Even 'failed stars' form planets

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An international team of astronomers says the process of building planets is more universal and robust than had previously been assumed. Brown dwarfs, like more massive normal stars, are formed when interstellar gas and dust clouds collapse. When this happens, a central, dense area builds up, embedded in a rotating disc made of gas and dust. These circumstellar discs produce infrared radiation according to their temperature.

The collapse of gas and dust clouds ends when the increasing pressure, temperature, and density in the central area causes nuclear fusion to start – that is, the burning of hydrogen into helium. This causes the dense area to become its own star. If its mass is too small, however, for the fusion to take place, a brown dwarf is created instead. It will have no further source of energy, and will slowly radiate the compression temperature created by the collapse.

The team of astronomers investigated six young brown dwarfs from the Chamaeleon star-forming region in the direction of the south celestial pole. The objects are between one and three million years old, and their masses are between 40 and 70 times that of Jupiter. The astonomers used SPITZER to record the detailed spectrum of infrared light, from which they derived information about the size of the radiated particles and their minerological composition.

The data analysis showed that in five of the six cases they looked at, dust particles in the circumstellar disc of the 'failed stars' stuck together and made larger clumps of olivine, a material made of silicon and crystalline structures. The discs of young normal stars are already known to contain this material. It is also found in comets – the leftover material from the time when our own planetary system was being built. Apparently, the same growth and crystallisation processes take place in the circumstellar discs that we see in normal stars (including the Sun) at the beginning of planet formation.

Futhermore, there was evidence that the circumstellar discs flatten out in a way that one would also expect given how the dust components develop. Daniel Apai, who is doing reserach at the Steward Observatory in Tuscon, Arizona and is a member of the Life and Planets Astrobiology Center NASA´s Astrobiology Institute, says that ‛Using SPITZER, we can investigate planet formation under all different kinds of conditions. Our observations show that the first steps of planet formation are determined to a lesser extent by details than we previously thought'. Kees Dullemond at the Max Planck Instiute for Astronomy stresses that ‛this result is important also because it narrows down theories about planet formation and thus gives us a deeper insight into the process'.

These observational results show that in the future, in projects to find extrasolar planets – like ESA's DARWIN mission and NASA's terrestrial planet finder – it could be worth it to look for planets in the neighborhood of brown dwarfs.

We can look at these spectra when we do a wavelength analysis on the light collected in the telescope, similar to the way a drop of water or a prisma turns sunlight into a rainbow. The bright ‛arches', which appear at different wavelengths, are the ‛fingerprints' which allow us to read the chemical features (i.e., it contains silicate), the size, and the physical condition (from amorphous to crystalline).

In the picture, the light green vertical stripes indicate the ‛fingerprints' of crystals which are made primarily of the minieral olivine, which is green, made of silicate, and appears on earth. It seems the spectra of three of the four brown dwarfs have similar components. In interstellar dust, they are unrecognisable. They are most clearly visible in the spectrum of the Hale-Bopp comet. The bigger the dust particles, the wider the 'arches' are in their emission spectrum.

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