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Gravity's Shadow

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The Hunt for Dark Matter and

Dark Energy in the Universe

By Evalyn Gates

Norton. 305 pp. $25.95In recent years, astronomy went over to the dark side and has yet to return. Baffling entities called dark matter and dark energy are the two biggest mysteries facing 21st-century astronomers. Their arrival is enough to turn Darth Vader dark green with envy.

It has been a jolt to learn that the universe we've become so familiar with -- all those planets, stars, swirling galaxies and glowing gases -- is just 4 percent of the overall content. Six times more consists of another type of matter altogether, possibly a subatomic particle yet to be discovered. The remaining three-quarters? A bizarre energy -- an anti-gravitational pressure -- that permeates space-time and has the potential to rip ou r cosmos apart in the distant future. We are mere flotsam within this covert cosmic realm.

What stands out in Evalyn Gates's cogent review of this intriguing topic is the sheer cleverness astronomers have demonstrated in fashioning tools to study the unseeable. As its name implies, dark matter emits no light. It can be detected only by its gravitational effects. So astronomers study it by closely observing how light, coursing through the universe, is gravitationally bent as it passes by the spheres of dark, invisible matter that surround galaxies and clusters of galaxies. This is, in effect, the ingenious "telescope" that Gates refers to in her title. Following Einstein's rules of gravity, a dark-matter mass can serve as a gigantic gravitational lens that magnifies more distant celestial objects lying behind it, such as primordial galaxies too dim to see otherwise. "Seen through an optical telescope," Gates writes, "a cluster is a large collection of galaxies . . . Observed with an X-ray telescope, a cluster looks like a big blob of hot gas. Viewed through Einstein's Telescope, a cluster appears to be a giant dent in spacetime caused by far more matter than is visible in gas and galaxies." In this way, dark matter's gravitational fingerprints are being found all over the cosmos, enabling astronomers to map where it is and assess what it might consist of to act the way it does.

In the cosmic scheme of things, the notion of dark energy is far more startling. Astronomers assumed for decades that our expanding universe was slowing down, only to find out that it's actually accelerating, somehow boosted by the presence of an odd, cosmos-wide pressure. As Gates writes so engagingly, its recent detection was "like finding an elephant on top of a table impeccably set with the finest china and silver . . . We stare in shock at the uninvited guest and demand to know where the elephant came from -- and how it got into [the] room." To find out, astronomers and physicists are exploring many avenues, from carrying out computer simulations to tracing dark energy's effects on the distribution of galaxies throughout the universe. is even getting involved, developing a Web portal that will allow astronomers, students and amateurs alike to assess data gathered by a special telescope, poised to regularly scan the entire hemisphere from the Chilean Andes in the next decade.

Gates aims to write for both professional scientists and laypeople, though she openly concedes that to newcomers some of these concepts will be "difficult to digest the first time through." In places her book does read like a textbook, but at least a textbook with style. A dry tome wouldn't ask you to look through the end of an empty wineglass to learn how dark matter can bend light due to the warps it imprints on space-time.

So much more has been revealed since I wrote a book on dark matter 16 years ago. A reviewer at that time was dismayed that I offered no final answers to the mystery. There's still no happy ending, but as Gates so aptly demonstrates, describing how science works toward a solution provides 99 percent of the enjoyment for any reader. *

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