Hyun Youk

Contact Information

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Research Focus

Non-equilibrium Capacity of Living Systems - Elucidating Physical Principles that Dictate the Inevitability & Irreversibility of Its Loss. Specifically:

- **Self-organizing Capacity**: Exploring how biological time progresses towards increased and maintained spatial order, including patterns, structures, and self-replication dynamics; why and how self-organizing capacity is inevitably and irreversibly lost.
- **Inevitability of Death**: Investigating the physical principles that dictate the inevitable and irreversible cessation of biological time.

Current Position

Associate Professor of Systems Biology **11/2020 - Present**
University of Massachusetts Chan Medical School, MA USA
Department of Systems Biology

Past Positions

Assistant Professor of Physics & Quantitative Biology **01/2015 - 10/2020**
Delft University of Technology, The Netherlands
Kavli Institute of Nanoscience

Damon Runyon Postdoctoral Fellow **2011 - 2014**
Laboratory of Wendell Lim - University of California, San Francisco, USA

Education

Massachusetts Institute of Technology, MA USA **2006 - 2010**
Ph.D. in Physics

Johns Hopkins University, MD USA **2004 - 2006**
M.A. in Astronomy & Physics

University of Toronto: *Victoria College*, Canada **2000 - 2004**
Honours B.Sc. in Physics & Mathematics (*"high distinction"* designation)

Selected Awards

2022 - NIH-NIGMS Maximizing Investigators' Research Award (MIRA)
2018 - EMBO Young Investigator
2018 - CIFAR Azrieli Global Scholar
- CIFAR: Canadian Institute For Advanced Research
- 2-year appointment at CIFAR for junior PIs of any nationality and country of residence.

2017 - IUPAP Young Scientist Prize in Biological Physics
- IUPAP: International Union of Pure and Applied Physics
- International award for young investigators within 8 years of obtaining a PhD.

2016 - Teacher of the Year Award in Nanobiology (Quantitative biology) program, TU Delft
2016 - Dutch Organization for Scientific Research (NWO) VIDI Physics Award
- 5-year personal grant from NWO's physics division (FOM).

2015 - European Research Council (ERC) Starting Grant
- 5-year personal grant for early career PIs in Europe.

2014 - NIH-NIGMS K99/R00 Pathway to Independence Award. - *Declined*
- 5-year grant to support postdoc-to-faculty transition and starting PIs in USA.

- *Declined due to my move to Europe.*

2011 - Damon Runyon Fellowship Award
- 3-year postdoctoral fellowship.

2011 - Jane Coffin Childs Memorial Fund Fellowship - *Declined*

2011 - Miller Research Fellowship (University of California, Berkeley) - *Declined*
- 3-year independent research fellowship in any field of basic science.

2010 - Finalist, American Physical Society's (APS) PhD Thesis Prize in Biological Physics
- 1 of 3 finalists: Annual prize for outstanding PhD research in biological physics.

2008 - NSERC Postgraduate Scholarship (2 years of graduate fellowship).
- NSERC: Natural Sciences and Engineering Research Council of Canada.

2006 - Lester Wolfe Fellowship in Physics (Dept. of Physics, MIT).

2006 - Krieger School of Arts and Sciences Excellence in Teaching Award.
- Campus-wide award: One of three teaching assistant winners in Arts & Sciences.

2003 - 1^{st} Prize at the 39^{th} Canadian Undergraduate Physics Conference.
- National Winner: Award for best undergrad research and presentation in Canada.

2003 - Margaret & Thomas Paxton Taylor Award in Mathematics (Univ. of Toronto).

2000 - Arthur L. Schawlow Physics Scholarship (Victoria College, Univ. of Toronto).

PUBLICATIONS: FROM MY GROUP 2015 - NOW

A. Xu and **H. Youk**.
Electric cell death
Nature Physics (News and Views) **20**, 1225-1226 (Aug. 2024)

R. M. Walker, V. C. Sanabria, and **H. Youk**.
Microbial life in slow and stopped lanes
Trends in Microbiology (Review) **32**, 650-662 (July 2024)

H. Daneshpour, P. van den Bersselaar, C.-H. Chao, T. G. Fazzio, and **H. Youk**.
Macroscopic quorum sensing sustains differentiating embryonic stem cells
Nature Chemical Biology (Research Article) **19**, 596-606 (Jan. 2023)

D. S. Laman Trip, T. Maire, and **H. Youk**.
Slowest possible replicative life at frigid temperatures for yeast
Nature Communications (Research Article) **13**, 7518 (Dec. 2022)

L. Koopmans and **H. Youk**.
Predictive landscapes hidden beneath biological cellular automata
Journal of Biological Physics (Review) **47**, 355-369 (Nov. 2021)

T. Maire, T. Allertz, M. A. Betjes, and **H. Youk**.
Dormancy-to-death transition in yeast spores occurs due to gradual loss of gene-expressing ability
Molecular Systems Biology (Research Article) **16**, e9245 (Nov. 2020)

D. S. Laman Trip and **H. Youk**.
Yeasts collectively extend the limits of habitable temperatures by secreting glutathione
Nature Microbiology (Research Article) **5**, 943-954 (April 2020)

Y. Dang, D. A. J. Grundel, and **H. Youk**.
Cellular dialogues: cell-cell communication through diffusible molecules yields dynamic spatial patterns
Cell Systems (Research Article) **10**, 1-17 (January 2020)

H. Daneshpour and **H. Youk**.
Modelling cell-cell communication for immune systems across space and time
Current Opinion in Systems Biology (Review) **18**, 44-52 (Dec. 2019)

D. S. Laman Trip, T. Maire, and **H. Youk**.
Evaluation of Schink et al.: Having the gem shine through a fog
Cell Systems (Featured as Exemplary Peer Review), **9**, 3-7 (July 2019)

E. P. Olimpio*, Y. Dang*, and **H. Youk**.
Statistical dynamics of spatial-order formation by communicating cells
iScience (Research Article - *co-first authors), **2**, 27-40 (April 2018)

E. P. Olimpio, D. R. Gomez-Alvarez, and **H. Youk**.
Progress towards quantitative design principles of multicellular systems
in *Systems Biology* (Book chapter) - (Editors: J. Nielsen & S. Hohmann) (March 2017)

B. A. Doganer, L. K. Q. Yan, and **H. Youk**.
Autocrine signaling and quorum sensing: Extreme ends of a common spectrum
Trends in Cell Biology (Review) **26**, 262-271 (April 2016)

T. Maire and **H. Youk**.
Molecular-level tuning of cellular autonomy controls the collective behaviors of cell populations
Cell Systems (Research Article) **1**, 349-360 (Nov. 2015)

T. Maire and **H. Youk**.
A collective path towards regeneration
Cell (Preview), **161**, 195-196 (April 2015).

PUBLICATIONS: BEFORE STARTING MY GROUP 2005-2014

H. Youk, and W. A. Lim.
Sending mixed messages for cell population control
Cell (Preview), **158**, 973-975 (Aug. 2014).

H. Youk, and W. A. Lim.
Secreting and sensing the same molecule allows cells to achieve versatile social behaviors
Science (Research Article), **343**, 1242782 (Feb. 2014).

H. Youk and A. van Oudenaarden.
Microbiology: Altruistic defence
Nature (News and Views), **467** 34-35 (Sept. 2010).

H. Youk, A. Raj, and A. van Oudenaarden.
Imaging single mRNA molecules in yeast
in *Method in Enzymology: A Guide to Yeast Genetics (3rd Ed.)* (2010).

H. Youk and A. van Oudenaarden.
Growth landscape formed by perception and import of glucose in yeast
Nature (Research Article). **462**, 875-879 (Dec. 2009).

J. Gore, **H. Youk**, and A. van Oudenaarden.
Snowdrift game dynamics and facultative cheating in yeast
Nature (Research Letter). **459**, 253-256 (May 2009).

G.-W. Chern, D. Clarke, **H. Youk**, and O. Tchernyshyov.
Halfvortices in flat nanomagnets

in *Quantum Magnetism, Proceedings of NATO Advanced Study Institute* (2008)

J.B. Fouet, F. Mila, D. Clarke, **H. Youk**, O. Tchernyshyov, P. Fendley, and R.M. Noack.
Condensation of magnons and spinons in a frustrated ladder
Physical Review B (Research Article) **73**, 214405, (2006).

H. Youk, G.-W. Chern, K. Merit, B. Oppenheimer, and O. Tchernyshyov.
Composite domain walls in flat nanomagnets: The magnetostatic limit
Journal of Applied Physics (Research Article) **99**, 08B101, (2006).

G.-W. Chern, **H. Youk**, and O. Tchernyshyov.
Topological defects in flat nanomagnets: The magnetostatic limit
Journal of Applied Physics (Research Article) **99**, 08Q505, (2006).

H. Youk, R. List, and T. Ola.
The growth of ice crystals by molecular diffusion
Journal of the Atmospheric Sciences (Research Article) **63**, (6) 1650-1657. (2006).

H. Youk.
Numerical study of quadrupole magnetic traps for neutral atoms: Anti-Helmholtz coils and U-chip
Canadian Undergraduate Physics Journal (Research Article) **Vol. III** (2), 13-18. (2005).

Teaching

- At UMass Chan Medical School:
  - Founded and co-directed *Graduate Program in Systems and Computational Biology* (grad.; 2023 - present)
  - Founded and co-directed *Summer Program in Quantitative Biology* (undergrad, 2023)
  - *Quantitative Approaches in Gene Regulation* - Co-instructor (grad.; 2022 - 2023)
  - *Systems Biology* - Co-instructor (grad.; 2022 - present)
  - *Cancer and Cell Signaling* - Co-instructor (grad.; 2020 - 2021)

- At TU Delft:
  - *AP3162: Physics of Cellular Systems - Mathematical modelling of cellular dynamics* (grad.; 2016 - 2020)
  - *AP3161D: Cellular dynamics - Stochasticity and Signaling* (grad.; 2015 - 2016)
  - *NB5030: Proposal writing* (grad; 2018 - 2019)
  - *NB1140: Physics I - Classical Mechanics and Thermodynamics* (undergrad; 2015 - 2019)
  - *TN1661: Orientation to physics research* (undergrad.; 2015 - 2017)
  - *Nanobiology minor* (undergrad.; 2016)

- At MIT:
  - Instructor for *Advanced Undergraduate Seminar - 7.342: Systems and Synthetic Biology: How the Cell Solves Problems.*(undergrad.: Sept. - Dec. 2010)
  - Instructor for *Physics III: Survey of Modern Physics* (June - Aug. 2010) Minority Introduction To Engineering and Science (MITES 2010) program at MIT.
  - Instructor for *Calculus II: Multivariable calculus* (June - Aug. 2009) Minority Introduction To Engineering and Science (MITES 2009) program at MIT.
  - Instructor for *Physics III: Oscillations and Waves* (June - Aug. 2008) Minority Introduction To Engineering and Science (MITES 2008) program at MIT.

Advisees

- **Current PhD Students:**

Lars Koopmans (co-advised at Univ. of Amsterdam: May 2022 –)
Michela Oster (Sept. 2023 –)

- **Previous PhD Students:**
  4. Diederik Laman Trip (09/2017 - 02/2022)
     - Next: Postdoc, Pedro Beltrao's group at ETH Zurich, Switzerland
  3. Theo Maire (09/2017 - 02/2022)
     - Next: Postdoc, Felix Hol's group at Pasteur Institute, Paris
  2. Hirad Daneshpour (10/2016 - 09/2021)
     - Next: Consultant, KPMG, The Netherlands
  1. Yiteng Dang (11/2015-01/2020)
     - Next: ELBE Postdoc Fellow at Max Planck Institutes (MPI) for Physics of Complex Systems & of Molecular Cell Biology and Genetics, Germany