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Figure 1. Professor Hoffman outside Chamberlin Observatory, May 2012

1 TELL US ABOUT YOURSELF, SUCH AS WHERE YOU WENT TO SCHOOL, HOW YOU BECAME INTERESTED IN YOUR MAJOR RESEARCH AREAS, AND HOW YOU FOUND YOUR WAY TO DU

I majored in physics and astrophysics as an undergrad at UC Berkeley and got my Ph.D. in astronomy from the University of Wisconsin-Madison. All I knew when I started grad school was that I wanted to learn about stars, as opposed to planets, galaxies, cosmology, etc. The professor who became my adviser happened to have funding for a study on interacting binary stars at the time I needed a project, so that became the focus of my dissertation. In my postdoctoral work at Rice, I studied very young, just-forming stars using the same observing and modeling techniques I had developed for the binary systems. Then I got an NSF fellowship to apply the same techniques to supernova explosions, and I went back to Berkeley to work with supernova research groups on the UC campus and at the Lawrence Berkeley Laboratory. During grad school I had discovered I really enjoyed teaching, so when I started applying for faculty jobs, I was deliberately looking for a school that valued teaching and research equally highly. DU was one of the only places I applied that seemed to get that balance right, so I was delighted to take a faculty job here.

Coincidentally, I took my very first astronomy class at DU! I was in middle school, visiting Denver for a two-week summer camp; we lived in Centennial Halls, took classes in Boettcher, and visited the Chamberlin Observatory. So, when I came back here as a professor and astronomer, it was like coming full circle.

2 WHY DID YOU BECOME A SCIENTIST? WHAT DREW YOU TO THIS FIELD? WHAT MAKES YOU GET UP IN THE MORNING?

I'm here because studying astronomy makes me feel connected to the Universe. I don't think of it as an escape or a pursuit that's separate from the "real world." Just as other sciences help us understand our relationship to the Earth, astronomy shows us how both we and the Earth fit into a larger, cosmic environment. I think it's amazingly cool that just by looking out into space from our tiny planet, we can figure out what the Universe is made of, how we are related to it, what a beautiful variety of phenomena it contains, how it began and how it might end.

Figure 2. Professor Hoffman giving a tour of the Chamberlin Observatory to Chancellor Jeremy Haefner, November 2021

3 WHAT ARE YOUR TEACHING INTERESTS? WHAT IS YOUR TEACHING PHILOSOPHY?

My goal in teaching is to make science welcoming and accessible to students from all backgrounds. I'm motivated by the concept of "groundskeeping," developed by Dr. Beronda Montgomery at Michigan State University. Many of our traditional academic and scientific practices take the form of "gatekeeping," or restricting access to specialized knowledge based on biased assumptions about who is deserving and talented enough to receive it. By contrast, a groundskeeping approach asks the instructor to pay attention not only to the subject matter in a class but also to the culture of the learning community and the needs and well-being of the people within it. This is important because successful learning and scientific discovery depend not only on individual efforts but also on the academic and professional environments we navigate. In my classrooms and other communities, I'm trying to create healthy, supportive social ecosystems that allow all participants to thrive.

4 WHAT SPARKED YOUR INTEREST IN THE FIELD THAT YOU WORK IN?

Like many kids, I was super interested in space at a young age and wanted to be an astronaut, particularly after the Challenger disaster in 1986 halted the spaceflight program for a couple of years. I thought that was a shame and wanted to volunteer to go to space immediately! But during high school, I realized I was really interested in learning about stars, planets, and galaxies and that I could do that just as well, if not better, from the ground as from Earth orbit.

5 HOW HAS THE PROCESS, OR THE PROFESSION OF RESEARCH CHANGED OVER THE PAST FEW DECADES IN YOUR FIELD?

Astronomy is undergoing a really interesting transition into an era of "big data." My dissertation focused on one single object, a binary star known as beta Lyrae, but now that we have enormous multiwavelength and time-dependent all-sky surveys, the days when one scientist studies one star or star system at a time are probably over. A fun example shows up in the way we name supernovae. These stellar explosions are going on all the time in galaxies both near and far from us. But before telescopes were invented, people could only detect supernovae with the unaided eye, so they could only see nearby explosions within the Milky Way or its satellite galaxies. These were so rare that each one had its own name, like "Tycho's supernova" in 1572. In the 20th century, high-quality telescopes and digital imaging allowed us to discover more supernovae each year, so we started naming them with the year and a letter. For example, Supernova 1987A was the first one discovered in 1987. In the late '80s, when we started discovering more than 26 supernovae per year, we started over in the alphabet with "SN 1989aa, SN 1989ab," etc. This combined one- and two-letter scheme gets you up to 26 x 27, or 702 supernovae per year. But in recent years with new automated sky surveys, we've started to discover even more than that. As of November 2021, we are up to "SN 2021qqq," which is the 11,249th supernova discovered this year alone! With terabytes of data rolling in on thousands of objects, the focus is now on developing powerful methods for classifying and analyzing them in large groups, as well as detecting and interpreting patterns in these massive data sets. So computational methods are increasingly important for the future of astronomy research.

6 DESCRIBE YOUR CURRENT RESEARCH IN LAYMAN'S TERMS

We know that stars more massive than the Sun explode as supernovae when they reach a certain stage of their lives or, as astronomers say, their "evolution." But our understanding of the physics of supernova explosions relies on the assumption that the original star is a "loner," far away from other stars. It turns out that

Figure 3. A snow-covered Pine Bluff Observatory, Pine Bluff, WI, early 2000s

the majority of massive stars interact with stellar companions at some point in their lives. Their mutual gravitational forces and the actions of their strong stellar winds can pull gas off the stars, transferring it from one to the other or ejecting it away from both, and this loss of mass can be significant enough to alter the course of the stars' subsequent evolution. This is great news because companion interactions may help explain the extremely wide variety of supernovae and other related explosive stellar phenomena that we observe. But the wide variety of different effects these interactions can have on stellar evolution definitely makes the picture more complicated!

My research group studies how binary interactions may affect the evolution of massive stars and whether we can see evidence of these interactions in supernova explosions. We do this with a technique called polarimetry, which measures not just the amount of light we receive from astronomical objects but also how much, and in what direction, that light is polarized, meaning the light waves are partially aligned. This alignment happens when light bounces off free electrons in the hot, ionized material surrounding the stars or supernova. We can use the information encoded in the polarization to figure out where that ionized material is located and what its shape is. We are investigating whether the gaseous structures that form when two massive stars exchange material might leave detectable signatures after one of the stars explodes. To do this, we obtain time-dependent polarization observations of massive binary systems in our Galaxy and faraway supernovae, using big ground-based telescopes like the MMT in Arizona and the Southern African Large Telescope in South Africa. Then we use supercomputers to create simulations of both kinds of stellar systems to help us interpret the data. This process lets us build 3-dimensional reconstructions of stellar phenomena that are too far away for even the most powerful telescopes to image.

7 WHAT WOULD YOU CHANGE TO IMPROVE HOW WORK IN YOUR FIELD IS DONE? IN OTHER WORDS, WHAT LEGISLATION MIGHT YOU PASS OR WHAT POLICIES WOULD YOU CHANGE AND WHY?

This isn't legislation or policy, and it's not a magic wand for fixing all that ails us. But I wish I could convince everyone that science isn't a holy, faultless endeavor completely divorced from the rest of society. It's a pursuit developed by and practiced by people, and the people who have historically developed and practiced Western science are an extremely homogeneous group of white folks, primarily men, of European descent. So, their human flaws and biases, as well as the systematic flaws and biases of their cultural systems, are baked into the entire structure of science as we know it. It's good that many scientists are starting to acknowledge that we need to create a more diverse and inclusive scientific community, both to find better, more innovative solutions to complex problems and to create a more just, humane, and equitable scientific culture. But if we're going to do more than pay lip service to these ideals, we have to understand that our institutions and practices are still rooted in systemic racism and colonialism. It's not a betrayal of science to recognize these facts, and it's not anti-scientific to work to change traditions that we know are biased and harmful.

8 CAN YOU SHARE A TURNING POINT OR DEFINING MOMENT IN YOUR WORK AS A SCIENTIST?

When I was in grad school, my Ph.D. adviser was an expert in stellar polarimetry, so he taught me what I know about the observational side of my work. I had a second mentor who was an expert in creating the kinds of simulations that I began to use to interpret the polarimetric data I was obtaining, and she trained me in the theoretical and computational side of the project. In my dissertation research, I combined the two techniques by creating new kinds of simulations to model polarization data in particular.

I remember that at one point, in my fourth year of grad school or so, I ran into a problem that was simultaneously too computational for my adviser to answer and too observational for my mentor to answer, so I couldn't ask either one of them for help. I experienced a moment of simultaneous excitement and terror when I realized I was the only person, maybe in the world, who could figure out the answer to this problem. Probably something like this happens to everyone who gets a Ph.D., because the point of pursuing a doctorate is to become an independent expert in your own specific research area. But I remember it as a very intense revelation that I had gotten to the point where no one else could help me do the thing I had set out to do. Although the emotional memory is vivid, I don't even remember now what the problem was, but I must have eventually figured it out!

9 WHAT DO YOU LIKE TO DO WHEN YOU AREN'T WORKING ON RESEARCH?

I manage DU's historic Chamberlin Observatory (Figure 1 and 2), in collaboration with the Denver Astronomical Society, which lets me involve the public in astronomy and encourage people to think about the night sky as part of their cultural heritage and daily life. I co-direct a summer camp called DU SciTech with Dr. Robin Tinghitella and Dr. Shannon Murphy from biology that brings middle-school girls of color to campus for hands-on science activities – we recently published a research paper with many of the camp participants from 2019! Outside my professional activities, I like to read, hike, and birdwatch. I have also sung with the Colorado Chorale for the past 10 years. Once I even helped organize an astronomy-themed concert and associated observatory night!

10 WHAT ARE YOUR VIEWS ON CURRENT PUBLIC POLICY ISSUES IN SCIENCE AND MORE SPECIFICALLY PHYSICS?

The absolute most important issue for everyone in the world right now is climate change. That doesn't mean my field is irrelevant – in fact, astronomy has an important role to play in our response to the climate crisis. Astronomy can help us contextualize the enormity and seriousness of the recent global temperature increases and understand what happens to planets under extreme climate conditions. But I think it does mean that all of us need to find ways to pressure governments, corporations, and other influential organizations to take immediate and dramatic action to slash CO_2 emissions and to protect vulnerable communities from the environmental disaster that is already in motion. We have waited far too long for gradual, painless solutions to have any impact. Now we're talking about our kids' and grandkids' future. The biggest danger right now, I think, is that as people in the biggest carbon-consuming countries realize we are too late to prevent a significant amount of damage to the climate, they may get so discouraged they feel that nothing can be done. This isn't true! The answer is not to give up hope or fantasize about escaping to some other planet. Rather, we need to find ways to rediscover a sense of responsibility, kinship, and connectedness with our environment. Collectively, we can muster the will to save what can still be saved, minimize further damage, and learn to live more respectfully on the Earth, which is home to the only sparks of life we know about in the whole Universe.

11 OTHER FUN FACTS

While I was in grad school in Wisconsin, I got to be the resident and caretaker at the Pine Bluff Observatory, a research observatory 10 miles west of campus on a rural hilltop in the little unincorporated town of Pine Bluff (Figure 3). My partner and I lived there for four years. Our nearest neighbors were dairy farmers, deer and possums and coyotes wandered through the meadow around the building, and it was blissfully quiet. We mowed the grass and shoveled the snow and set up bluebird boxes in the meadow and dealt with hordes of migrating ladybugs and went on long rambling walks over the rolling hills and got up in the middle of the night when one of the undergraduate observing team members had trouble with the telescope. We even got married on the back lawn and gave our wedding guests tours of the dome! I felt extremely grounded and connected to my surroundings there, and I'm grateful I was able to experience it.