Where Do Runaway Stars Come From?

Our universe is full of stars, and many of those stars are born in enormous clouds of gas in space. Sometimes, thousands and thousands of stars can be born out of a single cloud and we call that collection of stars a **cluster**. Newton's Law of Universal Gravitation says that these stars attract each other, and **collapse** down into a denser and denser cluster. The Hubble Space Telescope has taken beautiful photographs of such clusters, such as the ones pictured below in **Figure 1**.

Figure 1. Photograph of a Stellar Cluster. This photograph, taken using the Hubble Space Telescope depicts Westerlund 2, a giant cluster of about 3000 stars, as well as the surrounding nebula. A circle has been added to highlight the star cluster.
Source: NASA, ESA, the Hubble Heritage Team (STScI/AURA), A. Nota (ESA/STScI), and the Westerlund 2 Science Team

Sometimes, astronomers observe stars that appear to be leaving star clusters. Somehow these stars, called **runaway stars**, have gained enough **velocity** to escape the powerful gravitational field of the other stars in their home star cluster. Astrophysicists are still debating how these stars could gain such an huge velocity. There are two predominant hypotheses.

One of these theories predicts that in densely packed clusters, stars might get too close to each other and be slingshotted out of their home cluster. As the stars pass nearby each other, they can gain a huge velocity, and potentially become runaway stars. The other theory supposes that that these runaway stars come from binary systems. A **binary star system** is one in which two stars that form very close together in a star cluster come to orbit one another. Stars in a binary system are held together by an enormous gravitational force and orbit around each other at with extremely high large velocities and are, held together by an equally enormous gravitational force. The second theory for the origin of runaway stars posits that If one of the stars explodes in a what astronomers call a **supernova**, the other star could be left moving very quickly without its partner star binding it in circular motion with its gravity. If the velocity is enough for the star to escape the gravitational pull of its home star cluster.

It might seem bizarre to think that a massive star could suddenly disappear, but astronomers have observed many supernova events, in which stars explode and scatter all of their mass away into space, leaving only dense cores behind. These explosions are so bright, we can sometimes see supernovae in the sky even with our naked eye! In fact, ancient Chinese and Islamic astronomers recorded a supernovae explosion in the year 1006 AD, which modern astronomers believe may have been the brightest stellar event in recorded history. Supernovae are considered a transient phenomenon, meaning they appear bright in the sky before fading after a few weeks or months, which is a very short amount of time in the world of astronomy.

In a recent paper, astrophysicist Catherine McEvoy suggests that by looking at the chemical makeup of runaway stars, it could be possible to decipher where they came from. In this publication, she studies the chemical makeup of the stars in an attempt to support one or both of these theories, but does not find conclusive evidence for either in their stellar compositions. As often happens in science, a negative results is just as important as a positive one. Dr. Mcevoy states that in the the results of this work highlights the need for a better understanding of the chemical composition of binary stars. Science is not done in a vacuum, and this paper will help drive the further study of binary systems, allowing future scientists to solve this cosmic mystery of runaway stars.

References

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