The Sun rises in Albuquerque on December 10, 2020, as the Prize is announced in Beijing.

CMC citation for 2020 Micius Quantum Prize (theory portion)

For foundational work on quantum metrology and quantum information theory, especially for elucidating the fundamental noise in interferometers and its suppression with the use of squeezed states.

CMC remarks at the press conference announcing award of the Prize

First, thanks to the Micius Foundation for awarding me this prestigious, international research prize. The prize is aptly named for the ancient Chinese philosopher Micius, whose moral teachings emphasized introspection, self-reflection, and authenticity, all values that I hold dear, and who taught that all people are equal and that innovation is as valuable as tradition.

Second, thanks to the Selection Committee. That this group of outstanding scientists thought that my scientific contributions are worthy of recognition is both gratifying and humbling.

Third, thanks to Peter Zoller for a very favorable rendering of my contributions to science. I can only wonder where Peter was back when I was trying to get the University of New Mexico to raise my salary.

It is a great honor to have been awarded a prize of this magnitude and prestige. But prizes are dangerous. The head swells, and it needs to be deflated, and for deflation, I have my two kids, Eleanor Caves and Jeremy Rugenstein, both of whom are scientists, as are their spouses. I happened to open the e-mail informing me I had been awarded the Micius Prize on a Saturday morning a few weeks ago, just as I was about to Skype with Eleanor in the UK and Jeremy in Colorado. I was excited and told them about the Prize. Their immediate reaction was to look at the Micius Prize web site and report, "Dad, we thought you grew your hair out and switched to a moustache/chin-beard because of the pandemic. Now we see you were trying to look like Micius so they would be forced to give this prize to you." My reaction? Hadn't thought of that, but emulating Micius is a pretty good idea.

My citation for this prize draws attention to a lifetime of work on quantum metrology and quantum information and, particularly, to my explanation of the fundamental noise in interferometry and of how to reduce that noise by using squeezed light. You can ask me questions about squeezing and interferometry later should you be interested—I have lots to say, but no time to say it now. Indeed, for now, I want to focus on that lifetime of work, which was carried out with colleagues, postdocs, and PhD students. We always worked on what we thought was most interesting and most important, with the goal of understanding how the world works.

Sometimes we got lucky, and others found our research interesting and important. More often, we weren't so lucky. This, indeed, is what being a research scientist is all about: you work—or at least I hope you do—on what you find most interesting and most important, with the full knowledge that most of the time, your intense interest will not be shared by the research community. To all those who have worked with me throughout my life, thank you. All of you share in this prize. Whether or not we won big with our research, we had the joy of discovery and, just as important, the joy of discovery together. Working with all of you has been one of the chief things that made my life worth living.

And, guess what. Life goes on. That's a call-out to my present research collaborators, Raf Alexander and Chris Jackson. We have work to do, and once today's excitement is over, I'll get back to work.

Thank you for giving me the opportunity to make these remarks.

Additional remarks on squeezing and quantum noise in interferometry

This is my discovery, made in May 1980, that, first, the fundamental noise in interferometry comes from the vacuum (nothing) entering the unused port of an interferometer and, second, things can be improved by substituting squeezed vacuum in place of the vacuum. Light can be put into any interferometer in two ways—two input ports we call them—and one of the input ports is illuminated by a coherent source, always in modern times a laser. That the fundamental quantum noise comes from the vacuum entering the second, unused port is completely obvious now, but in 1980 it was not understood at all. The conventional understanding in quantum optics was that the noise in interferometry comes from the particulate nature of light—that light is made up of photons—and although this is a perfectly good explanation, like any explanation in quantum physics, it is incomplete and, importantly, it is incomplete in a way that would never lead to the idea of improving things using squeezed light. Indeed, the situation was like reading a detective novel where the author carefully directs attention away from the murder scene. All of quantum optics at the time was, at least on this score, about misdirection. Don't look at the unused port. There's nothing there to look at. Literally nothing. It's vacuum. No photons. So don't go there.

Now, I think there were some smarts in figuring this out, to realizing that the fundamental quantum noise in an interferometer is all due to the vacuum that sneaks into the unused port and to realizing that you don't have to be stuck with vacuum, that you can make things better by putting squeezed light into the unused port. But there was also a lot of luck, as accompanies, really, any accomplishment in life. Luck to work in a research group, Kip Thorne's at Caltech, where attention to fundamental questions in quantum measurement was valued and encouraged. Luck to know just enough to realize there is a problem, but not so much as to have absorbed the misdirection of contemporary understanding. Luck to have the luxury of time to work on something of fundamental importance where nobody else was paying attention because the payoff, should there ever be one, was way too far in the future for most physicists to be interested. Luck that the future is now, forty years on, when the use of squeezed light turns out to be of great practical importance as it improves the sensitivity of the LIGO and Virgo laser-interferometer gravitational-wave detectors.   Making billion-dollar projects work better—that does attract attention.

Squeezing of all sorts, in optical, atomic, and opto-mechanical systems, is now an industry, with applications all over quantum metrology and quantum computation.   It is extremely gratifying to think that my ideas on noise in interferometry lit a fuse that is now exploding all over the landscape of quantum technologies.