

Advancing Diversity and Excellence in Physics

by Ed Bertschinger

Diversity without excellence is destitute,
excellence without diversity is an orphan.

My mother was raised on a farm in Finland during World War II. It was a difficult life; the country was invaded by the Soviet Union and its eastern parts amputated, and after the war Finland had to pay reparations to its invader. A few years after the war, with an eighth-grade education and no English, my mother came to the US in her twenties to seek a better life in Berkeley, California. There she met my father, a draftsman in training. I was born in Oakland, the oldest of four boys, and attended two years of school there before we moved to my paternal grandparents' home in southern California. My father, who never completed his college education, started a television repair business that barely enabled us to meet the bills and which taught me some electronics. We were the only white family in a Hispanic neighborhood that became dominated by Chicano gang violence. Like the other families we were materially poor but enriched by an immigrant's hope for the future.

This upbringing gave me both a profound sense of multiculturalism and an intense desire to escape the barrio. Like my mother, I was a misfit driven to find a better life. Her lack of education and experience with hardship inspired both my insatiable desire to learn and my understanding of life as a minority. I had friends in the barrio but was the only student in my high school with

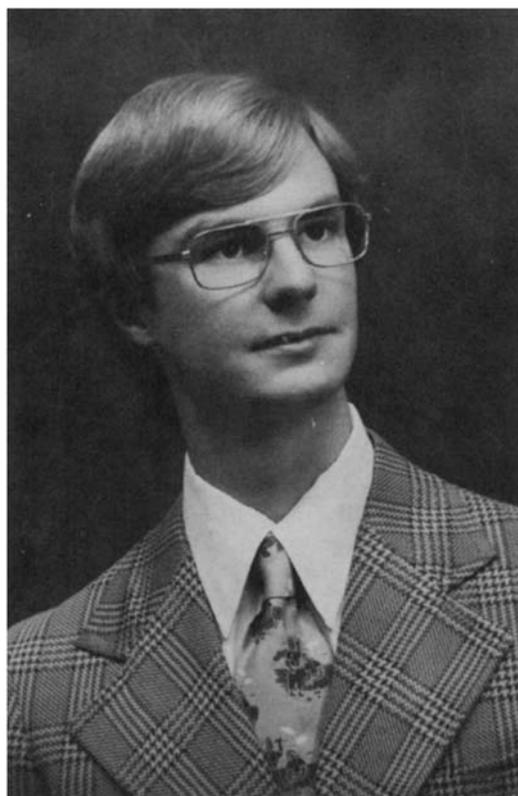
the ambition to attend a top college and become a scientist—or so I thought.

It was my dream to attend MIT, study theoretical physics and cosmology, and become a professor in the University of California system. Unfortunately, my freshman application was rejected by MIT so I went instead to Caltech. The last thing I expected to find there was another student from the barrio. Surprisingly, I learned that one year ahead of me at Caltech, excelling in electrical engineering, was a Hispanic student, John, who graduated from Chino High one year before me. I hadn't seen far enough across the neighborhood to recognize a kindred spirit.

I struggled with Physics at Caltech, earned a C in advanced electromagnetism, and was discouraged from going into theory. Although I was too young by a decade to experience the full utopianism of the 1960s, I participated in feminist and pacifist movements and questioned my childhood dream of an academic career. I spent the summer after college and the next three summers teaching at a summer science program for high school students. While in the Princeton astrophysics PhD program I contemplated dropping out to pursue a career in the foreign service. But my mother's persistence—in Finnish, *Sisu*—genetically propelled me to become a theoretical cosmologist and eventually brought me to MIT.

I understand students who love physics but question whether it can help their communities. To ensure that it does, and that physics benefits from the full available talent pool, I have made it my mission to make MIT's Physics Department not only the best place academically, but the best place for everyone to work and study—students, staff, faculty, everyone. At the end of my first term as Department Head, I offer some reflections on that journey.

How does one achieve both diversity and excellence? The short answer is by valuing people. Let me provide a contrast. When I came to MIT, the spirit among faculty and students seemed to be sink or swim; alumni from earlier years will recall speeches beginning, "Look to your left, look to your right." This approach seemed obviously flawed to me—after investing heavily in recruiting promising individuals, MIT (and other institutions) would fail to help people achieve their best. The result was poor morale leading to difficulty



*Ed Bertschinger, Class of '76,
Chino High School, Chino, CA*

recruiting and retaining talented people. After I was tenured, I determined to debunk this philosophy by investing my efforts in mentoring—first of graduate students, then of junior faculty. I had success; many of my mentees have become leading faculty in their fields at top universities and they have won numerous national awards. Several were women who did not imagine themselves as great physicists, but that is what they have become. So when I was given the opportunity to lead the MIT Physics Department, I made it a priority to mentor, support, and advance every promising individual and especially those from underrepresented groups in physics—women, African Americans, Hispanic Americans and Native Americans.

Accepting the premise of diversity and inclusion is one thing; achieving it is another. Five years ago I sought advice about this from the MIT Graduate Women in Physics group. They encouraged me to create a culture of caring in the department. Instead of suggesting specific steps I should take, they helped me see the problems in a new light and led me to believe that I could make a difference. With that change of perception, I was able to learn what to do myself.

Any department head looking to change the prevailing culture must think strategically, present a vision, show faculty how it benefits them, and help develop the next generation of leaders. Finnish *Sisu* helps, as does some management and leadership training. Finding role models is a good idea; I had two in Jerry Friedman and Michael Feld at MIT, and another in Meg Urry at Yale.

In his management classic *Leading Change*, John Kotter advises leaders to create short-term wins. The MIT graduate women helped achieve the first victory. Prior to 2008, the percentage of women who accepted graduate admissions offers was systematically lower by 25-50% than that for men. In 2008, however, the recruiting yield for women jumped to nearly 70%, more than double that for men. For three consecutive years, women accepted our graduate admissions offers at a higher rate than men. The women who came are outstanding and were strongly recruited by our our peers.

Why did the numbers change? Was it merely the same trend that had increased the percentage of women undergraduates in physics over the preceding decade? Interviews with the women show otherwise. In 2009, encouraged by the Physics Visiting Committee, I invited the American Physical Society Committees on the Status of Women in Physics and on Minorities to conduct a site visit of the MIT Physics Department (this visit followed a Title IX compliance review two years earlier [1]). Their report noted that graduate women were pleased with initial steps to improve the climate but also noted that many challenges remain, including improving work-life balance and eliminating implicit and sometimes explicit bias against women and underrepresented minorities by faculty members.

The increase in numbers of undergraduate women in physics has also been striking. In 2001, the Department initiated a flexible major option that allows students to replace three advanced physics subjects (typically senior thesis, the second semester of junior lab, and an advanced elective) with a concentration in any subject of interest. In 2000, only 35 physics majors earned SB degrees, of whom eight were women. After the introduction of the flexible option, the number of SB degrees grew quickly, with the greatest growth occurring among women. By 2008, we had 88 graduates of whom 26 were women. For a number of years women hovered around 30% of our graduating seniors. Last year, however, we had 36 female graduates, or 38% of the total. For comparison, women were 45% of all MIT graduating seniors and approximately 21% of physics graduates nationwide. The recent surge in growth of our major, and especially that of women graduates, greatly exceeds the national average. I believe this is due to improvements in teaching, mentoring and climate.

We have also increased significantly the numbers of underrepresented minority students. In 2007, 12% of our SB degrees and 0% of our PhDs were awarded to underrepresented minorities. By 2012 these percentages had grown to 13% and 11%, respectively. A statistic of national relevance is the number of students receiving a minority scholarship from the American Physical Society. During the past academic year, MIT held 29% of these scholarships nationwide (a total of 12 scholars; the second place institutions were Harvard, Columbia and the University of Puerto Rico, with 2 each). It has been a joy to mentor these students and help them obtain research positions. I have benefitted by learning to see MIT more clearly through the eyes of our underrepresented students.

The U. S. desperately needs to increase the education level of its population in science, technology, engineering and math. The greatest opportunities for this increase arise with advanced degrees for minority students—minority students persist at about half the rate of others at critical transitions (undergraduate to PhD, PhD to postdoc). Recognizing this, the American Physical Society has established a national Bridge Program which aims to increase the number of underrepresented minorities obtaining PhDs in physics by about 30 per year. [2] MIT is collaborating by providing summer research opportunities through the MIT Summer Research Program (MSRP) run by the Dean for Graduate Education. The Physics Department has mentored many MSRP students and, thanks to the leadership of Krishna Rajagopal, the Department will be hosting two MSRP graduates this coming academic year as the first participants in our new minority bridge program. MIT is the largest producer of undergraduate and graduate physics degrees in the nation, we are admired and emulated, and our efforts will inspire others.

Creating a culture of caring is not an exercise in numbers; it calls for celebration and reflection on the contributions and values of our broad

community. Two such events during the last two years stand out among my proudest MIT moments.

In 2011 MIT celebrated its 150th anniversary with a series of events including six major symposia. I led the organization of one of them, *Leaders in Science and Engineering: The Women of MIT*. [3] This two-day symposium brought together the greatest collection of speakers in science and engineering that I have ever seen at MIT, or anyplace else. It was a celebration with caveats. In the dozen years since the 1999 report “A Study on the Status of Women Faculty in Science at MIT,” there has been tremendous progress towards gender equity. However, women students are still occasionally told falsely that “you are here because of affirmative action.” New reports on the status of women in science and engineering at MIT showed that we have challenges remaining in faculty mentoring, child care, implicit bias, equity in service, and respect. Despite these concerns, more than one year later I still glow with the excitement of the superlative research presented by some of the best scientists and engineers in the world, all of whom happened to be women.

In January 2012, with staff member Debb Hodges-Pabon, I co-organized the *Institute Diversity Summit*. [4] This event brought nearly 300 people from across MIT together for a day of reflection on the tension at MIT between diversity and excellence that had been noted in the 2010 *Report of the Initiative on Faculty Race and Diversity*. [5] I have experienced the tension around the concepts of diversity and excellence in my discussions with faculty of very different views. [6] Some are troubled that such tension exists, others feel it is an inappropriate topic of conversation. Some even believe that inclusion and diversity dilute excellence. I strongly disagree and feel that the tension itself reflects underlying problems that detract from our excellence.

What lessons have I learned? First, that it is always possible to improve an organization by helping everyone in it to achieve their best. Second, that committed leadership is essential for organizational culture change. Finally, that change accumulates like compound interest. Throughout these years, I have been inspired and sustained by the enthusiasm of many for the vision of a culture of caring articulated by graduate students five years ago. At MIT, we like to say that we invent the future. I feel privileged to play a role in helping us invent our own future. [7]

ACKNOWLEDGMENTS

I am grateful to the Graduate Women in Physics for their inspiration and encouragement, and to my fellow members of the MIT Committee on Race and Diversity for their commitment and collaboration. Special thanks go to Associate Provosts Wesley Harris and Barbara Liskov, Professor Nancy Hopkins, Associate Dean Hazel Sive, MLK Visiting Professor Keivan Stassun, MLK postdoctoral fellow Chanda Prescod-Weinstein, Associate Dean and Director of the Office of Minority Education DiOnetta Jones, Alyce Johnson and Debb Hodges-Pabon of the Council on Staff Diversity and Inclusion, to Francine Crystal and Irene Porro, and to the attendees of the monthly Physics Diversity and Inclusion Luncheon.

REFERENCES

- [1] See my opinion piece on the Title IX compliance review, <http://tech.mit.edu/V128/N45/bertschinger.html>
- [2] APS Bridge Program, <http://www.aps.org/programs/minorities/bridge/index.cfm>
- [3] *Leaders in Science and Engineering: The Women of MIT*, <http://mit150.mit.edu/symposia/women-of-MIT>
- [4] Institute Diversity Summit 2012, <http://web.mit.edu/newsoffice/2012/diversity-summit-0201.html>
- [5] *Report on the Initiative on Faculty Race and Diversity*, <http://web.mit.edu/provost/raceinitiative>
- [6] Is there a conflict between diversity and excellence at MIT? <http://web.mit.edu/fnl/volume/242/bertschinger.html>
- [7] See the *MIT Inventing Our Future* website, <http://diversity.mit.edu/>

ED BERTSCHINGER is Professor and Department Head of Physics at MIT. He is a theoretical astrophysicist whose work focuses on cosmology, gravitation, and relativistic astrophysics. As a member of the MIT Kavli Institute for Astrophysics and Space Research, he leads a research program studying dark energy and dark matter. He and his research students (from high school to postdoctoral) investigate the formation of cosmic structure after the big bang, the physics of dark matter both in the early Universe and in forming galaxies, the physics of gravitation in general relativity and alternative theories, and the physical processes governing matter and radiation close to black holes. His group uses a combination of analytical, computational, and statistical methods.

Professor Bertschinger received his BS in physics from Caltech in 1979 and his PhD in Astrophysical Sciences from Princeton University in 1984. Following postdoctoral positions at the University of Virginia and at UC-Berkeley, he joined the MIT faculty in 1986. From 2002-2007 he served as Astrophysics Division Head before becoming Physics Department Head. He is a recipient of the Guggenheim Fellowship, Alfred P. Sloan Research Fellowship, and Helen B. Warner Prize of the American Astronomical Society.