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# NATIONAL GEOGRAPHIC

# GOING HOME



RETURNING TREASURES TO WHERE THEY CAME FROM ISN'T CLOSING MUSEUMS.  
IT'S OPENING NEW DOORS.

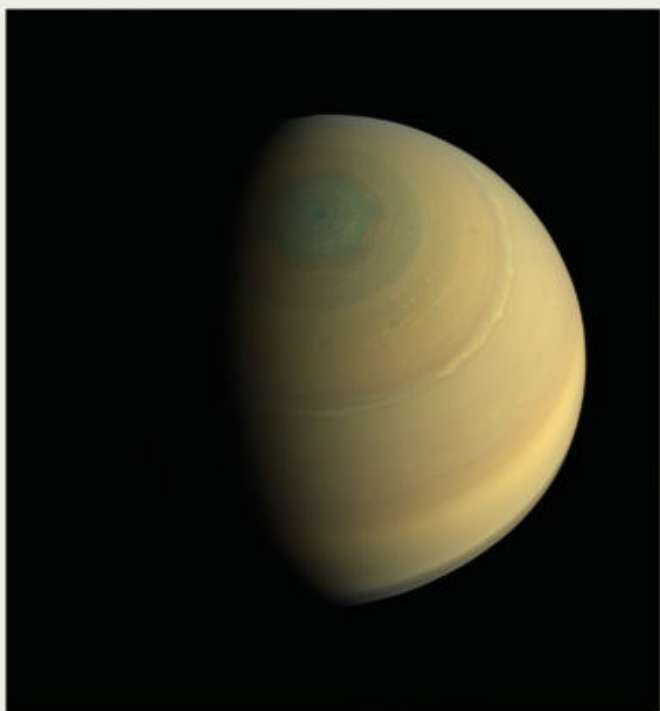




# Saturn: What Put the Rings on It?

SCIENTISTS HAVE LONG DEBATED THE AGE, ORIGIN, AND ANGLE OF THE BLING ON OUR SOLAR SYSTEM'S MOST DISTINCTIVE PLANET.

BY NADIA DRAKE



**WITHOUT ITS RINGS, SATURN LOOKS REALLY BORING.** Super blah. Erase those bangles—as blogger Jason Kottke did (left) from a NASA photo—and the planet is the blandest sphere in our solar system. Sure, a hexagonal vortex and some cool cyclones appear at the planet's poles—but its vanilla face lacks the pizzazz of Jupiter's watercolored bands, the spicy blue of Neptune, the suffocating murk of Venus.

Even rusty Mars looks more interesting.

Thankfully, at some point in the past 4.5 billion years, the cosmos gave Earth's neighborhood an upgrade: It put a big, bright, icy ring system around Saturn. But scientists don't agree on when Saturn's rings formed—or how the bangles even came to be. And that's been true for decades. In a twist, it turns out that the genesis of one of the solar system's iconic features is still an unsolved mystery.

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if the rings formed at the same time or if they were formed much later,” says Cornell University astrophysicist Maryame El Moutamid. “And the reason why it’s so interesting is not only to know that but to understand the Saturn system—we have a planet, a ring system, and a moon system, and we think there is a connection between the rings and the moons.”

That enigma is uniquely fascinating. For the most part, scientists have a good grip on the provenance of our solar system’s most spectacular sights: a chasm carved into Mars that would dwarf the Grand Canyon, Jupiter’s churning Great Red Spot, the moon’s enormous southern basin. But Saturn’s rings...

“Saturn’s rings are unique,” says Jeff Cuzzi of NASA’s Ames Research Center. “They’re the only big, massive rings, and they’re very, very bright, which is unusual. So this has been a puzzle.”

Scientists who think about this question tend to cluster into two camps. The first group suggests that Saturn’s rings are primordial—that they formed along with the planet more than four billion years ago—and that Saturn has never been a boring, blah world.

The other group suspects the rings are much younger, formed within the past several hundred million years. Under that theory, the rings are so young that if the dinosaurs had had a space program, they’d have seen a ringless Saturn through their telescopes (and maybe avoided obliteration by a wayward asteroid).

**“BOTH SCENARIOS HAVE** great arguments, but they also have weaknesses,” El Moutamid says.

Though separated in time by billions of years, both origin stories have one thing in common: violence. Making the rings required the cataclysmic destruction of an icy object—a comet, perhaps, or a moon. Somehow that object wandered too close to Saturn, and the planet’s gravity tore it into countless icy shards. A small fraction of those shards are bigger than houses; others are infinitesimally small. Most are made of bright, pristine water ice, but one band in the rings is a bit darker. Over time, those busted-up remnants organized themselves into the ring system we see today, which stretches some 170,000 miles across but is only about 30 feet thick.

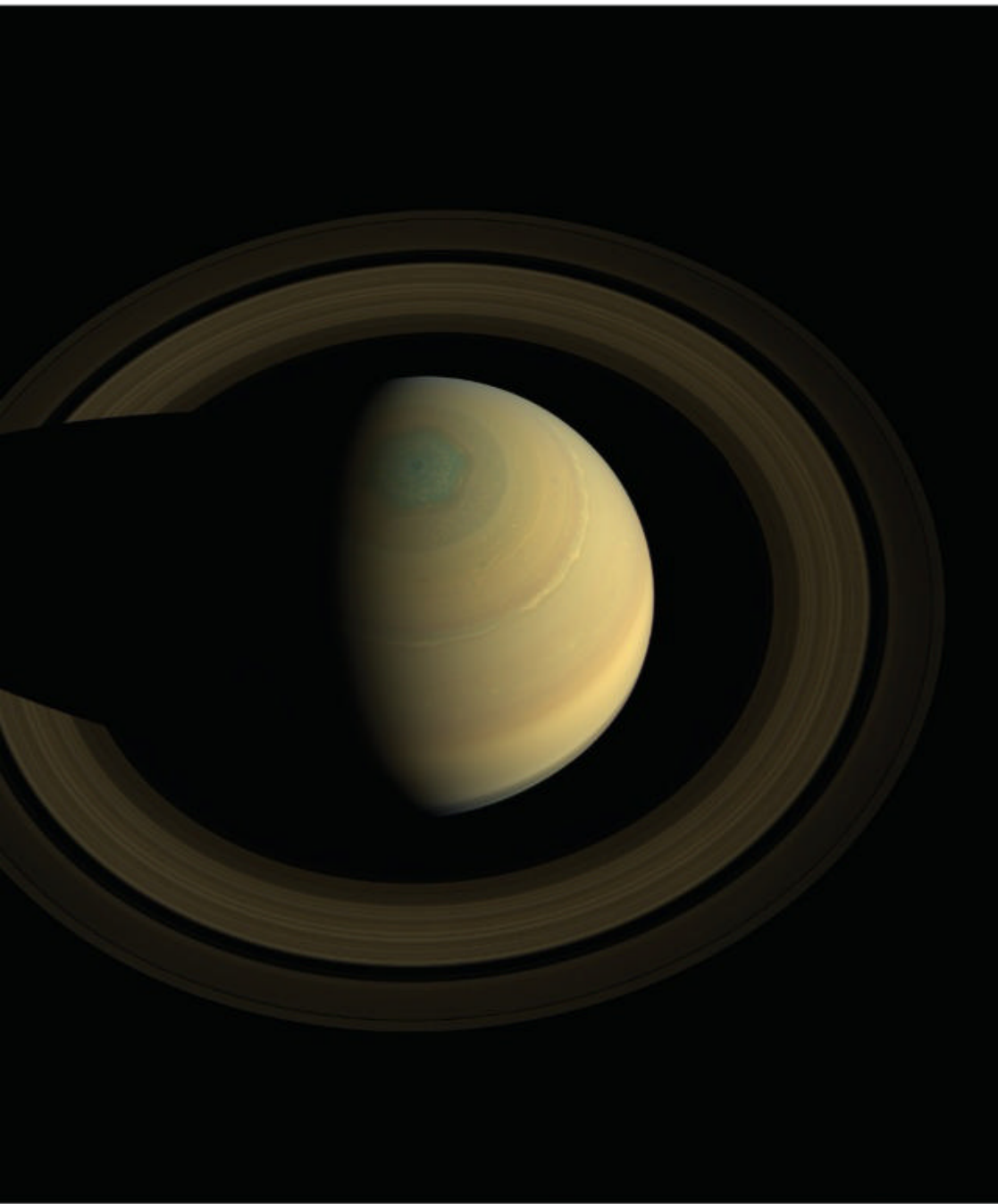
The “old-rings” crew says that the cataclysm occurred in Saturn’s early days. (It *is* scientifically likelier for a wayward object to enter a planet’s gravitational maw during the solar system’s youth.) One

## Across a human lifetime, the night sky may not seem to change much.

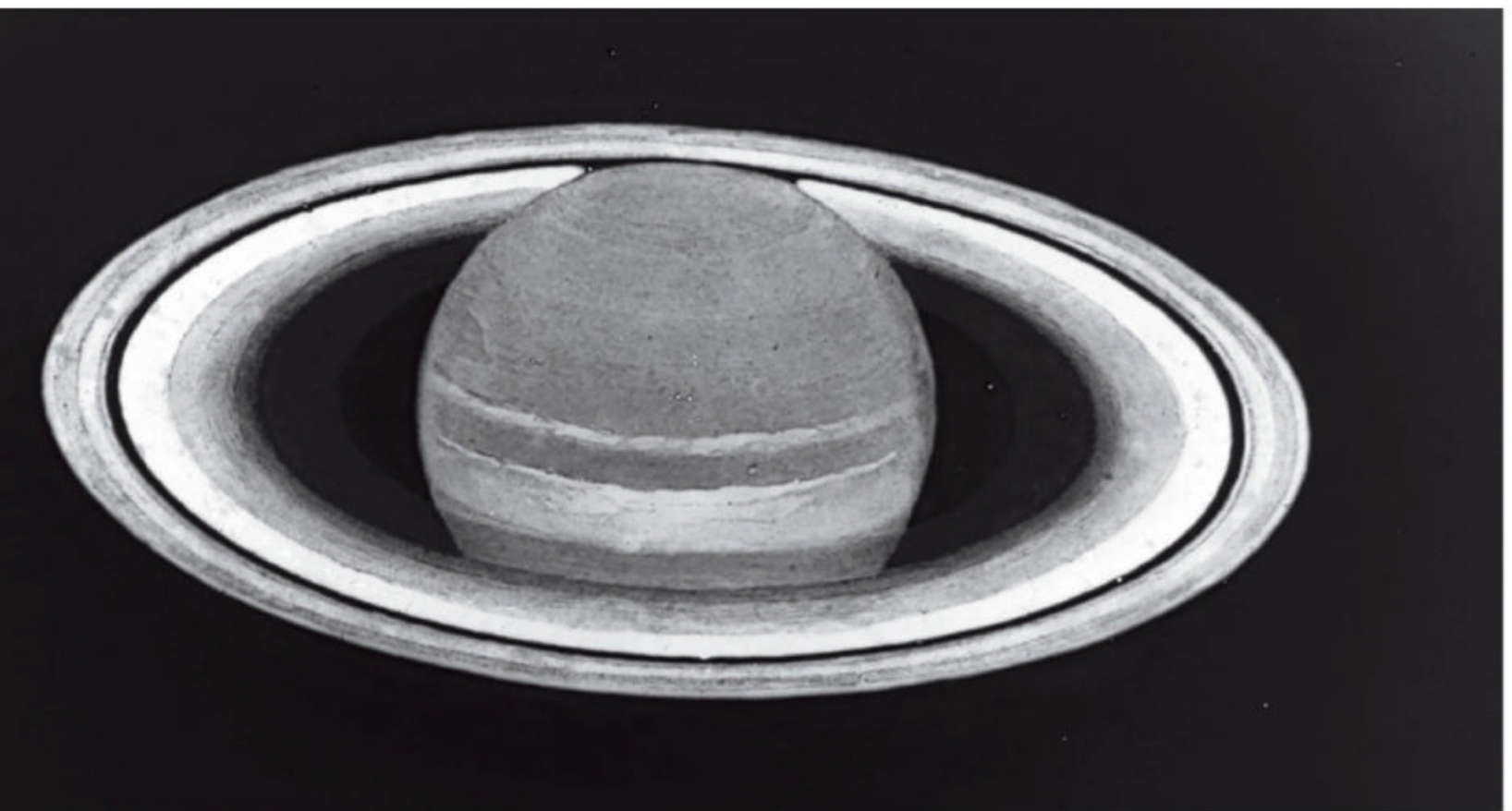
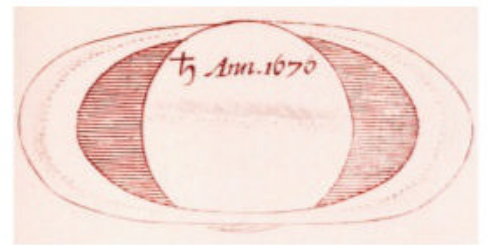
Planets move in predictable orbits, constellations rise and fall on schedule, time’s passage can be marked by the shifting lunar face. This is comforting because it means that, adrift on a verdant island in an infinite cosmic sea, small creatures like us have achieved some degree of celestial knowing. We have deciphered the harmonies of planetary motion; we can calculate, with precision, the appearance of something as magical as a blackened midday sun; and we know, to some degree, how everything came to be (except ourselves). In a bottomless universe, we cling to what we know.

“Your mind just wants things to be stable and permanent,” says NASA’s Jeff Cuzzi. “Celestial things are supposed to not be changing in front of our eyes. But that’s one thing [the Cassini probe] showed us when we were there at Saturn... We know stuff’s popping out there on all timescales. It’s a perspective shift that would be good for us.” —ND





Depictions of Saturn have come a long way since the earliest drawings (below, from top): what Galileo saw in 1610, then in 1616 with a better telescope; and a rendering by astronomer Giovanni Cassini, published in 1676. Voyager I took the first photo of Saturn in 1980 (bottom). When the Cassini spacecraft took a 2013 image (left) from above Saturn's pole, its rings didn't intersect the planet. That made them easy to edit out, for the ringless view on page 15.



version of that story proposes that the giant planets were not born where we see them today; rather, they migrated to their current locations and triggered a cascade of instability among smaller objects that ended up being flung all over the place like celestial Ping-Pong balls.

During the chaos of the solar system’s infancy, it wouldn’t be tough for an icy body to end up putting a ring around Saturn. The old-rings theory also predicts that some of Saturn’s moons formed from busted-up ring stuff that spread far enough from the planet to form clumps on its own. And therefore, some of the moons that today hover near the rings’ margins are made of the same material.

“Honestly, and without trying to be too neutral, I think the old age makes more sense to me than the young age,” El Moutamid says. “That’s my belief up to now, but I am happy to be convinced otherwise.”

The trouble is, the icy rings are too pearly white to be billions of years old—or at least that’s an argument the “young-rings” camp focuses on. Called the pollution argument, the problem hinges on the rate at which dark dust in the outer solar system collides with and dims rings’ resplendence. Put simply, some four billion years of drab cosmic rain should leave Saturn’s rings looking as dingy and unimpressive as Jupiter’s—unless the rings are massive, or they’re young. In 2017, using NASA’s Cassini spacecraft, scientists measured the mass of Saturn’s rings and found there’s not enough material to absorb a solar system’s age of dust and still look so pristine. Cassini also gathered data about how much dust ends up in the Saturn system, and that result also supports the idea that the rings are young.

Yet it’s highly unlikely that an object large enough to shatter into rings could have come within reach of Saturn—except in the chaos of the early solar system.

**WHAT IF, INSTEAD OF** shredding an interloping object, Saturn destroyed one of its own moons? Two recent theories suggest that—just as Spanish painter

Francisco de Goya depicted in a bloody masterpiece— Saturn, in fact, devoured one of its children.

Theory number one, proposed in 2016, suggests that roughly a hundred million years ago, the Saturn system slid into a position where the sun’s gravity jostled its inner moons onto colliding orbits that eventually fastened a ring of debris around the planet. That idea also explains the seemingly young surfaces of several Saturnian moons, since the ring-forming event would have destroyed some and caused them to re-form.

Theory number two, from late 2022, largely blames the rings on Saturn’s megamoon Titan, which is slowly tiptoeing away from its home world. A couple hundred million years ago, Titan’s slow-motion exodus put it in resonance with—that is, exerted a gravitational influence on—a hypothetical moon that scientists call Chrysalis. As a result, Chrysalis got chucked toward Saturn and ripped into a ring. (This theory would also explain the curious angle at which Saturn is tilted, as a gravitational interaction with the orbit of Neptune.)

Needless to say, some don’t buy either of those scenarios. But in Cuzzi’s view, “Debate is good for science. It’s not a bad thing that not everyone is convinced.”

Young Saturnian rings challenge our comfortable notions of cosmic permanence, even as stars explode and meteors streak through our sky. That one of the solar system’s most familiar sights—magnificent ringed Saturn—may not have always looked this way is startling, just as when the star Betelgeuse dramatically dimmed and changed the celestial outline of the constellation Orion. As Cuzzi says, objects we know and love in our nighttime sky aren’t supposed to do that.

Yet to me, young Saturnian rings also suggest that life on Earth got lucky. Serendipitously, evolution produced us—a species capable of crafting telescopes—in an age that intersects with Saturn’s magnificent cosmic spectacle. □

Science journalist and longtime *National Geographic* contributor **Nadia Drake** specializes in covering astronomy, astrophysics, and planetary science. She serves on a NASA panel that’s studying unidentified anomalous phenomena, formerly known as UFOs.

## DISK OF RINGS

The varied rings were assigned a letter in the order of their discovery, while gaps and divisions between them are named for astronomers. Tiny “shepherd” moons like Pan, Atlas, Prometheus, and Pandora orbiting within the bright rings maintain the breaks.

