

Women in Radio Science



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This time I present Patricia Doherty, Director at the Institute for Scientific Research at Boston College, Massachusetts. Pat is the only female Commission Chair of the ten Commissions of URSI. Pat's Commission G comprises Ionospheric Radio and Propagation, in line with her interests in space weather and global navigation satellite systems with applications.

Pat's story is similar to those of several other female scientists of her generation. Due to talent in mathematics and technology, she chose at that time what was still an unusual career way for a woman. She did not continue directly in scientific research, and stayed a few years at home with kids. This prepared her well to go over to space research and make a wonderful career there. Here comes her story

Oh the Places You Will Go...

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When asked to write this article, I thought whatever will I write? As a child, I did not have long-term goals of being a scientist. My goals were more immediate: get good grades, finish homework early to be able to go out to play, and generally have fun. My family was close – perhaps a little too close, as I grew up in a three-family home, with my grandparents on the first floor; my aunt, uncle, and cousins on the third floor; and my family sandwiched in the middle, on the second floor. My immediate family included my parents and my two brothers. Together with my brothers and cousins, we walked to the neighborhood Polish Catholic School; we worshipped at the neighborhood Polish church; and we played within a four-block radius of our home, in an ethnic part of Boston. Although Boston was a big city, we lived in a very small part of it: a very nice small part, by my recollection, but quite limited in its view of the world.

Ours was largely a blue-collar family, and it was my generation that was deemed to be the first college graduates in the family. At the time, it seemed to be a heavy expectation, starting with *whatever will I be?* The common goals among girls I knew at that time included becoming teachers, nurses, and secretaries. All noble careers, for sure, but nothing that interested me. It wasn't until I was at the University of Massachusetts that I appreciated a strong aptitude for mathematics and statistics, and an interest in physical science. Here is where I started my career: not as a scientist, but as a statistician for the insurance industry, and later for the US Internal Revenue Service. This path seemed like a good idea at the time, and it broadened my view of the world just a little bit more – but still generally limited to New England.



**Figure 1. Oh, the places you will go!
A most memorable coffee making
experience in Ethiopia.**

Just a few years into my professional career, I married a wonderful man (also from Boston). We soon had a daughter, and then a son. With this young family, I felt that I was needed more at home, and decided to take eight years out of the workforce. Those were memorable years, and I enjoyed them immensely. It did put a gap in my career, but it also gave me more time to think about the future, as I was sure that I wanted to professionally follow a different path.

Around the time I decided to resume my career, I had a fantastic opportunity to join a research group at Emmanuel College. This came about quite unexpectedly, through a friend who knew my interests and technical capability. As it happens, she also knew the Director of the Emmanuel College Space Science group, and thought we would be a good match. I am forever grateful to this person, as it was a turning point in my career. The Emmanuel College group supported US Air Force scientists in their studies of the Earth's ionosphere and radio propagation. Although this was somewhat of a foreign topic for me, it certainly peaked my interest, and I made it my ambition to learn as much as possible on the topic.

Another lucky occurrence for me was that I had the unparalleled opportunity to work with leaders in our field, including Mr. Jack Klobuchar and Drs. Santimay and Sunanda Basu. They were quite patient with me as I learned as much as possible from them and furthered my studies. As you can see, my world was getting larger by this time, as I also had opportunities to work with radio scientists and engineers from around the world when they visited our laboratories in the Boston area.

A couple of years later, I moved to the Institute for Scientific Research at Boston College to expand my adventures in space research. It was at Boston College that



**Figure 2. Oh, the places you will go! The BC/ICTP
Outreach Workshop of 2017: 17 women from 14
countries.**

my career really started to take shape. After several more years of study and research, I developed competence as a radio scientist, with a focus on studying the ionosphere using satellite signals of opportunity, and later with the Global Positioning System (GPS) satellites. I was also researching space weather, and its effects on GPS and GPS-based applications, such as the US Federal Aviation Administration's Wide Area Augmentation System (WAAS), a civil aviation system that would be largely dependent on GPS satellites. At Boston College, I continued to advance my career from Research Scientist to Senior Research Scientist, Principal Investigator, and finally as the Director for the Institute for Scientific Research (ISR) at Boston College. ISR is an organized research institute, supporting the research mission of Boston College to conduct national and international significant research that advances insight and understanding, enriches culture, and addresses pressing social needs. With this mission, I felt most at home in my career of choice – or, more appropriately, my career of happenstance. It was certainly not something I planned, but something that has been most rewarding and enjoyable. It has given me extraordinary opportunities to observe the scientific exploits of our highly skilled team



**Figure 3. Just a few URSI friends from around the
world: US, Canada, UK, and India.**

of scientists in the fields of space physics, space chemistry, solar-terrestrial research, space weather, and astrophysical studies. It has further expanded my view of the world, with many chances to work and make friends from around the globe.

One of the highlights of my career has been an outreach program that has played a role in the expansion of space science education and research in developing countries (Figure 1). This program has been performed under a partnership between Boston College and the Abdus Salam International Centre for Theoretical Physics (ICTP) to host a series of workshops on the use of Global Navigation Satellite Systems (GNSS) for applications with societal benefits and for space science research. Since 2009, annual workshops have hosted approximately 50 participants from developing countries in Africa, Asia, Eastern Europe, and South America. These workshops have increased the number of young scientists studying space science in developing nations, and have dramatically increased the publication rate of scientists from these countries. In addition, we have worked to increase the number of women participating in our workshops. Our first workshop included just a few female participants from Nigeria, Kenya, and Egypt. However, over the years we have steadily increased the number of women participants (Figures 2 and 3). This success was particularly evident in our 2018 workshop, where we had participation from 29 countries, and 49% of those participants were women. This, together with many other international experiences, have certainly expanded my view of the world: from a small and sheltered beginning to having so many colleagues and friends from around the world.

I am humbled to note that along the way, I have been blessed by much recognition in the world of radio science. This has ranged from serving as the 2013-2015 President of the Institute of Navigation (ION) and as the current Chair of URSI Commission G, to being awarded fellowships in ION, the African Geophysical Society (AGS), and URSI. Finally, I am a recent recipient of the 2017 GPS World Leadership Services Award and the 2018 American Geophysical Union (AGU) Space Physics and Aeronomy Richard Carrington (SPARC) Education and Public Outreach Award.

I have many people to thank for the enjoyment of my career. I have had much support from supervisors, sponsors and colleagues, both male and female. We often hear stories where women felt they had been held back in their career due to male dominance in the workplace. I can honestly state that this has not been my personal experience. Both men and women alike have done much to support me along the way. I particularly thank my mentors, including Jack Klobuchar, Santimay Basu, and Sunanda Basu; and my colleagues, including everyone at Boston College's ISR and so many others in the US and beyond. I would like to note a special thanks to Dr. Reinhart Leitinger and

Jack Klobuchar, who sparked my interest in URSI; to Dr. Sunanda Basu, for encouraging me to lead a scientific organization; to Dr. P.V.S. Rama Rao (now deceased), who supported all of my efforts in leadership of the URSI Commission G and its Beacon Satellite Study group; and especially to Prof. Sandro Radicella, who inspired me to reach out to the developing world. Together with Sandro and his team at ICTP, our organizations have performed 10 outreach workshops that have been as enjoyable as they were effective. Finally, I thank my husband, Charlie, my children, Karen and Brian, and my three beautiful grandchildren, Hailey, Liam, and Julia. Without their love and support, nothing here could have happened.

When looking back on my career, the book *Oh, the Places You'll Go* by Dr. Seuss comes to mind. After growing up in a very small and somewhat sheltered part of Boston, I have had paramount opportunities to perform space research, to work with a stellar group of national and international scientists, and to travel to distant places on the globe.

Now that I have been in this career for many years, I feel that I can offer some advice to young women entering this field: that is to have confidence in yourself to do what you may think is not possible; to not be afraid to make a mistake (everyone make mistakes); to respect your colleagues (even when they make mistakes); to reach out to other women (and men) for friendship and to provide reassurance and encouragement they may need to succeed; and, finally, to be patient, flexible and understanding when it comes to balancing work and family for yourself and for your colleagues and staff. You really can have it all!

"Today is your day. You're off to Great Places! You're off and away!"

Dr. Seuss



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