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Astro Guy

A Belle Mead Resident
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THE EAGLE NEBULA

One of the iconic objects of the night sky made famous by the Hubble Space Telescope. The nebula shines brightly in so-called Hydrogen-alpha light, which is a deep red color near the edge of the range of visible light detectable by human vision. It is fairly easy to take nice photographs of this object. The image above was taken with a 10-inch reflecting telescope. Distance to Earth: about 5,700 light years. Exposure time was two hours. – From “Sizing Up the Universe.”



THE PLEIADES

This constellation, also known as the Seven Sisters, Messier 45, and Subaru (in Japan) is an asterism and an open star cluster containing middle-aged, hot B-type stars in the north-west of the constellation Taurus. At a distance of about 444 light years, it is among the nearest star clusters to Earth.

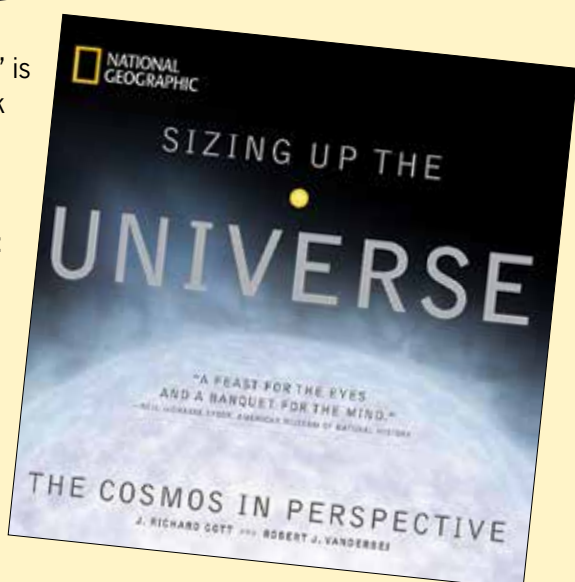
The Perfect Holiday Gifts for Young Scientists



◀ Journey into the universe in stereoscopic 3D in this *New York Times* bestseller titled “Welcome to the Universe.”

Price: \$29.95
ISBN: 9780691194073
Published: 2022
Pages: 208
Princeton University Press

▶ “Sizing Up The Universe” is a National Geographic book on astronomy. The book is loaded with beautiful pictures. It also answers several fundamental questions: From small to big, what is out there in the universe, how big are those things, and how far away are they? The book starts with a survey of what we see when we look at the night sky, both with and without a telescope.



Astro Guy

Robert J. Vanderbei Shoots the Moon, Stars, & Planets

Princeton Professor Vanderbei takes amazing photographs of outer space — mostly from the driveway of his Montgomery Township home.



Above: Professor Robert “Bob” Vanderbei.

“Space is big. You just won’t believe how vastly, hugely, mind-bogglingly big it is.”

— Douglas Adams,
“A Hitchhiker’s Guide
to the Galaxy”

By Melissa Drift

Known as astrophotography, the use of photography in astronomy is the photographing of celestial objects and phenomena.

Princeton University professor Robert Vanderbei takes these photos at his home in Montgomery Township.

As a mathematician, he likes to understand the physical properties of the objects he photographs. He is especially interested in how big the universe is and how to measure the distances to, and sizes of things.

In 2010, he co-wrote a book with J. Richard Gott, published by National Geographic, called “Sizing Up the Universe.” He also teaches a course at Princeton with the same name.

Both the book and the class are all about how people can do these measurements using a telescope and camera that the average person can afford. They cover basic questions, such as, how we know the earth is spherical, how we know how far away the sun and planets are, and how far away stars are.

In 2022, he co-authored a second book with Neil Degraffe Tyson, J. Richard Gott, and Michael Strauss, called “Welcome to the Universe in 3D.” The book comes with an attached pair of 3D glasses to view the stereoscopic photos of planets, stars, and other celestial bodies, which he photographed.

Most of Vanderbei’s pictures are of astronomical objects called nebulae and globular clusters, which are his favorite things to photograph.

Latin for “cloud” or “fog,” a nebula is an interstellar cloud of dust, hydrogen, helium, and other ionized gases. They are the basic building blocks of the universe. Stars inside these clouds of gas

cause them to glow with beautiful reds, blues, and greens. These colors are the result of different elements within the nebula.

“I like the nebulae because they’re all different and beautiful, and I like the globular clusters kind of for the same reason,” says Vanderbei.

Derived from the Latin, globulus, which means a small sphere, globular clusters are spherical collections of stars that orbit a galactic core, like a satellite. They are tightly bound by gravity, which gives them their spherical shapes and relatively high stellar densities toward their centers.

Vanderbei likes the randomness of the stars’ distribution within the cluster.

“It’s more dense in the middle and it’s beautiful in a different way from the nebulae. But the fact that it’s got sort of this globular density — more density in the middle and less dense as you move out from the center — it makes it also artistically interesting to me,” he says.

Vanderbei uses a 10” Ritchey-Chretien telescope with an attached camera. It’s mounted on a tripod, attached to a contraption called a wheelie bar that allows him to wheel it around. He bought and assembled the setup 15 years ago and has never disassembled it. He does most of his work from his driveway, and the telescope stays in his garage when not in use.

The telescope, which is controlled by a laptop computer, rotates automatically. The process starts with a polar alignment to ensure the axis of rotation on the telescope’s mount is aligned with the way the earth rotates. This allows the telescope to accurately track objects as they move through the night sky.

Vanderbei manually points the telescope to a particular landmark that is easily visible with the naked eye, such as a bright star. The particular star or planet he prefers to use for this purpose, varies depending on the time of the year.

— Continued on page 17

All space photos are by Robert J. Vanderbei.



THE ROSETTE NEBULA WITH A MOON OVERLAY

The Rosette Nebula is a star-birth region of the Milky Way galaxy. The nebulosity is mostly deep-red Hydrogen-alpha light emitted by a cloud of interstellar hydrogen atoms. This cloud of atoms is slowly condensing to form young stars. The stars give off light, which excites the hydrogen atoms in the interstellar nebula causing the nebula to glow. The moon overlay gives one the sense of the size of this nebula. Vanderbei photographed the nebula from his driveway with his 4-inch refractor using H-alpha and O-III filters to cut through the light pollution. From vanderbei.princeton.edu/images.

— *Continued from page 16*

He inputs that starting point into his computer and can then program the software to move the telescope in different directions from there, depending on what he wants to photograph.

“From then on, the rest of the evening, I can just use my computer to point at whatever I want.”

The final image is made by stacking all the individual pictures that were taken during the night in a software program called Maxim DL. Each individual picture in a sequence usually is taken over the course of a few minutes. For example, he may set the exposure for each picture to be two minutes and then take 100 pictures.

“I might start taking them at 11 or 12 at night and finish up at one or two in the morning,” Vanderbei says.

He mostly creates still images but will occasionally create short animations by overlaying images taken on different nights. This allows him to easily see if there have been changes in an object over time.

One would think this type of photography would lend itself to surprises, perhaps even unexpected discoveries in the night sky.

“I’ve been doing this for almost 20 years, and I tell people I take a lot fewer pictures per year now than I did in the early days, and the main reason is things don’t change. I’ve already got an awesome picture of that, you know? I could take another one, but it’s going to be like the last one I took before,” he said.

But there are always exceptions.

The Crab Nebula is one interesting story. It resulted from a super nova explosion that happened roughly a thousand years ago. If a supernova explosion happened in our galaxy in our lifetime, it would be so bright that it would for a time be visible in the daytime everywhere on Earth.

As it happens, the written records from the year 1054 both in China and in India indicate that people saw something strange in the sky that looked like a star in the daytime. That was the Crab Nebula as it formed.

Eventually the explosion leaves gas that continues to expand out forever but gets dimmer and dimmer as it spreads. Professional astronomers determined many years ago that the Crab Nebula is still noticeably moving outward.

Vanderbei took two pictures of the Crab Nebula 12 years apart and when he overlaid them, he noticed that looks just a little bit bigger in the more recent picture.

Of course, for Vanderbei, this becomes a problem of applied math.

“I actually have, just for fun, compared those two pictures and made an estimate of how long ago I think it exploded just from how much that second picture has expanded, and I get around the year 1050, plus or minus 50 years. But I get about the right answer,” he says. “It’s pretty cool.” ■

Visit cnjn.org to watch Melissa Drift’s videos on Robert “Bob” Vanderbei. ■



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THE CRAB NEBULA

Also known as Messier 1, it is a remnant from the supernova explosion of 1054 AD. At the center of the nebula lies the Crab Pulsar.



THE WHIRLPOOL GALAXY

Also known as Messier 51, its spiral arms are star-forming factories— compressing hydrogen gas and creating clusters of new stars. Discovered by Charles Messier in 1773, M51 is located 31 million light-years from Earth in the constellation Canes Venatici, according to science.nasa.gov.



Visit: vanderbei.princeton.edu/images to view more amazing photographs by Vanderbei the Astro Guy.