Astronomers discover how white dwarf stars get their 'kicks'

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University of British Columbia astronomer Harvey Richer and UBC graduate student Saul Davis have discovered that white dwarf stars are born with a natal kick, explaining why these smoldering embers of Sun-like stars are found on the edge rather than at the centre of globular star clusters.

White dwarfs represent the third major stage of a star's evolution. Like the Sun, each star begins its life with a long stable state where nuclear reactions take place in the core supplying the energy. After the core fuel is depleted, it swells up and turns into a huge red giant. Later, the red giant ejects its outer atmosphere and its core becomes a white dwarf that slowly cools over time and radiates its stored thermal heat into space.

Using NASA's Hubble telescope, Richer and his team looked at the position of white dwarfs in NGC 6397, one of the globular star clusters closest to Earth. Globular clusters are dense swarms of hundreds of thousands of stars. About 150 of these clusters exist in the Milky Way, each containing between 100,000 and one million stars.

"The distribution of young white dwarfs is the exact opposite of what we expected," says Prof. Richer, whose study will appear in the *Monthly Notices of the Royal Astronomical Society Letters* in January 2008.

Richer explains that globular clusters sort out stars according to their mass, governed by a gravitational billiard-ball game among stars. Heavier stars slow down and sink to the cluster's core, while lighter stars

pick up speed and move across the cluster to its outskirts. The team found that the older white dwarfs were behaving as expected; they were scattered throughout the cluster according to weight.

“Newly-minted white dwarfs should be near the center, but they are not,” says Richer. “Our idea is that when these white dwarfs were born, they were given a small kick of 7,000 to 11,000 miles an hour (three to five kilometers a second), which rocketed them to the outer reaches of the cluster.”

Using computer simulations, Richer and his team showed that when white dwarfs were born, their own mass acts like “rocket fuel” propelling them forward.

“If more of this mass is ejected in one direction, it could propel the emerging white dwarf through space, just as exhaust from a rocket engine thrusts it from the launch pad,” says Richer.

The researchers studied 22 young white dwarfs up to about 800 million years old and 62 older white dwarfs between 1.4 and 3.5 billion years old. They distinguished the younger from the older white dwarfs based on their color and brightness. The younger ones are hotter, and therefore bluer and brighter than the older ones.

Source: University of British Columbia

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