

# Simple Rules Capture Nature's Complexity



M. Cristina Marchetti

William R. Kenan, Jr Professor of Physics

## CURRENT RESEARCH

### Predicting complex organization using simple physical rules

A flock of starlings folds in the sky like a soft cloud, a sheet of cells under the microscope moves as a single cohort and reveals geometric patterns. Can we identify simple laws that govern the organization of such seemingly complex systems? Dr. Cristina Marchetti, the William R. Kenan Professor of Physics at Syracuse University, is a soft matter physicist that studies "active matter" - a term coined to describe assemblies of self-driven entities, such as birds, bacteria, or engineered microswimmers, that take energy from the environment to produce coordinated motion.

One may think that the rich patterns seen in nature must be controlled by complex communication pathways or biochemical signaling. Work by Dr. Marchetti and others over the last two decades has shown, however, that the organization seen on scales from bird flocks to living tissues can emerge from simple physical rules similar to those controlling the organization of familiar inert matter. This provides a new powerful mathematical framework for understanding emergent phenomena in nature, where large groups exhibit coordinated behaviors that are very different from those of the individuals. Using theory and computer simulations, and working closely with colleagues from experimental physics, biology and engineering, Dr. Marchetti develops the minimal rules that are needed to understand such emergent behavior. In other words, can physical rules explain how organizing operates?

Dr. Marchetti's research brings together ideas and techniques from soft matter and statistical mechanics to describe a broad range of systems that are far from thermal equilibrium. These include subcellular structures that control the motility of individual cells...

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## AFFILIATION



Syracuse University

## EDUCATION

- Ph.D. in Physics, University of Florida Gainesville
- Laurea in Physics, University of Pavia, Italy

## AWARDS

- Fellow of the American Physical Society and of the American Association for the Advancement of Science
- Member of the American Academy of Arts & Sciences
- Co-Editor of Annual Reviews of Condensed Matter Physics
- Simons Fellowship in Theoretical Physics, 2013
- National Science Foundation Creativity Award, 2001

## RESEARCH AREAS

Technology, Materials Science / Physics

## FUNDING REQUEST

Your contributions will support the continued theoretical research of Dr. Cristina Marchetti, of Syracuse University, and the students that she helps to transform into independent scholars. Donations will fund the necessary \$75K/year for postdocs, \$45-50K/year for graduate students and an additional \$3-5K/year for travel and computing funds for each member of the lab. In choosing to donate, you will play a role in developing the frameworks for future technologies and innovations.