'Oddball' star cluster is a hybrid, astronomer finds

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(PhysOrg.com) -- Scientists will tell you that the romantic idea is factually true: we are made of the same stuff as stars. In fact, all chemical elements heavier than helium are made in the stars, and research into how the universe became enriched in these “metals” is the focus of much current research in astronomy. Astronomers tend to call these elements “metals,” though many are not metals in the usual sense.

One thing astrophysicists agree on is that each successive generation of stars should be more enriched in metals than the previous generations. The massive stars that create much of the metals live for only a short time, and when they die, they spit out or eject the metals they have created. The expelled metals become part of the raw material out of which the next stars are formed. Thus, there is a relationship between the age of a star and how much metal it contains: old stars have a lower metallicity than do younger ones. Less massive stars live longer than higher mass stars, so low mass stars from early generations still survive today and are studied extensively.

Indeed, it was found decades ago that there are two distinct classes of star clusters in the Milky Way Galaxy: very old, metal-poor ones – called “globular clusters” — and younger, metal-rich ones – called “open clusters.” It is believed that the sun itself originated from an open star cluster that dissolved long ago. In general, the properties of globular and open clusters are very different.
And yet, according to Johns Hopkins astronomer Imants Platais, there is one case which has puzzled astronomers for decades: a well-known,

seemingly open star cluster in the constellation of Lyra, named NGC 6791.

“This cluster is about twice the age of the sun and is unusually metal rich (at least twice the Sun’s metallicity),” said Platais, of the Henry A. Rowland Department of Physics and Astronomy’s Center for Astrophysical Sciences. “A couple of decades ago, it was also found that NGC 6791 contains a handful of very hot but somewhat dim stars, called hot subdwarfs. The presence of such stars in an open cluster is rare, though not unique.”

Prompted by the many unusual characteristics of NGC 6791, a team led by Platais and Kyle Cudworth from The University of Chicago’s Yerkes Observatory proceeded to obtain as complete a census of stars in this cluster as possible.

They achieved this by measuring proper motions of nearly 60 thousand stars in the vicinity of the cluster. While casual Milky Way stars move across the sky somewhat randomly in all directions, the cluster stars stay together and “march” like a formation of soldiers. Using this pattern of motion and measuring the brightness and color of stars, they separated cluster member stars from other stars which happen to lie in the same direction in space, but are not cluster members.

From this census, they discovered that NGC 6791 contains several luminous stars apparently belonging to the so-called classical horizontal branch; stars which normally are found only in globular clusters significantly older than this cluster. The hot subdwarfs are confirmed to be cluster members, but they now appear to be simply the bluest horizontal branch stars. Unlike a typical globular cluster, however, NGC 6791 contains simultaneously both red and very blue horizontal branch stars.

This adds to the peculiarities previously known of being both metal rich and old. Thus, NGC 6791 is the first known star cluster juxtaposing the properties of open and globular clusters and, as such, represents a new class of star clusters, which likely originated in the central Bulge region of the Milky Way. Essentially, this new work – which appeared in the May 20 issue of *Astrophysical Journal Letters* – has revealed the hybrid nature of this star cluster in our Galaxy.

“Star clusters are the building blocks of galaxies and we believe that all stars, including our own sun, are born in clusters. NGC 6791 is a real oddball among about 2,000 known open and globular star clusters in the Milky Way and as such provides a new challenge and a new opportunity, to our understanding of how stars form and evolve,” said Platais, who presented this work last week at the 218th meeting of the American Astronomical Society in Boston.

Provided by Johns Hopkins University