

corridor

Spring 2024



Making Space Sustainable

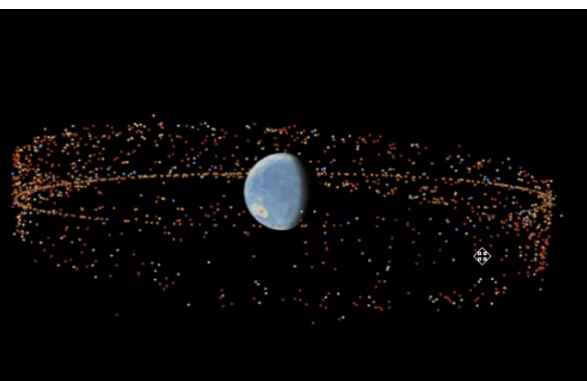
**How Researchers from
the MIT Astrodynamics,
Space Robotics, and
Controls Lab are Steering
Space Policy**

Making Space Sustainable



Professorships and fellowships are the engines of innovative research at MIT, and many of them are supported by planned gifts. This funding has been critical for researchers at the MIT Astrodynamics, Space Robotics, and Controls Lab (ARCLab) to follow timely opportunities as they work to further space exploration and the Earth-bound policies that affect it.

When the first satellites entered Earth's orbit in the mid-20th century, it seemed impossible that space would ever want for, well, space. But the steady increase of spacecraft in low Earth orbit (LEO)—up to 1,200 miles from the Earth's surface—has risen steadily since then, with an exponential leap in the past decade. The risk of collisions and debris in LEO looms large while remaining out of most Earth-dwellers' sights.



“Our future as a spacefaring civilization could be at risk due to this debris,” says Richard Linares, the Rockwell International Career Development Professor and ARCLab lead. “There’s a global need for us to come

together and understand how we can ensure that space becomes sustainable.”

Linares joined MIT's Department of Aeronautics and Astronautics in 2018 and founded ARCLab, which is a member of MIT's Small Satellite Collaborative—a group of labs working together to advance novel research and education on small satellites, including their missions, subsystems, and payloads, enabling new technologies and increasingly complex applications. Back then, the idea of “sustainability in space” hadn't reached the mainstream. “Our lab saw that space debris in low orbit could be a big problem,” he says. “Since then, major space agencies have confirmed it. The forward-thinking research environment at MIT allowed us to get a head start on what we saw would be most impactful, and now we're at the forefront of this field.”

COVER: Clockwise from top left: Professor Linares and graduate students Adriana Mitchell, Thomas González Roberts, and Miles Lifson.

ABOVE: A simulation of the hundreds of satellites in orbit provided by Roberts.

A shared vision. One recent innovation in Linares's group was the MIT Orbital Capacity Assessment Tool (MOCAT) launched in December 2023. MOCAT is open-source software that allows users to model the long-term future space environment, furthering their understanding of the growth in space debris

to prevent collisions and overpopulation. “The goal of the tool is to get a handle around the overall capacity—a complicated quantity with a lot of different variables,” says Linares. “With this tool, we can try to quantify the correct orbital capacity and how many satellites we can operate in space safely and in a sustainable way.”

The open-source aspect of the software is important to promote a transparent, international vision of space. “If we are going to make effective regulatory decisions, both companies and policymakers need access to the same open-source tool that can be used in that decision process,” Linares says. “That was our goal in making MOCAT accessible to the community—to encourage academic research but also encourage transparency among regulators and satellite operators.”

MOCAT is one tool that could help determine the future of LEO regulations, which Linares argues requires a multifaceted approach on a technical—both hardware and software—political, and industry front. ARCLab's fellow research groups in the MIT Small Satellite Collaborative take different approaches to the obstacles objects face when moving through space, presenting different collaboration opportunities. “The space debris problem requires a holistic component—not just simulation but hardware,” he says. “We also need more technically minded policymakers who can pursue technically sound solutions to this problem internationally. With the interdisciplinary research that's going on at MIT, we're in a good position to address this problem.”

Vital support. The progress that ARCLab has made, Linares said, could not have been made without early and consistent philanthropic support through professorships and fellowships for graduate researchers. “The Rockwell Career Development professorship has definitely given me more freedom in my research,” he says. “In the years since receiving it, I've seen how it directly enabled many of our papers and funded travel for me and my students to important conferences around the world, which gave projects like MOCAT more visibility and momentum. Thanks to those opportunities, we're set up to be a leader in solving this societal problem.” ●

ARCLab Researchers, Across the Universe

LOW EARTH ORBIT

Miles Lifson SM '20, PhD '24

Research focus: My research is on developing ways to coordinate and understand how groups of satellites use low Earth orbit. Working on MOCAT has been a highlight of my time at MIT. I am inspired by the belief that MOCAT will help us all collectively arrive at better answers to the hard questions and trade-offs we'll have to adjudicate in the coming years about how to manage space.

Fellowship impact: The MathWorks Fellowship I received enabled me to pursue my thesis research and develop the theoretical basis for parts of what we implemented in MOCAT. The fellowship gave me the freedom to explore high-risk research directions and to develop research that has translated to subsequent publications, grants, and advice to policymakers.

GEOSTATIONARY EARTH ORBIT

Thomas González Roberts SM '21, PhD candidate

Research focus: I model the near-Earth space environment to contribute to world order in space, using principles from observational astronomy, ground-based telescopes, and radar systems to track and characterize satellite locations primarily about 20,000 miles above the Earth. I apply that to understanding the network of rules, laws, and treaties that govern space behavior from an international relations standpoint to contribute to evidence-based rules and policymaking.

Fellowship impact: Having fellowships totally changes the game for a graduate student, and I know that because I wasn't on one when I started at MIT. I've since received funding from various sources, including the National Science Foundation and Schmidt Futures. It's important to have the freedom and time to design and execute a research project well enough to become the kind of thought leader that MIT is so good at producing.

DEEP SPACE

Adriana Mitchell SM '21, PhD candidate

Research focus: I am researching the improvement of robust autonomous visual navigation algorithms under variable illumination conditions, focusing specifically on terrain-relative navigation during planetary entry, descent, and landing. Currently, I am collaborating with NASA's Jet Propulsion Laboratory on applying and validating my developed algorithms on NASA Lunar and Martian image datasets.

Fellowship impact: One example of a fellowship providing research flexibility was the incredible six-month research abroad opportunity funded by the MIT Progetto Rocca Fellowship and the national GEM Fellowship. At the Polytechnic Institute of Milan, I collaborated with their Deep-space Astrodynamics Research and Technology group on creating visual navigation image-processing techniques to be used onboard the European Space Agency CubeSat M-Argo.



TAKE ACTION

For many of the graduate students working with Richard Linares in ARCLab, the financial support provided by their fellowships gives them the freedom to do their work. Planned giving donors, both during their lifetimes and through estate gifts, continue to be champions of this type of student support. Contact the MIT Office of Gift Planning at giftplanning@mit.edu to find out how your bequest or other type of planned gift can support out-of-this-world research.

Fusion, Friends, and Philanthropy at the KDMS Brunch

The Katharine Dexter McCormick (1904) Society (KDMS) appreciation brunch, held annually each fall, is a way for the MIT Office of Gift Planning to thank planned giving donors who ensure that the Institute can continue its world-changing work. Anyone who informs MIT about a bequest intention or makes a life income gift is invited to join KDMS.



MIT connections. As brunch host Melissa Nobles, MIT chancellor and the Class of 1922 Professor of Political Science, pointed out in her opening remarks, KDMS members are following in the footsteps of Katharine Dexter McCormick herself, whose bequest transformed the Institute. “KDMS members celebrate and extend her legacy,” Nobles said. “Their commitment of funding helps to support discoveries and innovative collaborations, strengthens our education and research enterprise, and amplifies all that MIT does in service to the world.”

Rick ’68, SM ’74 and Karla ’68, SM ’70, PhD ’83 Karash have attended several KDMS events over the years. “We always have a good time. It is a great pleasure to see MIT people we know from our class and neighboring classes,” Rick says, noting that a highlight was seeing his former mentor, MIT professor emeritus and former dean of the MIT Sloan School of Management Glen Urban.

The majority—but not all—of KDMS members are MIT alumni. For first-time attendee Kevin Wang ’03, SM ’04, the wide range of class years represented was a standout element of the event. “It was a unique opportunity to be all together,” Wang says. “KDMS reminded me of MIT’s amazing people in all stages of life, from the current student ambassadors to the alumni who’ve earned their red jackets. It’s a really exceptional community.”

MIT today. “Our KDMS events have become windows into what’s going on at MIT,” said KDMS co-chair Bob Johnson ’63 in his remarks. Current students were in attendance at each table and in a much-lauded performance by MIT’s coed a capella group, the Chorallaries. Dennis Whyte, the Hitachi America Professor of Engineering and former director of the MIT Plasma Science and Fusion Center (PSFC), delivered the feature presentation on fusion energy and how MIT is leading the way to a future that does not depend upon fossil fuels.

“We have to come up with a holistic solution to climate change, but massive amounts of carbon-free energy generation must be at the core of it, almost certainly from new technologies,” Whyte said in his presentation. He noted that the way MIT does research matters. “What I really admire about MIT and PSFC is the complete integration of education into a world-leading research endeavor,” Whyte remarked. “My students continuously challenge me in my own class about what we are doing in

terms of fusion. My motto for MIT is that we do research through education and education through research.”

“Professor Whyte’s presentation on fusion was very hopeful and exciting,” says Karla Karash. “Not only the research going on and the possibilities, but a practical way of implementing it. It was also a thrill to hear the Chorallaries—it gives you a sense of the breadth of MIT. These young people are not only smart, they can really sing!”

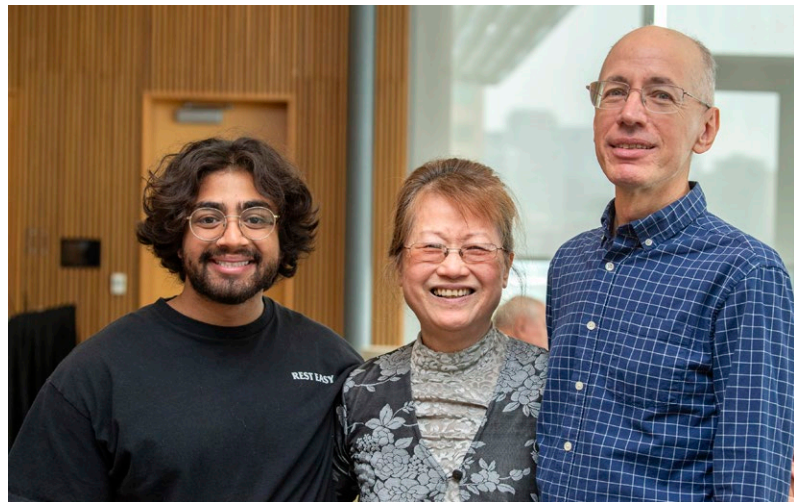
Celebrating impact. In her closing remarks, KDMS co-chair Heather Cogdell ’89 summarized how planned gifts make a difference at MIT: “Your support makes it possible for MIT to ensure that there are initiatives that target long-term issues like climate change, and that they can endure and be flexible to the dynamic needs of the moment.” That sentiment echoes what many KDMS members feel in their giving to MIT. “I’m confident that the resources that we give back to MIT will be used in a way that will drive progress forward and will effect change in the world,” says Wang.

Many attendees have seen the positive impact of philanthropy in their own lives and appreciated the chance to celebrate together. “Ever since my sophomore year, I have felt the importance of giving back to help others who have followed me to successfully matriculate through the Institute,” says Jim Banks ’76. “I had already included MIT when I began my estate planning, but had not notified MIT. Working with the Office of Gift Planning has helped me to better focus that contribution. This was my first KDMS brunch, and I’ll definitely want to attend again in the future.” ●



LEARN MORE

A recording of the 2023 KDMS appreciation brunch program is available at giving.mit.edu/kdms2023. To learn more about KDMS or to let MIT know about your bequest intention, contact the MIT Office of Gift Planning at giftplanning@mit.edu.



CLOCKWISE FROM TOP LEFT: Victor Tom and Sze-Wen Kuo; Amelia Yin (center) and Robert Cohn with their scholarship student, Raza S. Abbas ’24; Amy Goldman, senior director of the Office of Gift Planning, and Chris Toro, executive director of the Office of Individual Giving; Kevin Wang (center).

OPPOSITE PAGE: Rick and Karla Karash (top); Jim Banks with KDMS co-chair Heather Cogdell (second from left) and her family.





Q&A: Behind the Gift Process at MIT

Julia Topalian, Director of Gift Administration and Recording Secretary

Julia Topalian joined MIT in 2013 as senior director of campaign operations, overseeing comprehensive philanthropic activities related to the MIT Campaign for a Better World. Since becoming the director of gift administration and recording secretary in 2019, she has led the team of gift administration and finance professionals that receives donations on behalf of MIT.



What does the Office of the Recording Secretary do, and what do you appreciate most about your current role?

Our work typically begins once a donor tells MIT they're ready to make a gift. We draft gift agreements, establish dedicated funds for gifts, send gift receipts, and ensure accounting and tax compliance. If planned gifts or bequests are involved, we work with the Office of Gift Planning (OGP) to

set up an additional level of documentation that routes donations according to how the donor envisions their legacy. What I appreciate most about the function our office serves is how we work to translate the wishes of the donor into a document that will administer their gift for generations to come. For example, looking at gift documentation, I truly see what a tremendous impact that scholarship gifts have, and how donors' giving will affect current students and the future of MIT. It is a privilege to be a part of crafting the language that ensures that each generous gift will make a meaningful impact on so many students in the future.

How are bequest gifts processed at MIT?

When MIT receives an estate gift, OGP coordinates with the donor's representative to handle the transition of funds. The funds are then sent to my office either by wire, check, or securities; in the case of securities, our office handles their liquidation. Contributions are moved directly into the fund that the donor's estate documents indicate they'd like to support. Often, the donor specifies that the funds are for MIT's general support. In those cases, funds will be classified as unrestricted and applied to

MIT's most pressing needs. The Office of the Vice President for Finance, Resource Development, and the MIT Investment Management Company all coordinate to make sure that these gifts are handled carefully and thoughtfully.

What are the benefits of sharing information about a bequest intention with MIT, and what information is most helpful for the donor to share?

The benefit of sharing the details of an estate gift with MIT in advance is that we can help to articulate your goals and ensure a legacy that will live on at the Institute. We sometimes run into issues when a donor has left a specific request in their will that is difficult to accommodate, like for an academic area that has merged with another or for student support from an area from which we do not have many students. If donors are willing to share their intentions with us while they are doing their estate planning, we can help provide language for their documents that can address the areas they hope to support, but also allow flexibility as the academic direction of MIT evolves over time.

Why are planned gifts important to MIT?

MIT is a leader in higher education in part because alumni and friends have generously supported its mission and the programs that allow students and faculty to thrive. Planned gifts have been and continue to be a major source of that support. When someone makes a planned gift to MIT, they are entrusting us with their legacy. I am truly inspired and honored to help make a donor's gift of a lifetime a part of MIT's future. ●

Julia Topalian will be one of the speakers at the *Corridor* webinar, **Estate Planning at Any Age**, on Wednesday, May 1, from noon to 1 pm ET. Register to attend at giving.mit.edu/ogpwebinar, or contact corridorwebinar2024@mit.edu for more information.



“Our exceptional students, researchers, and faculty bring boundless energy to their work, and are always aiming for the

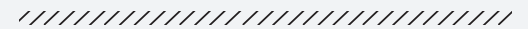
stars — sometimes literally! Support provided by bequests, life income gifts, donor-advised funds, and retirement plans makes it possible to establish new fellowships and professorships that attract the best graduate students. When we give our investigators the tools to pursue new ideas, some of the discoveries made at MIT will surely change the world.”

Julie A. Lucas
Vice President for Resource Development

Sample Bequest Language

Below is suggested language to share with your advisor if you would like to include MIT in your will or estate plan. Contact us if you prefer your gift to be designated for a specific purpose so we can help personalize your bequest.

I give [all of the residue of my estate OR an amount equal to X percent of the residue of my estate / thereof OR \$ _____] to the Massachusetts Institute of Technology (MIT), a Massachusetts nonprofit corporation, for its general educational and charitable purposes.



All information in this newsletter should not be considered legal or financial advice. We encourage you to discuss these options with your advisor.

Contact Us

Learn more about how making a planned gift to MIT can help you to:

- meet your financial goals
- achieve your charitable aspirations
- bolster MIT’s groundbreaking programs
- provide income to you and/or your beneficiaries

Ready to start the conversation?



Scan the QR code with your smartphone to contact the Office of Gift Planning for a confidential conversation, or call 617.253.4082.



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Office of Gift Planning
600 Memorial Drive W98-500
Cambridge, MA 02139-4822

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From the MIT
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Gift Planning

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