Molecules Come to Life

scialog 2016®

The Second Annual Scialog Conference
March 31 - April 3. 2016 at Westward Look Resort
Tucson, Arizona

GORDON AND BETTY MOORE FOUNDATION

RESEARCH CORPORATION *for* SCIENCE ADVANCEMENT

Conference Objectives and Process

Objectives

Engage in dialog with the goal of accelerating high-risk/high-reward research.

Identify and analyze scientific bottlenecks and develop approaches for breakthroughs.

Build a creative, better-networked community that is more likely to produce breakthroughs.

Form teams to write proposals to seed novel projects based on highly innovative ideas that emerge at the conference.

Process

Brainstorming is welcome; don't be afraid to say what comes to mind.

Consider the possibility of unorthodox or unusual ideas without immediately dismissing them.

Discuss, build upon and constructively criticize each other's ideas – in a spirit of cooperative give and take.

Make comments concise to avoid monopolizing the dialog.

Contents

From the Research Corporation for Science Advancement President

Welcome to the second annual **Scialog: Molecules Come to Life**.

Once again Research Corporation for Science Advancement (RCSA) is delighted to be joined in this multi-year program by our co-sponsor, the Gordon and Betty Moore Foundation. Together we continue to focus on untested ideas and to champion innovative thinking in an effort to understand more completely the cellular processes fundamental to life.

As a result of the first Scialog: MCL, we awarded 13 grants to five teams of investigators. These grants, totaling $731,000, enable awardees to pursue ambitious, high-risk, highly impactful discovery research on untested ideas in physical cell biology. Each investigator has received $56,250 and works in a team of two or three. We are eager to fund more teams as an outcome of this second Scialog.

Again, we encourage you to engage in lively discussions over the next few days, and to be bold in bringing up that wild idea or nagging hunch that may have occurred while you were performing research of a more "incremental" bent. In the process we hope you feel you are becoming a part of a long-lived, creative, cross-disciplinary community that is prone to producing breakthrough science.

Richard Wiener, Silvia Ronco (both RCSA) and Gary Greenburg (Moore Foundation) are here once again to facilitate this conference along with respected senior scientists. We are grateful for their efforts and dedication.

Over all, Scialog continues to focus on solving real-world problems of global significance through an unwavering dedication to basic research; and its funding is aimed squarely at early career scientists. Our fundamental premise, which applies to science philanthropies such as Gordon and Betty Moore Foundation and Research Corporation as well as to the talented people we support, is that in a complex, dynamic world collaboration and innovation are essential keys to success.

We welcome equally the new Scialog Fellows who join us for the first time and those Fellows who were here for the initial Scialog: MCL. Participate, communicate—and enjoy!

Robert N. Shelton
President
Research Corporation for Science Advancement

From the Gordon and Betty Moore Foundation President

The Gordon and Betty Moore Foundation, in partnership with the Research Corporation for Science Advancement, warmly welcomes you to the second **Scialog: Molecules Come to Life**.

This conference embodies the spirit of the Moore Foundation's Science Program, which supports the world's top scientists in their pursuit of high-risk, high-impact research to advance knowledge in emerging fields and tackle important scientific problems.

By bringing you together for this conference, we hope to generate productive and enduring collaborations that will unite theory and experiment, and entice you to explore creative and exciting new research directions at the interface of biology and physical science.

We encourage you to take this opportunity to engage with one another throughout the conference: interact, break down barriers and cultivate new collaborations that address the pressing questions that underlie biology's complexity.

Enjoy the conference, and have fun!

Harvey V. Fineberg
President
Gordon and Betty Moore Foundation

From the Program Officers

This year we are holding the second **Scialog: Molecules Come to Life** conference, which continues Research Corporation's tradition of highly interactive Scialog meetings on scientific topics of great importance with a focus on identifying bottlenecks and finding innovative ideas for potential breakthroughs. The emphasis of Scialog meetings is on science dialog, networking and building new collaborations to pursue novel high risk discovery research.

The Gordon and Betty Moore Foundation and Research Corporation chose to focus this Scialog on the topic of quantitatively understanding the physical biology of cells and their interactions because we believe this critical area of science is on the cusp of major breakthroughs. But we just as firmly believe these breakthroughs can be accelerated by physicists, biologists and those in related fields crossing disciplinary boundaries to work collaboratively, particularly with theorists and experimentalists combining efforts. The goal of **Scialog: Molecules Come to Life** is to catalyze multidisciplinary collaborations between Scialog Fellows, a highly select group of exemplary early career U.S. scientists.

We have two outstanding keynote speakers:

- **Ken Dill** Director, Louis and Beatrice Laufer Center for Physical and Quantitative Biology at Stony Brook University
- **Jennifer Lippincott-Schwartz** Group Leader at Janelia Farm Research Campus

We also have outstanding discussion facilitators including **Myriam Cotten**, Hamilton College; **Daniel Cox**, University of California, Davis; **Michael Graham Espey**, National Cancer Institute; **Daniel Fisher**, Stanford University; **Holly Goodson**, University of Notre Dame; **Martin Gruebele**, University of Illinois at Urbana-Champaign; **Rigoberto Hernandez**, Georgia Institute of Technology; **Jané Kondev**, Brandeis University; and **Boris Shraiman**, University of Santa Barbara, California. We are delighted to have several representatives from other foundations in attendance, including **Marian Carlson**, Simons Foundation; **Mark Cardillo**, Camille and Henry Dreyfus Foundation; and **Kathy Richmond**, the Paul G. Allen Family Foundation.

Scialog conferences focus on dialog and team building with the goal of creating novel strategies for overcoming research bottlenecks that require collaborative approaches. An important feature of Scialog meetings is the opportunity for Scialog Fellows to form teams and write proposals to pursue particularly creative ideas that emerge through the dialog. We hope this competition is exciting, but regardless of which proposals are funded, the purpose is to catalyze a deeper and more meaningful exchange of ideas than ordinarily occurs at scientific conferences. This year 25% of Scialog Fellows are attending for the first time. We hope their new perspectives along with those of the outstanding returning Fellows help make this a great meeting!

We hope each participant finds the Scialog experience of great value. Please do not hesitate to provide feedback – we are here to listen and make this a great meeting for you!

Richard Wiener
Senior Program Director
Research Corporation

Gary Greenburg
Program Officer
Gordon and Betty Moore Foundation

Conference Agenda
Westward Look Resort
March 31-April 3, 2016

Thursday, March 31

1:00 pm	**Registration Opens**	Lobby
3:00 - 3:00 pm	**Lunch**	Palm Room & Terrace
5:00 - 6:30 pm	**Poster Session and Reception**	Sonoran Ballroom
6:30 - 7:30 pm	**Dinner**	Ocotillo & Saguaro
7:30 - 7:45 pm	**Welcome** Robert Shelton, *President, RCSA* Robert Kirshner, *Chief Program Officer, Moore*	Ocotillo & Saguaro
7:45 – 8:00 pm	**Conference Overview, Hoped for Outcomes & Guidelines for Collaborative Proposals** Richard Wiener, *Senior Program Director, RCSA* Gary Greenburg, *Program Officer, Moore*	Ocotillo & Saguaro
8:00 - 9:00 pm	**Introductions**	Ocotillo & Saguaro

Friday, April 1

7:00 - 8:00 am	**Breakfast**	Palm Room & Terrace
8:00 - 9:30 am	**Keynote Presentations** Ken Dill Jennifer Lippincott-Schwartz	Ocotillo & Saguaro
9:30 - 9:50 am	**Conference Photo & Break**	
9:50 - 10:00 am	**Breakout Sessions Description & Goals**	Ocotillo & Saguaro
10:00 - 11:00 am	**Breakout Session I**	Ocotillo & Saguaro
11:00 - 11:30 am	**Report Out**	Ocotillo & Saguaro
11:30 am - 12:00 pm	**Mini Breakout Session I**	Multiple Rooms
12:00 - 1:00 pm	**Lunch**	Palm Room & Terrace
1:00 - 2:15 pm	**Collaborative Team Presentations**	Ocotillo & Saguaro
2:15 - 3:15 pm	**Breakout Session II**	Ocotillo & Saguaro
3:15 - 3:40 pm	**Report Out**	Ocotillo & Saguaro
3:40 - 4:10 pm	**Mini Breakout Session II**	Multiple Rooms
4:10 - 5:45 pm	**Afternoon Break**	
5:45 - 6:45 pm	**Poster Session and Reception**	Sonoran Ballroom
6:45 - 8:00 pm	**Dinner**	Ocotillo & Saguaro

Saturday, April 2

6:15 - 7:15 am	**Optional Nature Walk**	WL Trails
7:00 - 8:00 am	**Breakfast**	Palm Room & Terrace
8:00 - 8:50 am	**Collaborative Team Presentations**	Ocotillo & Saguaro
8:50 - 9:50 am	**Breakout Session III**	Ocotillo & Saguaro
9:50 - 10:15 am	**Report Out**	Ocotillo & Saguaro
10:15 - 10:45 am	**Mini Breakout Session III**	Multiple Rooms
10:45 - 11:00 am	**Morning Break**	
11:00 am - 12:00 pm	**Breakout Session IV**	Ocotillo & Saguaro
12:00 pm - 12:30 pm	**Report Out**	Ocotillo & Saguaro
12:30 - 1:30 pm	**Lunch**	Palm Room & Terrace
1:30 - 6:00 pm	**Team Formation, Informal Discussion, & Proposal Writing** Proposals due 8:00 am Sunday morning	Multiple Rooms
6:00 - 6:30 pm	**Reception**	Ocotillo & Saguaro
6:30 - 7:30 pm	**Dinner**	Ocotillo & Saguaro

Sunday, April 3

7:00 - 8:00 am	**Breakfast**	Palm Room & Terrace
8:00 - 10:30 am	**Presentations of Proposal Ideas**	Ocotillo & Saguaro
10:30 - 11:00 am	**Assessment Survey & Wrap-up**	Ocotillo & Saguaro
11:00 - 12:00 pm	**Lunch** Available to go	Cholla Room

Keynote Speaker

Will biology ultimately be understood in terms of "Grand Principles," as physics is?

Ken Dill
Director, Louis and Beatrice Laufer Center for Physical and Quantitative Biology at Stony Brook University

Abstract: In 1996, in *Current Biology*, Lewis Wolpert raised the following questions: Do we already know all the principles of biology? Does it just remain for us to fill in the gene-by-gene details? To me, the situation seems very much the opposite of that. Our past forty years of molecular, structural, cellular, computational and "-omics" biology have given us vast knowledge of atom-by-atom and molecule-by-molecule detail. The great opportunity for the future is now to understand what it all means. It's an opportunity for leadership from physicists and mathematicians, and for much deeper penetration of model-based thinking into biology. As a small illustration, I will briefly describe our interests in minimalist modeling of cell properties.

Bio: Ken Dill is the Louis and Beatrice Laufer Professor of Physics and Chemistry at Stony Brook University and the Director of the Laufer Center for Physical and Quantitative Biology. Previously, he was on the faculty of the University of California, San Francisco. Dill received SB and SM degrees from MIT in Mechanical Engineering, a PhD in Biology at the University of California, San Diego, and did postdoctoral research in Chemistry at Stanford University. He received the Hans Neurath Award in 1998 from the Protein Society, for his research on structures, properties and folding of proteins. He has been president of the Biophysical Society, and is a member of the National Academy of Sciences and the American Academy of Arts and Sciences. With Sarina Bromberg, he co-authored *Molecular Driving Forces*, a textbook in physical chemistry and statistical mechanics.

His research interests are at the intersection of statistical physics and cell biophysics and structural biology. His work has elucidated that protein folding occurs on funnel-shaped energy landscapes and that protein structures are largely determined by hydrophobic interactions. And, with Dr. Ron Zuckermann, he has developed peptoids, a new class of polymer materials that have protein-like properties.

Keynote Speaker

Navigating the Cellular Landscape with New Optical Probes, Imaging Strategies and Technical Innovations

Jennifer Lippincott-Schwartz
Group Leader at Janelia Farm Research Campus

Abstract: Emerging visualization technologies are playing an increasingly important role in the study of numerous aspects of cell biology, capturing processes at the level of whole organisms down to single molecules. While developments in probes and microscopes are dramatically expanding the areas of productive imaging, there are still significant roadblocks. Primary challenges include 1) fluorophore bleed-through, which limits the number of fluorophores that can be simultaneously imagined, 2) imaging speeds that are too slow, and 3) labeling densities that are too low for deciphering fine subcellular architecture. Here, I will discuss new imaging methods that can overcome these roadblocks, focusing on their potential for clarifying subcellular organelle dynamics. To surmount fluorophore bleed-through, we combined excitation-based spectral unmixing and lattice light sheet microscopy to visualize up to six organelles (i.e., ER, Golgi, mitochondria, lysosomes, peroxisomes and lipid droplets) simultaneously within cells. This allowed us to track these organelles through time and analyze their inter-organelle contacts. To increase temporal resolution during imaging, we employed total internal reflection fluorescence combined with structured illumination microscopy to visualize organelle dynamics at very high temporal-spatial resolution. Examining the ER, we observed that many peripheral ER sheets seen using diffraction-limited imaging are actually highly perforated structures comprised of tightly latticed groups of dynamic tubules. Within the latticed ER tubule meshwork, subdiffraction-limited holes were observed (~150-250 nm diameter) having transient lifespans (~250 msec). Viewed at higher resolution using lattice light sheet microscopy combined with point accumulation for nanoscale topology (PAINT), the peripheral ER sheets represented a complex meshwork of tightly cross-linked ER tubules. I discuss possible roles this complex ER structural organization has for diverse cellular functions.

Bio: Jennifer Lippincott-Schwartz received her B.A. from Swarthmore College, her M.S. in Biology from Stanford University, and her Ph.D in Biochemistry from Johns Hopkins University. She did post-doctoral training at the National Institutes of Health (NIH) under the mentorship of Dr. Richard Klausner and served as Chief of the Section on Organelle Biology in the Cell Biology and Metabolism Branch of the National Institute of Child Health and Human Development at NIH until 2016. She is currently group leader at Janelia Farm Research Campus, Ashburn, VA.

Lippincott-Schwartz's research uses live cell imaging approaches to analyze the spatio-temporal behavior and dynamic interactions of molecules and organelles in cells. Her group has pioneered the use of green fluorescent protein (GFP) technology for quantitative analysis and modeling of intracellular protein traffic and organelle biogenesis in live cells and embryos, providing novel insights into cell compartmentalization, protein trafficking and organelle inheritance. Most recently, her research has focused on the development and use of photoactivatable fluorescent proteins, which 'switch on' in

Keynote Speaker

Jennifer Lippincott-Schwartz

Continued

response to light. One application of these proteins she has put to use is photoactivated localization microscopy, (i.e., PALM), a superresolution imaging technique that enables visualization of molecule distributions at high density at the nano-scale.

Her work has been recognized with election to the National Academy of Sciences (2008) and the National Institute of Medicine (2009), and with the Royal Microscopy Society Pearse Prize (2010) and the Society of Histochemistry Feulgen Prize (2001). Dr. Lippincott-Schwartz is currently Editor for *Current Protocols in Cell Biology* and *The Journal of Cell Science* and is on the editorial boards of *Cell, Physiology* and *Integrative Biology*. She is President-elect of the American Society of Cell Biology and has had leadership roles in the Biophysical Society. She serves on the advisory board for the Searle Scholar Program and scientific review board of Howard Hughes Medical Institute, and is a non-resident Faculty Fellow of the Salk Institute, La Jolla, CA.

2015 Scialog Molecules Come to Life Collaborative Awards

Building an Artificial Motile Tissue through Self-Organized Rhythmic Contractility

Michael Rust, University of Chicago

Jennifer Ross, University of Massachusetts, Amherst

Rae Robertson-Anderson, University of San Diego

Immersive DNA Force Sensors and Predictive Mechanical Modeling for Tissue Morphogenesis

Justin Kinney, Cold Spring Harbor Laboratory

Lisa Manning, Syracuse University

Margaret Gardel, University of Chicago

Rebooting the Gut Microbial Ecosystem using Bacterial Dueling

Raghuveer Parthasarathy, University of Oregon

Brian Hammer, Georgia Institute of Technology

Joao Xavier, Memorial Sloan-Kettering Cancer Center

Uncovering Essential Gene Functions by Exploiting Differentiation within a Biofilm

Gurol Suel, University of California, San Diego

Kerwyn Huang, Stanford University

Rethinking the Idea of Cell Type

Grégoire Altan-Bonnet, Memorial Sloan Kettering Cancer Center

Pankaj Mehta, Boston University

Proposal Guidelines

Collaborative Awards

1. Awards, which are one year in duration, are intended to provide seed funding for teams of two to four Scialog Fellows formed at this conference.
2. Two-page proposals should describe the proposed project and the role of each team member. No budget is necessary. A third page may be used for references.
3. Awards will be in the amount of $50K (direct funding) for each team member.
4. A Scialog Fellow can be a member of no more than two teams. If a Scialog Fellow is a member of two teams, the other team members must be different. No team can submit more than one proposal.
5. Scialog Fellows who previously won Scialog Collaborative Awards can be a member of only one team. The other team members must be different from the members of the previously awarded team.
6. Teams may not include members who have previously collaborated with one another.
7. Teams are encouraged to:

   a) Include a theory and experimental component.
   b) Focus on fundamental research rather than disease-oriented research.
   c) Base their proposal on an innovative, high-risk, blue sky idea.
   d) Address an important question in physical cell biology amenable to quantitative modeling.
   e) Base the proposal on an idea unlikely to garner federal funding because it is too early, cross-cutting or high risk.

8. Additional funding after one year for the most promising projects is possible but not guaranteed.
9. Proposals must be submitted electronically by Sunday morning at 7:00 am to RCSA Senior Program Directors Richard Wiener (rwiener@rescorp.org) and Silvia Ronco (sronco@rescorp.org) and Moore Program Officer Gary Greenburg (gary.greenburg@moore.org).

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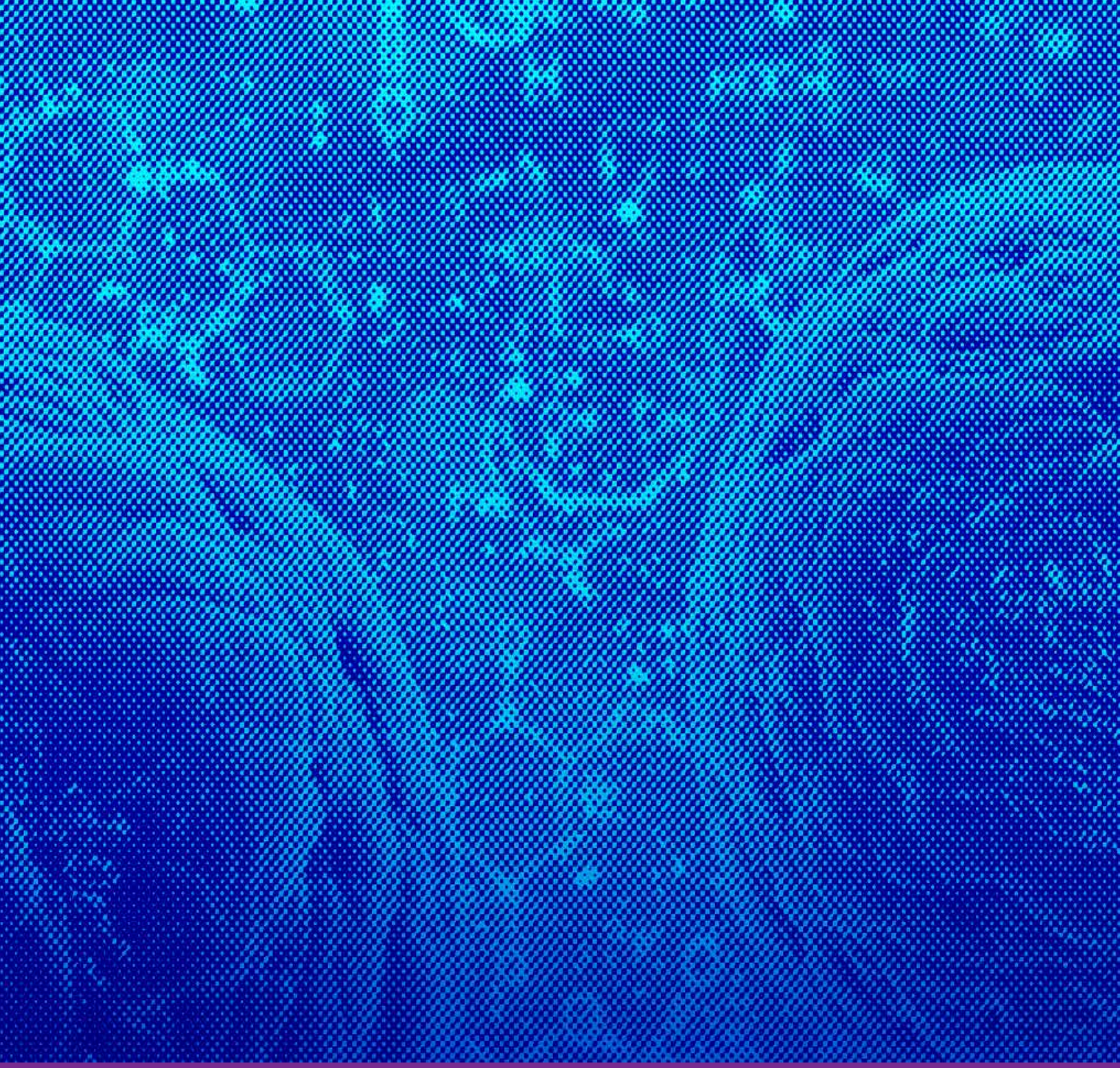

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