

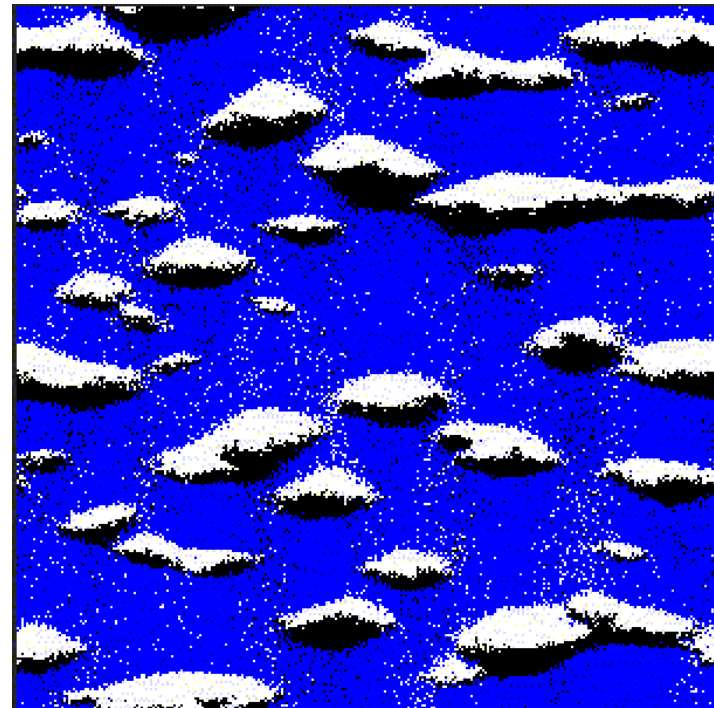
# Statistical Mechanics far from Equilibrium

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Physical intuition, schooled in equilibrium statistical physics, can be misleading when faced with non-equilibrium (open, current-carrying) systems. Diffusion generally tends to homogenize particle densities, allowing only short-range spatial correlations. Dramatic differences emerge when two diffusing particle species ('charges') experience an external force ('electric field') driving them into opposite directions. Long-range correlations and cloud-like clusters are some of the most striking consequences. Models of this type capture many features of vehicular and pedestrian traffic jams, and can even be applied to protein synthesis.

*J. Phys.* **A36**, 4936 (2003); *Phys. Rev.* **E68**, 021910 (2003).



Particle clusters on a periodic square lattice. White (black) particles drift down (up); when they meet, they must step sideways to pass. Bigger “clouds” grow at the expense of smaller ones, until only a single one survives.

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## Education:

Jay Mettetal, a Goldwater scholar and winner of an NSF Graduate Fellowship, was one of five undergraduates working on this project. He analyzed the rapid growth of traffic jams on two-lane roads. Two recent PhDs decided to share their love of physics with the next generation: Robert Astalos now teaches at Feather River (California) and Irina Mazilu at Hanover College (Indiana).



This newspaper photograph shows BS (front center) at the formal opening of the International Science Center in Essen, Germany (Neue Ruhr Zeitung 11/12/02).

## 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 taught at various summer schools, and participate in national and international programs to advance women in science and engineering.