Time domain imaging of transient and variable radio sources

Cendes, Y.N.

Curriculum vitæ

Five generations ago, a schoolteacher in a village in the eastern wine region of Hungary scraped together enough money to send his son to university. That son- my great-great-grandfather- ultimately got a PhD in law, thus becoming the first Dr. Csendes. And so a family passion was born for education, with each generation's son earning a doctorate. The turbulence of World War II in central Europe cemented this further with the pragmatism of refugees everywhere, who know the only resource you are guaranteed to carry is what is in your own head. Half of the family shifted to Canada during those turbulent years, and the name shifted to Cendes with my father when he later became a US citizen.

It has been a difficult path in many ways, for many people, but what you hold is the fifth generation of a doctoral thesis from a long line of scholars. It is, I hope, noteworthy in many ways, but one of those is how out of all these family doctorates it is the first written by a woman. While it is trendy in some circles these days to suggest these things do not matter, people like my grandmother would disagree- she always said her greatest regret in life was never being able to learn algebra, because while her brother was sent to university to become a doctor she was sent to finishing school. It is a prime reminder to all of us that while talent is universal, opportunity is not, and I have thought of her many times as these pages came together.

But anyway, onto me. Three astronomical things of note happened in the span of a week in late January, 1986, although you are forgiven for not recognizing them all at the time. The first was, of course, the shocking explosion of the *Challenger* space shuttle on January 28, seconds after launch. The second was, on January 24, the closest approach by *Voyager 2* to the planet Uranus and its moons. And the third was, on January 23, my birth in Pittsburgh, Pennsylvania, USA, twenty minutes after my twin brother and almost two years to the day after our older sister. (My mother insists I was a fairly quiet child until I was about four years old, when I realized if I didn't start talking more no one would pay attention to me.) Childhood in Pittsburgh progressed as these things typically do, although with more Hungarian speaking and devouring of books than average. I do remember a great excitement when I was ten years old when my father announced the great comet Hyukatake was in the sky, and we would drive out to the country after dinner for a better look. "Think of me next time you see it," he joked, after telling us of its 70,000 year orbit. I stared with the awe and wonder of someone realizing what a cosmic scale is for the first

time.

However, I would really argue that my life has been divided in two ways: the part before a fateful autumn day in 1999, and everything after. I was 13 years old, and had a tedious hour-long school bus ride each way between home and school. I would pass the time by reading, and one day ran into the library after class with the emergency of nothing to read, and minutes to solve the impending crisis. For whatever reason, I grabbed a general book about astronomy- *From the Big Bang to Planet X* by Terrence Dickinson, with a fetching image of the Andromeda Galaxy on its cover- and my view of the universe was never the same after. I realized that *anyone* who was 13 years old could conceivably grow up to be an astronomer someday- even if you lived in Pittsburgh- and that decision never really wavered since. I am a lover of stories, and the story of the cosmos is the biggest and grandest one we have.

I settled on radio astronomy fairly quickly too, thanks to the book and movie *Contact* by Carl Sagan and essentially deciding at age 15 that I wanted to be Ellie Arroway. I got my amateur ("Ham") radio license soon after turning 16, and my teenage bedroom was defined by my telescope, over a dozen radios (store bought and homemade), and giant maps of the world and North America with pins for all the stations I ever heard. I learned to tease out signals from the noise, and that when radio works it's as close to magic as you can get short of a wand and a bag of salamanders. Years later, I got my first real taste of radio astronomy doing a summer REU program at the SETI Institute working for Jill Tarter, the inspiration for Ellie Arroway herself.

I started university in 2004 at Case Western Reserve University in Cleveland, Ohio, where I did my bachelor's and master's degrees in physics. My research there was in cosmic rays- specifically on GPS timing units for the Pierre Auger Observatory in Argentina, which are vital to sorting out where ultra-high-energy cosmic rays originate from in our universe. (We still don't know.) In 2007, I studied a semester at the University of Auckland in New Zealand, which sparked a love for serious travel. In between my degrees I have backpacked around the world, most of it solo, to over sixty countries. Along the way I have gotten punched by a wild mountain gorilla, visited Everest Base Camp, gazed at Antarctic islands, and many other experiences. I am very lucky to have had so many adventures I always assumed as a child I would only read about.

It is this love of travel that led me to consider PhD programs abroad, and ultimately took me to the Netherlands for my PhD. I am very grateful to have the opportunity to obtain my PhD from Leiden University, and also conducted predoctoral research at the University of Amsterdam and University of Toronto. I will probably always remember September 12, 2019 as the date my thesis was finally approved, and I went to town hall to marry my husband, Floris Gerardus Looijesteijn, so it all worked out in the long run but in the span of an afternoon!

Finally, I have to mention that along the way, I have been a writer- I thought my calling in life was journalism before I discovered astronomy, so it has been rewarding to succeed in both. Over the years, I have written numerous features that have appeared in *Astronomy*, *Sky & Telescope*, *Discover*, *Scientific American*, and others. Online, my comments are read by millions of people regularly on the platform Reddit, many of which have inspired others to pursue their own STEM careers. I firmly believe that science is an act of human expression, no less valid than music or art, and that outreach by scientists is of vital importance in a world held in the increasing sway of ignorance and misinformation.

In October 2019, I began my position as a postdoctoral fellow at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts. I cannot wait to see where my life's cosmic adventures lead to next.

Acknowledgments

It is very difficult to stand at the end of a journey as long as a PhD thesis and thank everyone who brought it in the world. You are trying to capture everything about your journey that cannot be read on the previous pages, and when that journey encompasses three institutions on two continents you realize no words will truly acknowledge them all. So, with that, I will summarize it with five thank yous, and hope it covers everyone.

First of all, I would like to thank my family for their unwavering love and support in all the moments of my journey, especially my parents, brother, and sister. A special *köszönöm* to Sári mamama, whose greatest hope was a woman in our family would earn her own PhD instead of claiming a corner of another's diploma. *Sok szeretettel, mindig.*

Second, there are not enough words to describe my thanks to my supervisors, Bryan, Xander, and Maria. Bryan, thank you for your morals and courage to make our science and corner of the world a better place than you found it. I know some will feel it's melodramatic to suggest an adviser can save a student's life, but in I will always feel like you saved mine. Xander, your cheerful pragmatism has saved many as well, and is an example for the kind of scientists we should strive to be. Thank you again for the SOFIA flight! And Maria, thank you so much for our wonderful collaboration. It struck me more than once during our fits of laughter that this is exactly what I hoped science would be like, and that it was worth fighting for.

Third, thank you to my friends, colleagues, and collaborators around the world, especially for our many cheerful moments over various delicious beverages. Special thanks to Casey Law, who is on the first and last research chapters chronologically, and to Dario Carbone who I will always consider my PhD twin. And thank you so much to Adam, Natalie, and Milena for all the times you listened, and for all your solicited and unsolicited opinions and advice.

Fourth, thank you to my editors at my various publications, and the thousands of folowers on Reddit. I am humbled to have such wonderful platforms to share my astronomical passion with others, who regularly remind me of why I fell in love with it in the first place.

Finally, thank you and love to my Floris, without whom this work would not have been completed. I would do it all again if it was the price I had to pay to meet you.

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