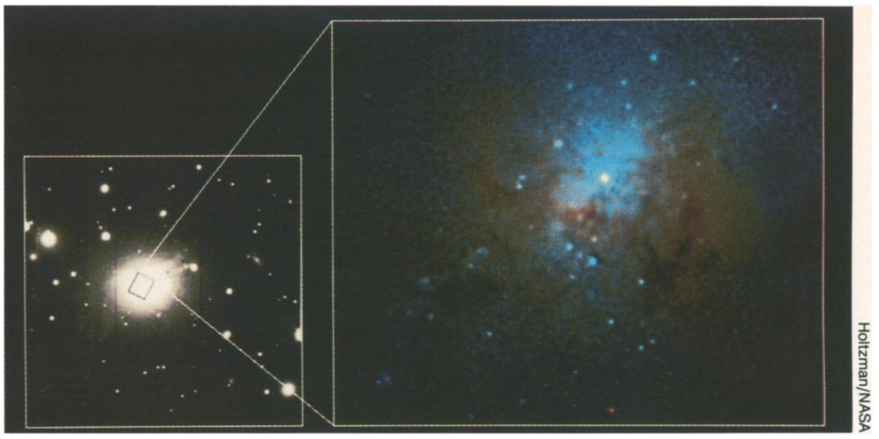
Hubble Captures a Violent Universe



Left: Ground-based image of the galaxy NGC 1275. Right: Blue dots in Hubble image reveal young globular clusters near the galaxy's center.

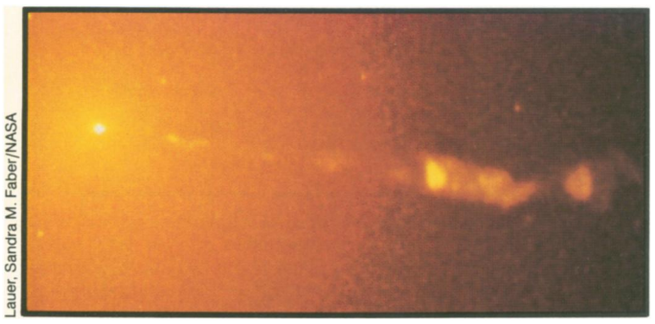
Who knows what violence lurks in the hearts of galaxies?

Hubble knows.

Peering into the cores of two galaxies, the Hubble Space Telescope is gleaning new insight on explosive collisions and hidden powerhouses. In one galaxy, Hubble gathered evidence for the recent creation of globular clusters, star groupings normally considered ancient. In the other, the orbiting telescope found fresh signs that the galaxy harbors a massive black hole.

Astronomers have struggled for years to prove the existence of black holes — unseen objects so massive that even light cannot escape their gravitational clutches. In 1978, theorists first proposed that M87 — a giant galaxy some 52 million light-years from Earth — housed such an object. They speculated that a brilliant, fuzzy blob visible near the galaxy's center might constitute a densely packed collection of stars circling a black hole. If so, the black hole could represent the hidden power source fueling a giant jet of bright material spewing from the center of M87.

New Hubble observations, reported last week at a meeting of the American Astronomical Society in Atlanta, bolster the case for a black hole at M87's core. In fact, says Tod R. Lauer of the National Optical Astronomy Observatories in Tucson, Ariz., a single additional measurement — one that will likely require corrective optics to compensate for Hubble's flawed mirror — could provide the first proof that a black hole exists.



Hubble image of the core of the elliptical galaxy M87 shows high concentration of starlight and a central jet.

Using Hubble's Wide-Field/Planetary Camera, Lauer and his colleagues photographed the core of M87 with unprecedented clarity. The resulting images show a unique, fiery glow: light from stars packed so tightly that their density exceeds 300 times that typical of "normal" giant elliptical galaxies. Indeed, Lauer says, the actual star density may well exceed this estimate, which is based on Hubble's current optical images.

A black hole about 2.6 billion times the mass of the sun may best explain the extraordinary clustering near M87's core, Lauer asserts. This concentration of starlight combined with new Hubble images of M87's jet, he says, provides "the first time we've seen evidence of a possible black hole influencing the structure of a galaxy." The jet, Lauer adds, may represent the remnant of a dead quasar once powered by the black hole.

However, he cautions, features other than a black hole, such as a massive flow of gas into M87's center, might also draw in a dense collection of stars.

Although the black-hole candidate "looks like a duck, we haven't heard it quack yet," Lauer notes. Conclusive proof, he says, awaits spectroscopic evidence that stars rapidly orbit a compact object at M87's core. Those stars would orbit slowly if the core contained only gas, he notes.

Though Lauer maintains that data on M87 provide the best evidence for a nearby black hole, others disagree. Ground-based observations of rapidly orbiting stars at the core of two galaxies much closer to the Milky Way — the Andromeda galaxy and NGC 3115 — provide stronger evidence for nearby black holes, argues astrophysicist Douglas O. Richstone of the University of Michigan in Ann Arbor.

In another Hubble study, Jon A. Holtzman of Lowell Observatory in Flagstaff, Ariz., and his colleagues reported at the astronomy meeting that they had found a group of intriguing star clusters near the center of NGC 1275, an elliptical galaxy some 200 million light-years from Earth. These densely packed star groupings, known as globular clusters, normally range in age from 10 billion to 15 billion years (SN: 4/6/91, p.218). But a new Hubble image reveals that 50 globular clusters in NGC 1275 radiate intense blue light, a signature of recent starbirth. In fact, these clusters likely formed just a few hundred million years ago, Holtzman says.

Moreover, he notes, each of the 50 clusters emits a remarkably similar hue of blue, indicating that they formed at the same time — perhaps in a cataclysmic collision between galaxies. Ground-based observations also suggest that NGC 1275 suffered a violent collision in the recent past, Holtzman adds.

In addition to supporting the controversial notion that some globular clusters are young, the new work lends credence to the idea that elliptical galaxies form in the collision of two spiral galaxies, says Keith M. Ashman of the Space Telescope Science Institute in Baltimore. Though researchers have argued this merger theory for years, it seemed to carry a fatal flaw: If two spiral galaxies form an elliptical, then why do ellipticals apparently contain so many more globular clusters than their parent galaxies?

Ashman and his colleague, Stephen E. Zepf, now at the University of Durham in England, speculate that colliding galaxies gravitationally attract the massive gas clouds needed to spawn globular clusters. Indeed, the two now suggest in the Jan. 1 ASTROPHYSICAL JOURNAL that large populations of old globular clusters, such as those surrounding the Milky Way, likely formed during similar collisions billions of years ago. — *R. Cowen*