Abstract for GR-TR Conference on Statistical Mechanics and Dynamical Systems

Plenary Invited Invited Talk

New Approaches to the Modelling and Forecast of Epidemics in a World without Frontiers

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The efficiency of epidemic modelling and forecasts has suffered in the past from a poor description of the spatial dynamics. Accurate models are needed e.g. to test potential strategies to control the spread of an epidemic. While the local infection dynamics is well understood for many diseases, little was known about the statistical laws by which humans and their germs disperse. We have simulated the dispersal of pathogens by international air traffic in a comprehensive network model and used it to forcast the spreading of SARS; it can be used to test the efficiency of various control strategies.

To obtain a better spatiotemporal resolution we need the statistical laws governing human travel on all scales, i.e. by all means of transportation. As accurate data were previously not available, we have studied this problem empirically and theoretically using the dispersal of dollar bills as a proxy. The time dependent probability density obtained in this way exhibits pronounced spatiotemporal scaling and superdiffusive spreading, which we model by an ambivalent Lvy random walk. The empirical data can be described very accurately in terms of a bifractional diffusion equation with few parameters.

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[1] D. Brockmann, L. Hufnagel, and T. Geisel, *Nature* **439**, 462 (2006).

[2] Hufnagel, D. Brockmann, and T. Geisel, *PNAS*, **101**, 15124 (2004).