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MIT Faculty Newsletter

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in this issue we offer commentary on the Iran nuclear negotiations and a Q&A about the New Horizons mission to Pluto (below); the From The Faculty Chair feature by new Chair Krishna Rajagopal (p. 4); an Open Letter to President Reif concerning divesting from fossil fuels (p. 10); and continuing commentary on MIT's East Campus construction plans (p.13).

Pluto in True Color

Pluto in View! O! The Joy!

The following Q&A by the Faculty Newsletter (FNL) was held with MIT professor Richard Binzel (RB), a co-investigator on NASA's New Horizons mission to Pluto and the Kuiper belt.

A CAREER-LONG ODYSSEY in the study of Pluto, getting a mission to the launch pad, and a successful flyby after a decade of interplanetary flight.

FNL: *According to news reports, you were part of a group that began proposing a Pluto mission 25 years ago, which was cancelled six times before finally launching in 2006. What is it like to keep at this goal for so long and how did you maintain your determination?*

RB: Well, beyond the trademark persistence that permeates all of us here at MIT,

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Iran and the P5+1 Pact

Noam Chomsky

THROUGHOUT THE WORLD THERE is relief and optimism about the nuclear deal reached in Vienna between Iran and P5+1. There are, however, striking exceptions: the United States and its closest regional allies, Israel and Saudi Arabia – where fear of the "Iranian threat" sometimes reaches virtual hysteria – a stand shared by prominent sectors of American opinion. Even sober commentary in the United States, pretty much across the spectrum, declares Iran to be "the gravest threat to world peace." U.S. supporters of the agreement are wary, given the exceptional gravity of the Iranian threat and concerns about the terrible Iranian record of violence and deceit.

It is perhaps of some interest that the world sees the matter rather differently: it is the United States that is regarded as the gravest threat to world peace

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Editorial

MIT's Role in the Iran Nuclear Negotiations

ONE OF THE MAJOR ISSUES before Congress this fall is whether or not to approve the agreement negotiated among the P5+1 nations (U.S., China, Russia, France, UK, and Germany) and Iran, with respect to non-proliferation of nuclear weapons. Prof. Chomsky's article makes the case for supporting the negotiated agreements.

MIT has a deep connection to the process with numerous colleagues and past graduates playing critical roles in the Iran negotiations, discussions in the media, and working with Congress (see ***news.mit.edu/2015/us-iran-nuclear-deal-0724***).

Our colleague, Ernest J. Moniz, was the lead technical negotiator and has played a major, constructive role in the P5+1 negotiations with Iran with regard to its nuclear facilities (see e.g. ***nyti.ms/1Mv87eK***).

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MIT's Role in the Iran Nuclear Negotiations
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Prof. Moniz is currently the United States Secretary of Energy and the Cecil and Ida Green Professor of Physics and Engineering Systems, Emeritus. He has served on the faculty since 1973 and has had a long and distinguished career at the Institute (see ***https://esd.mit.edu/Faculty_Pages/moniz/moniz.htm***).

Prof. Moniz is also playing a key role in explanations to Congress. Even members of Congress who oppose the deal have praise for his authoritative testimony. "Thus far, he's by far been the best witness, the best person to talk to," Sen. Bob Corker, the Chairman of the Foreign Relations Committee, told reporters shortly after the deal had been announced (***www.realclearpolitics.com/articles/2015/07/28/ernest_moniz_obamas_mvp_on_iran_deal_127576.html***).

An important reason for the success of the Iran negotiations was Moniz's ability to work well and connect personally with Ali Akbar Salehi, a 1977 MIT PhD in Nuclear Engineering and the head of the Atomic Energy Organization of Iran (***https://en.wikipedia.org/wiki/Atomic_Energy_Organization_of_Iran***) since 2013 (No. 2 Negotiators in Iran Talks Argue Physics Behind Politics, David E. Sanger, *The New York Times*, March 28, 2015). Dr. Salehi served as Iran's foreign minister from 2010 to 2013, and has been a professor and chancellor (***https://en.wikipedia.org/wiki/Chancellor_(education)***) of the Sharif University of Technology (***https://en.wikipedia.org/wiki/Sharif_University_of_Technology***).

Dr. Jim Walsh is a Research Associate at MIT's Security Studies Program (SSP) and has been playing a major role in the congressional and public discussion of the Iran negotiations and agreement. An expert in international security, Dr. Walsh is a major player in the Iran Project, a non-profit group dedicated to the understanding and improvement of U.S.-Iran relations (***iranprojectfcsny.org***). He is one of a handful of Americans who has traveled to both Iran and North Korea for talks with officials about nuclear issues. He has testified many times about the Iran negotiations in Congress and is a regular commentator on NPR and many other news organizations. (See ***web.mit.edu/ssp/people/walsh/faculty_walsh.html*** for more information.)

R. Scott Kemp is Assistant Professor of Nuclear Science and Engineering and has significantly contributed to the technical and policy discussion about Iran. He was previously the Science Advisor for Nonproliferation and Arms Control, where he participated in early P5+1 talk and laid the basis internally for much of the current agreement with Iran. He has also been a regular participant in the track-II diplomacy effort that met several times a year with Salehi, Foreign Minister Zarif, or P5+1 ambassadors to help sort out technical questions about how negotiations might play out. These discussions produced the solutions now adopted for the Fordow centrifuges and for the plutonium program. His research combines physics with engineering to understand the limits and policy options for achieving international security under technical constraints. He is an expert on nuclear centrifuges and has pointed out that this changes the international security framework in new and difficult ways (see ***web.mit.edu/nse/people/faculty/kemp.html***).

An important reason for the success of the Iran negotiations was Moniz's ability to work well and connect personally with Ali Akbar Salehi, a 1977 MIT PhD in Nuclear Engineering and the head of the Atomic Energy Organization of Iran . . . .

As this issue goes to press, the outcome of the Congressional vote remains uncertain. We continue to believe that diplomacy is the preferred course in defusing international tensions.

Editorial Subcommittee

From The Faculty Chair

The Year Ahead

Krishna Rajagopal

I AM GRATEFUL TO the editors of the *Faculty Newsletter* for offering the Chair of the Faculty the opportunity to write a regular column. Together with the new Associate Chair of the Faculty, Prof. Leslie Kolodziejski from Electrical Engineering and Computer Science, and the new Secretary of the Faculty, Prof. Chris Capozzola from History, I am looking forward to the coming academic year with anticipation. I hope that your summers have been as invigorating as mine. Leslie, Chris, and I are honored to serve as your Faculty Officers for the coming two years.

Looking ahead, this year – as in any year – MIT faces a variety of challenging questions that, in different ways, go to the core of who we are, what we value, and what we contribute to the world. I will list a few, no doubt missing as many as I list:

• How will MIT, and in particular the MIT faculty, rise to the challenges put to us by the recent reports from the Task Force on the Future of MIT Education and from the MIT Climate Change Conversation Committee? What are the most effective ways via which MIT can harness the energies of its students, staff, and faculty toward finding solutions to the climate challenge? How can we best catalyze transformations in pedagogy and extensions to MIT's educational impact, including those envisioned by the Task Force?

• What new opportunities are there for MIT to lead in the development of residential education experiences that are intensely rigorous, inclusive, healthy, and welcoming? How should MIT best employ the many ways in which we, all of us in different ways and at different times, support students in our community? How can we strengthen the health and wellness of all our students, and of all of us? How can we most effectively weave the strong fibres that thread through our community into a resilient safety net?

• How will MIT remain a beacon of discovery and innovation when federal support for basic research is under stress? How do we envision the MIT campus evolving over the coming decade or two, as student life and faculty life evolves? How will the changing campus landscape (dorms, maker spaces, classrooms, offices, research facilities . . .) improve our quality of life and empower us to achieve our ambitions?

Together with my fellow Faculty Officers, as the Chair of the Faculty I have the challenge of articulating the perspectives of the faculty in many conversations, including at the highest levels of the administration, as MIT finds its way toward answering these and other central questions, in so doing shaping its future. But, what are the perspectives of the faculty? Conversations among us, in many different circles, about these kinds of questions are vital. I expect that in future columns I will share thoughts about some of these questions, informed by my continuing conversations and with the goal of prompting them further.

Through the Faculty Policy Committee, on which all three of us serve, the Faculty Officers are also stewards of MIT's shared faculty governance. The coming academic year will see the faculty, first through its committees and then as a whole, considering an unusually large suite of curricular innovations, likely including a PhD program centered in our new Institute for Data, Systems and Society, new undergraduate majors, and a new Masters program developed by the Sloan School, as well as several other new majors and minors. In addition, many faculty and departments are building and trying out new online tools to improve how we teach on campus and to reach out to the world, and are exploring new forms of flexibility and modularity, among many pedagogical innovations.

How can we all benefit from our colleagues' experience as we develop our own next innovation? What are the implications for student learning and the student experience, including the flexibility to tailor unique learning experiences as well as potential impacts on pace, pressure and stress, of our evolving mix of half-term and full-term subjects? Here the faculty committees play a key role, ensuring that new programs, new proposals, new innovations are all strengthened via synthesizing the insights and experience of faculty and departments across the Institute. So too do the web of collegial ties via which each of us interacts with colleagues outside our own departments, labs, and centers.

As I reread what I have written above, what jumps out in my own mind as I think about how to serve effectively as your Chair in a year with such a variegated suite of challenges, is how critically important it is for me to talk with as many of you as I possibly can, and to hear from as many more of you as I can at one degree of separation through Leslie, Chris, and the members of the Faculty Policy Committee. Please find me; please find us. How? I'll close with two specific suggestions, but please find me any way that you like.

First, please come to MIT faculty meetings; to the meetings themselves, and to the reception afterwards.

Second, I much look forward to seeing you when you are one of the faculty members invited to one of the random faculty dinners. For me, these dinners that were started by Jay Keyser about three decades ago, have long been among my favorite features of faculty life. The opportunity they provide to make and renew connections with colleagues from across the Institute over wine and dinner play a valuable role in knitting our community together; certainly for me over the years they have built cross-links that later came to be of value in unpredictable ways. For the next two years, Leslie, Chris, and I will endeavor to be at all of them. One of the challenges I look forward to is trying to emulate Jay's light but reassuring touch in guiding the open discussion that we have over dessert and coffee at the conclusion of each dinner. There is never an agenda, but time is allotted for any of you to raise current issues on your mind.

Krishna Rajagopal is a Professor of Physics, a MacVicar Faculty Fellow, and Chair of the Faculty *(krishna@mit.edu)*.

Teaching this fall? You should know . . .

the faculty regulates examinations and assignments for all subjects.

View the complete regulations at: ***web.mit.edu/faculty/teaching/termregs.html***.
Select requirements are provided below for reference.

Contact Faculty Chair Krishna Rajagopal at x3-6202 or *krishna@mit.edu* for questions or exceptions.

No required classes, examinations, oral presentations, exercises, or assignments of any kind may be scheduled after the last regularly scheduled class in a subject, except for final examinations scheduled through the Schedules Office.

Undergraduate Subjects
By the end of the **first week** of classes, you must provide:

- a clear and complete description of the required work, including the number and kinds of assignments
- the approximate schedule of tests and due dates for major projects
- an indication of whether or not there will be a final examination, and
- the grading criteria and procedures to be used

By the end of the **third week**, you must provide a precise schedule of tests and major assignments.

Tests, required reviews, and other academic exercises outside scheduled class times shall not be held on Monday evenings. In addition, when held outside scheduled class times, tests must:

- not exceed two hours in length
- begin no earlier than 7:30 PM when held in the evening, and
- be scheduled through the Schedules Office

In all undergraduate subjects, there shall be no tests after Friday, December 4, 2015. Unit tests may be scheduled during the final examination period.

Graduate Subjects
By the end of the **third week**, you must provide:

- a clear and complete description of the required work, including the number and kinds of assignments
- the schedule of tests and due dates for major projects
- an indication of whether or not there will be a final examination, and
- the grading criteria and procedures to be used

For each graduate subject with a final examination, no other test may be given and no assignment may fall due after Friday, December 4, 2015. For each subject without a final examination, at most, either one in-class test may be given, or one assignment, term paper, or oral presentation may fall due between December 5 and the end of the last regularly scheduled class in the subject.

Collaboration Policy and Expectations for Academic Conduct
Due to varying faculty attitudes towards collaboration and diverse cultural values and priorities regarding academic honesty, students are often confused about expectations regarding permissible academic conduct. It is important to clarify, in writing, expectations regarding collaboration and academic conduct at the beginning of each semester. This could include a reference to the MIT Academic Integrity Handbook at: ***integrity.mit.edu***.

The Iran and the P5+1 Pact
Chomsky, from page 1

(WIN/Gallup). Far below in second place is Pakistan, its ranking probably inflated by the Indian vote. Iran is ranked well below, along with Israel, North Korea, and Afghanistan.

Opponents of the nuclear deal charge that it did not go far enough. With quite different concerns, some supporters agree, holding that "If the Vienna deal is to mean anything, the whole of the Middle East must rid itself of weapons of mass destruction." The author of these words, Iran's Minister of Foreign Affairs Javad Zarif, adds that "Iran, in its national capacity and as current chairman of the Non-Aligned Movement, is prepared to work with the international community to achieve these goals." Iran has signed "a historic nuclear deal," he continues, and now it is the turn of Israel, "the holdout." Israel, of course, is one of the three nuclear powers, along with India and Pakistan, whose nuclear weapons programs have been abetted by the United States and that refuse to sign the Nonproliferation Treaty. Minister Zarif was referring to the regular five-year NPT review conference, which ended in failure in April when the U.S. once again blocked the efforts to move towards a WMD-free zone in the Middle East (joined this time by Canada and Britain).

These efforts have been led by Egypt and other Arab states for 20 years. Two of the leading figures promoting them at the NPT and other UN agencies, and at the Pugwash conferences, Jayantha Dhanapala and Sergio Duarte, observe that "The successful adoption in 1995 of the resolution on the establishment of a zone free of weapons of mass destruction (WMD) in the Middle East was the main element of a package that permitted the indefinite extension of the NPT." Repeatedly, implementation of the resolution has been blocked by the U.S., most recently by Obama in 2010 and again in 2015. Dhanapala and Duarte comment that the effort was again blocked "on behalf of a state that is not a party to the NPT and is widely believed to be the only one in the region possessing nuclear weapons," a polite and understated reference to Israel. They "hope that this failure will not be the *coup de grâce* to the two longstanding NPT objectives of accelerated progress on nuclear disarmament and on establishing a Middle Eastern WMD-free zone."

Opponents of the nuclear deal charge that it did not go far enough. With quite different concerns, some supporters agree, holding that "If the Vienna deal is to mean anything, the whole of the Middle East must rid itself of weapons of mass destruction." The author of these words, Iran's Minister of Foreign Affairs Javad Zarif, adds that "Iran, in its national capacity and as current chairman of the Non-Aligned Movement, is prepared to work with the international community to achieve these goals."

A nuclear weapons-free zone in the Middle East is a straightforward way to address whatever threat Iran's nuclear programs allegedly poses. And as these comments make clear, a great deal more is at stake in Washington's continuing sabotage of the effort – protecting its Israeli client. This is not the only case when opportunities to end the alleged Iranian threat have been undermined by Washington, raising further questions about just what is actually at stake.

What in fact is the Iranian threat? It can hardly be military. U.S. intelligence years ago informed Congress that Iran has low military expenditures by the standards of the region and that its strategic doctrines are defensive, designed to deter aggression. It also concludes that "Iran's nuclear program and its willingness to keep open the possibility of developing nuclear weapons is a central part of its deterrent strategy."

Details are provided in an April study of the Center for Strategic and International Studies, which finds "a conclusive case that the Arab Gulf states have . . . an overwhelming advantage [over] Iran in both military spending and access to modern arms." Iran's military spending is a fraction of Saudi Arabia's, and is far below even the spending of the United Arab Emirates. Altogether, the Gulf Cooperation Council states – Bahrain, Kuwait, Oman, Saudi Arabia, and the UAE – outspend Iran on arms by a factor of eight, an imbalance that goes back decades. The CSIS observes further that "The Arab Gulf states have acquired and are acquiring some of the most advanced and effective weapons in the world [while] Iran has essentially been forced to live in the past, often relying on systems originally delivered at the time of the Shah," which are virtually obsolete. The imbalance is of course even greater with Israel, which, along with the most advanced U.S. weaponry and its role as a virtual offshore military base of the global superpower, has a huge stock of nuclear weapons.

No serious analyst believes that Iran would ever use a nuclear weapon if it had one, thus suffering instant destruction. There is, however, real concern that a nuclear weapon might fall into jihadi hands – not from Iran, where the threat is minuscule, but from U.S. ally Pakistan, where it is very real. Two leading Pakistani nuclear scientists, Pervez Hoodbhoy and Zia Mian, write in *International Affairs* that increasing fears of "militants seizing nuclear weapons or materials and unleashing nuclear terrorism [have led to] the creation of a dedicated force of over 20,000 troops to guard nuclear facilities." They warn that "There is no reason to

assume, however, that this force would be immune to the problems associated with the units guarding regular military facilities," which have frequently suffered attacks with "insider help." In brief, the problem is real, and largely ignored, displaced by fevered fantasies concocted for other reasons.

It might also be useful to recall – surely Iranians do – that not a day has passed since 1953 when the U.S. was not severely harming Iranians. As soon as Iranians overthrew the hated U.S.-imposed regime of the Shah in 1979, Washington at once turned to supporting Saddam Hussein's murderous attack on Iran. In recent years the hostility has extended to sabotage, murder of nuclear scientists (presumably by Israel), and cyberwar, openly proclaimed with pride. The Pentagon regards cyberwar as an act of war, justifying a military response, with the accord of NATO, which affirmed in September 2014 that cyber attacks may trigger the collective defense obligations of the NATO powers.

Do Iranian leaders intend to develop nuclear weapons? We can decide how credible their denials are, but that they had such intentions in the past is clear. It was asserted openly on the highest authority, which informed foreign journalists that Iran would develop nuclear weapons "certainly, and sooner than one thinks." The father of Iran's nuclear energy program and former head of Iran's Atomic Energy Organization was confident that the leadership's plan "was to build a nuclear bomb." A CIA report also had "no doubt" that Iran would develop nuclear weapons if neighboring countries did (as they have).

All of this was under the Shah, the highest authority just quoted. That is, during the period when high U.S. officials – Cheney, Rumsfeld, Kissinger, and others – were urging the Shah to proceed with nuclear programs, and pressuring universities to accommodate these efforts. As part of these efforts, MIT made a deal to admit Iranian students to the nuclear engineering program in return for grants from the Shah, over the very strong objections of the student body, but with comparably strong faculty support, in a meeting that older faculty will doubtless remember well.

What then is the real threat of Iran that inspires such fear and fury? Recall the analysis of U.S. intelligence that Iran's nuclear programs (with no effort to produce bombs, as far as intelligence can determine) are "a central part of its deterrent strategy."

Who would be concerned by an Iranian deterrent? The answer is plain: the rogue states that rampage in the region. Far in the lead in this regard are the U.S. and Israel, with Saudi Arabia joining the club with its invasion of Bahrain to support the crushing of the reform movement and now its murderous assault on Yemen, sharply accelerating the humanitarian catastrophe there.

For the United States, the characterization is familiar. Fifteen years ago, Samuel Huntington warned in *Foreign Affairs* that for much of the world the U.S. is "becoming the rogue superpower," considered "the single greatest external threat to their societies." His words were echoed shortly after by the president of the American Political Science Association, Robert Jervis, who observed that "In the eyes of much of the world, in fact, the prime rogue state today is the United States." As we have seen, global opinion supports this judgment today by a substantial margin.

No serious analyst believes that Iran would ever use a nuclear weapon if it had one, thus suffering instant destruction. There is, however, real concern that a nuclear weapon might fall into jihadi hands – not from Iran, where the threat is minuscule, but from U.S. ally Pakistan, where it is very real.

Furthermore, the mantle is worn with pride. That is the clear meaning of the insistence of the leadership and the political class, in media and commentary, that the U.S. reserves the right to resort to force if it determines, unilaterally, that Iran is violating some commitment. It is also a long-standing official stand of liberal Democrats, for example the Clinton Doctrine that the U.S. is entitled to resort to "unilateral use of military power" even for such purposes as to ensure "uninhibited access to key markets, energy supplies and strategic resources," let alone alleged "security" or "humanitarian" concerns. And adherence to the Doctrine is well confirmed in practice, as need hardly be discussed.

These are among the critical matters that should be the focus of attention in analyzing the nuclear deal at Vienna, whether it stands or is sabotaged by Congress, as it may well be.

Noam Chomsky is a Professor in the Department of Linguistics and Philosophy *(chomsky@mit.edu).*

Pluto in View! O! The Joy!
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it is the raw spirit of exploration to "reach the unreachable" that fueled my determination. During one of the many downturns you mention, I happened to pick up Stephen Ambrose's Undaunted Courage, the story of the Lewis and Clark expedition. The parallel went right to my core: the determination and effort required to get across the continent 200 years ago was exactly what we had to muster to reach that next frontier across the solar system. In my office I put up a painting depicting the Lewis and Clark journey and I read their journals day-by-day. In getting to Pluto, every day became just one more step in a journey of exploration.

FNL: *How did you first get involved with a Pluto mission?*

RB: The success of Voyager 2 reaching Neptune in 1989 signaled that Pluto could be in reach of a spacecraft. At that time, I was one of only a handful of Pluto scientists worldwide. We happened to be together at a conference in Baltimore in May 1989. Over dinner our discussions turned to the concept of a Pluto mission. Our conclusion: Why not now? Why not us? The die was cast, and most strongly with Alan Stern who would become the New Horizons Principal Investigator. I cannot give enough credit to Alan and the team he assembled over the years to make this mission a success. In the end, I am just a small member of the team.

FNL: *If there were so few Pluto scientists, how is it that Pluto captured your scientific interest to begin with?*

RB: Like many things, it was happenstance that goes back to 1978 when I was an undergraduate. I was a summer "UROP" (which hadn't been invented yet) working at the U.S. Naval Observatory in Washington, DC. Pluto's large moon (Charon) was literally discovered in the office next door during the first week of my internship. On the very day of discovery (June 22, 1978), I was there along side the professionals examining the fuzzy telescopic images of Pluto on glass photographic plates. A persistent bump on the photographs moved around Pluto that fit its known 6.4 days rotation period. So from the very beginning of my career I was there helping to calculate the rotationally synchronous orbit of Pluto's moon. Even that minor participation in such a major discovery yielded a very powerful lesson: Even what seems unknowable can be unraveled.

FNL: *Based on your own research, what did you expect to see on Pluto and what surprised you the most?*

RB: In graduate school I began my own Pluto observations that led to the detection of "eclipses" between Pluto and its moon. Again this was a fortuitous once-per-century alignment, but the passing of Charon across Pluto's disk (like a scanner) allowed us to directly map the surface of Pluto long before the Hubble Space Telescope did it. Happily, as it turns out, those maps proved quite correct within their limits, revealing bright polar regions and an overall darker equatorial band. Surprising us *in situ* was the starkness in the contrast – having icy regions as bright as we see means they have to be geologically recent deposits. Together with my graduate student, we are trying to figure out exactly how seasons work on Pluto. The driving forces are its 248-year elliptical orbit changing the global solar insolation it receives by a factor of two and the fact its spin vector is tilted over by about 60 degrees with a precession period of a few million years.

FNL: *What were some of the most daunting technical challenges to reach Pluto?*

RB: Space flight is hard and the great distance makes everything even harder. To reach the destination in a survivable lifetime for both the team and the spacecraft requires flight at high velocity (more than 20 km/sec). But at that velocity, we can't carry enough fuel to slow down and orbit.

Prof. Binzel on the Launchpad

So everything had to be done as a flyby, and with a nine-hour communication delay (light-time travel 4.5 hours each way), it all had to be completely autonomous. The autonomous flyby requirement dictated every aspect of the instrument design down to the most minute detail for choreographing our data acquisition and storage during closest approach. Solar panels are not effective at that distance, meaning we needed a radioisotope (plutonium, of course) to generate power. Getting that fueled and the approval process completed in time for launch was a huge hurdle. Our data return rate from Pluto's distance (and only 40 watts of power) is 1000 bits per second, reminiscent of a dial-up modem with an acoustic coupler. So now, it is a patient process to get all of the data down to Earth.

FNL: *How much did the New Horizons mission cost? Did Pluto's reclassification as a "Dwarf Planet" have any effect on the mission?*

RB: New Horizons is a NASA-funded $700 million mission, placing it in the "mid-range" of planetary mission budgets. As for the label, this had no effect whatsoever other than rekindling public interest in Pluto. (For what it's worth, the Sun is classified as a dwarf star.)

Scientifically, we have always sought to explore Pluto as its own unique world, regardless of its label. Pluto itself has proved us right about being different! One enjoyable fallout of the "planet debate" was many engaging conversations with Jay Keyser on the linguistics of why labels are so difficult to define across many fields.

FNL: *What was the most satisfying part of your experience?*

RB: The most satisfying part was the human element of seeing the joy on the faces of one's colleagues who have become a family during this long journey from concept to destination. We did it! In that journey, some of MIT's own students (trained by the late Professor James Elliot) rose to the top ranks of Deputy Project Scientists – and there is no joy greater than seeing our students succeed. Leslie Young (EAPS PhD '94) [the daughter of retired Aero Astro Professor Larry Young] and Cathy Olkin (EAPS PhD '96) are high level faces for at least one-quarter of the team who are women, which we think is the highest proportion on any NASA mission. It is very satisfying to know that New Horizons is pushing this frontier as well.

FNL: *What advice do you give your students about taking on these kinds of challenges?*

RB: Start early! Even a journey of 3 billion miles begins with a single step. Keep in your heart that spirit of exploration to steel yourself against how hard it is to reach unreachable frontiers.

Pluto Shown in Enhanced Colors to Distinguish Surface Details

FNL: *What's next?*

RB: We have a healthy spacecraft continuing to fly through the Kuiper Belt, a newly recognized region beyond Neptune that is like an "asteroid belt" only even more populous. We have at least one known object (about 50 km across) in our sites that's within our remaining fuel budget. We'll soon be asking for NASA's approval for an extended mission to go there.

FNL: *Anything else you would like to add?*

RB: Two things. First, we feel very privileged to be the capstone team for the generation completing the first reconnaissance of all the planets in our solar system, many aspects of which we owe to MIT colleagues. Mariner 4 flew by Mars exactly 50 years prior, and in those decades we have explored every planet from Mercury outward, including the largest main-belt asteroids. Second, we hope New Horizons becomes "the Apollo moment" for a new generation of young scientists and engineers. I guess we'll find out when we quiz the entering class of 2030 about how they got interested in their careers.

Richard P. Binzel is a Professor of Planetary Science in the Department of Earth, Atmospheric, and Planetary Sciences. He holds a joint appointment in the Department of Aeronautics and Astronautics and is a MacVicar Faculty Fellow *(rpb@mit.edu).*

An Open Letter to President Reif and the Executive Committee on Divesting from Fossil Fuel Companies

To add your name to this open letter, please visit: ***www.MITFacultyDivest.org****. [Electronic references supporting many of the points in the letter below are included in the Web version.]*

DEAR PRESIDENT REIF AND THE EXECUTIVE COMMITTEE,

We, the undersigned faculty of MIT, write in support of divesting MIT's endowment from fossil fuel companies. The unique position of the Institute provides us with both the means and the obligation to take bold action against the harmful effects of climate change.

One of the clearest and most powerful ways to demonstrate our seriousness about tackling catastrophic climate change is to divest from fossil fuels, as part of a multi-faceted climate action plan.

We support divestment – as one of the Institute's actions – for reasons including the following:

> Divestment recognizes the scientific necessity of drastically and rapidly reducing greenhouse gas emissions to avoid global warming beyond the 2 degree Celsius limit agreed to by virtually every country on Earth. At least two-thirds of all existing global fossil fuel reserves must never be burned, yet every year the fossil fuel industry spends hundreds of billions of dollars looking for more.
>
> Our integrity is at stake. Many fossil fuel companies have a proven record, past and present, of actively working to obscure the scientific consensus around climate change. By continuing to invest in these companies, we knowingly endorse efforts to undermine MIT's commitment to scientific analysis and practical action for the betterment of humankind.
>
> Divestment is the moral course of action, and also the financially prudent one. Any solution to climate change will require an unprecedented reduction in the demand for fossil fuels. Many of the world's foremost investment experts are warning that fossil fuels are overvalued in light of their dangers, risking trillions of dollars of stranded assets.
>
> Divestment is not only right, it is powerful. Over the decades, divestment has proven effective at engendering the political will needed for bold leadership and legislation. MIT recognized this when it divested in 2007 in response to the human tragedy in Darfur. The impact of universities' thought leadership on public perception is tremendous.
>
> By divesting from fossil fuels, MIT can call out the contradictions between the fossil fuel industry's business practices and the requirements for a safe and stable future. The social and political momentum created can help shift the efforts of both policymakers and industry toward development of sustainable resources. And as a component of a larger strategy, divestment inspires hope and galvanizes passion and action in both society and our students.
>
> We do not call for divestment lightly, and the bounds of divestment must of course be carefully chosen. But in the end, we have a moral obligation to future generations – our children, our students, and beyond – to do everything we can to limit the most devastating consequences of human-driven climate change.
>
> We stand alongside thousands of MIT students, staff, and alumni in urging you to divest the Institute's endowment from fossil fuels as part of a comprehensive climate action plan.

Sincerely yours,

The undersigned faculty of MIT.

Scott Aaronson
Associate Professor
Department of Electrical Engineering & Computer Science;
Frank Ackerman
Lecturer
Department of Urban Studies & Planning;
Takako Aikawa
Senior Lecturer in Japanese
Global Studies & Languages;
Eric Alm
Associate Professor
Department of Biological Engineering;
Department of Civil & Environmental Engineering;
Angelika Amon
Kathleen & Curtis Marble Professor of Cancer Research
Koch Institute for Integrative Cancer Research; Howard Hughes Medical Institute;
Deborah Ancona
Seley Distinguished Professor of Management
Sloan School of Management;

Jolyon Bloomfield
Lecturer
Department of Physics;
Karen Boiko
Lecturer II
Comparative Media Studies/Writing;
Louis Bucciarelli
Professor (Emeritus) of Engineering & Technology Studies
Department of Science, Technology & Society;
John S. Carroll
Gordon Kaufman Professor of Management
Sloan School of Management;
Noam Chomsky
Institute Professor (retired)
Department of Linguistics & Philosophy;
Ian Condry
Professor of Japanese Culture & Media Studies
Head, Global Studies & Languages;
Jane Abbott Connor
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Bruno Coppi, O.M.R.I.
Professor of Physics (Emeritus)
Department of Physics;
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Associate Professor
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Jennifer Craig
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Daniel Cziczo
Victor P. Starr Professor of Atmospheric Chemistry
Department of Earth, Atmospheric & Planetary Sciences; Department of Civil & Environmental Engineering;
Michel Degraff
Professor
Department of Linguistics & Philosophy;
Junot Díaz
Rudge and Nancy Allen Professor of Writing
Comparative Media Studies/Writing;
Robert G. Eccles
Visiting Lecturer
Sloan School of Management;

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Associate Department Head
Department of Civil & Environmental Engineering;
Dara Entekhabi
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Bacardi and Stockholm Water Foundations Chair
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William F. Pounds Professor in Management
Professor of Organization Studies
Sloan School of Management;
Danny Fox
Anshen Chomsky Professor in Language and Thought
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Robert M. Freund
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Aram Harrow
Assistant Professor
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Charles F. Harvey
Singapore Professor of Environmental Science
Department of Civil & Environmental Engineering;
Sally Haslanger
Ford Professor
Department of Linguistics & Philosophy;
Department of Women's & Gender Studies;

Colette L. Heald
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Stefan Helmreich
Elting E. Morison Professor of Anthropology
Head, Anthropology Program;
Arne Hessenbruch
Lecturer
Department of Materials Science & Engineering;
Erica Caple James
Associate Professor
Director, Global Health & Medical Humanities Initiative
Anthropology Program;
Pablo Jarillo-Herrero
Associate Professor
Department of Physics;
Jason Jay
Senior Lecturer
Director of Sustainability Initiative
Sloan School of Management;
David Keith
Assistant Professor
Sloan School of Management;
Christine Kelly
Senior Lecturer
Sloan School of Management;
Michael Kenstowicz
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Jonathan Alan King
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Assistant Professor
Department of Earth, Atmospheric & Planetary Sciences;

Open Letter to President Reif
continued from preceding page

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Dennis McLaughlin
H.M. King Bhumibol Professor of Water Resource Management
Department of Civil & Environmental Engineering;
Haynes Miller
Professor
Philip Solondz (1948)-MacVicar Fellow
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Comparative Media Studies/Writing;
Robert Nachtrieb
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Leslie Norford
George Macomber (1948) Professor in Construction Management
Department of Architecture;
James B. Orlin
The Edward Pennell Brooks Professor of Operations Research
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Ozalp Ozer
Visiting Professor of Operations Management
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Heather Paxson
William R. Kenan, Jr. Professor of Anthropology
MacVicar Faculty Fellow
Anthropology Program;
Lee David Perlman
Senior Lecturer
Concourse Program;
David Pesetsky
Ferrari P. Ward Professor of Modern Languages & Linguistics
Margaret MacVicar Faculty Fellow
Head, Department of Linguistics & Philosophy;
Martin Polz
Professor
Department of Civil and Environmental Engineering;
Bjorn Poonen
Claude Shannon Professor of Mathematics
Department of Mathematics;
Jeffrey S. Ravel
Professor of History
Professor of Global Studies & Languages
Department of History; Global Studies & Languages;
Agustín Rayo
Professor
Department of Linguistics & Philosophy;
Norvin Richards
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Susan Ruff
Lecturer II
Comparative Media Studies/Writing;
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Leona D. Samson
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Department of Biological Engineering;
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Hilke Schlichting
Assistant Professor
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Michael S. Scott Morton
Jay W. Forrester Professor of Management (Emeritus)
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Kieran Setiya
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Robert Stalnaker
Laurance S. Rockefeller Professor of Philosophy
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S. C. Fang Professor of Chinese Language & Culture
Director, New Media Action Lab
Executive Director, NGO2.0
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Stephen Yablo
David S. Skinner Professor of Linguistics & Philosophy
Department of Linguistics & Philosophy;
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Sloan Distinguished Professor of Management
Sloan School of Management

MIT Construction Plans Continue to Undervalue Graduate Student Needs

Frederick P. Salvucci

DURING AUGUST, MITIMCO (MIT Investment Management Company) convinced the Cambridge Historic Commission to reduce the landmark protection for the Eastgate Married Student Housing building, which MITIMCo seeks to demolish and replace with a commercial laboratory building. This continues a pattern of MIT losing sight of its core missions of education and research, as it seeks to behave as a real estate developer.

The MITIMCo plan continues to pay only lip service to dealing with the serious challenge of providing affordable on- or near-campus housing for graduate students facing an increasingly harsh, superheated rental market in Cambridge and Boston, as it pursues commercial real estate development in Kendall Square. When MIT acquired the land near Kendall Square decades ago, it entered into contractual agreements with the Cambridge Redevelopment Authority and federal HUD to forgo commercial use of the land in order to focus on its core education and research missions. Since 1962, MIT had a policy of providing at least 50 percent of graduate students affordable on-campus housing, and the current superheated rental market requires even more.

Kendall Square is a perfect location to renew and expand graduate student housing at and near Eastgate. But MITIMCo today instead is prioritizing commercial ventures at Kendall, with the most readily available and developable vacant sites being proposed for luxury housing, commercial office space, commercial laboratory use, and very expensive underground parking. Proposals to increase graduate student housing, with no clear funding or timetable, are included on sites encumbered with existing historic buildings currently occupied by important MIT uses. For example, the MIT Press building is occupied by many different MIT organizations, and MITIMCo proposes to do radical rehabilitation of the structure which will be very expensive and require all the existing users to relocate, with no relocation plan and no explanation of how the current occupants will be able to afford to ever return.

Rather than renovating the Eastgate Married Student Housing building, MITIMCo proposes to demolish the building and daycare facility to re-use the land for a commercial laboratory, and is negotiating with the Cambridge Historic Commission to avoid landmark status for the building, which would make it more difficult to destroy. MITIMCo has stated that before the Eastgate housing is destroyed, new units of housing will be available, but with no explanation of when this will occur, nor a financial plan to deliver the housing.

If the expansion of affordable near-campus graduate student housing were prioritized by MIT, the luxury housing proposed on MIT land on Main Street could be used immediately for a combination of Married Student Housing and affordable units, and Eastgate tenants could be relocated there while Eastgate is rehabilitated and expanded as net new, affordable graduate student housing. The largely vacant Cambridge Trust site adjacent to the MBTA entrance could be another excellent site for graduate student housing. MIT should not be undertaking hyper-expensive underground parking, but could instead use the money for affordable graduate student housing, as well as incentivizing transit use by employees.

The failure to provide affordable on-campus student housing damages the viability of the unique MIT model of student-based high quality research, and simultaneously imposes serious burdens on the neighboring community by competing for ever scarcer affordable neighborhood housing. Conversely, if MIT takes aggressive action to provide more on-campus student housing, it will serve both the core education and research mission of MIT, and relieve the housing pressure on the neighboring communities.

Building significant amounts of on-campus housing sooner rather than later requires land, money, and priority. Instead of using scarce MIT land for commercial ventures and scarce dollars for underground parking, MIT should prioritize student housing that will reinforce its core mission and honor the commitments it made when the land was acquired, leaving real estate development to the private sector.

Frederick P. Salvucci is a Senior Lecturer in the Department of Civil and Environmental Engineering *(salvucci@mit.edu)*.

A Frog in Water
Part I: The Forces That Move Us

Thomas W. Eagar

THE PARABLE OF FROGS in water suggests that a frog immediately placed in very hot water will jump out and free itself; while a frog placed in cool water will remain as the water is slowly heated until the frog expires. A rapid change of environment causes a rapid response, but gradual changes provoke no response and can lead to death. So it is with our MIT environment.

MIT is an intense environment and probably always has been; or else we would not have accomplished so much over the past 150 years. Our intensity is part of our strength; but from time to time we should reflect if the nature of our intensity has changed. The nature of what keeps me busy has changed over the 40 years I have been a faculty member and it has not all been for the better.

As a new assistant professor in 1976, I was expected to pay 50 percent of my academic year salary and teach one subject per semester. At that time 25 percent of all NSF proposals were funded and you had an even better success rate if you were from an elite research university such as MIT. Multiple federal research grants were not frowned upon but were a sign of proposing significant scientific work. Peer review generally involved true peers and the process was not politicized.

Compliance with regulations, both external and internal, was minimal. Mail was slower and there was much less of it. While it took longer to communicate with others, the quality of communication was better. There were many fewer people demanding your attention or asking you to complete purposeless surveys, the answers to which were already known.

To understand how we have evolved, it is necessary to probe further back in time. Before World War II, MIT was primarily an undergraduate educational institution, located in the old complex of buildings. The pressure of the war and the need for the best and brightest to help solve a multitude of new problems, from nuclear fission, to engineering of practical radar, to bomb sights and ordnance control, to production of new metals, measurement of stress and strain and the like, brought research for national needs into focus with new sources of funding. After the war, the nation formed the Office of Naval Research, the Atomic Energy Commission, NACA (predecessor to NASA) and the NSF to expand on the proven successes of science during WWII. MIT added a School of Humanities and required that all undergraduates take 20 percent (now 25 percent) of their coursework in Humanities. The Sloan School of Management was created from the Department of Business and Industrial Development in the School of Engineering. Watson and Crick in England discovered the structure of DNA and MIT became a leader in molecular biology. The list goes on. New buildings were added to the MIT campus but interestingly, relatively few new departments were created.

As a new assistant professor in 1976, I was expected to pay 50 percent of my academic year salary and teach one subject per semester. At that time 25 percent of all NSF proposals were funded and you had an even better success rate if you were from an elite research university such as MIT.

The big change after WWII was the Soviet deployment of Sputnik. The United States, deep in an ideological war with the USSR, and feeling technologically superior to the rest of the world after WWII, was shocked. Congress started pouring money into science and engineering. My thesis advisor, Bob Rose, who lived through this as a young professor, often said the joke was "While you are up, get me a grant." MIT grew from 600 faculty to 1000 faculty within a decade and the graduate student population grew even faster. National graduate fellowships meant any qualified young person desiring a doctoral degree in science or engineering could be paid a stipend to attend graduate school. Previously, doctoral candidates often took instructorships, which were much more limited in number. To permit the faculty to pursue more research and to produce more doctoral degrees, funding agencies agreed to pay 50

percent or more of the faculty member's academic salary. In science and engineering the expected teaching load dropped from four subjects per year to two. This, along with the additional tuition from the larger number of graduate students, helped fund the rapid growth in number of faculty.

To MIT's credit, the administration during the second half of the twentieth century kept undergraduate education as the driving force for departmental budgets. New laboratories could be established to take advantage of the government's largesse, but these administrators had grown up when MIT's educational mission was paramount, and they did not depart from what they had been taught in their youth. The 1950s through the 1970s were the heyday of the research universities who had contributed so much during WWII; and there were only 30 to 40 of these research-ready universities.

By the mid-1970s other universities attempted to copy the prosperous "research universities." They hired our graduating doctoral students. The State universities asked for new facilities and staff from their legislatures. Their successes at becoming elite research institutions were marginal. There is more to creating the culture and intensity of an MIT or a CalTech than buildings and money as so many other universities around the world have proven over the past 50 years.

The culture of MIT resides in the people who make up the Institute. Some complain that MIT is too inbred; but some inbreeding is necessary to preserve the culture to excel, to think creatively, to have the humility to know one's limitations, to be in an environment where others of similar qualities can help us overcome our individual weaknesses. The balance of accepting people from all world cultures while preserving enough inbreeding to perpetuate the culture that started with William Barton Rogers and was established over our first 100 years is essential to our future success. We attract the best and the brightest students and we should not fear keeping some of them, especially those who understand the legacy of MIT.

With their limited success in competing with the research universities for federal grants, the other 250 universities changed their tactics and made their case directly to Congress. Research grants should be distributed geographically since citizens from every state paid taxes, and many of these other universities had even better football teams than MIT. Who could argue with such logic? Pork barrel funding of research and geographical quotas became new metrics for receiving a research grant. Although Congress expanded the funding several fold, the 10-fold increase in universities seeking grants caused the success rate of grants to fall dramatically. The 25 percent rate at NSF fell to 5 percent, and if you were from one of those overfunded traditional research universities, your prospects were dim. No more than one federal grant per investigator became a measure of equal opportunity.

Obvious excesses, such as Stanford's funding of its alumni party yacht, were in the news. The old agreements that federal agencies would pay the full cost of research were unilaterally withdrawn by the new leaders in Washington. These new administrators in the funding agencies were babies when Congress lured the original few research universities with promises of new buildings, fellowships, grants, and the like. MIT took some serious financial hits in the late 1980s and early 1990s due to these broken agreements by Washington. Seeing the handwriting on the wall, MIT took additional financial hits by hardening faculty salaries, although the rule of one subject per semester for science and engineering faculty was not changed. The faculty numbers might not grow, but neither would they shrink. Through the strong economy and the generosity of alumni, the Institute survived the 1990s academic financial crisis.

With the 1990s financial crisis and new government regulations (I also believe as we passed the billion dollar per year budget mark) MIT added administrative staff and new regulations both external and internal. A faculty member now has to respond to new paperwork, new internal oversight with the attendant decrease in quality of life and time for academic scholarship.

With the new competition from our former students who are now faculty at competing universities, and the lower success rate of proposals, we are forced to steal time from our students, our research, and our teaching. As difficult as I thought my own time was as a junior faculty member, I would not want to endure what the junior faculty today have to endure in seeking funding from Washington. I am not sure I could adapt to the environment they face today. Surely we give them more start-up resources, but they compete in a larger world. They must not only sell the intellectual merit of their ideas, they must package the ideas for the approval of Wall Street and others. The junior faculty (and the senior faculty) are no longer being judged by their scientific peers; everyone criticizes their ideas. This is not the path to the best science; scientific research is not a populist enterprise.

Compared to 40 years ago, the faculty spend too much of their time writing proposals as opposed to doing the research; filling out paperwork rather than teaching; and sitting in meetings with well-paid administrators who have never been on the faculty and who do not understand how to teach and mentor students.

The environment has changed; the frog's water is slowly getting hotter and we do not seem to notice.

In Part II I will explore the broader and longer-term consequences of these changes in our environment.

Thomas W. Eagar is a Professor of Materials Engineering and Engineering Management *(tweagar@mit.edu).*

Why MIT Is Implementing Duo Two-Factor Authentication

John Charles
Nickolai Zeldovich

BEGINNING OCTOBER 1, 2015, MIT faculty, staff, and affiliates will need a second authentication factor for access to MIT systems where sensitive data are stored. These include systems accessed through the Touchstone authentication service, systems managed by Information Systems and Technology (IS&T), and systems located within IS&T data centers, as well as systems accessed through the MIT Virtual Private Network (VPN). Duo authentication will be required from wherever you connect, whether via direct connection to MITnet, VPN, or from a remote address.

Why is two-factor authentication (2FA) important?

When it comes to online authentication, passwords are now a weak link. This is as true at MIT as anywhere. For example:

1. Some users choose weak (i.e., easy to guess) passwords. There are well-known databases of common passwords that are used by adversaries to break into accounts.

2. Some users use the same passwords on different systems or Websites. This means that an adversary who steals the password database from some not-very-important Website can look for @mit.edu accounts, and try to log into that MIT account using the same password.

3. Some users fall for phishing attacks – for example, responding to an email that pretends to be from an administrator asking for your password, or accidentally mistyping a Website's URL and typing your password into a Web page controlled by a hacker. This, again, allows the bad guys to gain access to an MIT account.

Two-factor authentication significantly raises the barrier and limits the effectiveness for all of the above attacker scenarios. Even if hackers compromise Kerberos passwords via a phishing email, malware, or other attack, they still won't have access to the second factor, i.e., the associated smartphone, landline, or token.

One common example of this has involved the use of phishing email to obtain end-user credentials for attacks against direct deposit payroll systems. These attacks have been successful at a number of MIT's peer institutions, including BU and Duke University. MIT has seen these attacks as well, although the Institute has not been targeted as aggressively as some other universities.

Increases in computing power, the rapidly expanding inventory of viruses and other types of malicious code, and keystroke loggers have also made it easier for hackers to obtain passwords.

On top of these vulnerabilities, there's another major concern. Users may not know for long periods of time that their passwords have been compromised. A hacker logging in with a compromised password merely shows up within security logs as a successful login.

How two-factor authentication helps

In the face of these security threats from compromised passwords, IS&T has been piloting the Duo service. Two-factor authentication is a mechanism used to protect systems, services, and accounts for which a password alone provides insufficient security. It is based on the principle of something you know (your username and password) and something you have (your smartphone, landline, or a hardware token). Users are first prompted to authenticate with their username and password; they are then prompted for a second authentication step using their phone or a token.

For convenience, Duo allows users to "remember" their browsers for 30 days, so that the second factor need not be entered at every login. For most use cases the increased risk associated with this convenience is small. Nevertheless, for the most secure computing experience, IS&T recommends not using the "remember" feature.

Two-factor authentication significantly raises the barrier and limits the effectiveness for all of the above attacker scenarios. Even if hackers compromise Kerberos passwords via a phishing email, malware, or other attack, they still won't have access to the second factor, i.e., the associated smartphone, landline, or token. Two-factor authentication can also help prevent abuse of MIT's VPN. IS&T sees several dozen compromised Kerberos accounts used to access the VPN each month. Requiring Duo for VPN access will help prevent these attacks and increase the effectiveness of security

implemented for systems and services intended to be available only to users from within MIT's network.

Duo has been in use on a pilot basis since 2013 for Kerberos and VPN access, and was recently extended to Windows Remote Desktop, MIT's critical infrastructure systems, and all IS&T-managed Windows servers.

Support

If you're not yet using Duo, several resources are available to help get you started. To learn how to install and use Duo at MIT, see the Duo Home Page in the Knowledge Base at ***kb.mit.edu/confluence/x/m9YwCQ***. You may also want to check out Duo's Guide to Two-Factor Authentication at ***https://guide.duosecurity.com/***.

If you have a smartphone, you should use the Duo app – it's the most convenient option (there are no numbers to type), and you will not incur SMS charges when you use the Duo service.

If you have a flip phone, you may want to use a hardware token (called a YubiKey). You can sign up for one using the Duo Token Request Form at ***ist.mit.edu/duo/token-request***. Instructions for registering your YubiKey are available in the Knowledge Base at ***kb.mit.edu/confluence/x/to8wCQ***.

If you have questions about setting up or using Duo, contact the IS&T Service Desk at *helpdesk@mit.edu* or 617.253.1101.

John Charles is Vice President for Information Systems and Technology *(jcharles@mit.edu)*; **Nickolai Zeldovich** is an Associate Professor in the Department of Electrical Engineering and Computer Science *(nickolai@mit.edu)*.

Nominate a Colleague as a MacVicar Faculty Fellow

PROVOST MARTIN SCHMIDT IS calling for nominations of faculty as 2016 MacVicar Faculty Fellows.

The MacVicar Faculty Fellows Program recognizes MIT faculty who have made exemplary and sustained contributions to the teaching and education of undergraduates at the Institute. Together the Fellows form a small academy of scholars committed to exceptional instruction and innovation in education.

MacVicar Faculty Fellows are selected through a competitive nomination process, appointed for 10-year terms, and receive $10,000 per year of discretionary funds for educational activities, research, travel, and other scholarly expenses.

The MacVicar Program honors the life and contributions of the late Margaret MacVicar, Professor of Physical Science and Dean for Undergraduate Education.

Nominations should include:

• a primary nomination letter detailing the contributions of the nominee to undergraduate education,

• three-to-six supporting letters from faculty colleagues, including one from his or her department head if the primary letter is not from the department head,

• three-to-six supporting letters from present or former undergraduate students, with specific comments about the nominee's undergraduate teaching,

• the nominee's curriculum vitae,

• a list of undergraduate subjects, including the number of students taught, and

• a summary of available student evaluation results for the nominee.

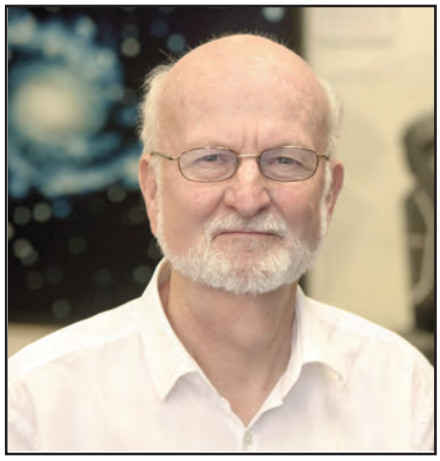
For more information, visit ***web.mit.edu/macvicar*** or contact the Office of Faculty Support at x3-6776 or *macvicarprogram@mit.edu*.

Nominations are due on Thursday, November 19.

Professor John W. Belcher Receives Prestigious 2016 Oersted Medal

Newsletter Staff

Highest teaching award from American physics community



JOHN W. BELCHER, Class of 1922 Professor of Physics and MacVicar Faculty Fellow, has been awarded the 2016 Hans Christian Oersted Medal of the American Association of Physics Teachers (AAPT). The award was given in recognition of Prof. Belcher's "tireless work with TEAL (Technology Enabled Active Learning) and Massive Open Online Courses (MOOCs)." The Oersted Medal recognizes those who have had an outstanding, broad and lasting impact on the teaching of physics. It is awarded annually by the American Association of Physics Teachers, a non-profit organization founded in 1930 to "enhance the understanding and appreciation of physics through teaching."

TEAL is an active engagement format for teaching introductory physics that is used in 8.01 and 8.02, the mainstream introductory physics courses at MIT. TEAL was funded by the Alex and Brit d'Arbeloff Fund for Excellence in Education and by iCampus. The implementation of this format at MIT, beginning on a large scale in spring 2003, was not without controversy. The often times turbulent history of the TEAL program has been recounted by Dr. Lori Breslow of MIT in an article in *Change: The Magazine of Higher Learning*, "Wrestling with Pedagogical Change: The TEAL Initiative at MIT" (42(5), 23-29, 2010).

Professor Belcher's current research interests concern the interaction of the heliosphere with the local interstellar medium. He was the principal investigator on the Voyager Plasma Science Experiment during the Voyager Neptune Encounter – the end of the Grand Tour. Belcher is now a co-investigator on the Plasma Science Experiment on board the Voyager Interstellar Mission. The Voyager spacecraft are still returning data, 37 years after launch, with a predicted demise in 2031.

Nine members of the MIT Physics Department have now won the Oersted Medal. Other MIT physics department recipients of the Oersted Medal include Mildred S. Dresselhaus (2008), alumnus and Nobel Laureate Carl Wieman (2007), John G. King (2000), Daniel Kleppner (1997), Anthony French (1989), Victor Weisskopf (1976), Francis Friedman (1963), and Jerrold Zacharias (1961). ■

Enhanced MIT Mental Health Initiatives and MindHandHeart Announced

IN A LETTER TO the community on September 2, 2015, Chancellor Cynthia Barnhart and MIT Medical Director William Kettyle announced immediate and long-term actions to enhance mental health and well-being at MIT.

Barnhart and Kettyle described listening to students, faculty, and staff, and responding to the main themes they heard:

1. More counseling and support options will help students; and

2. The best way to build a healthier, stronger MIT is by leveraging the innovative problem-solving skills and knowledge of our whole community.

New initiatives at MIT Medical and Mental Health and Counseling Service (MH&C) include:

• Adding two new full-time psychologists by the end of September (Student Support Services is also increasing their staffing levels);

• Opening a new MH&C location on main campus for drop-in consultations:

Starting on September 22, an MH&C clinician will be available in 8-316 to students for informal, confidential 20-minute consultations from 1-3 p.m., Tuesdays through Fridays. Walk-in hours for more urgent concerns continue to be available at MH&C (E23, 3rd floor) weekdays from 2-4 p.m.

• Adding an online appointment request form on MIT Medical's Website beginning September 10;

• Monitoring and sharing with students the availability and specialties of local providers who are accepting new patients;

• This summer, Student Outreach and Support, in collaboration with MH&C, trained 32 new students to serve as "Peer Ears." This more than triples the number of confidential peer-to-peer support providers available in MIT residence halls to help students navigate academic and social life at MIT.

Barnhart and Kettyle also announced the MindHandHeart Initiative (***mindhandheart.mit.edu***). The goal of the holistic, campus-wide effort sponsored by both the Chancellor's Office and MIT Medical is two-fold: over time, we want members of our community to feel more comfortable asking for help when they need it, and we want to build a healthier, stronger community.

MindHandHeart is co-chaired by Professor Rosalind Picard and consists of a steering committee and working groups of students, faculty, and student health and wellness experts. The steering committee and working groups are responsible for working to align existing support services and developing and implementing new innovative efforts. Their work will be guided in part by the recent results of the 2015 Healthy Minds Study, available at ***chancellor.mit.edu/data***.

To make progress, MindHandHeart requires strong community engagement. Barnhart and Kettyle encouraged community members to take part in several ways, including:

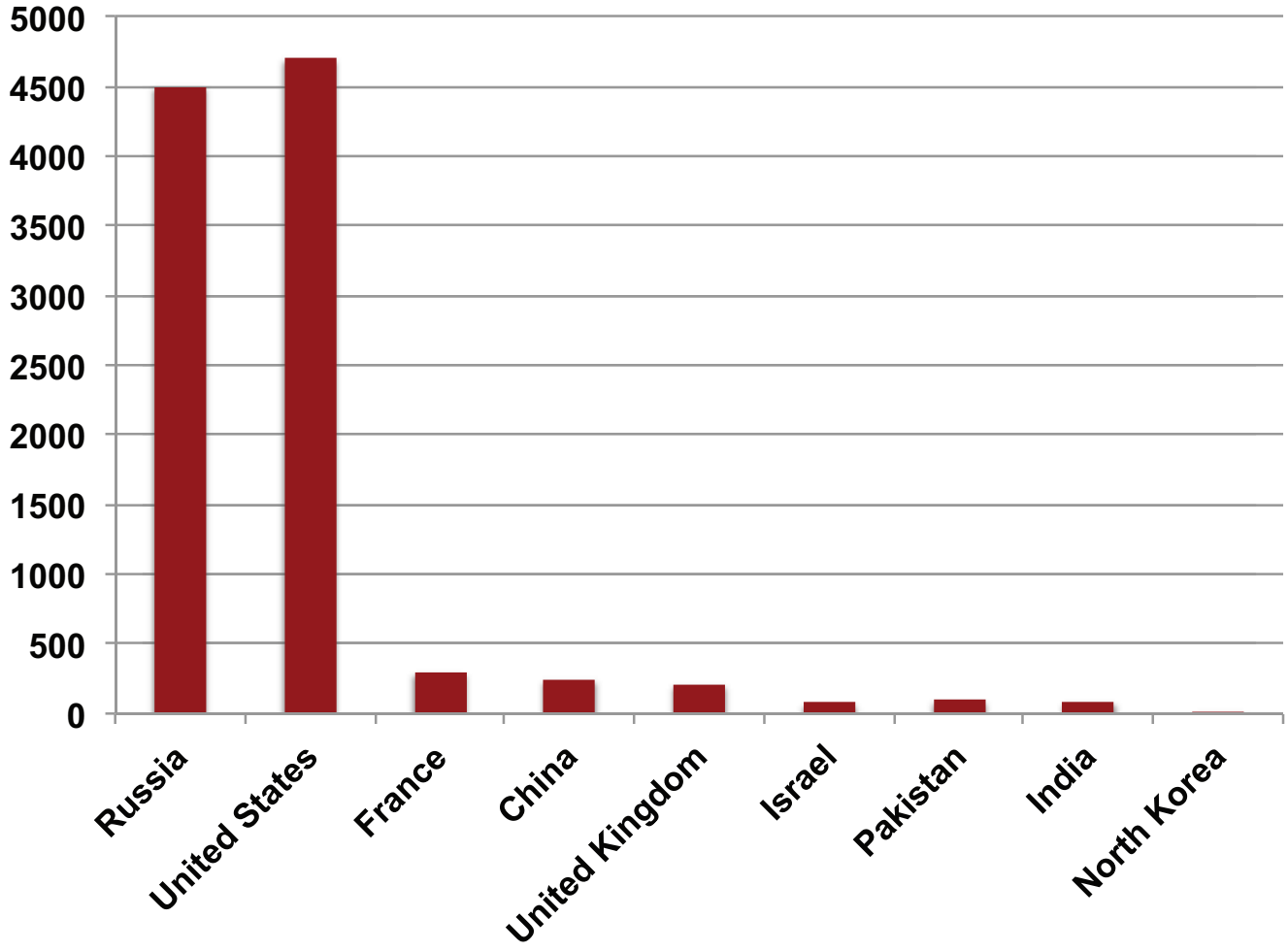
• Submitting proposals to the MindHandHeart Innovation Fund;

• Displaying the postcards and reading materials from the "Don't struggle alone – it's OK to ask for help" (***together.mit.edu/askforhelp***) public awareness campaign;

• Signing up to volunteer on MindHandHeart's working groups or research and student councils.

Numbers

Status of World Nuclear Forces 2015: Military Stockpile*



Russia	United States	France	China	United Kingdom	Israel	Pakistan	India	North Korea
4500	4700	300	250	215	80	100-120	90-110	<10

*All numbers are approximate estimates and further described in the *Nuclear Notebook* (***bos.sagepub.com/cgi/collection/nuclearnotebook***) in the *Bulletin of the Atomic Scientists*, and the nuclear appendix in the *SIPRI Yearbook* (***www.sipri.org/contents/publications/yearbooks.html***). See also status and 10-year projection (***fas.org/programs/ssp/nukes/publications1/TrimmingNuclearExcess.pdf***) of U.S. and Russian forces. Additional reports are published on the FAS Strategic Security Blog (***fas.org/blog/ssp/category/hans_kristensen***). Current update: April 28, 2015.