Statistical Mechanics far from Equilibrium

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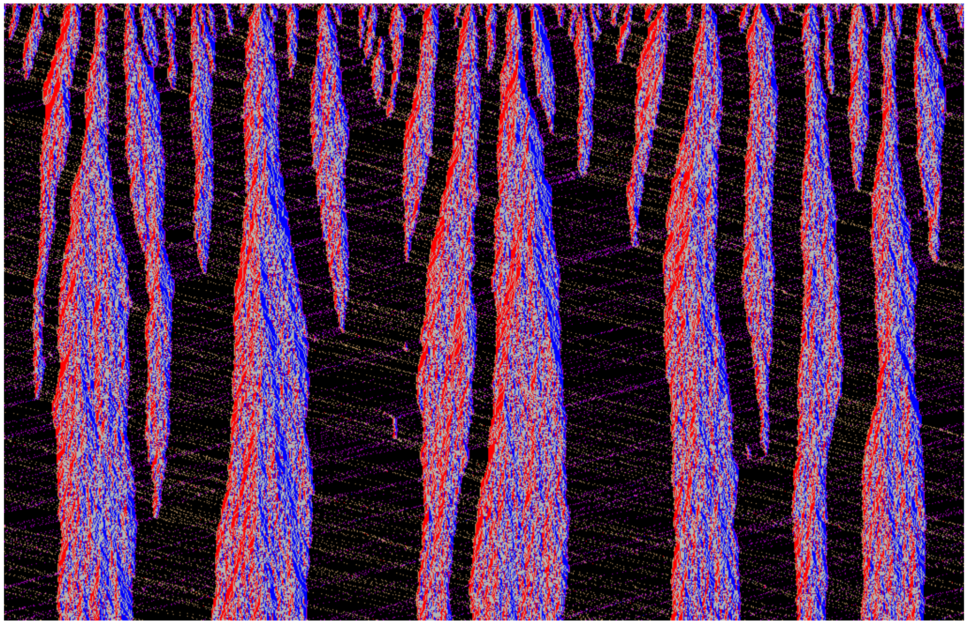
How do traffic jams form on a long road? Will a driver encounter few large jams, or many smaller ones? How fast will the jams grow in time? Analyzing a simple model of fast and slow cars, we discovered that the answer depends sensitively on the number of lanes. For a single-lane road, many small jams form and persist; for two lanes or more, small jams form initially but then merge into bigger ones until, eventually, only a single jam remains. In this case, the average jam size increases with time t as $t^{2/3}$ which is much faster than in related models.

Traffic falls into the realm of non-equilibrium phenomena. The fundamental understanding of such complex systems, consisting of many interacting components and carrying energy or mass currents, forms a central goal of modern statistical physics.

I.T. Georgiev, B. Schmittmann and R.K.P. Zia, Phys. Rev. Lett. ***94****, 115701* (2005) *and to be published.*



Space-time plot of jam formation on a two-lane ring road. Time (space) runs vertically (horizontally). Red (blue) pixels represent fast (slow) cars, driving from left to right and viewed from a co-moving frame. Black pixels are empty parts of the road. The cars are initially randomly distributed along the road and begin to form jams since fast cars need some time to pass slow cars. With time, small jams disappear, leaving fewer but larger jams behind.

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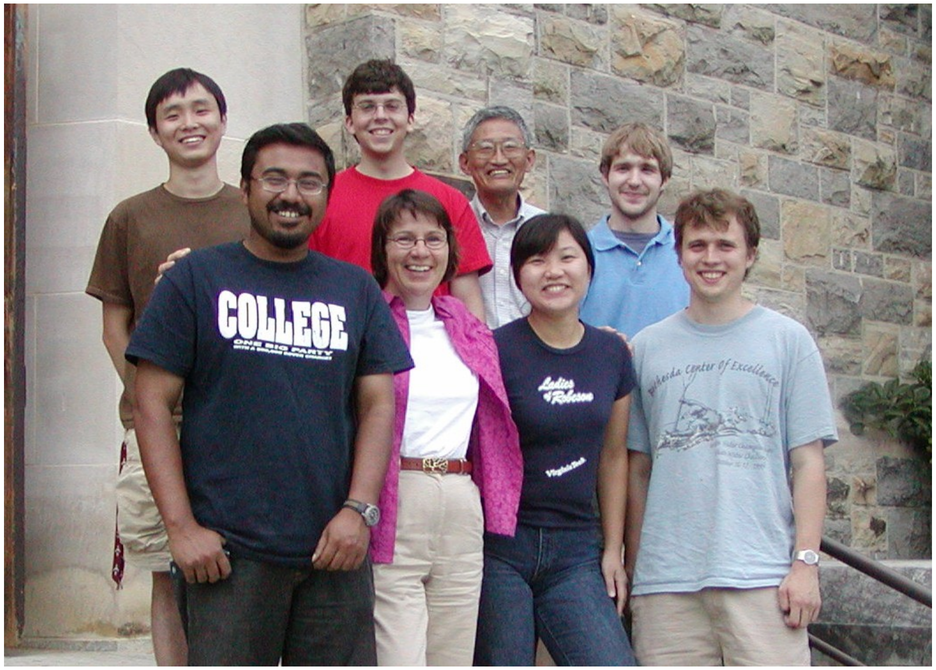
Education and outreach:
Undergraduate and graduate research is an important component of our project. In particular, undergraduates often conduct pilot studies in order to explore a more speculative issue. If an intriguing discovery results, we know that a full-scale analysis will be worth the effort. The work outlined here was first initiated by an undergraduate student, Jay Mettetal (now at MIT). Currently, five undergraduates, *David Adams, Mike Avery, David Erickson, Sam Gong and Brian Skinner* and two graduate students, *Jiajia Dong and Sayak Mukherjee*, are partly supported by this project.



Back row, from left: Sam Gong, Mike Avery, Royce Zia, and David Adams; front row, from left: Sayak Mukherjee, Beate Schmittmann, Jiajia Dong and Brian Skinner. David Erickson (not in photo) won a fellowship to spend part of his summer at UCLA.