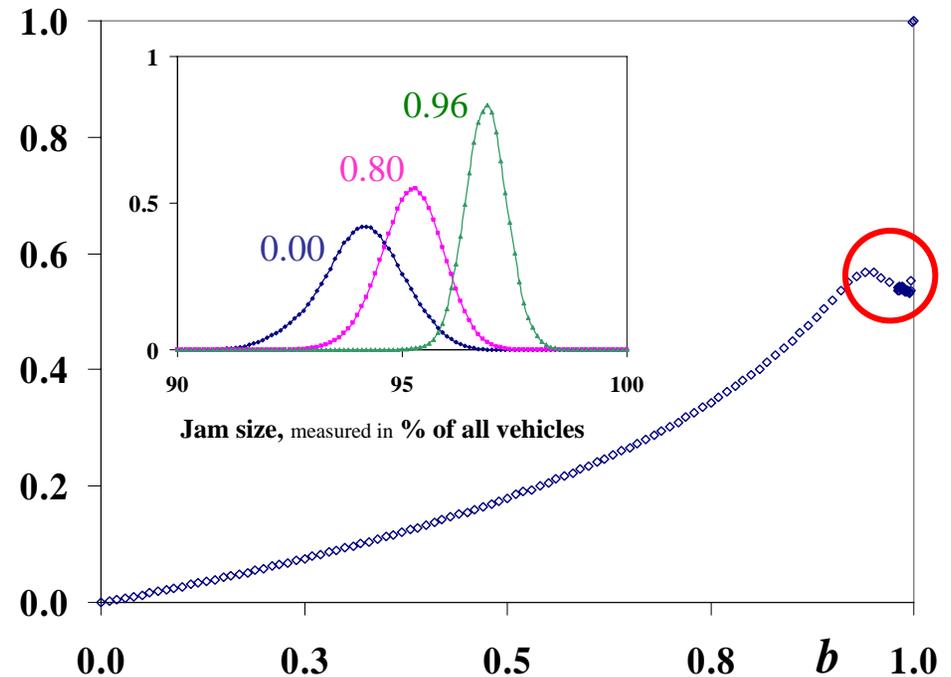# Statistical Mechanics far from Equilibrium

Beate Schmittmann and Royce K.P. Zia,
Virginia Tech, DMR-0088451 and 0414122

Do traffic jams ease when trucks prefer the slow lane? In a simple model of cars and trucks on a 2-lane interstate, we vary *b,* the preference of drivers for one of the two lanes. If *b*=0, drivers change lanes randomly; if *b*=1, cars stick to the fast, and trucks to the slow lane. Surprising pheno-mena abound as *b* increases: first, jams get *longer*, but worse, vehicles can get *pushed out* of their preferred lanes (i.e., *negative* response)! These findings illustrate that we must reshape our intuition when faced with a typical non-equilibrium (open, current-carrying) system.

J. Krometis, B. Schmittmann and R.K.P. Zia, to be published (2004).

Fractional excess of cars over trucks in the fast lane, *vs. b*.
The region of *negative response* is circled in red.
Inset: Distribution of jam sizes, for three values of *b* (0.00, 0.80, and 0.96).

Statistical Mechanics far from Equilibrium

Beate Schmittmann and Royce K.P. Zia,
Virginia Tech, DMR-0088451 and 0414122

Education:

Undergraduate research is an important component of these projects. Three students have contributed over the past year: Heike Lohse-Busch, Brian Skinner, and David Erickson. Two others, David Newton and David Adams, are just starting. Students gain a broad overview of equilibrium and non-equilibrium statistical physics, learn the basics of scientific computing, and become familiar with modeling and data analysis techniques

Outreach:

Probability theory and statistics require careful thinking. Even simple random walks offer challenges, if we attempt to analyze incomplete data sets. In "Watching a drunkard for ten nights: A study of distributions of variances" (*Am. J. Phys.* **71**, 859, 2003), the PIs illustrated these subtleties for a wider audience. They also teach at various summer schools, and participate in national and international programs to advance women in science and engineering.