Oldest Planet Is Revealed, Challenging Old Theories

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By JOHN NOBLE WILFORD

In new observations of a distant region of primitive stars, astronomers have found the oldest known planet, a huge gaseous object almost three times as old as Earth and nearly as old as the universe itself.

The discovery, based on measurements by the Hubble Space Telescope, challenged scientists to rethink theories of how, when and where planets form. It is tantalizing evidence, astronomers said, that planets began appearing billions of years earlier than previously thought and so may be more abundant.

Astronomers reported yesterday that the planet is more than twice as massive as Jupiter and is orbiting a pair of burned-out stars. It appears to have formed 12.7 billion years ago, within a billion years of the origin of the universe in the theorized Big Bang.

"What we think we have found is an example of the first generation of planets formed in the universe," Dr. Steinn Sigurdsson of Pennsylvania State University announced at a news conference at the National Aeronautics and Space Administration in Washington.

A detailed report by Dr. Sigurdsson and his colleagues is being published today in the journal Science.

Dr. Alan P. Boss, a theoretical astrophysicist at the Carnegie Institution in Washington, who was not involved in the research, called the discovery a "stunning revelation" that will force scientists to revise their ideas of planetary formation.

The discovery challenged a widely held view among astrophysicists that planets could not have originated so early because the universe had yet to generate enough of the heavy elements needed to make them.

Planet-making ingredients include iron, silicon and other elements heavier than helium and hydrogen. These so-called metallic elements are cooked in the nuclear furnaces of stars, and accumulate from the ashes of dying stars, which are recycled in new stars and their families of planets.

The planet was found in the heart of a group of extremely ancient stars, known as a globular star cluster. This cluster, M4, is 7,200 light-years from Earth in the summer constellation Scorpius. The stars there are estimated to have formed almost 13 billion years ago, so early that the region is deficient in heavy elements.

Astronomers had assumed that such primitive stars could not have planets, and observations of other globular clusters seemed to support that view until the detection of the "Methuselah planet," in Dr. Boss's phrase.

The Sun and its planetary system are about 4.6 billion years old, products of what astronomers call the third generation of stars. By that time, the gas and dust of interstellar space was richer in heavy elements. In less than a decade, astronomers have discovered planets around more than 100 Sun-like stars in the Milky Way, Earth's home galaxy.

The research began in 1988 when a pulsar, a rapidly spinning stellar remnant, was discovered in the M4 cluster. Further observations revealed that the pulsar was linked gravitationally with a white dwarf star, an object that has exhausted its nuclear fuel. Later, astronomers noticed irregularities in the pulsar signals, betraying the presence of a third object, which was orbiting the other two.

The recent Hubble telescope examination determined the mass and other properties of the object. It cannot be seen, only inferred from its effects on the pulsar's motions. And the neighborhood is an unlikely place for a planet. It is almost surely a planet, astronomers said, but not one that is likely to be hospitable to life.

The research team also reported that the distant planet probably has had a tempestuous life, surviving the shock waves of stars aborning and dying explosively all around. The small star and its planet probably formed in the suburbs of the star cluster, then migrated toward the center and came too close to the ancient pulsar, which captured them. The three objects together were themselves flung by gravitational recoil back into an outer region of the cluster.

In the Science report, Dr. Sigurdsson's group concluded that the findings imply "that planets may be relatively common in low-metallicity globular clusters and that planet formation is more widespread and has happened earlier than previously believed."

Dr. Harvey Richer, a member of the group from the University of British Columbia in Vancouver, said it was "tremendously encouraging that planets are probably abundant in globular star clusters." But he sounded a note of caution.

"We have been talking about a single planet from a single globular cluster," he said. "We ought not to extrapolate from a sample of one, and first look more closely to see if there are planets in other clusters."