Astronomy

From a meeting in Toronto of the American Astronomical Society

Lone stars

Call them outcasts, label them nomads. They're stars without a home galaxy, and for the first time astronomers have spied hundreds of them adrift in the Virgo cluster, a collection of galaxies some 60 million light-years from Earth. Each isolated star is gravitationally bound to the cluster as a whole but not to any particular galaxy among the 2,500 in Virgo.

Harry C. Ferguson of the Space Telescope Science Institute in Baltimore, Nial Tanvir of the University of Cambridge in England, and Ted von Hippel of the University of Wisconsin-Madison found the stars by aiming the Hubble Space Telescope's wide-field and planetary camera at a seemingly blank area near the center of the cluster. By comparing the number of stars in this field to the number in an image of the Hubble Deep Field, a region devoid of nearby clusters, Ferguson and his collaborators counted about 600 homeless stars and deduced that as many as 10 million others, too faint for Hubble to detect, may reside at Virgo's center.

A trillion stars similar in mass to the sun may roam the vast emptiness of intergalactic space in Virgo, the team estimates. This population could account for 10 percent of the Virgo cluster's mass. Another team used the Anglo-American Telescope in Coonabarabran, Australia, to observe planetary nebulas, or clouds of gas ejected from dying stars, in the Virgo and Fornax clusters. These scientists estimate that intergalactic stars make up 40 percent of the mass of a cluster.

The existence of homeless stars is no surprise, says Ferguson. For years, astronomers have searched for such stars, believed to have been tossed out of their birth galaxies by collisions, mergers, or simply close encounters with other galaxies in the cluster. Diffuse, excess light recorded by ground-based telescopes hinted at a population of roaming stars in Virgo.

James Gitlin/NASA

Drawing shows the Virgo cluster as seen from a hypothetical planet orbiting an intergalactic star.

Ferguson notes that most of the stars seen by Hubble appear to be unusually bright red giants. These elderly stars have a uniform brightness. They may thus offer a new way to estimate the distance to Virgo, a stepping-stone to determining the size and age of the universe, Ferguson says. In addition, the number of these stars and their distribution throughout the cluster may help trace the vast amount of invisible material, or dark matter, thought to reside in Virgo. — *R.C.*

Of planets and planetary nebulas

More than 2 centuries ago, English astronomer William Herschel spied several round, wispy objects that looked like the planet Uranus, which he had discovered just a few years earlier. He named the new objects planetary nebulas.

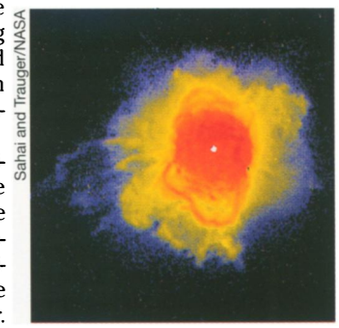
Later observations revealed that the nebulas weren't planets, but clouds of gas blown off by dying stars. The misleading moniker stuck nonetheless.

Two astronomers now suggest that planetary nebulas may have an intimate connection with planets after all.

Raghvendra Sahai and John L. Trauger of NASA's Jet Propulsion Laboratory in Pasadena, Calif., used the Hubble Space Telescope to examine several compact, relatively bright, and presumably young planetary nebulas. The researchers sought out youthful nebulas in hopes that these clouds would retain clues to their formation. The images, which show that the nebulas have fingerlike projections, filaments, loops, arcs, and other complex shapes, highlight a long-standing puzzle.

According to a popular model, planetary nebulas take their final form when the gaseous wind from a dying star plows into the shroudlike gas cloud that the star had previously ejected. The cloud is spherical, however, and the wind can't easily sculpt it into the irregular shapes seen by Hubble.

Tinkering with this scenario, theorists have added a high-speed jet of material that smashes into the cloud before the wind does. If the jet varies in direction and intensity, it would clear a zigzag path through the cloud. The wind following behind it would then expand faster in some directions than others, generating the complex shapes seen in nebulas.



Sahai and Trauger/NASA

False-color image of the young planetary nebula PK358-003#2 shows myriad loops, filaments, and arcs, particularly to the left of the central star. Blue indicates the faint outer parts of the nebula, red the bright inner parts.

No one knows the exact origin of such a jet, but some astronomers suggest that the gravitational tug of a companion star causes the jet's variability. Sahai and Trauger take this concept a step further. They speculate that massive planets and failed stars known as brown dwarfs lie close to the dying star. The gravitational influence of these objects is a more likely source of variation in the jet, they suggest.

Sahai and Trauger are not alone in their musings. In the Sept. 10, 1996 ASTROPHYSICAL JOURNAL, Noam Soker of the University of Haifa in Oranim, Israel, proposes that the destruction of massive planets and brown dwarfs spiraling into the dying star may generate the jet, as well as the wiggles within it. — *R.C.*

Seeking the source of gamma-ray bursts

For a fleeting moment, gamma-ray bursts radiate more energy than any quasar, then they vanish without a trace. Their brief and unpredictable appearances make it difficult to determine whether these flashes originate within the Milky Way or far beyond. Gamma-ray bursts have not been definitively linked to any known star, galaxy, or other celestial object.

If these bursts do come from distant sources, they probably lie in galaxies. Although astronomers have yet to find a smoking gun—a particular galaxy from which a burst has emerged—Samuel B. Larson, Ian S. McLean, and Eric E. Becklin of the University of California, Los Angeles have done the next-best thing.

Using infrared telescopes, which can detect galaxies hidden by dust, they surveyed small patches of sky around the locations of several bright gamma-rays bursts. The observations reveal that, on average, these regions contain twice as many galaxies as similar regions in which no gamma-ray bursts have been found. In addition, the estimated distance of these galaxies from Earth, their luminosity, and their distribution within the patch suggest that one of them could be the source of a burst.

"These observations offer the first direct connection between gamma-ray bursts and another class of objects," the team reports. Theorist Leonid Ozernoy of George Mason University in Fairfax, Va., says the study provides supporting evidence that bursts originate outside our galaxy. — *R.C.*