Astronomy

From a meeting in Washington, D.C., of the American Astronomical Society

Mapping the universe

Thanks to the keen eye of the Hubble Space Telescope, astronomers may have accounted for virtually all of the sources of visible light in the universe. That's what Michael S. Vogeley of Princeton University concludes after analyzing variations in the faint background glow between galaxies in the Hubble Deep Field, the tiny patch of sky that the telescope stared at for 2 weeks in late 1995. These Hubble observations are the most detailed survey of galaxies ever taken.

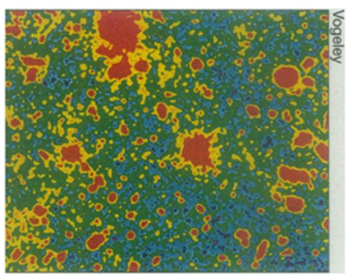
The smoothness of the background—varying by as little as 0.1 percent throughout the Hubble Deep Field—suggests that there are relatively few galaxies fainter than the ones Hubble detected, says Vogeley. Had there been many galaxies too faint for the telescope to detect as individual objects, they would have shown up as large fluctuations in the brightness of seemingly blank regions of the sky.

"We appear close to completing a [visible-light] census of the universe," Vogeley says. The new results suggest that "most of the visible light in the universe hails from galaxies that Hubble can detect."

Vogeley's analysis also indicates that the substantial infrared background revealed in new sky maps (SN: 1/10/98, p. 20) can only be explained by an entirely new population of galaxies, one that can't be seen in visible light. If so, several infrared telescopes now being developed should provide a new window on the universe, he notes.

The Infrared Space Observatory (ISO), launched 2 years ago, is already opening that window. By staring into the far reaches of space through a small, relatively dustfree region of our galaxy, ISO has found 30 far-infrared point sources. David L. Clements of the Institut d'Astrophysique Spatiale in Orsay, France, and his colleagues say that number is 10 times higher than can be accounted for by galaxy counts recorded by an earlier satellite at shorter infrared wavelengths.

The team says the sources probably represent a new population of distant, dusty galaxies that are churning out stars at an enormous rate. Their starlight is presumably absorbed by the surrounding dust, which reemits the radiation in the mid infrared. The expansion of the universe then shifts that light to the far infrared, where ISO detects it.



False-color view of the Hubble Deep Field, with stars and galaxies shown in red.

Clements and his team haven't obtained spectra of these point sources yet, so the distance to these putative galaxies is unknown. They are planning further observations with ISO in other parts of the sky to determine whether the galaxies are "just the tip of the iceberg," he says. If infrared instruments larger than ISO find many more such populations, "it would mean that an awful lot of the action in the universe has been missed," Clements says. —*R.C.*

Dino death: A stellar weapon . . .

Two astronomers have refined previous estimates of how close certain types of stars must come to the Oort Cloud, a proposed reservoir of comets at the fringes of the solar system, in order to trigger a comet shower that might wreak havoc on Earth. The comets most susceptible to the tug of a passing star are those with highly elongated orbits—that is, bodies whose farthest point from the sun is about 30,000 times Earth's distance from the sun and whose closest approach might equal Neptune's distance from the sun. If such comets are jostled out of position, they could venture near Earth as a comet shower about 2 million years later.

Although researchers have evidence of only one large body slamming into Earth around the time that the dinosaurs began dying out, some scientists believe the creatures may have taken several million years to become extinct and that a series of comets may have contributed to the death toll.

Over the past year or so, researchers at NASA's Jet Propulsion Laboratory (JPL) in Pasadena, Calif., have zeroed in on the triple star system Algol and the single star Gliese 710 as nearby bodies that might have disturbed the Oort Cloud in the recent past or may do so in the near future.

Recently, however, Lawrence A. Molnar and Robert L. Mutel of the University of Iowa in Iowa City examined the same stars but took into account some subtle effects—the motion of the sun as it orbits the Milky Way compared to the motion of nearby stars orbiting the galaxy, and the differences in the galaxy's gravitational pull on the sun and on neighboring stars. Using the Very Long Baseline Array, a suite of 10 radio telescopes spread out between Hawaii and the Virgin Islands, the researchers also measured the velocity of Algol with great accuracy, enabling them to trace more precisely its path back in time.

The new analysis indicates that Algol, now 63 light-years from Earth, came within 13 light-years of the solar system 4.3 million years ago, not as close as the JPL team had initially estimated. Molnar and Mutel also find that Gliese 710 will come within 3.1 light-years of the solar system 1 million years from now. The new figures reveal that neither star comes close enough to shake up the Oort Cloud and generate a comet shower.

Algol didn't miss by much, however. Given its mass, six times that of the sun, and its relatively low velocity, about 6 kilometers per second (km/sec), this star system could have induced a shower from as far away as 4 light-years, Molnar and Mutel report. In comparison, Gliese 710, which has half the mass of the sun and a relative velocity of about 14 km/sec, would have to pass within a light-year of the sun—adjacent to or just inside the outer edge of the Oort Cloud. The researchers plan to search the Hipparcos catalogue, a recently released listing of very accurate distances and velocities for over 100,000 stars, for better candidates. —*R.C.*

. . . or a high-energy flash?

Kenneth Brecher of Boston University has a different idea about what might have killed the dinosaurs. He speculates that a gamma-ray burst may have done them in indirectly. Gamma-ray bursts are mysterious flashes of high-energy radiation that come from random directions in the sky. The origin of the vast majority of these energetic pulses is unknown, but a few have been associated recently with distant galaxies.

In line with recent estimates of the energy of gamma-ray bursts, Brecher's scenario would require a flash that radiates an amount of energy equivalent to 10 percent of the sun's mass. If such a burst came within 300,000 light-years of our galaxy, it could vaporize the outer layers of myriad small comets thought to lie in the Oort Cloud, he calculates. The explosively vaporized material could act as a propellant, flinging some of the smallest, least massive comets—those with a diameter of 1 km or less—into the inner solar system. Some might have fallen to Earth and may even have caused the death of the dinosaurs, Brecher says.

Lawrence A. Molnar of the University of Iowa in Iowa City notes that the population of small comets in the Oort Cloud is unknown, and Brecher admits his work is highly speculative. None of the gamma-ray burst experts present at his talk found serious fault with the conjecture, however, and Brecher says the report may spark new studies on the local influence of the bursts. —*R.C.*