Summary of Tarun Kota's AAS 238 Briefing Presentation:

Using Proper Motions from CatWISE2020 to Uncover New Objects in the Solar Neighborhood

Three previously missed objects announced at the 238th meeting of the American Astronomical Society highlight the fact that exciting discoveries are still to be made near the Sun — and can be made by high school students and citizen scientists willing to explore NASA's data sets.

Two of the discoveries are M dwarfs at distances of 50 to 90 light-years, and the third discovery is believed to be a cold brown dwarf, a kind of "failed star" but one with a very high velocity.

M dwarfs are stars like our Sun that burn steadily for billions of years and are very common in the Milky Way. The two new M dwarfs had been missed by all previous surveys because their motions are small. Even the European Gaia space mission, which is poised to find all such M dwarfs within hundreds of light-years of the Sun, "missed" these two objects from its latest inventory.

Cold brown dwarfs are very low-mass objects that, unlike the Sun, continue to cool forever This one had been missed previously because it is exceptionally faint.

This scientific breakthrough was spearheaded by a unique trio of individuals. Mr. Tarun Kota is a junior from Eastview High School in Apple Valley, Minnesota. Mr. Dan Caselden is a cybersecurity connoisseur turned citizen scientist. Dr. J. Davy Kirkpatrick is an astronomer at Caltech/IPAC who provided professional guidance. This atypical collaboration was made possible by the Student Astrophysics Society (co-founded by Mr. Kota) and the NASA-funded citizen science project *Backyard Worlds: Planet 9.*

In their research, the trio made use of CatWISE2020 — a NASA-funded catalog of objects that leverages the long time baseline data from NASA's WISE and NEOWISE missions to identify motion stars. With almost 1.9 billion objects in CatWISE2020, the trio had to find an efficient way to select objects of interest.

Machine learning was used to search through CatWISE2020 to select objects that had color and motions typical of known, nearby stars and brown dwarfs. Using this method, the trio was able to save hundreds of hours that would have been spent manually searching the database, and they narrowed their search to only 6,000 interesting objects. {Quote from Caselden here.}

To find the most interesting objects, they sifted through datasets from other telescopes, to gather brightnesses of these objects as seen at other wavelengths. In doing so, they were able to separate the mundane from the extraordinary.

The trio would like to test their hypotheses about these new discoveries by obtaining additional data. The spectrum of the cold brown subdwarf, for example, is likely obtainable only with either NASA's Hubble Space Telescope or with NASA's James Webb Space Telescopes, the latter of which is launching this October.

This trio of individuals represents the changing phases in astronomy and science in general. With the rapid rise of technology and the internet, people have access to massive amounts of data and resources. Gone are the days where astrophysics is restricted to only those with a Ph.D., but rather it's available to anyone with a computer and internet connection.

Contacts:
Tarun Kota
tkota0910@gmail.com

J. Davy Kirkpatrick
davy@ipac.caltech.edu

For high schoolers and college undergraduates who would like to learn more about getting directly involved with research and meeting like-minded students, see the Student Astrophysics Society website.

For citizen scientists interested in exploring the immediate vicinity of the Sun for missing brown dwarfs and maybe even far-flung planets in our own solar system, see the Backyard Worlds: Planet 9 website.