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 phenomena 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.


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).
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.