

Yifeng Qi

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Education

Massachusetts Institute of Technology (MIT)

Ph.D. in Theoretical Chemistry/Computational Biophysics

Cambridge, Massachusetts

Sept. 2016-Present

University of California, Los Angeles (UCLA)

Cross-disciplinary Scholars in Science and Technology Program

Los Angeles, California

July-Sept. 2015

University of Science and Technology of China (USTC)

B.S. in Chemical Physics

Hefei, China

Sept. 2012-June 2016

Research Interests

Computational modeling of biological systems from proteins to human genome, with potential applications to protein structure-function relationship and rational drug design using computational chemistry and machine learning

Research Experiences

○ Predictive modeling of 3D organization of individual human chromosomes

with Prof. Bin Zhang (MIT)

Feb. 2017 - Mar. 2018

- Developed and applied Maximum Entropy Algorithm to enable predictive modeling of 3D chromosomal structure
- Coded up core energy force field in Python and performed large-scale molecular dynamics simulations to generate structural ensemble of chromosomes and conducted statistical data analysis on simulated data

○ Data-driven modeling of whole-nucleus 3D human genome

with Dr. Alejandro Reyes (Broad) and Prof. Bin Zhang (MIT)

April 2019 - Feb. 2020

- Developed efficient data-driven modeling approach by extending the Maximum Entropy Algorithm to a whole-nucleus scale and identified important mechanisms dictating genome organization
- Coded up an open-source software in Python with three other languages and opened up various new research directions on mechanistic investigations of genome structure

○ Whole-genome modeling of genome reorganization in tumorigenesis

with Martin Aryee Lab (HMS/Broad) and Bradley Bernstein Lab (MGH/Broad)

Mar. 2019 - June 2020

- Applied whole-nucleus genome organization modeling on real-patient data and revealed for the first time a large-scale reorganization of 3D genome organization in colorectal tumor cells in a quantitative manner
- Led computational modeling part in a massive collaboration among Harvard, MIT, Broad Institute and MGH

○ Deep learning-based characterization of chromatin folding landscape

with Dr. Wenjun Xie and Prof. Bin Zhang (MIT)

Feb. 2019 - Oct. 2019

- Applied variational autoencoder together with *in silico* polymer model systems to analyze the fluctuation and heterogeneity of chromatin structures generated by single-cell imaging experiments

Papers

*Equal contribution.

Yifeng Qi, Bin Zhang. Predicting three-dimensional genome organization with chromatin states. *PLoS Computational Biology*, 15.6 (2019): e1007024.

Yifeng Qi, Alejandro Reyes, Sarah E. Johnstone, Martin J. Aryee, Bradley E. Bernstein, Bin Zhang. Data-driven polymer model for mechanistic exploration of diploid genome organization. *Biophysical Journal*, in press.

Sarah E. Johnstone*, Alejandro Reyes*, **Yifeng Qi**, et al. A topological atlas reveals layers of genome reorganization in colorectal cancer, *Cell*, 182.6 (2020): 1474-1489.

Wenjun Xie, **Yifeng Qi**, Bin Zhang. Characterizing chromatin folding coordinate and landscape with deep learning, *PLoS Computational Biology*, <https://doi.org/10.1371/journal.pcbi.1008262>.

Liangqi Xie, ..., **Yifeng Qi**, ..., Robert Tjian, Zhe Liu. 3D ATAC-PALM: Super-resolution Imaging of the Accessible Genome. *Nature Method*, 17.4 (2020): 430-436.

Zhaowei Chu, ..., **Yifeng Qi**, ..., Bin Zheng. STAG2 regulates interferon signaling in melanoma via enhancer loop reprogramming. *Submitted*.

Tao Chen, Tao Chen, Sheng Chen, Yuwei Zhang, **Yifeng Qi**, Yuzhou Zhao, Weilin Xu, Jie Zeng. Catalytic Kinetics of Different Types of Surface Atoms on Shaped Pd Nanocrystals. *Angewandte Chemie International Edition*, 55 (2016): 1839-1843.

Yifeng Qi, Bin Zhang. Exploring the free energy landscape of nucleolar coalescence in human cell nucleus. *In preparation*.

Xingcheng Lin*, **Yifeng Qi***, Andrew Latham, Bin Zhang. Learning mechanisms of genome folding with maximum entropy optimization. *In preparation*.

Liangqi Xie*, Peng Dong*, **Yifeng Qi***, et al. Super-resolution Imaging Reveals 3D Structure and Organizing Mechanism of Accessible Chromatin. *In preparation*.

Talks and Posters

Talks

- NSF-funded Genome Architecture and Function Workshop MIT, June 2020
- MIT Biophysics Retreat Cape Code MA, Oct. 2019
- Annual Greater Boston Area Statistical Mechanics Meeting Brandeis University, Oct. 2019
- Models, Inference & Algorithms (MIA) Seminar Broad Institute, Mar. 2019
- Annual Greater Boston Area Statistical Mechanics Meeting Brandeis University, Oct. 2018
- Annual Greater Boston Area Statistical Mechanics Meeting MIT, Oct. 2017

Posters

- The Biophysics Society (BPS) Annual Meeting San Diego CA, Feb. 2020
- Molecular Biophysics in the Northeast Meeting Northeastern University, Nov. 2019
- Gordon Research Conference-Stochastic Physics in Biology Ventura CA, Jan. 2019
- MIT Biophysics Retreat Cape Code MA, Oct. 2018
- Keystone Symposia-Chromatin Architecture and Chromosome Organization Whistler (Canada), Mar. 2018

Selected Awards

- Biophysics Society Graduate Student Award BPS, 2020
- Lester Wolfe Fellowship MIT, 2017/2020
- Guo Moruo Scholarship (the highest honor for USTC graduates) USTC, 2015
- Cross-disciplinary Scholar Science & Technology Scholarship UCLA, 2015
- National Scholarship (top 1% nationwide) P.R.China, 2014
- National Olympiad Competition in Chemistry 1st Prize P.R.China, 2011

Skills

Languages Python, C, Matlab, Fortran, Shell, \LaTeX
Software LAMMPS, VMD, Gaussian09, Github
Package Development DRAGON (Github link: <https://github.com/ZhangGroup-MITChemistry/DRAGON>)
Courses Statistical Mechanics, Statistical Physics Biology, Physical Biology, Machine Learning, Algorithms for Inference, Physics in Immunology, Computational Biology, Quantum Mechanics

Teaching Experiences

- Principle of Chemical Science (TA) MIT, Sept. 2016-June 2017
- Quantum Physics (TA) USTC, Sept.-Dec. 2015

Activities

Scientific Journal reviewer for *Quantitative Biology*; Co-host for *Greater Boston Area Theoretical Chemistry Lecture Series*

Extra-Curricular MIT Rowing Club; MIT Rock Climbing Club