Curriculum Vitae

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Heungwon Park
Status: Postdoctoral Research Associate

CONTACT INFORMATION

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EDUCATION

University of Chicago, Chicago, IL USA
Ph.D. in Physics (2010)
Thesis Topic: Fluctuation/response relation in bacterial chemotaxis
Advisor: Professor **Philippe Cluzel** (now a Professor in the Department of Molecular and Cellular Biology in FAS and the Gordon McKay Professor of Applied Physics in SEAS, Harvard University)

Inha University, Incheon, Korea
M.S. in Physics (1996)
Thesis Topic: Critical phenomena in non-equilibrium reaction model systems
Advisor: Professor **Hyunggyu Park** (now a Professor in the School of Physics, Korea Institute for Advanced Study (KIAS))

Inha University, Incheon, Korea
B.S. in Physics (1994)

RESEARCH EXPERIENCE

Basic Sciences Division
Fred Hutchinson Cancer Research Center, Seattle, WA USA
Advisor: Professor **Arvind Subramaniam** (January 2016-present)

1. Developing kinetic model on ribosome dynamics on mRNA based on temporal measurements of fluorescent protein expression with different codon variants at the single cell level in budding yeast.

Department of Biology and Department of Physics
Duke University, Durham, NC USA
Advisor: Professor **Nicolas E. Buchler** (September 2010-Dec 2015)

1. Experimental and theoretical model studies on dynamical behaviors of protein sequestration based synthetic genetic oscillatory circuits in budding yeast.

2. Experimental and theoretical model studies on long term transient oscillations in cell sizes and constitutive gene expressions in bacteria.

3. Developing fast timelapse luminescence microscopy for single budding yeast cells.

4. Developing a microfluidic device for single cell experiments of many different organisms from bacteria to mammalian cells.

5. Developing a microfluidic device for single cell level studies of malaria parasite and its gene expression dynamics in red blood cells.

University of Chicago, Chicago, IL USA
Advisor: Professor **Philippe Cluzel** (Summer 2001, December 2002-June 2010)

1. Experimental studies at the single cell level on the relationship between spontaneous fluctuations and cellular response to an external stimulus in bacterial chemotaxis.

2. Experimental studies on how the sensitivity of chemotactic response varies depending on the relative chemotactic protein concentration.
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3. Experimental and theoretical model studies on how the signaling noise affects to the switching behavior of the Bacterial Flagellum.

Inha University, Incheon, Korea
Advisor: Professor **Hyunggyu Park** (March 1994 - February 1996)

1. Simulation studies on the critical phenomena of the non-equilibrium absorbing phase transition model systems.

TECHNICAL SKILLS

Microscopy:

I used Total Internal Reflection Fluorescence (TIRF) microscopy.
For my Ph.D. works in Cluzel lab, I developed and used a setup for microscopic observation of the rotational motion of the single motor of individual E.coli cells. To develop this experimental setup, I combined many different devices such as optical lenses, mirrors, light filters, mechanical shutters, a strong UV illuminator and a photo detector with a microscope and controlled them by LabVIEW.
For single cell experiments in Buchler lab, I am using an automatized microscope, DeltaVision (with a phase objective) and microfluidic devices, such as CellASIC and home-made PDMS microfluidic devices for single cell level experiments.

Flow cytometry: MACS Quant VYB

Cloning:

I constructed plasmids which are needed to develop protein sequestration based synthetic genetic circuits in budding yeast which show excitable and oscillatory behaviors in its gene expression dynamics.
I constructed plasmids to express chemotactic proteins with the fluorescent tags, i.e. YFP-CheR and CheB-CFP for Bacterial Chemotaxis experiments.

Computational methods:

I used Monte Carlo simulations to study about critical phenomena in non-equilibrium phase transition model systems.

Programming languages:

C, idl, Matlab, LabVIEW and COPASI

Micro-fluidic device:

I fabricated and used PDMS microfluidic devices for single cell experiments of various model systems such as bacteria, malaria infected red blood cells, mammalian cells, budding yeasts and other fungi.

PUBLICATIONS

Publications: 287 citations (by January 2016)
https://scholar.google.com/citations?user=k1cGj8AAAAAJ&hl=en

1. Y. Tanouchi*, A. Pai*, **H. Park***, S. Huang, R. Stamatov, N.E. Buchler and L. You, *A noisy linear map underlies oscillations in cell size and gene expression in bacteria:* Nature 523, 357-360 (2015). * These authors contributed equally to this work.
2. A. Mazo-Vargas, **H. Park**, M. Aydin and N.E. Buchler, *Measuring fast gene dynamics in single cells with timelapse luminescence microscopy:* Molecular Biology of the Cell v25, p3699-3708 (Nov. 5, 2014).
3. **H. Park** et al. *Noise underlies switching behavior of the bacterial flagellum:* Biophysical Journal 101(10), p. 2336-2340 (2011).
4. **H. Park** et al. *Fine-Tuning of Chemotactic Response in E. coli Determined by High-Throughput Capillary Assay:* Current Microbiology 62 (3), 764-769 (2011).
5. **H. Park** et al. *Interdependence of behavioral variability and response to small stimuli in bacteria:* Nature 468, 819-823 (2010).
6. Korobkova, E.A., Emonet, T., **Park, H**. and Cluzel, P., *Hidden stochastic nature of a single bacterial motor.* Phys Rev Lett, 2006. **96**(5): p. 058105.

7. Bainer, R., **H. Park**, and P. Cluzel, *A high-throughput capillary assay for bacterial chemotaxis.* J Microbiol Methods, 2003. **55**(1): p. 315-9.
8. Hwang, W., Kwon, S., **Park, H.** and Park, H., *Critical phenomena of nonequilibrium dynamical systems with two absorbing states.* Physical Review E, 1998. **57**(6): p. 6438-6450.
9. H. Park and **H. Park**, *Critical behavior of an absorbing phase transition in an interacting monomer-dimer model.* Physica A, 1995. **221**(1-3): p. 97-103.
10. **H. Park**, M.H. Kim, and H. Park, *Dynamic scaling behavior of an interacting monomer-dimer model.* Physical Review E, 1995. **52**(5): p. 5664-5666.

PAPER REVIEWS

I reviewed two Physical Review Letters (2015 & 2013) and one Physical Review X (2014) papers with Professor Nicolas E. Buchler.

TEACHING EXPERIENCE

TA at the University of Chicago:

Phys 142: General Physics II (Honors) (Winter 2010)
Phys 121, 131: General Physics I (Autumn 2009)
Phys 143: General Physics III (Honors) (Spring 2009)
Phys 142: General Physics II (Honors) (Winter 2009)
Phys 121: General Physics I (Autumn 2008)
Phys 123: General Physics III (Spring 2008)
Phys 237: Nuclei and Elementary Particles (Spring 2003)
Phys 121,122,123,131,132,133: General Physics I, II and III (Autumn 2000 – Winter 2003)

TA at Inha University

Mathematical Methods in Physics (Fall 1995)
Statistical and Thermal Physics (Spring 1995)

ADVANCED COURSEWORK

Quantum Field Theory (I, II, III)
Many Body Theory
Soft Condensed Matter Physics
Biological Physics
Solid State Physics

HONORS

Best undergraduate student in Physics (Inha University, 1994)

CONFERENCES

Talks:

"A synthetic oscillator couples to the cell division cycle in budding yeast": The ninth q-bio summer conference (Virginia Tech, Blacksburg, Virginia, August 5-8, 2015). A contributed talk.

Posters:

"Microfluidics, Excitable/Oscillatory circuit in Budding Yeast": DARPA Biochronicity meeting (San Francisco CA, Jan. 7-8, 2014)

"Relationship between behavioral variability and adaptation in bacterial chemotaxis": BLAST meeting (Laughlin NV., Jan. 8-12, 2007)

"Critical behavior in an absorbing phase transition of a non-equilibrium interacting monomer-dimer model": Korean physical society spring meeting (1995)

Attended:

19th IUPAP Conference on Statistical Physics (Xiamen, PRC, July 31-Aug. 4, 1995)