

Galaxies Demand a Stellar Recount

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Images from NASA's Galaxy Evolution Explorer spacecraft and the Cerro Tololo Inter-American Observatory in Chile.

(PhysOrg.com) -- For decades, astronomers have gone about their business of studying the cosmos with the assumption that stars of certain sizes form in certain quantities. Like grocery stores selling melons alone, and blueberries in bags of dozens or more, the universe was thought to create stars in specific bundles. In other words, the proportion of small to big stars was thought to be fixed. For every star 20 or more times as massive as the sun, for example, there should be 500 stars with the sun's mass or less.

This belief, based on years of research, has been tipped on its side with new data from NASA's Galaxy Evolution Explorer. The ultraviolet telescope has found proof that small stars come in even bigger bundles than previously believed; for example, in some places in the cosmos, about 2,000 low-mass stars may form for each massive star. The little stars were there all along but masked by massive, brighter stars.

"What this paper is showing is that some of the standard assumptions that we've had - that the brightest stars tell you about the whole population of stars - this doesn't seem to work, at least not in a constant way," said Gerhardt R. Meurer, principal investigator on the study and a research scientist at Johns Hopkins University, Baltimore, Md.

Astronomers have long known that many stars are too dim to be seen in the glare of their brighter, more massive counterparts. Though the smaller, lighter stars outnumber the big ones, they are harder to see. Going back to a grocery store analogy, the melons grab your eyes, even though the total weight of the blueberries may be more.

Beginning in the 1950s, astronomers came up with a method for counting all the stars in a region, even the ones they couldn't detect. They devised a sort of stellar budget, an equation called the "stellar initial mass function," to estimate the total number of stars in an area of the sky based on the light from only the brightest and most massive. For every large star formed, a set number of smaller ones were thought to have been created regardless of where the stars sat in the universe.

"We tried to understand properties of galaxies and their mass by looking at the light we can see," Meurer said.

But this common assumption has been leading astronomers astray, said Meurer, especially in galaxies that are intrinsically small and faint.

To understand the problem, imagine trying to estimate the population on Earth by observing light emitted at night. Looking from above toward North America or Europe, the regions where more people live light up like signposts. Los Angeles, for example, is easily visible to a scientist working on the International Space Station. However, if this method were applied to regions where people have limited electricity, populations would be starkly underestimated, for example in some

sections of Africa.

The same can be said of galaxies, whose speckles of light in the dark of space can be misleading. Meurer and his team used ultraviolet images from the Galaxy Evolution Explorer and carefully filtered red-light images from telescopes at the Cerro Tololo International Observatory in Chile to show that many galaxies do not form a lot of [massive stars](#), yet still have plenty of lower-mass counterparts. The ultraviolet images are sensitive to somewhat small stars three times or more massive than the sun, while the filtered optical images are only sensitive to the largest stars with 20 or more times the mass of the sun.

The effects are particularly important in parts of the universe where stars are spread out over a larger volume -- the rural Africa of the cosmos. There could be about four times as many stars in these regions than previously estimated.

"Especially in these [galaxies](#) that seem small and piddling, there can be a lot more mass in lower mass stars than we had previously expected from what we could see from the brightest, youngest [stars](#)," Meurer said. "But we can now reduce these errors using satellites like the Galaxy Evolution Explorer."

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