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Billions, billions and more billions

New estimate triples number of stars populating cosmos

By Ron Cowen

Astronomers studying eight galaxies have found evidence of a surprising abundance of faint, low-mass stars — each galaxy has about 10 times as many as the Milky Way. The scientists extrapolate that the heavens contain up to three times the total number of stars previously estimated.

That profusion suggests that early cosmic history may need a rewrite. Previous estimates of the total stellar mass in many of the universe's first, massive galaxies may need to be doubled. Pieter van Dokkum of Yale University and Charlie Conroy of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass., describe their study online December 1 in *Nature*.

The researchers examined light from the central regions of each of eight massive elliptical galaxies — four in the Coma cluster and four in the Virgo cluster. Such galaxies are thought to account for one-third of the stellar mass in the universe. Spectra of the galactic light indicate that faint red dwarfs account for 80 percent of stars in elliptical galaxies.

"Extrapolating from the central regions of these eight galaxies to the entire universe is somewhat hazardous, but if the galaxies are typical examples of their class it may well lead to a tripling" of the number of stars in the cosmos, van Dokkum says. Previous estimates put that number at roughly 100 billion trillion.

Still, the results might be otherwise explained by fewer low-mass stars if they differ in chemical makeup from those in the Milky Way, says astronomer Richard Ellis of Caltech.

Demise of a moon, rise of the rings

Icy particles surrounding Saturn may be remains of satellite

By Alexandra Witze

Saturn's majestic rings are the remnants of a long-vanished moon that was stripped of its icy outer layer before its rocky heart plunged into the planet, a new theory proposes. The icy fragments would have encircled the solar system's second largest planet as rings and eventually spalled off small moons of their own that are still there today, says Robin Canup, a planetary scientist at the Southwest Research Institute in Boulder, Colo.

The ice in Saturn's rings may be remains of a moon that crashed into the planet.

NASA/JPL/UNIVERSITY OF COLORADO

"Not only do you end up with the current ring, but you can also explain the inner ice-rich moons that haven't been explained before," she says. Her paper appears online December 12 in *Nature*.

Earlier ideas about how Saturn's rings formed have fallen into two categories: either a small moon plunged intact toward the planet and shattered, or a comet smacked into a moon, shredding the moon to bits. Both scenarios would produce an equal mix of rock and ice in Saturn's rings — not the nearly 95 percent ice seen today.

Canup studied what happened after Saturn (and the sun's other planets) coalesced from a primordial disk of gas and dust 4.5 billion years ago. In previous work, she had shown that moon after moon would be born around the infant gas giant, each growing until the planet's gravitational tug pulled it to its destruction. Moons would have stopped forming when the disk of gas and dust was used up.

In the new study, Canup calculated that a moon the size of Titan — Saturn's largest, at some 5,000 kilometers across — would begin to separate into layers as it migrated inward. Saturn's tidal pull would cause much of the moon's ice to melt and then refreeze as an outer mantle. As the moon spiraled into the planet, Canup's calculations show, the icy layer would be stripped off to form the rings.

A moon so large would have produced rings several orders of magnitude more massive than today's, Canup says. That, in turn, would have provided a source of ice for new, small moons spawned from the rings' outer edges. Such a process, she says, could explain why Saturn's inner moons are icy, out to and including the 1,000-kilometer-wide Tethys, while moons farther out contain more rock.

"Once you hear it, it's a pretty simple idea," says Canup. "But no one was thinking of making a ring a lot more massive than the current ring, or losing a satellite like Titan. That was the conceptual break."

"It's a big deal," agrees Luke Dones, also of the Southwest Research Institute, who has worked on the comet-makes-rings theory. "It never occurred to me that the rings could be so much more massive than they are now."

Some questions still linger about Canup's model, says Dones, like why some of Saturn's inner icy moons have more rock in them than others.