

Astro 101 Slide Set: New Neighbors

- Developed by the WISE Team

Topic:

Nearby brown dwarfs

Concepts:

Solar neighborhood, brown dwarfs, binary systems

Missions:

WISE, Gemini, Spitzer

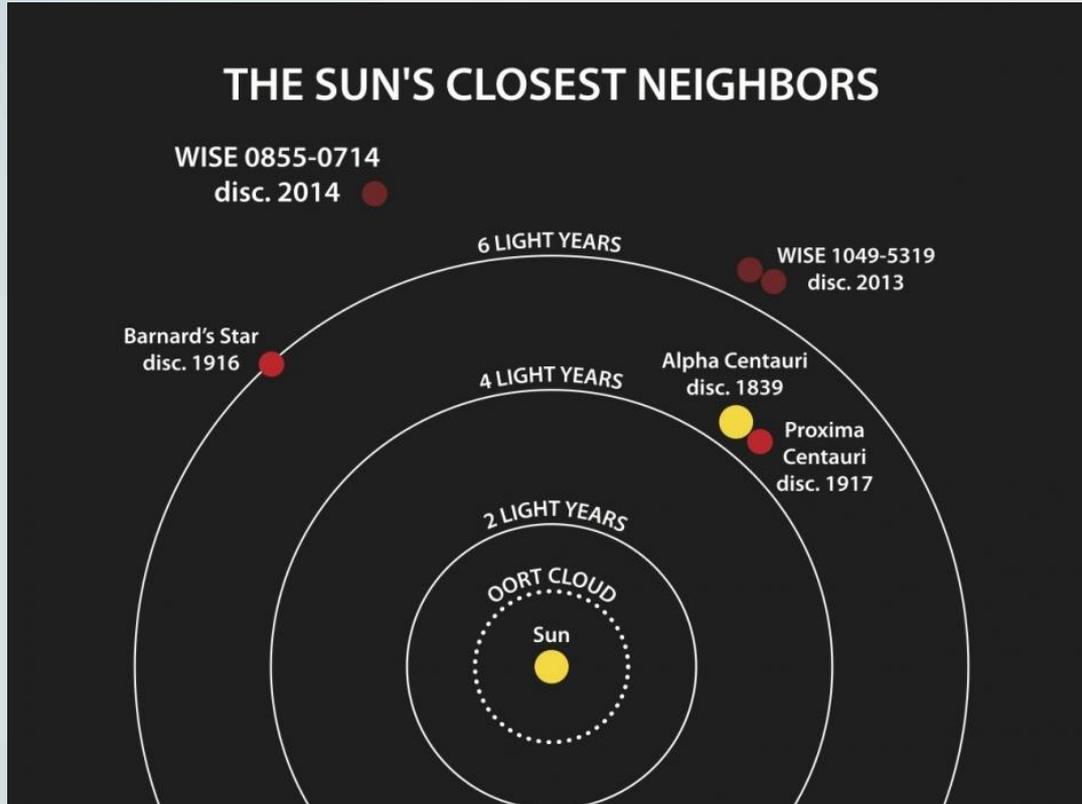
Coordinated by

the NASA Astrophysics Forum

An Instructor's Guide for using the slide sets is available at the ASP website

<https://www.astrosociety.org/education/resources-for-the-higher-education-audience/>

The Discovery



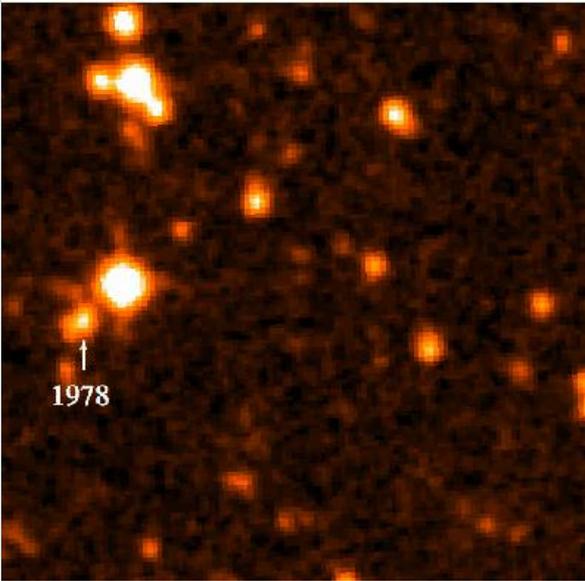
The diagram shows the distances of the four nearest stellar neighbors to the sun (and the years their distances were determined): the triple system Alpha Centauri/Proxima Centauri, Barnard's Star, and the newly discovered brown dwarfs. (The Oort Cloud boundary is the outer edge of the gigantic reservoir of icy leftovers surrounding the sun from which long-period comets originate.) Credit: Penn State University.

The sun's neighborhood has gotten a little more crowded thanks to the WISE mission with the recent discovery of the third- and fourth-closest stellar neighbors to the sun.

WISE 1049-5319 is a pair of "brown dwarfs"—stars too small to burn hydrogen like ordinary stars--located about 6.6 light years away.

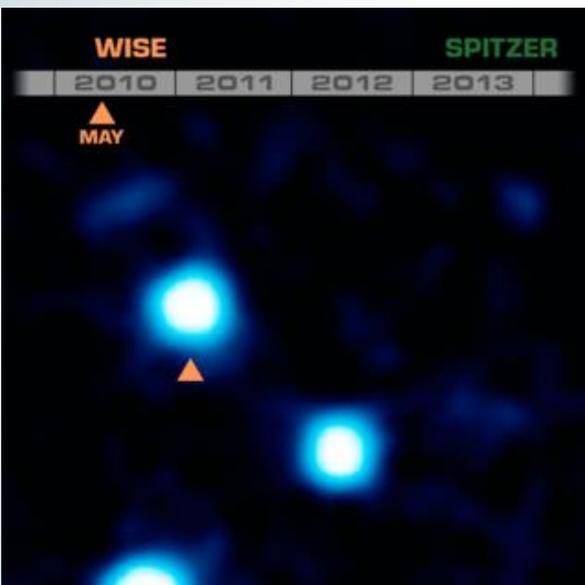
WISE 0855-0714 is another brown dwarf—the smallest and coldest yet discovered—located about 7.2 light years away.

How was the Discovery Made?



NASA's Wide-Field Infrared Survey Explorer (WISE) made two complete scans of the sky in infrared light in 2010 with additional coverage in 2011.

Scientists mining its vast catalog of images found faint infrared-emitting objects displaying high “proper motions”--changes of position in the sky. Their rapid motion and “parallax”—their apparent shift against the background of distant stars as seen from opposite sides of the Earth’s orbit—confirmed their nearness.

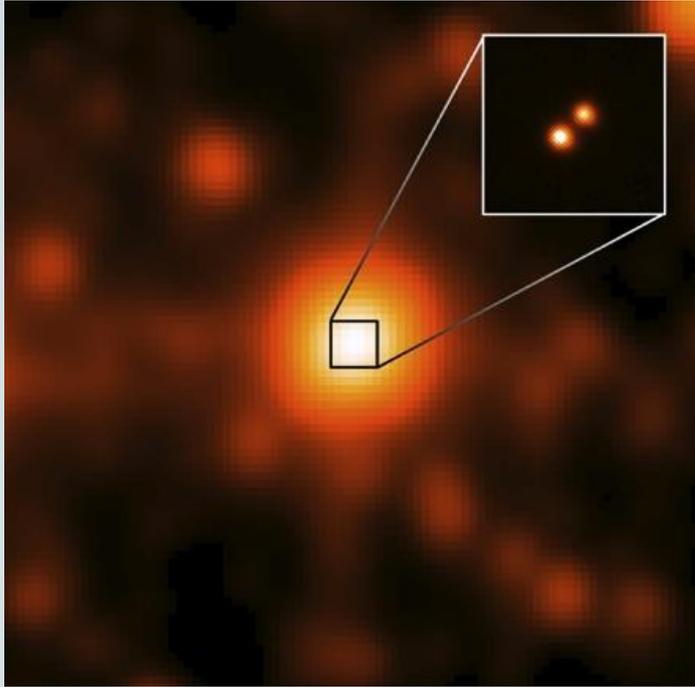


The stars’ dimness and infrared signatures confirmed their brown dwarf natures.

Previous images from the Digitized /Sky Survey and the Two Micron Survey, in addition to WISE images, show the proper motion of WISE 1049-5319 across the sky. Credit: NASA/STScI/JPL/IPAC/U of Mass.

Images from WISE and Spitzer show the proper motion of WISE 0855-0714 across the sky. Credit: NASA/JPL-Caltech/Penn State.

The Big Picture



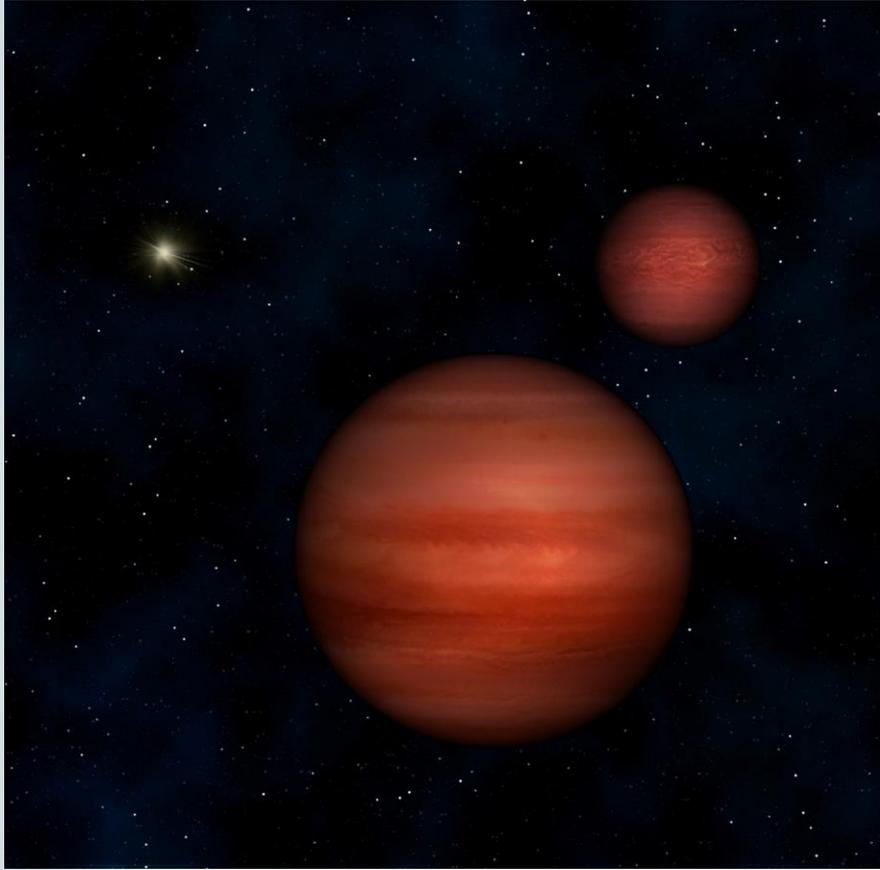
The binary nature of WISE 1049-5319 was revealed in the inset image taken by the Gemini Observatory. Credit: NASA/JPL/Caltech/Gemini Observatory/AURA/NSF,

Brown dwarfs are a class of objects, believed to be very numerous, filling the gap between the largest gas planets and the smallest hydrogen-burning stars. They range in mass from a few times to about 75 times the mass of Jupiter, emitting radiation primarily in the infrared portion of the spectrum.

More massive brown dwarfs like the WISE 1049-5319 pair (30 to 50 times Jupiter's mass) fuse deuterium—"heavy hydrogen"—in their cores at a much lower temperature than is needed for hydrogen fusion which characterizes true stars.

Low mass brown dwarfs like WISE 0855-0714 (three to 10 times Jupiter's mass) are probably just losing heat from their formation; its "surface" temperature is as cold as Earth's North Pole.

How Does this Change our View?



Artist's depiction of the brown dwarf binary WISE – 1049-5319, with the sun in the background. Credit: Janella Williams, Penn State University.

Because brown dwarfs are so small and faint, they cannot be seen out to very large distances. WISE is helping to detect nearby ones, including these two examples which constitute some of the sun's nearest neighbors in space.

Nearby brown dwarfs may also be good places to search for extra-solar planets. There is evidence that one of the dwarfs making up the WISE 1049-5319 binary system may be orbited by such a planet; investigation is continuing.

Resources

Papers:

<http://m.iopscience.iop.org/2041-8205/767/1/L1/>

<http://iopscience.iop.org/2041-8205/786/2/L18/>

Press Releases:

<http://www.jpl.nasa.gov/news/news.php?release=2013-090>

<http://science.psu.edu/news-and-events/2013-news/Luhman3-2013>

<http://www.nasa.gov/jpl/wise/spitzer-coldest-brown-dwarf-20140425>

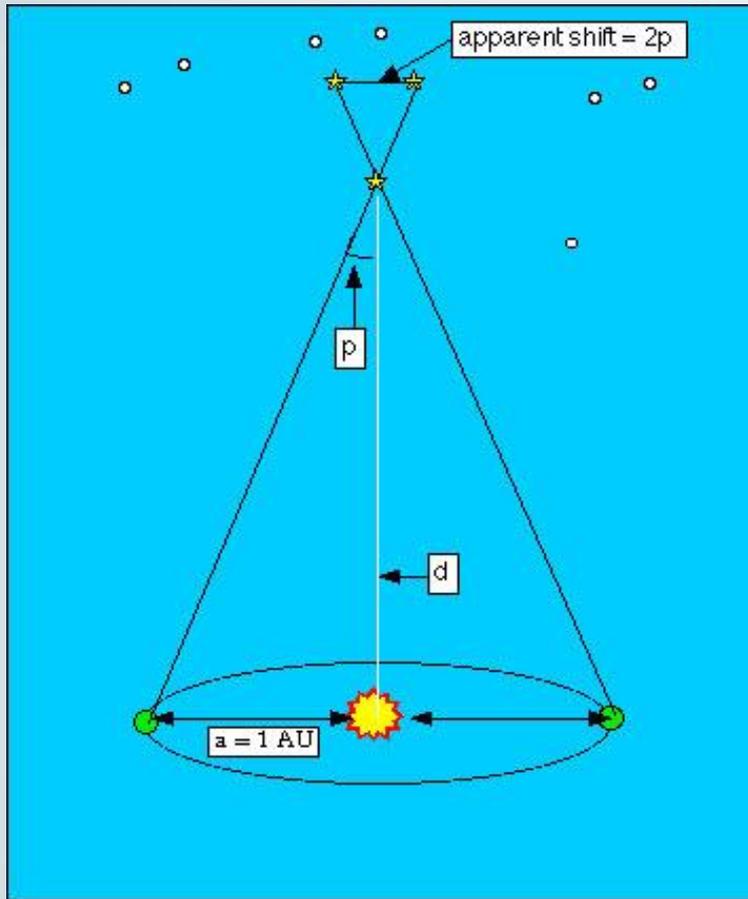
Mission Web site:

http://www.nasa.gov/mission_pages/WISE/main/index.html

Near Neighbors

BONUS CONTENT

Stellar Parallax



Hold out your thumb at arm's length and first close one eye and then the other; note how your thumb appears to change position against the background. The apparent shift is called parallax.

The parallax of a nearby star can be determined similarly—by measuring the apparent shift of the star against the more distant starry background as observed from opposite sides of the Earth's orbit. By accurately measuring the amount of apparent shift, the distance to the star can be calculated.