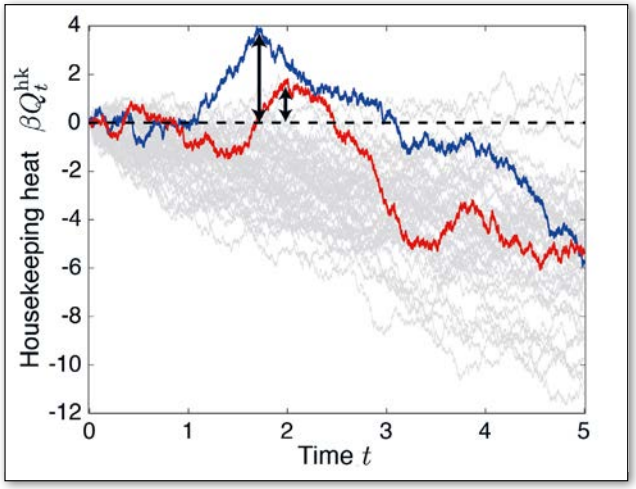
Highlights from European journals

STATISTICAL PHYSICS

Martingale theory for housekeeping heat



▲ Traces of fluctuating housekeeping heat (grey lines) behave like downtrend stocks. Our work investigates statistics of extrema (black arrows) against the average tendency.

Which universal thermodynamic properties emerge in a nonequilibrium process, in isothermal conditions at temperature T, that result from the violation of detailed balance, and how may they be quantified? The housekeeping heat is the fluctuating heat exchanged between a mesoscopic system and its environment due to the violation of detailed balance. Using the framework of martingale theory widely used in probability theory and finance, we derive a number of universal equalities and inequalities for extreme-value and stopping-time statistics of the housekeeping heat. Our theory provides a quantitative link between minimal models of gambling and financial markets (martingales) and heat fluctuations. The housekeeping heat behaves like a gambler's fortune in a casino: its expected value in the future is always smaller or equal regardless of its past values. The super-martingale structure of the housekeeping heat implies that certain statistical properties of the housekeeping heat are system-independent, *i.e.* universal. A particular result of our theory is that the average value of the maximum housekeeping heat that a system absorbs from its environment cannot exceed k_BT, with k_B Boltzmann's constant. ■

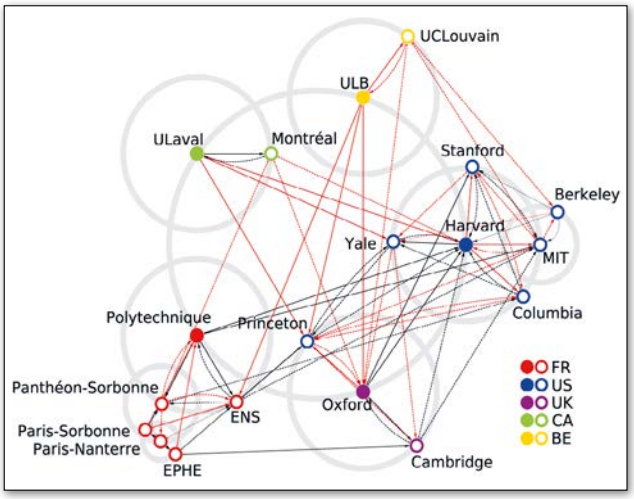
▮ **R. Chétrite**, **S. Gupta**, **I. Neri** and **E. Roldán**, 'Martingale theory for housekeeping heat', *EPL* **124**, 60006 (2018)

COMPLEX SYSTEMS

New university ranking system includes the cultural perspective

A new study proposes a new way of ranking universities, using a more balanced cultural view and based on 24 international editions of Wikipedia

Scientists in France have developed a new way of generating a ranking of the world's universities that places more emphasis on the cultural perspective. In a study published recently, the authors perform an analysis of Wikipedia editions in 24 languages, collected in May 2017—previous studies pursuing a similar approach focused on data from 2013. Employing well-known ranking algorithms, they establish a Wikipedia Ranking of World Universities based on the relative cultural views of each of the 24 language-specific Wikipedia editions. Thus, they provide a more balanced view that reflects the standpoints of different cultures. Specifically, the authors use (for the first time for this purpose) a new tool for the analysis of online networks, which is based on the PageRank algorithm and known as reduced Google Matrix analysis. In this study, they determine the interactions between leading universities on a scale of ten centuries, which provides insights into the relative influence of specific universities in each country. ■



▲ Network of friends of top 20 PageRank universities from the French Wikipedia edition.

▮ **C.Coquidé**, **J.Lages**, and **D. L. Shepelyansky**, 'World influence and interactions of universities from Wikipedia networks', *Eur. Phys. J. B* **92**, 3 (2019)