Astrobiology News May 2014:
Solar Siblings

People excel at finding – and creating – patterns. Ancient cultures told stories about the patterns they observed in the night sky. These patterns, and their associated stories, are preserved in the constellations we can still recognize today. Of course most of the stars that appear close in the night sky are only close in projection as seen from Earth. Since the stars are at different distances, two stars that appear to be neighbors may in fact be many light years apart and unrelated to each other. There are some notable exceptions – the stars that make up the familiar pattern of Orion form an OB Association, a group of stars that were born from the same giant interstellar cloud, while the Pleiades form a star cluster whose members are still loosely bound to each other by gravity. As observations with radio and infrared telescopes have enabled us to peer into the dusty clouds (nebulae) where stars are born, we've learned that most stars form in clusters, with siblings.

The stars that light up the famous Orion Nebula are 10,000 times brighter than our Sun, but many less luminous stars are embedded in the nebula as well, including stars that resemble younger versions of our Sun. In fact, there is strong evidence that our Sun formed in an environment similar to the Orion Nebula. The fact that meteorites contain the "daughter" products of short-lived radioactive isotopes suggests that the explosion of a nearby massive star (supernova) injected these isotopes into the solar nebula while the planets were forming. The orbits of icy objects in the outer Solar System also bear the imprint of close encounters with other stars in the distant past. So what happened to the Sun's siblings?

Young star clusters dissipate on timescales of about 100 million years, and their members eventually disperse through the Galaxy. There are various reasons for this – winds and radiation from young stars disperse their natal clouds and can unbind clusters, and stellar encounters between cluster members affect the orbits of individual stars. Eventually, the stars drift apart as they orbit the center of the Galaxy, but, like human siblings, these stars should be of the same "generation" and share similar chemical compositions ("stellar DNA", so to speak). In principle, sibling stars could be found through detailed age and composition measurements of large samples of stars. "In principle" that is, but practically speaking, it wouldn't be possible to carry out such large detailed surveys without further constraints. Fortunately, today's computer simulations can model the Galaxy's "gravity well" and predict the paths sibling stars might travel, so the search can be narrowed to a more manageable sample. Using these methods, a group of astronomers led by Ivan Ramirez at the University of Texas at Austin claims it has identified the first long-lost sibling of our Sun[1]! You can read more about how this star was identified, and where to find it in the night sky (with binoculars), in a blog on the Adler Planetarium's website[2].

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[1] Ramirez, I. et al. 2014, *Elemental Abundances of Solar Sibling Candidates*, Astrophysical Journal, 787, 154 (17pp)

[2] www.adlerplanetarium.org/blogs/our-sun-now-has-a-brother-star-the-first-one-ever-found

In *Cosmos: A Spacetime Odyssey* episode 11 (with the provocative title, *The Immortals*), Neil Tyson posed the possibility that the seeds of life might be transferred between planets orbiting different stars under certain conditions. Our Solar System orbits the center of our Galaxy once in about 230 million years (a "galactic year"). Over the course of its orbit, the Solar System occasionally passes through a giant interstellar cloud. During such an encounter, comets from the Oort cloud[3] can be hurled away from the Solar System or plunge inward towards the Sun. Collisions of comets with planets can launch rocks into space, which could potentially transfer microbes between planets orbiting different stars in the same interstellar cloud. We don't yet know how life originated on Earth, but it's possible that such a collision might have transferred life between Earth and a "cousin" world eons ago.

My colleagues and I have been studying a class of objects that were first identified by citizen scientists participating in the *Milky Way Project*[4]. In fact, we're currently preparing a research paper that presents evidence that these objects may be evolutionary links between dense clouds, in which star clusters begin to form, and older stellar nurseries, like the Orion Nebula. Our next steps will focus on using computer models to simulate the physical properties of these objects. We are excited by the prospect that this project could tell us a lot about the conditions under which stars like our Sun were born, and we owe a debt of gratitude to the folks who began tagging these objects as "yellowballs" as they meticulously combed through *Milky Way Project* images[5]!

Stay tuned,

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[3] A vast, spherical shell of icy bodies that extends from about 5,000-10,000 Astronomical Units from the Sun, where 1 Astronomical Unit is the distance between the Sun and the Earth.

[4] www.milkywayproject.org

[5] My former postdoctoral scholar (Kim Arvidsson), who currently holds a faculty position at Schreiner University, wrote the first blog about these objects a few years ago. See http://blog.milkywayproject.org/2011/03/04/what-are-yellowballs/