope Separation Across Nanoporous Graphene[1] JOSHUA SCHRIER, Haverford College — Experiment and theory indicate that a single graphene sheet is impermeable to gases even as small as helium; pores are required for transmission of atoms and molecules. Nanoporous forms of graphene, such as two-dimensional polyphenylene (2D-PP), consist of a regular array of sub-nanometer pores which can be used for separating atoms and molecules by size. Because the nanoporous graphene barrier is only an atom-thick, quantum tunneling plays a role in the the transmission of atoms through the nanoporous barrier, even at room temperature. This talk describes how the mass-dependence of the tunneling, combined with a temperature gradient, can be used to separate isotope mixtures under conditions where classical transmission cannot. Using transition state theory, we show that the zero-point and tunneling contributions lead to isotopic separations in opposite directions with respect to the temperature gradient. We examine the separation of ^{3}He/^{4}He across a 2D-PP membrane under modest temperature and pressure conditions. We will also describe 2D-PP bilayer structures that yield resonant tunneling of helium atoms, and new nanoporous graphene structures suitable for separating heavier noble-gas isotopes.

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