WHAT I REALLY WANT TO KNOW IS...
Can we find new neighbours for the Sun?

Ralf-Dieter Scholz describes his successful ongoing search for brown dwarfs in our home star's own neighbourhood

INTERVIEWED BY PAUL SUTHERLAND

The night sky appears to be filled with stars but, surprisingly, most of those closest to us are too faint to be seen with the naked eye. Our closest known neighbour is Proxima Centauri, a red dwarf star that lies just 4.2 lightyears away, yet it was not discovered until 1915 because it is only magnitude 11. About 10 years ago, I became interested in looking for undiscovered faint neighbours of the Sun, including red dwarfs and their even dimmer relatives, brown dwarfs. These are objects that failed to get the critical mass and energy source to become proper stars when they formed from an initial cloud of gas and dust.

Within a distance of 20 lightyears from the Sun, we know of around 150 stars but only 15 brown dwarfs, including two that I recently discovered. But theory suggests there should be many more brown dwarfs. We expect there to be at least as many of them as there are ordinary stars.

ESO

An artist's impression of a brown dwarf. Hundreds may lie undiscovered

Tiny movements

Astronomers are able to tell if a star is close by measuring its proper motion – the shift in its position in the sky due to its actual movement through space. This may be tiny, but it is detectable by comparing photos of its position taken years apart. Of course, a bright red star could be a red dwarf close by or a very distant red giant travelling at great speed, but checking the star's spectrum tells us what type of star it is.

I have been searching for new neighbours using data from NASA's Wide-field Infrared Survey Explorer (WISE) space telescope. Data covering a little more than half the sky was recently made public and I decided to search it for brown-dwarf candidates and compare those with an older sky survey made a decade ago to see if they had moved. Though nearby brown dwarfs are optically faint, they appear very bright to WISE. These stars have cooled over a very long timescale to an 'oven temperature' of around 230°C, so their infrared glow is all WISE sees. WISE was designed to help find brown dwarfs by scanning the sky in two different wavebands of infrared light. In one waveband the infrared light can pass through a brown dwarf's atmosphere so it appears bright, but the other band light is blocked – so a brown dwarf is dim.

I spent two or three weeks checking for companions of known nearby stars without success. Then I started looking across the whole sky for bright WISE sources that hadn't shown up in a previous near-infrared survey. At once I found two sources, which I was subsequently able to identify in a third database, the Sloan Digital Sky Survey.

I measured the proper motion for each and found it was very large – in one case one and a half, and in the other two and a half arcseconds per year. That was an immediate indication that they should lie within 30 lightyears or so, and we have since determined their distances more accurately as 15 and 18 lightyears. It was an exciting moment.

Within a few days we had the chance to observe one of the brown dwarfs with the Large Binocular Telescope in Arizona. A week later we were ready to publish our discovery, so it happened very quickly. I expect there will be many more discoveries. There could even be one closer than Proxima Centauri.

Some people have suggested that the Sun could have an undiscovered brown dwarf companion, as some similar stars do, orbiting at more than 1,000 times the distance of the Earth from the Sun. I can't rule that out, but a brown dwarf in such a distant orbit would disturb the Oort Cloud, the vast reservoir of comets that lies at the edge of our Solar System, in a regular manner. It would also be very bright in the infrared and have a large motion across the sky, so I suspect that if it existed it would have already been found.

ABOUT RALF-DIETER SCHOLZ

Dr Ralf-Dieter Scholz is a researcher at the Leibniz Institute for Astrophysics Potsdam, Germany, with a special interest in tracking down the Sun's neighbours.