

Bob Benjamin, Part Two

(As published in The Oak Ridger's Historically Speaking column the week of December 22, 2025)

Benita Albert brings us part two of the two-part series on the career of Bob Benjamin. His career interest in astronomy began soon after graduating from Oak Ridge High School. You will find it interesting to learn that Bob was instrumental in creating a map of the Milky Way! Get ready to be amazed...

When Bob Benjamin, 1983 Oak Ridge High School graduate, was given an assignment in his undergraduate course in astronomy at Carleton college, he chose a research study that focused on the 'galactic fountain.' It was a study that would shape his early research interests and lead him to an amazing career in astrophysics and astronomy. He describes that early work below.

"In my one astrophysics class as an undergraduate, we were supposed to pick an astronomy topic from *Scientific American* and do a class presentation on it. At random, I picked an article on "The Coronae of the Galaxy," by Klaus de Boer and Blair Savage. Just like the Sun is surrounded by a million degree 'corona' of hot gas, there was evidence that our Milky Way was surrounded by an envelope of superheated gas. One model for the origin of this gas is a galactic fountain, where stars in the Milky Way Galaxy explode in supernova explosions and heat up the interstellar gases. These gases expand out of the disk of the galaxy, cool, condense, and 'rain' back in. It was a fascinating picture, sort of like those images of the hydrological cycle of the Earth where water vapor rises, and rain falls back to the Earth."

"When I arrived at the University of Texas (for graduate studies), I found that a professor there, Prof. Paul Shapiro, was one of the original developers of the idea of the galactic fountain. My thesis was developing new models of this process and then testing them using data from the Hubble Space Telescope (which was launched while I was in graduate school). Some years later, I would come to the University of Wisconsin (Madison), and I had the opportunity to work with Blair Savage whose writing had inspired me as an undergraduate."

In an online bio, Bob describes his primary research interests: "I work on the global structure of the Milky Way Galaxy, studying the distribution of stars and gas in order to determine the structure of the bulge, bar, disk, spiral arms, and warp. I also work on large-scale models of the interstellar medium (ISM) and high velocity clouds (HVCs)."

The ISM encompasses the matter and radiation that exist in the space between stars in the galaxy, a medium that is primarily gas and dust. Raw materials in the ISM provide a medium conducive to star formation when dense regions within the space collapse.

HVCs are clouds of gas which are observed to be moving at speeds significantly higher than expected in relationship to the rotation of the Milky Galaxy. An area of active research, HVCs are considered important to understanding the evolution of galaxies.

The Milky Way is a large spiral bar galaxy which appears as the combined light of countless stars and interstellar gas and dust concentrated into a flattened rotating disk. Bob's research studies and consultant work with NASA's space probe missions and telescopes have provided exciting new discoveries.

I asked him to highlight a few of his important findings.

"When I reached Wisconsin, I got involved in an observational program to map the Galaxy using NASA's new infrared telescope, the Spitzer Space Telescope. I was able to make several discoveries using data from this telescope, including finding that the bar of the Milky Way was much longer than previously thought and that some of the spiral arms were more prominent than others."

Subsequently, in 2008 Bob was the driving force, along with a NASA artist, in the creation of a map of the Milky Way, an oft-cited online image. <https://www.spitzer.caltech.edu/image/ssc2008-10b-a-roadmap-to-the-milky-way-annotated>

Bob Benjamin, Part Two

(As published in *The Oak Ridger's Historically Speaking* column the week of December 22, 2025)

"Probably the most important discoveries of my career have to do with the structure of the Galaxy: the length of the bar, the nature of the spiral arms, and a press release coming out soon about mapping the ionized nebulae around the sun in 3D. And that continues to be my passion."

"I have a lot of questions about the Galaxy with more and more data piling up to answer those questions. But the most surprising discovery? Twenty years ago, a colleague and I found a two-degree long, very straight line of ionized gas across the sky. (It sort of looked like the interstellar version of a jet contrail. We published a paper about it in 2001.) Fast forward to twenty years later, and two young astronomers in Europe found it again, but showed it was a 30 degree-long, perfectly circular, arc in the sky. I helped them with the analysis. We think it's due to the explosion of a very nearby star in the direction of the Big Dipper. If you extend the arc into a full circle, it would completely encircle the Big Dipper! We named it the 'Ursa Major Arc,' and there's still a lot we don't know about it. But after twenty years, progress!"

I asked Bob to speak to the challenges facing today's astronomers. He replied, "The biggest challenge is getting paid to do astronomical research, something that has become a lot harder recently. But for those of us who have (or had) jobs, one of the biggest challenges is the overwhelming amount of data we are now obtaining."

He cited the just announced launch of the Legacy Survey of Space and Time via the NSF-DOE Vera C. Rubin Observatory, a ten-year survey of the night sky using the biggest digital camera ever made which will capture an ultra-wide, ultra-high-definition, time-lapse record of the universe. And the proposed Nancy Grace Roman Space Telescope (to be launched in September 2026) is a NASA project designed to investigate dark energy, exoplanets, and infrared physics. Bob proudly noted that Nancy Grace Roman is a Tennessean whose NASA career included her pivotal work in planning and developing the Hubble Space Telescope.

Bob concluded that, "Every astronomer now also needs to be a computer scientist." His comment led me to another of my questions, namely, advice for students who want to study astronomy. He advised, "Two things: learn to love math, and it's never too early to get involved in research. One of the hardest things about getting into research is learning what the questions are. But the more you do, the more it draws you in. During my first postdoc, I mentored a high school student in a project, and now he's a very successful professor of astronomy at the University of Arizona. He is grateful for his early start in research."

After completion of his PhD in astronomy from UT Austin and two, three-year postdoctoral studies, Bob accepted academic assignments in the physics departments of The University of Wisconsin at Madison and Whitewater. Joining the staff of UW-Whitewater as an Assistant Professor of Physics in 2003, he assumed the Chairmanship of the Physics Department from 2013-2018, and retired in 2024 to assist in caring for his ailing mother.

As I mentioned in Part One of Bob's story, I knew him as a keenly perceptive student in my ORHS classes, AP Calculus BC and Calculus 2. In fact, I enlisted his talents as a mentor in those classes when I was absent, and he was given rave reviews by students. Later, his teaching skills were expanded via his involvement in such programs as a Teaching Assistant for an NSF Teacher Workshop in Astronomy for Middle School Teachers, Instructor for a University of Minnesota graduate-level course in *Extragalactic Astronomy*, and an instructor in the University of Wisconsin (Madison) *Physics Learning Program*.

He served as a Director for UW-Madison's *Astrophysics Research Experiences for Undergraduates* (Astronomy and Physics) from 2002-2015. When he accepted the faculty position at the University of Wisconsin, Whitewater, he taught four courses each semester alongside his active research studies. His teaching opportunities have extended into his research work. He said, "One of the things I have loved about my connection with NASA projects is that public education and inspiration are baked in."

I could not resist asking Bob to comment on special teaching moments.

He answered, "Regarding tales of being a professor, as you might imagine, I was always animated in my classroom. Even if students forget Gauss's Law, they will always remember how excited their professor was about Gauss's Law. I mostly taught intro physics to our majors and some upper-level classes. It's odd to look back over my 20-year career and think of

Bob Benjamin, Part Two

(As published in *The Oak Ridger's Historically Speaking* column the week of December 22, 2025)

the lives I influenced. It seems like an awesome responsibility. I involved dozens of students in my research. For over a decade, I would take two or more of my students each year to observe at the Kitt Peak National Observatory. There's nothing like having a key that allows you to go through those doors marked 'Authorized Personnel Only'."

"One story that I have frequently told was of grading student exams at a local coffeeshop early in my time as a professor. The owner saw me and helpfully suggested, "Just give them all A's and let the free-market sort them out." Without a moment's thought I replied, "Well one day one of these students could be designing your airplane." He looked at me, paused, and then replied, "Oh, in that case, grade them really hard!" Years later, I can now say that I actually do have a former student designing airplanes; she's become the leader of her group at Boeing."

Bob's consultant work with NASA is ongoing and includes, among many plans, his desire to update the above-cited online map of the Milky Way Galaxy. In the less than two decades since he published the 2008 map, the understanding of our galaxy has grown exponentially due to advances in technology and data analysis. Reflecting on the astronomer's lifestyle of his early years, Bob said, "Early in my career I was traveling to mountains and staying up all night to operate telescopes, fix broken equipment, and curse the clouds. But as of late I am finding that I am just proposing observations and having the data shipped to me, usually from space. So, a bit of the romance of astronomy has been lost. I still remember the thrill of getting a set of keys that allowed me access to various ground-based observatories."

He followed the above comments with, "It really never stops being fun." The "it" to which he now refers is how rapidly our understanding of the universe is expanding. Recent data from the European Space Agency observatory Gaia and multiple other telescopes and surveys have gathered images and spectra for millions of stars. Bob's dreams of 'seeing the Milky Way from outside the Galaxy' are manifesting as to the structure of our galaxy and to its evolution over time. Consider this quote from the February 2024 *Scientific American* article, "Our Turbulent Galaxy:" "(The new) maps show not the Milky Way in static equilibrium as researchers expected, but rather the galaxy's departure from it."

Bob Benjamin serves as the tour guide/character for the above article as well as the cheerleader for the emerging results. His enthusiasm is contagious as he discusses his cross interests in stars and gas clouds, the two sides described as largely nonoverlapping communities. Bob identifies more with the gas people saying, "I think of a galaxy as alive and breathing."

The article concludes by mentioning the potential of new maps, stating: "We can see how constellations have warped and shifted with time and how the galaxy has and will continue to change." Or as Bob observed: "We can run the movie forward and backward. We can do that with certainty."

I was captivated by the quote from Eden Phillpotts that Bob used as an introduction to his curriculum vita. It is a most fitting mantra for his life's work: "The universe is full of magical things, patiently waiting for our wits to grow sharper." My thanks to Bob for sharing some of his inspiring insights into the 'magic of our universe.' Be assured that he is not done 'sharpening his wits.'

Thank you, Benita, what an amazing story and I agree, Bob is not done... He is doing research that explains what is happening in our Milky Way galaxy. I find it interesting that he says information is now being provided to him from space rather than ground-based telescopes. We are living in such an astonishing time!

Bob Benjamin, Part Two

(As published in The Oak Ridger's Historically Speaking column the week of December 22, 2025)



Bob Benjamin