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Brower Center

MARYK FEST

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It is a privilege and a delight to join the physics community in singing the praises of the brilliant, and kind, Mary K. Gaillard.

Today, I would like to couch my encomiums within a story of two career paths, which came together at a certain space-time point, my own, and that of Mary K, and later diverged, but had a transformative effect on my career and life. Together, our paths suggest that physics can, indeed, take one to a myriad of interesting places, and which might be helpful for the early career members of our audience. So please allow me to tell you about the points where Mary K and I intersected and diverged, and intersected again, and to share my thoughts about them.

Mary K and I met at Fermilab in 1973, when she was a visiting scientist in the theory group headed by Dr. Benjamin Lee, and I was a postdoc, having just completed my doctorate in theoretical elementary particle physics at MIT.

She already had done impressive work on kaon decay. While at Fermilab, as you know, in collaboration with Ben Lee, she correctly predicted the mass of the charm quark, and, with Ben Lee and Dr. Jonathan Rosner, considered the production and detection of the charm quark, which shortly would be

discovered experimentally.
Needless to say, I looked up to her, and respected her greatly. And, as we shared sometimes snowy walks between the barracks where our offices were and the cafeteria, we became fast friends.

We had certain things in common, of course–including the fact that, as women, she and I were both highly atypical theoretical physicists in the early 1970s. The wonder is that, nearly 20 years into the 21st century, we still are highly atypical.

For Mary K, Fermilab was a welcome break from CERN, where she worked, but where she had not been offered a staff position, despite considerable recognition in the wider community of physicists. Instead, she was employed by the CNRS, or the French National Center for Scientific Research.

In the early 1970s, there was a great deal of skepticism about female physicists at CERN, and elsewhere, especially female theorists. Fermilab offered a break for Mary K from this hidebound thinking about the proper role of women.

For me, however, small-town Batavia, Illinois, was not an escape from hidebound thinking about race. Just to find a landlord who would rent an apartment to an African American, I had to go to Chicago, which made for a long 70-mile round-trip daily commute to Fermilab.

As Mary K's sojourn at Fermilab was nearing a close, she said to me, "You should come to CERN, so that we can work together." She used her contacts and influence to get me an invitation.

The trick was: CERN was supported by European nations, and they did not give money to American scientists. I had had a Ford Foundation fellowship as a graduate student. On a lark, I thought, “Let me see if they support post-docs.” At that time, they did not, but they said that because I had had one of their fellowships, and they knew my work, they were willing to give me an individual grant.

Mary K knew that this was not enough to live on in Geneva, Switzerland, so she persuaded CERN to match the grant.

So that was how I got to CERN. While there, I collaborated with Mary K on a problem in neutrino physics, and investigated Reggeon field theories, which got me to topology and the topological aspects of solutions of non-linear field theories, which would prove important in my later research career.

I enjoyed the international community of scientists at CERN, and made other good friends, including the theoretical particle physicists Barbara and Fridger Schrempp, with whom I would hike and picnic in the Alps.

Although I had been to a theoretical physics summer school in Erice in Sicily as a graduate student, this was my first extended experience of living abroad.

I had a fabulous time, not only because of the friends I made, but also because it was such an exciting time in high-energy physics, as the Standard Model was just crystallizing, and new elementary particles were being discovered. While I was at CERN, Dr. Samuel C.C. Ting, who had a research group there, and whom I had known as a professor at MIT, discovered the J/ψ [J/psi] meson, the first charmed particle, at Brookhaven — experimental confirmation of Mary K’s theoretical work. As you know, Sam Ting and Burton Richter, who independently discovered the same particle at SLAC, were awarded the Nobel Prize in 1976 for this discovery.

At CERN, I had the time and the freedom to think about what I really wanted to do. And I had the courageous example of Mary K to inspire me.

She was managing a challenging career, under challenging circumstances. Theoretical physics is challenging to begin with. I do not think most people go into it looking for the easy life.

But Mary K managed to do groundbreaking research with her collaborators — including offering the first systematic guidance for experimentalists searching for the Higgs boson — under duress. She was raising three children in France, overseeing schools and child care, while moving between the United States and Europe, giving talks and organizing conferences — and all the while, being consistently undervalued, and sometimes insulted, by her home institution.

But she handled it all with aplomb and stayed focused on her work. She just refused to be turned back from pursuing her passion, which was theoretical elementary particle physics.

Now, I am going to shock and dismay this audience: At CERN, I began realizing that particle physics was not my passion.

My first love was condensed matter systems — so please allow me to explain how I wound up with a doctorate in theoretical elementary particle physics.

I had had a rather chilly experience as an undergraduate at MIT, where I was one of just two African American women in my class. It was not merely the students who were unwelcoming, leaving me out of their study groups. Some of the professors were equally unwelcoming, and tried to discourage my interest in physics, as somehow inappropriate for a young African American woman.

But I realized that I was faced with a choice: either to give in to ignorance, or to pursue excellence. I chose the latter, and chose physics.

When I was a senior at MIT, ready to be elsewhere, and deciding where to go to graduate school, The University of Pennsylvania physics department, hoping to recruit me, invited me to visit. I had done work on superconductivity for my bachelor's thesis at MIT. One of the physicists whose work in the field most interested me, Dr. John Robert Schrieffer, was at Penn, so I accepted the invitation. He would, of course, soon share the Nobel Prize for the BCS theory of superconductivity.

But a strange, tragic coincidence sent me down a different path. As I was leaving Penn after the visit, in a car with a friend, on my way to the Philadelphia airport, the radio broadcast was interrupted, and we learned that the Reverend Dr. Martin Luther King Jr. had been shot, and later died. We nearly drove the car off the road.

By the time I got back to Cambridge, inspired by the courage of Dr. King, I had decided that I would remain at MIT for graduate school. I knew MIT, and knew that MIT was the place where I would have the greatest possible opportunity to change things for the better. Of course, MIT was an excellent place to study theoretical physics, but it was not as active in condensed matter physics at that time, so I changed my focus to elementary particle physics.

I was part of a group of like-minded students who presented proposals to the MIT administration that would make MIT a much more welcoming place for minorities. Associate Provost Paul Gray, who later became President of MIT, formed a Task Force on Educational Opportunity, and asked me to join it.

The Task Force accomplished a great deal, and MIT began, for the first time, to actively recruit minority students and faculty in significant numbers.

The students I helped to bring to MIT — and helped to adjust to its culture — truly excelled. They proved to the world that scientific and engineering talent is not restricted to one race, or one sex, or one story of origin.

And because I had proven that I could do theoretical physics well, and address a complex challenge in a difficult domain, I became a trusted advisor to many organizations, and was offered many more opportunities for leadership.

So sacrificing condensed matter physics, at that time, for elementary particle physics had been worthwhile, and I had made a difference at MIT because of it. But as I left CERN for Fermilab to complete my second post-doctoral year, I was driven by the reality that jobs in physics were, in general, hard to come by — but in high-energy physics, they were particularly scarce. Mary K did her best to help me find a berth, but my heart was not in it.

She had given me the courage to do what I loved — to switch to condensed matter physics.

I had attended, as a graduate student, a theoretical physics summer school at the University of Colorado, Boulder, where I met Dr. John Klauder, a theorist at the great Bell Labs, who facilitated an introduction to the head of the theoretical physics department at Bell Labs, Dr. T. Maurice Rice.

At a meeting of the American Physical Society in Atlanta, I told Dr. Rice about my work on neutrinos, but also my thoughts about the potential role of topology in condensed matter systems.

He invited me to give a talk at Bell Labs, and I talked about some concepts in topology and its role in Landau–Ginzburg models of condensed matter systems, which won me a limited-term appointment there. It was made permanent a year later, after I had done some interesting work on two-dimensional systems.

At Bell, I predicted that certain layered metals developed topological structures which determined the thermodynamics and conductivity of those systems. Looking at polaronic effects in 2D electron systems, I predicted topological objects that came out of a path integral formulation I did of the physics of electrons on the surface of liquid helium films. Ultimately, I gained recognition for my work on the electronic and optical properties of 2D systems — and it all started with Reggeon field theories at CERN — all facilitated by Mary K's efforts to get me there.

I had one child, a son, and a wonderful partner in my husband, experimental physicist, Dr. Morris Washington. I found, like Mary K, that there were some advantages to raising a young child as a research scientist, without the regular teaching duties attached to serving on a faculty.

However, we both eventually wound up at universities: Mary K, of course, moved to University of California at Berkeley in 1981, when she finally was offered roles commensurate with her achievements. I enjoyed visiting her in Berkeley. In my case, in 1991, after 15 years at Bell Labs, I moved from full-time to part-time, and accepted a tenured full professorship in theoretical physics at Rutgers University, because I wanted to teach and mentor students.

Two other windows had opened for me during my time as a researcher at Bell Labs, that set me down another path, and changed my life.

First, I was asked to join the board of a natural gas company — New Jersey Resources — and for the first time became engaged with energy policy. As a result, I was a natural choice when a recruiter was looking for new director for PSEG, or Public Service Enterprise Group. PSEG owned or co-owned five nuclear reactors. Because of my earlier background in elementary particle physics, I sat on, and later chaired for a number of years, the PSEG nuclear oversight committee, visiting its nuclear power plants often.

The second window was government service. I was asked by New Jersey Governor Tom Kean to join the New Jersey Commission on Science and Technology as a founding member. The Commission created partnerships between industry and government, through investments in the major universities in the state, in disciplines important to the New Jersey economy, such as advanced biotechnology and medicine. The position was unpaid, but required State Senate confirmation, and introduced me to a number of prominent business people and government leaders. Two governors subsequent to Governor Kean also tapped me for unpaid advisory roles — one of which also required State Senate confirmation.

I am unsure how my name arose when President Bill Clinton was looking, in 1994, for a Commissioner for the U.S. Nuclear Regulatory Commission — or NRC — which, as you know, licenses, regulates, and safeguards the civilian use of nuclear power and materials. However, given my scientific background, government service in New Jersey, and familiarity with nuclear power plants from PSEG, I was ready for this leap. After I interviewed for a spot as one of five commissioners, President Clinton offered me the job of Chairman of the NRC.

To take on the role, I had to step away from my tenured position at Rutgers, which required some temerity. Suddenly, I had a staff of 3,000 people, a budget of over $500 million, and responsibility for an organization that oversaw a multi-hundred-billion dollar set of enterprises, at a time of growing public concerns about the safety of nuclear power — especially in the aftermath of the accident at the Chernobyl Nuclear Power Plant in the Ukraine in 1986.

The Chairmanship of the NRC played to my strengths. I certainly understood the nuclear physics, the technology, the associated public policy, and could work through the complexities of the markets and geo-political environments in which nuclear power, and nuclear non-proliferation, operated. And at NRC, I discovered that I was capable of leading people, and a large and complex organization.

We developed the first strategic plan for the NRC, and a related planning, budgeting, and performance management system (PBPM), which put the NRC on a more businesslike footing, and remains the basis of planning and budgeting at the NRC today.

We also put in place license renewal, to extend, by twenty years, the operating lives of nuclear reactors, and I introduced an approach to regulation at the NRC that used probabilistic risk assessment on a consistent basis — risk-informed, performance-based regulation — which also persists to this day in the nuclear regulatory and operational arena.

After meeting, early in my tenure at the NRC, with my senior nuclear regulatory counterparts from around the world, I saw the need for even greater international cooperation to avoid disasters such as Chernobyl in the future. So, I spearheaded the formation of the International Nuclear Regulators Association as a high-level forum to allow nations to assist each other in promoting nuclear safety, and was elected the first Chairman of the group.

Four years later — just a little over 20 years ago — another unforeseen opportunity arose for me, and another decision. Although I did not have academic leadership experience, I was the unanimous choice of the Board of Trustees of Rensselaer Polytechnic Institute to serve as its 18th President. They were looking for a change agent after a difficult period during which Rensselaer had five presidents in 14 years.

Rensselaer has had a rich history since 1824 of producing outstanding graduates, who have designed and built much of the physical and the digital infrastructure of the United States. One of my predecessors as President, and a Rensselaer graduate, George M. Low ’48, ran the Apollo program that put humans on the moon — an achievement we are celebrating the 50th anniversary of this year.

Together, the Rensselaer community developed the *Rensselaer Plan* to steer our choices. Guided by the *Plan*, we have put into place the people, programs, platforms, and partnerships that have sparked a renaissance at Rensselaer. Among many other metrics of success, we have nearly quadrupled applications to our freshman class during my 20-year tenure, and in a difficult climate for federal funding, tripled our sponsored research.

In taking on the Presidency of Rensselaer, I nonetheless kept my fingers on the pulse of industry by serving on the boards of leading corporations, including IBM, FedEx, and PSEG. I also served on the boards of leading nonprofits and associations, including the Smithsonian Institution, where I was Vice Chair of the Board of Regents.

I have maintained my commitment to policymaking in science and national security. In 2009, President Barack Obama appointed me to the President's Council of Advisors on Science and Technology, or PCAST, where I served for over five years. In 2014, President Obama then to asked me serve as co-Chair of the President's Intelligence Advisory Board (PIAB), which assesses issues pertaining to the quality, quantity, and adequacy of intelligence activities — an important role at a fraught time.

I also served on the U.S. Department of State International Security Advisory Board from 2011 to 2017 and the U.S. Secretary of Energy Advisory Board from 2013 to 2017, where I co-chaired a study on the future of high-performance computing, including data-centric, neuromorphic, and quantum computing.

While at Rensselaer, I have had the opportunity, as well, to serve as President of the American Association for the Advancement of Science (AAAS).

As the President of Rensselaer, with a national profile in the policy realm, I have had a platform to speak about the kind of obstacles Mary K faced in her career, alerting the nation to what I call "The Quiet Crisis": Our national failure to draw women and minorities in sufficient numbers into professions in the physical sciences and engineering, which represents a threat to America's leadership in innovation — especially as the scientists of my generation retire, and demographics change.

Indeed, trying to sustain the most knowledge- and technology-intensive economy in the world, while discouraging over half of one's population, will not work.

Unfortunately, physics still has a very low share of degrees awarded to women — although at the doctoral level, it has increased from 13.3 percent to 19.3 percent over the last 20 years, which does offer hope.

A number of studies have demonstrated the ways that stereotypes about their abilities disadvantage young women in the sciences — starting even in elementary school. Of course, Mary K experienced overt bias, of a kind that would not be tolerated today. Unfortunately, even the most enlightened college and university administrations are largely powerless against unconscious bias, which persists — and which means that professors still may subtly discourage young women from pursuing scientific careers.

It is especially important, then, that young women, and all people, know of the life and career of women like Mary K.

Mary K benefited, as I did, from wonderful parents, especially her mother, whose expectations for her were not limited because of her gender. I suspect that this was the source of her stubborn persistence, which Mary K has called a “survival mechanism.”

Mary K also has taken on high-level policymaking roles in her career. She served on federal High Energy Physics Advisory Panel subpanels that considered the fate of a Colliding Beam Accelerator at Brookhaven and the Superconducting Super Collider in Texas. Discouraged by the cancellation of the Superconducting Super Collider in 1993, she accepted an appointment to the National Science Board, to strengthen public understanding of the crucial need for investments in fundamental research, and to advise on improving K-12 math and science education.

There is, I believe, one important difference between Mary K and me: I took on policymaking roles because I thoroughly enjoyed working at the nexus of academic science, industry, and government, and I have had great success bringing experience gained in one realm into the others. Mary K was willing, but not eager, to wade into the public sphere, in order to defend her great passion: elementary particle physics.

Although theoretical physics is considered, by outsiders, to be one of the most abstract of all exercises of human intelligence — I would argue that it does, indeed, offer excellent training for leadership.

As a physicist, one develops an ability to look at systems that seem to be chaotic — not to impose order — but to figure out a way to understand their complexity. Physicists see beyond the individual phenomena, and try to find the principles that are both explanatory and predictive. Such an approach is valuable to problems not merely measurable in light-years or Planck lengths — but those of societal or global scale as well.

Of course, that is my approach.

When Mary K's memoir was first published, she was asked if she had any advice for women going into physics today.

She said, "Just do what you like. Find a nice partner."

That also is excellent life advice, and not just for physicists!

I am assuming that she was referring to a romantic partner who would be supportive. But it is typical of Mary K to underscore the importance of love to the practice of science. She openly it admits that it was love that kept her going in physics: she loves it. She always has communicated the joy of theoretical physics as a shared endeavor to everyone who ever worked with her. As a result, she has made dear friends of her colleagues, collaborators, and students.

And even when her children were young and her responsibilities approached infinity, Mary K always has had time for her friends. That is why we all are here to celebrate her.

Although relentless in her pursuit of the fundamental truths of nature — by nature, she herself is gentle, calm, and direct. She always was so supportive of me and encouraged me to soar — the kind of friend who does not come along many times in one's life.

I am so very grateful that our paths converged in snowy Batavia, Illinois. And when they diverged, we each took the road less traveled by. I am so grateful for the opportunity today to honor Dr. Mary K. Gaillard.

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