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Thermodynamics of nuclear transport[1] CHING-HAO WANG, PANKAJ MEHTA, Department of Physics, Boston University, Boston, MA 02215, MICHAEL ELBAUM, Department of Materials and Interfaces, Weizmann Institute of Science, Rehovot, Israel — Molecular transport across the nuclear envelope is important for eukaryotes for gene expression and signaling. Experimental studies have revealed that nuclear transport is inherently a nonequilibrium process and actively consumes energy. In this work we present a thermodynamics theory of nuclear transport for a major class of nuclear transporters that are mediated by the small GTPase Ran. We identify the molecular elements responsible for powering nuclear transport, which we term the "Ran battery" and find that the efficiency of transport, measured by the cargo nuclear localization ratio, is limited by competition between cargo molecules and RanGTP to bind transport receptors, as well as the amount of NTF2 (i.e. RanGDP carrier) available to circulate the energy flow. This picture complements our current understanding of nuclear transport by providing a comprehensive thermodynamics framework to decipher the underlying biochemical machinery.

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