
MATT BIERBAUM

PHYSICS | SIMULATION | WEB

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425 Clark Hall
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EMPLOYMENT

2016 Postdoc - Cornell University, advisor James P. Sethna

EDUCATION

2009 - 2016 Cornell University - Ph.D. Physics, advisor James P. Sethna

2009 - 2012 Cornell University - M.S. Physics, advisor James P. Sethna

2005 - 2009 Northwestern University - B.A. Physics and Integrated Science, advisor Frederic Rasio

RESEARCH

CURRENT

Collective motion at heavy metal concerts

- Covered by NPR, Times, Atlantic, PopSci, NBC, NatGeo with 0.7M pageviews
- Described the phase transition between mosh and circle pit with GPU simulation of 1M agents

Zombie disease dynamics

- Featured on WaPo, WSJ, CBS, NBC, CBC, Smithsonian, HuffPo with 1.2M pageviews
- Modelled spread of zombieism across the continental US
- High performance interactive web simulation in JS incorporating full US population

Precision image featuring

- Extracting parameters from microscope images at the information limit (~1 nm)
- Created optimized open-source Python package available on PyPI

Continuum plasticity

- Dynamics of line defects in metals using PDEs simulated in CUDA
- Performed super computer computations with MPI / GPUs over 1M core-hours

OpenKIM pipeline

- Designed and implemented distributed computing environment for interatomic potentials
- Created frontend, backend, and testing framework used by hundreds of material scientists

Colloidal stresses - developing experimental techniques to measure forces in suspensions

Surface energies - using OpenKIM framework to create broken bond fits to surface energies

Phonon spectra - employing symmetries to create small parameter fits for phonon spectra

Smectic A - creation and dynamics of focal conic defects in layered materials

PAST

Globular cluster dynamics - formation of intermediate mass black holes in primordial clusters

Hidden paintings - using subsurface scattering to infer paintings below the surface

EXPERIENCE & SKILLS

GENERAL

Numerical simulation (PDEs, automata, MC) || High performance computing and GPUs || Constraint satisfaction || Analytical prediction || Data analysis

MAJOR

Python || C / C++ || CUDA || Javascript || Linux || Git || Vim || HTML5 / Canvas || CSS || AWS

MINOR

Web{Sockets,Workers} || SQL || MongoDB || Java || GLSL || GIS || Arduino || Blender || etc

PUBLICATIONS

- PUBLISHED**
- Deformation of crystals: Connections with statistical physics** – Sethna et. al – arXiv:1609.05838
 - Measuring nonlinear stresses generated by defects in 3D colloidal crystals** – Lin, Bierbaum, Schall, Sethna, Cohen – Nature Materials 2016
 - The weirdest martensite: Smectic liquid crystal microstructure and Weyl-Poincare invariance** – Liarte, Bierbaum, Mosna, Kamien, Sethna – PRL 116, 147802 2016
 - "Irregularization" of Systems of Conservation Laws** – Swan, Choi, Papanikolaou, Bierbaum, Chen, Sethna – arXiv:1506.05743
 - You can run, you can hide: The epidemiology and statistical mechanics of zombies** – Alemi, Bierbaum, Myers, Sethna – Phys Rev E 92, 052801 2015
 - Visualization, coarsening and flow dynamics of focal conic domains in simulated Smectic-A liquid crystals** – Liarte, Bierbaum, Zhang, Leahy, Cohen, Sethna – Phys Rev E 92 6, 062511 2014
 - Collective motion of humans in mosh and circle pits at heavy metal concerts** – Silverberg, Bierbaum, Sethna, Cohen – PRL 110 (22) 228701 2013
 - Scaling theory of continuum dislocation dynamics in three dimensions: Self-organized fractal pattern formation** – Chen, Choi, Papanikolaou, Bierbaum, Sethna – IJP 46, 94-129 2013
 - Formation of Massive Black Holes in Dense Star Clusters. II. Initial Mass Function and Primordial Mass Segregation** – Goswami, Umbreit, Bierbaum, Rasio – APJ 752 (1), 43 2012
- PREPARATION**
- Locating Colloidal Spheres at the Information Theoretic Limit** – Bierbaum, Leahy, Alemi, Cohen, Sethna
 - OpenKIM Processing Pipeline: A Virtual Machine Cloud-Based Automatic Materials Property Computation Engine** – Bierbaum, Alemi, Karls, Wennblom, Elliott, Tadmor, Sethna
 - X-ray Analysis of Continuum Dislocation Dynamics** – Bierbaum, Kent-Dobias, Choi, Chen, Sethna

INTERESTS

- DAILY**
- Bicycles - Carbon road, single speed road, single speed mountain bike
 - Short films / photography - filming, editing, timelapse
 - Fun physics - cost of a pot hole, physics of bubbles, projects below
- PROJECTS**
- Cupgame chaos* - formation of fractals from carnival games || *Plinko simulation* - investigating 'Price is Right' game || *Clicky* - one shared dot for the entire internet || *Onelook* - Ludum dare game uses light as game mechanic || *Billiards* - statistical study of pool shots