two quasars of the group with ~ 6 arcmin separation, is measured to be quite high ($\xi = 0.011$).

A similar overdensity of C IV systems has been observed in the field of Tol 1037–2704 (e.g. Jakobsen et al. 1986) and has been interpreted as being due to the presence of a supercluster. The dimensions of this supercluster would be at least 80 and 30 $h^{-1}$ Mpc along and perpendicular to the line of sight, respectively. To our knowledge no deep imaging of these fields exist and it would be very interesting to search for possible concentrations of galaxies.

## Future prospects

We have detected the transverse correlation of the intergalactic medium at the $3\sigma$ level up to separations of about 3–5 arcmin. The shape and correlation length of the transverse correlation function of the absorbing gas is in good agreement with expectations for absorption by density fluctuations in the warm photoionised Intergalactic Medium as described in CDM-like structure formation models. Our measurement is thus an important further independent confirmation that the Lyman-$\alpha$ forest is indeed caused by the filamentary and sheet-like structures of the cosmic web predicted by these models. In agreement with predictions of previous theoretical studies we find that our sample is still too small to obtain significant constraints on cosmological parameters. The improved errors of our larger sample compared to the sub-sample of Rollinde et al. (2003) suggest however that meaningful constraints on $\Omega_\Lambda$ can be obtained. For this, a larger sample and a careful analysis of the systematic uncertainties with a large suite of full hydrodynamical simulations are necessary. Mc Donald (2003) estimated that this requires a sample of $13(\theta/1')^2$ pairs on scales up to 10 arcmin.

In addition, our results open the prospect to reconstruct the 3D density field directly (see Pichon et al. 2001). For this a network of lines of sight in the same field should be observed. Intermediate and/or low spectral resolution is sufficient but the distance between lines of sight is crucial and should be smaller than about 5 arcminutes.

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# Extrasolar Planets and Brown Dwarfs: A Flurry of Results

Three ESO press releases on extrasolar planets and brown dwarfs in the last few months testify to the pace of activity in this field at the moment. They are summarised briefly here, and are available in complete form on the ESO website (PR 19/06, 28/06, 29/06).

## Planetary-Mass objects surrounded by discs

Two new studies show that objects only a few times more massive than Jupiter are born with discs of dust and gas, the raw material for planet making. This suggests that miniature versions of the solar system may circle objects that are some hundred times less massive than our Sun.

For a few years it has been known that many young brown dwarfs, ‘failed stars’ that weigh less than eight per cent the mass of the Sun, are surrounded by a disc of material. This may indicate that these objects form the same way as did our Sun. The new findings confirm that the same appears to be true for their even smaller cousins, sometimes called planetary-mass objects or ‘planemos’. These objects have masses similar to those of extrasolar planets, but they are not in orbit around stars – instead, they float freely through space.

“Now that we know of these planetary-mass objects with their own little infant planetary systems, the definition of the word ‘planet’ has blurred even more”, adds Ray Jayawardhana (University of Toronto, Canada), lead author of the study. “In a way, the new discoveries are not too surprising – after all, Jupiter must have been born with its own disc, out of which its bigger moons formed.” Unlike Jupiter, however, these planetary-mass objects are not circling stars.
In their study, Jayawardhana and Ivanov (ESO) used the VLT and NTT to obtain optical spectra of six candidates identified recently by researchers at the University of Texas at Austin. Four of the six turned out to have masses between five to 15 times that of Jupiter. All four of these objects are ‘newborns’, just a few million years old, and are located in star-forming regions about 450 light years from Earth. They show infrared emission from dusty discs that may evolve into miniature planetary systems over time.

In another study, Subhanjoy Mohanty (Harvard-Smithsonian Center for Astrophysics, CfA), Ray Jayawardhana (University of Toronto), Nuria Huelamo (ESO) and Eric Mamajek (also at CfA) used the VLT and NACO to obtain images and spectra of a planetary-mass companion discovered at ESO two years ago around a young brown dwarf that is itself about 25 times the mass of Jupiter. This planetary-mass companion is the first-ever exoplanet to have been imaged. The brown dwarf, dubbed 2M1207 for short and located 170 light years from Earth, was known to be surrounded by a disc. Now, this team has found evidence for a disc around the eight-Jupiter-mass companion as well.

## A brown dwarf – white dwarf pair

A rather unusual system has been found, in which two planet-size stars, of different colours, orbit each other. One is a rather hot white dwarf, weighing a little bit less than half as much as the Sun. The other is a much cooler, 55 Jupiter-mass brown dwarf.

"Such a system must have had a very troubled history", said Pierre Maxted, lead author of the paper that reports the study in the 3 August issue of Nature. "Its existence proves that the brown dwarf came out almost unaltered from an episode in which it was swallowed by a red giant." The two objects, separated by less than 2/3 of the radius of the Sun or only a few thousandths of the distance between the Earth and the Sun, rotate around each other in about 2 hours.

The two stars were not so close in their past. Only when the solar-like star that has now become a white dwarf was a red giant, did the separation between the two objects diminish drastically. During this fleeting moment, the giant engulfed its companion. The latter spiralled in towards the core of the giant. The envelope of the giant was finally ejected, leaving a binary system in which the companion is in a close orbit around a white dwarf. The separation between the two stars will slowly decrease.

The low-mass companion to the white dwarf (named WD0137-349) was found using spectra taken with EMMI on the NTT. The astronomers then used the UVES spectrograph on the VLT to take 20 spectra and so measure the period and the mass ratio.

The team members are Pierre Maxted (Keele University, UK), Ralf Napiwotzki (University of Hertfordshire, UK), Paul Dobbie and Matt Burleigh (University of Leicester, UK).

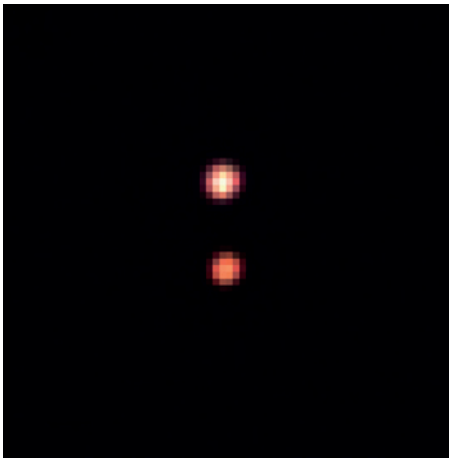
## A pair of planetary-mass objects

The cast of exoplanets has an extraordinary new member. Astronomers have discovered an approximately seven-Jupiter-mass companion to an object that is itself only twice as massive. Both objects have masses similar to those of extrasolar giant planets, but they are not in orbit around a star – instead they appear to circle each other. The existence of such a double system puts strong constraints on formation theories of free-floating planetary-mass objects.

Ray Jayawardhana (University of Toronto, Canada) and Valentin D. Ivanov (ESO) reported the discovery in the 3 August issue of Science Express. "This is a truly remarkable pair of twins – each having only about one per cent the mass of our Sun", said Jayawardhana. "Its mere existence is a surprise, and its origin and fate a bit of a mystery."

Roughly half of all Sun-like stars come in pairs. So do about a sixth of brown dwarfs, 'failed stars' that have less than 75 Jupiter masses and are unable to sustain nuclear fusion in their cores. During the past five years, astronomers have identified a few dozen even smaller free-floating planetary-mass objects in nearby star-forming regions. Oph 162225-240515, or Oph1622 for short, is the first one found to be a double.

The researchers discovered the companion candidate in an optical image taken with the NTT. They took optical spectra and infrared images of the pair with the VLT to make sure that it is a true companion, instead of a foreground or background star that happens to be in the same line of sight. These follow-up observations indeed confirmed that both objects are young, at the same distance, and much too cool to be stars. This suggests the two are physically associated.



The System Oph1622 (ISAAC/VLT).

The companion is estimated to be about seven times the mass of Jupiter, while the more massive object is about 14 Jupiter masses. The newborn pair, barely a million years old, is separated by about six times the distance between the Sun and Pluto, and is located in the Ophiuchus star-forming region approximately 400 light years away.

Planets are thought to form out of discs of gas and dust that surround stars, brown dwarfs, and even some free-floating planetary-mass objects. But, "it is likely that these twins formed together out of a contracting gas cloud that fragmented, like a miniature stellar binary", said Jayawardhana. "We are resisting the temptation to call it a 'double planet' because this pair probably didn't form the way that planets in our Solar System did", added Ivanov.

Oph1622B is only the second or third directly imaged planetary-mass companion to be confirmed spectroscopically, and the first one around a primary that is itself a planetary-mass object. Its existence poses a challenge to a popular theoretical scenario, which suggests that brown dwarfs and free-floating planetary-mass objects are embryos ejected from multiple protostar systems. Since the two objects in Oph1622 are so far apart, and only weakly bound to each other by gravity, they would not have survived such a chaotic birth.