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**Thermodynamics with information flow: Applications to Maxwell demons and biochemical sensing**

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Information is often perceived as an immaterial entity. However, since the birth of statistical physics, it has been argued, based on thought experiments by the likes of Maxwell, that there are physical thermodynamic implications to information manipulation. In this talk, I will discuss a unified framework for the information transfers between continuously interacting systems, describing how information generated in an auxiliary system can be utilized by another as a fuel for an otherwise impossible process. Indeed, while the joint system satisfies the second law, the entropy balance of each system is modified by an information term related to the mutual information between the pair of systems. I will then show how this result incorporates the traditional analysis of Maxwell's demon. In addition, I will use this framework to analyze the thermodynamics and energetics of biological sensory adaptation, employing the biochemical sensing network of *E. Coli* chemotaxis as a representative example.