

Time Domain Astrophysics: Stars and Explosions

scialog2016[®]

The Second Annual Scialog Conference
October 13-16, 2016 at Westward Look Resort
Tucson, Arizona



RESEARCH CORPORATION
for SCIENCE ADVANCEMENT

Conference Objectives

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

Identify and analyze bottlenecks in advancing time domain astrophysics 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.

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 even constructively criticize each other's ideas – in a spirit of cooperative give and take.

Make comments concise to avoid monopolizing the dialog.

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Scialog: Time Domain Astrophysics

From the President

As most of you know by now, the **Scialog Conference on Time Domain Astrophysics** encourages theorists, observers and computational scientists to collaborate on developing new and innovative programs to accelerate discovery via today's synoptic surveys.

In this process, we also hope to nurture a nascent community that will one day prove adept at innovating maximum discoveries from planned facilities still in the pipeline. The goal is not only more and better data, but more effective methodologies to enrich our understanding of supernovae, optical transients, binary stars, active stars, asteroseismology, and other time-domain phenomena.

In aiming for the stars, this past December we announced the results of the first Scialog:TDA: 29 team proposals resulted in six collaborative team awards totaling \$560,000 for 13 Scialog Fellows. Awards were:

- **Raffaella Margutti**, Northwestern University; **Brian Metzger**, Columbia University; **Ken Shen**, University of California, Berkeley, *"Bringing Novae into the Twenty-First Century"*
- **Laura Chomiuk**, Michigan State University; **Dimitrios Giannios**, Purdue University, *"Catching the Emergence of a Supernova Years After the Gamma Ray Burst"*
- **Gregg Hallinan**, California Institute of Technology; **Nick Law**, University of North Carolina at Chapel Hill, *"Monitoring Extrasolar Space Weather with the LWA and Evryscope"*
- **Sean Couch**, Michigan State University; **Nathan Smith**, University of Arizona, *"Nuclear Burps and Belches: Presupernova Eruptions in 3D"*
- **Nick Law**, University of North Carolina at Chapel Hill; **Jennifer Sokoloski**, Columbia University, *"Professional-Amateur Collaboration: Enhancing the Scientific and Societal Value of Evryscope"*
- **Leslie Hebb**, Hobart and William Smith Colleges; **Suvrath Mahadevan**, Pennsylvania State University; **John Wisniewski**, University of Oklahoma, *"Transformational Technologies and Techniques for High Precision Photometric and Spectroscopic Stellar TDA"*

We look forward to hearing progress reports from these Fellows, and we hope this year's conference yields a similar crop of proposals with another set of teams ultimately receiving funding. Of course that is up to you.

As always, our advice to you is simple. To paraphrase the immortal words first uttered by Capt. James T. Kirk 50 years ago last month: *Space, the final frontier. These are the collaborative enterprises of Scialog: Time Domain Astrophysics. Its 3-day mission: to explore strange new concepts, to seek out new algorithms and innovative research, to boldly go where no investigators have gone before.*

Have an interesting journey!

One final note: Special thanks are in order for conference organizers with emphasis on RCSA's Scialog Advisory Committee: Lars Bildsten, Professor of Physics and Director of the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara; Todd Boroson, President and Observatory Director at Las Cumbres Observatory Global Telescope Network; Suzanne Hawley, Professor and Chair of Astronomy at the University of Washington; Shrinivas Kulkarni, FRS, Professor of Astrophysics and Planetary Science at California Institute of Technology; and Keivan Stassun, Professor of Physics & Astronomy at Vanderbilt University.

Robert N. Shelton

President

Research Corporation for Science Advancement

From the Program Director

This year we are holding the second of two meetings for *Scialog: Time Domain Astrophysics: Stars and Explosions*. Research Corporation's highly interactive Scialog meetings have the goal of catalyzing new collaborations based on blue-sky ideas among Scialog Fellows who constitute a highly select group of exemplary early career U.S. scientists. The emphasis is on dialog, networking and building new collaborations to pursue novel high-risk discovery research. The second meeting in a Scialog initiative is always very exciting with the opportunity for Scialog Fellows to strengthen the previous year's interactions and form new teams.

Research Corporation chose to focus this Scialog on time domain astrophysics because we believe this critical area of science is on the cusp of major breakthroughs. Just as firmly, we believe these breakthroughs can be accelerated by astronomers, astrophysicists and data scientists working collaboratively on novel high-risk projects, particularly with theorists and observers combining efforts. We have three outstanding keynote speakers:

Vicky Kalogera, Northwestern University
Juna Kollmeier, Carnegie Institution for Science
Eliot Quataert, University of California, Berkeley

We also have outstanding discussion facilitators including **Vicky, Juna** and **Eliot, Lars Bildsten**, KITP, University of California, Santa Barbara, **Todd Boroson**, Las Cumbres Observatory, **Suzanne Hawley**, University of Washington, **Robert Kirshner**, the Gordon and Betty Moore Foundation, **Christopher Kochanek**, The Ohio State University, **Shri Kulkarni**, California Institute of Technology, **David Silva**, National Optical Astronomy Observatory, **Keivan Stassun**, Vanderbilt University, and **Craig Wheeler**, University of Texas at Austin.

Scialog conferences focus on dialog and team building with the goal of creating novel strategies and 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. Our intent is for this process to facilitate participants gaining new insights and connections that significantly advance efforts to understand stars, explosions and related aspects of time domain astrophysics.

The Scialog Advisory Committee – **Lars, Todd, Suzanne, Shri** and **Keivan** – deserve big thanks for helping to organize this meeting.

We hope each participant finds the Scialog experience of great value. Please do not hesitate to provide feedback on how to make the conference better. My fellow Senior Program Director **Silvia Ronco**, the RCSA staff, and I are here to listen and to make this a great experience for you!

Richard Wiener
 Senior Program Director
 Research Corporation for Science Advancement

Scialog: Time Domain Astrophysics

Conference Agenda Westward Look Resort October 13-16, 2016

Thursday, October 13

1:00 pm	Registration Opens	Lobby
1:00 - 5:00 pm	Snacks	Palm Room & Terrace
5:00 - 6:30 pm	Poster Session and Reception	Sonoran Ballroom
6:00 - 6:30 pm	Meeting for Discussion Facilitators	Ocotillo & Cholla
6:30 - 7:30 pm	Dinner	Ocotillo & Cholla
7:15 - 7:30 pm	Welcome Robert Shelton, <i>President, RCSA</i>	Ocotillo & Cholla
7:30 - 7:45 pm	Conference Overview, Hoped for Outcomes & Guidelines for Collaborative Proposals Richard Wiener, <i>Senior Program Director, RCSA</i>	Ocotillo & Cholla
7:45 - 8:30 pm	Keynote Presentation Vicky Kalogera	Ocotillo & Cholla
8:30 - 11:00 pm	TDA Starlight Café Snacks, Conversations, etc.	Palm Room & Terrace

Friday, October 14

7:00 - 8:00 am	Breakfast	Palm Room & Terrace
8:00 - 9:00 am	Introductions	Ocotillo & Cholla
9:00 - 9:45 am	Keynote Presentation Eliot Quataert	Ocotillo & Cholla
9:45 - 10:15 am	Conference Photo & Break	Palm Terrace
10:15 - 10:30 am	Breakout Sessions Description & Goals	Ocotillo & Cholla
10:30 - 11:30 am	Breakout Session I	Ocotillo & Cholla
11:30 - 12:00 pm	Report Out	Ocotillo & Cholla
12:00 - 12:30 pm	Mini Breakout Session I	Ocotillo & Cholla
12:30 - 1:30 pm	Lunch	Palm Room & Terrace
1:30 - 2:00 pm	Keynote Presentation Juna Kollmeier	Ocotillo & Cholla
2:00 - 3:00 pm	Breakout Session II	Ocotillo & Cholla
3:00 - 3:30 pm	Report Out	Ocotillo & Cholla
3:30 - 4:00 pm	Mini Breakout Session II	Ocotillo & Cholla
4:00 - 5:30 pm	Afternoon Break	
5:30 - 6:30 pm	Poster Session and Reception	Sonoran Ballroom
6:30 - 7:30 pm	Dinner	Ocotillo & Cholla
7:30 - 11:00 pm	TDA Starlight Café Snacks, Conversations, etc.	Palm Room & Terrace

Saturday, October 15

6:30 - 7:30 am	Optional Guided Nature Walk	WL Trails
7:00 - 8:00 am	Breakfast	Palm Room & Terrace
8:00 - 8:40 am	Collaborative Team Presentations	Ocotillo & Cholla
8:40 - 9:40 am	Breakout Session III	Ocotillo & Cholla
9:40 - 10:10 am	Report Out	Ocotillo & Cholla
10:10 - 10:40 am	Mini Breakout Session III	Ocotillo & Cholla
10:40 - 11:20 am	Morning Break	
11:20 am - 12:00 pm	Collaborative Team Presentations	Ocotillo & Cholla
12:00 - 12:30 pm	Mini Breakout Session IV	Ocotillo & Cholla
12:30 - 1:30 pm	Lunch	Palm Room & Terrace
1:30 - 6:00 pm	Team Formation, Informal Discussion & Proposal Writing Proposals due 7:00 am Sunday morning	Multiple Rooms
6:00 - 6:30 pm	Reception	Ocotillo & Cholla
6:30 - 7:30 pm	Dinner	Ocotillo & Cholla
7:30 - 11:00 pm	TDA Starlight Café and Proposal Writing Snacks, Conversations, etc.	Palm Room & Terrace

Sunday, October 16

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

Keynote Speakers

The Promise and Challenges of Gravitational-Wave Astronomy

Vicky Kalogera

*Erastus Otis Haven Professor, Department of Physics & Astronomy,
Northwestern University*



Abstract: The LIGO detectors have opened for us a new way of studying compact objects in the time domain. I will highlight what current results imply and what we can look forward to in terms of advancing our understanding of compact objects and the explosive phenomena they cause.

Bio: After earning her B.S. in Physics in Greece and her Ph.D. in Astronomy in Illinois, Vicky Kalogera joined the Harvard-Smithsonian Center for Astrophysics. At Northwestern, she was appointed Assistant Professor in 2001, Associate Professor in 2006, and was named the Erastus Otis Haven Professor in 2009. In 2015 she became Associate Chair of the Physics & Astronomy Department. Kalogera is co-founder and current director of CIERA, the Center for Interdisciplinary Exploration and Research in Astrophysics. Her research is in the formation and evolution of compact objects, which includes gravitational-wave data analysis and modeling using high-performance computing. Within the international LIGO Scientific Collaboration, Kalogera led the work on astrophysical implications of the history-making detection of gravitational-waves. She serves on the National Research Council's Committee on Astronomy and Astrophysics and the Executive Board of the Large Synoptic Survey Telescope Corporation. Her awards and honors include the Hans A. Bethe Prize from the American Physical Society (APS), the Fellowship in Theoretical Physics by the Simons Foundation, the David and Lucile Packard Foundation Fellowship in Science and Engineering, the Maria Goeppert-Mayer Award by APS, the Cottrell Scholar Award by Research Corporation, the NSF CAREER Award in Astronomy, and the A.J. Cannon Award by the American Astronomical Society (AAS). As a member of the discovery team of the first LIGO source (GW150914), she is also humbled to have been included in the 2016 Gruber Prize in Cosmology and the 2016 Special Breakthrough Prize in Fundamental Physics.

Keynote Speakers Continued

After SDSS-IV: What Would You Do?

Juna Kollmeier

*Astrophysicist, Carnegie Observatories,
Carnegie Institution for Science*



Abstract: As we look ahead to the 2020s, the landscape of astronomical facilities from space and on the ground is truly awe inspiring across all apertures and wavelengths. Indeed, modern astronomers have an embarrassment of riches when it comes to data. Despite this, however, foundational problems in astrophysics (such as what is the mass distribution and multiplicity of stars and black holes? and what is the dark matter?) remain unsolved. The Sloan Digital Sky Survey has long played a leading role in cosmology and galaxy formation, and as part of the planning procedures within the SDSS community we are now considering the possible roles to be played by wide-field surveys in this era. I will describe a particular hardware and operation concept for a survey in 2020 and encourage you to think about 1) what observations you could do with such a facility, and 2) what predictions will we be able to falsify within this framework?

Bio: Dr. Juna Kollmeier is a theoretical astrophysicist at the Observatories of the Carnegie Institution for Science. Her interests range across physical scales from planet formation to cosmology. She obtained the B.S. degree in physics from the California Institute of Technology in 2000 and the Ph.D. in astronomy from The Ohio State University in 2006. She was a Fulbright Fellow from 2000-2001 at the Max Planck Institute for Astrophysics. She was a Carnegie-Princeton and Hubble Fellow from 2006 until joining the permanent faculty of the Carnegie Observatories in 2008.

Progress and Puzzles in Massive Stellar Evolution

Eliot Quataert

*Professor, Department of Astronomy and Physics,
University of California, Berkeley*



Abstract: Massive stars play a key role in many areas of astrophysics, including fields outside of stellar astrophysics and time-domain surveys (e.g., galaxy formation and reionization). Our understanding of the evolution and fate of massive stars is poor relative to their lower mass counterparts due to uncertainties in mass loss, rotation, the role of binaries, and the physics of core-collapse supernovae. In this talk, I will provide an idiosyncratic overview of some of the puzzles in massive stellar evolution, highlighting some problems on which progress has been made and some that appear to be ripe for progress in the coming years.

Bio: Eliot Quataert is a Professor of Astronomy and Physics at UC Berkeley and the Director of the Theoretical Astrophysics Center. Quataert is a theorist who works on a wide range of problems, from the astrophysics of stars and black holes to how galaxies form. He has received a number of national awards for his research, including the Sloan and Packard Fellowships, the Simons Investigator Award, and the Warner Prize. He is also a highly regarded teacher and public lecturer.

2015 Scialog Time Domain Astrophysics: Stars and Explosions Collaborative Awards

Bringing Novae into the Twenty-First Century

Raffaella Margutti, Northwestern University

Brian Metzger, Columbia University

Ken Shen, University of California, Berkeley

Catching the Emergence of a Supernova Years After the Gamma Ray Burst

Laura Chomiuk, Michigan State University

Dimitrios Giannios, Purdue University

Monitoring Extrasolar Space Weather with the LWA and Evryscope

Gregg Hallinan, California Institute of Technology

Nick Law, University of North Carolina at Chapel Hill

Nuclear Burps and Belches: Presupernova Eruptions in 3D

Sean Couch, Michigan State University

Nathan Smith, University of Arizona

Professional-Amateur Collaboration: Enhancing the Scientific and Societal Value of Evryscope

Nick Law, University of North Carolina at Chapel Hill

Jeno Sokoloski, Columbia University

Transformational Technologies and Techniques for High Precision Photometric and Spectroscopic Stellar TDA

Leslie Hebb, Hobart and William Smith Colleges

Suvrath Mahadevan, Pennsylvania State University

John Wisniewski, University of Oklahoma

2016 Proposal Guidelines

Scialog: Time Domain Astrophysics Collaborative Awards

1. Awards 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 \$100K direct funding and divided between team members according to the team's preference.
4. No Scialog Fellow can be a member of more than two teams. If a Scialog Fellow is a member of two teams, other members of the two teams must be different. No team can submit more than one proposal.
5. No Scialog Fellow who previously has won a Scialog Collaborative Award can be a member of more than one team. The other team members must be different from the members of the previously awarded team.
6. No Scialog Fellow who has won two Scialog Collaborative Awards can be a member of a team.
7. Teams are encouraged to:
 - a) Include at least one theorist or computational scientist and one observer.
 - b) Not include members who have previously collaborated with one another.
 - c) Base their proposal on an emerging question in time domain astrophysics where a collaborative approach is likely to have the most impact.
8. 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).
9. Awards will be announced in about two months.

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For a full list of Scialog Fellows for both **2015** and **2016** meetings, please visit our website at:

<http://rescorp.org/gdresources/docs/Scialog-TDA-Fellows-Facilitators.pdf>

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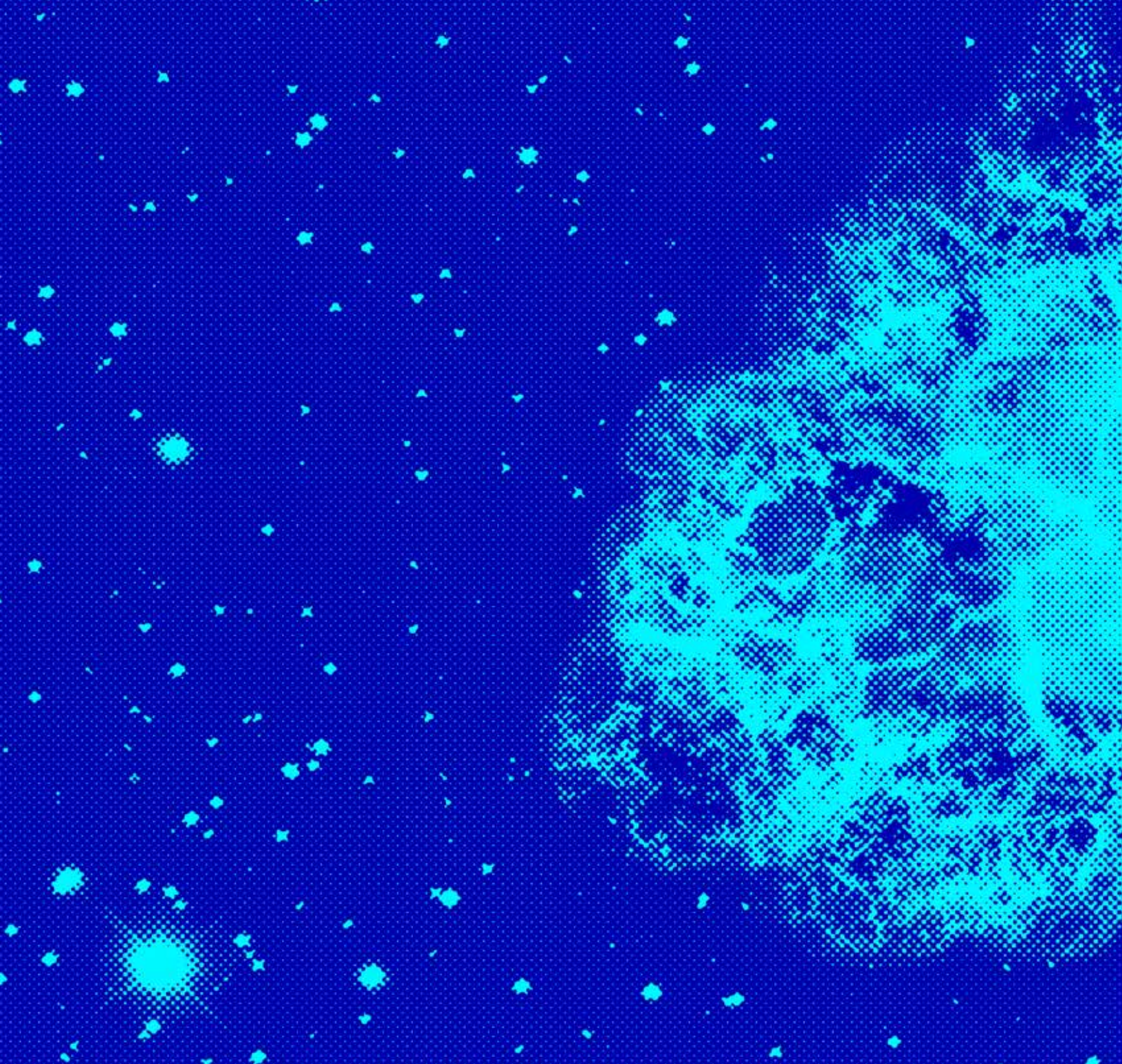
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