Stochastic thermodynamics with martingales

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Stochastic thermodynamics is a thermodynamics theory for mesoscopic systems, such as, colloidal particles or microelectronic devices. Martingales are stochastic processes that model a gambler's fortune in a fair game of chance or stock prices in e cient capital markets. This seminar presents a connection between stochastic thermodynamics and martingale theory. We will derive that the exponential of the negative entropy production is a martingale. Subsequently, we will use the exponential martingale structure of entropy production to derive universal relations for fluctuations of entropy production. These include an integral fluctuation relation for entropy production at stopping times, an infimum law for entropy production, and a symmetry relation in the conditional distributions of first-passage times for entropy production. The last part of the talk is an illustration of these generic results in overdamped Langevin process.