Séminaire de physique statistique

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Modeling the growth of cities

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The most fundamental problem for constructing a science of cities is to understand the hierarchical organization of city population and the statistical occurrence of megacities. This was first thought to be described by a universal principle known since almost a century as Zipf's law. However, the validity of this model has been challenged by recent empirical studies. In addition, a theoretical model must also be able to explain the rises and falls of cities and civilizations. Despite many attempts that I will briefly review here (the Gibrat and Gabaix models), these fundamental questions have not yet been satisfactorily answered. In this talk, starting from an empirical analysis of recent datasets (for Canada, France, the UK and the USA) I will derive a stochastic equation with multiplicative noises for modelling population growth in cities. This model reveals how rare, but large, interurban migratory shocks dominate city growth and predicts a complex shape for the distribution of city population. It also shows that, owing to finite-time effects, Zipf's law does not hold in general, implying a more complex organization of cities. It also predicts the existence of multiple temporal variations in the city hierarchy, in agreement with empirical observations.

Reference: V. Verbavatz, M. Barthelemy, "The growth equation of cities", Nature 587, 397-401 (2020).

The link to attend the talk on-line is: https://bbb.ipht.fr/b/mar-x7f-nkk