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The multiplicity of exoplanet host stars*

New low-mass stellar companions of the exoplanet host stars HD 125612 and HD 212301

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ABSTRACT

Aims. We present new results from our ongoing multiplicity study of exoplanet host stars, carried out with SofI/NTT. We provide the most recent list of confirmed binary and triple star systems that harbor exoplanets.
Methods. We use direct imaging to identify wide stellar and substellar companions as co-moving objects to the observed exoplanet host stars, whose masses and spectral types are determined with follow-up photometry and spectroscopy.
Results. We found two new co-moving companions of the exoplanet host stars HD 125612 and HD 212301. HD 125612 B is a wide M 4 dwarf (0.18 $M_{\odot}$) companion of the exoplanet host star HD 125612, located about 1.5 arcmin (~4750 AU of projected separation) south-east of its primary. In contrast, HD 212301 B is a close M 3 dwarf (0.35 $M_{\odot}$), which is found about 4.4 arcsec (~230 AU of projected separation) north-west of its primary.
Conclusions. The binaries HD 125612 AB and HD 212301 AB are new members in the continuously growing list of exoplanet host star systems of which 43 are presently known. Hence, the multiplicity rate of exoplanet host stars is about 17%.

Key words. stars: binaries: general – stars: individual: HD 125612 – stars: individual: HD 212301

1. Introduction

For more than a decade, radial-velocity and photometric planet search campaigns have indirectly identified more than three hundred exoplanets that revolve around mostly sun-like stars, in the solar neighborhood. The majority of these exoplanet host stars are isolated single stars, but during recent years more and more of them turned out to be the brighter primary component of stellar systems, identified by ongoing multiplicity studies. These studies were carried out with seeing limited near infrared imaging (see e.g. Mugrauer et al. 2004a,b, 2005b, 2006a, 2007a,b), high contrast diffraction limited AO observations (Neuhäuser et al. 2007, see e.g. Patience et al. 2002; Luhman & Jayawardhana 2002; Chauvin et al. 2006; and most recently Eggenberger et al. 2007), as well as from space (Luhman et al. 2007). In addition, data from visible and infrared all sky surveys like POSS or 2MASS are used to identify new companions of exoplanet host stars (as reported e.g. by Bakos et al. 2006; Raghavan et al. 2006; or most recently by Desidera & Barbieri 2007) .

Most of the detected stellar companions of exoplanet host stars are low-mass main sequence stars with projected separations of between a few tens up to more than 10 000 AU. In a few cases the companions themselves turned out to be close binaries, i.e. these systems are hierarchical triples (see Mugrauer et al. 2007a, for a summary). The closest of these systems presently known is HD 65216 A+BC, with a projected separation of about 250 AU (Mugrauer et al. 2007b). Also white dwarfs have been identified as companions of exoplanet host stars, suggesting that exoplanets can survive the post main sequence evolution of a nearby star (e.g. Gl 86 B, ~20 AU, see Mugrauer & Neuhäuser 2005, for more details). Later on, the first directly imaged substellar companion of an exoplanet host star, the T7-T8 brown dwarf HD 3651 B, was discovered (see Mugrauer et al. 2006b; and Liu et al. 2007). In addition to these imaging surveys a dynamical characterization of the closest exoplanet host binaries, like Gl 86 AB (see Lagrange et al. 2006), or γ Cep AB (see Neuhäuser et al. 2007), is being carried out to determine the full set of their orbital elements.

All these efforts will help to reveal the true impact of stellar multiplicity on the formation process of planets and the evolution of their orbits. For recent statistical studies we refer here to e.g. Mugrauer (2007) or Bonavita & Desidera (2007).

In this paper we present new results of our ongoing multiplicity study carried out at La Silla observatory with SofI/NTT. We detected two new low-mass stellar companions of the exoplanet host stars HD 125612 and HD 212301. Our SofI astro- and photometry is described in Sect. 2, the follow-up spectroscopy in Sect. 3. The properties of the newly found exoplanet host binaries are described in Sect. 4, where the SofI detection limits also are presented and the separation space of possible, so far undetected, additional companions is discussed. A list of all presently known and confirmed exoplanet host star systems is given in the Appendix.

2. Astro- and photometry

2.1. HD 125612

The exoplanet host star HD 125612 is a solar-like G3V star (1.1 ± 0.07 $M_{\odot}$, Fischer et al. 2007), which can be found on

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* Based on observations obtained on La Silla in ESO programs 079.C-0099(A), 080.C-0312(A).

Table 1. The astrometrical calibration of SofI/NTT. The pixel scale PS and the detector position angle PA with their uncertainties are listed. The detector is tilted by PA from north to west.

Instrument	Epoch	PS [″]	PA [°]
$SofI_{large}$	06/2007	0.28791 ± 0.00021	89.984 ± 0.026
$SofI_{large}$	01/2008	0.28794 ± 0.00025	89.997 ± 0.056

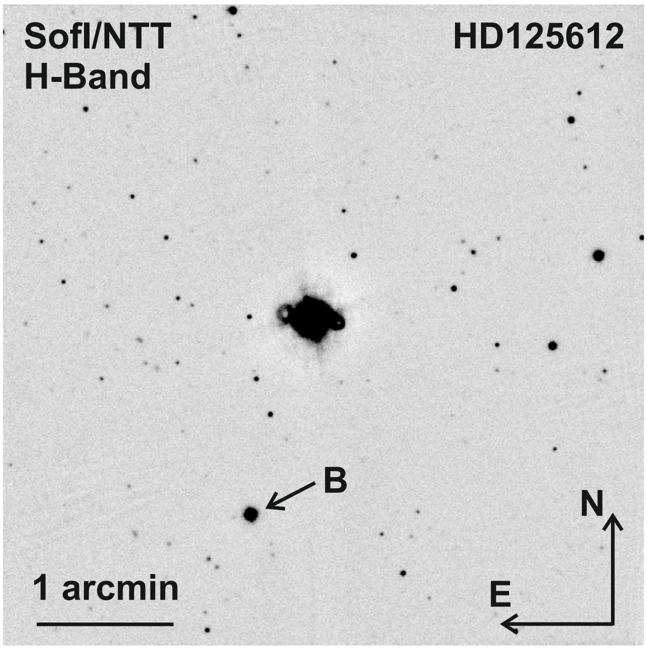

Fig. 1. SofI large field image of the exoplanet host star HD 125612. The detected co-moving companion of the exoplanet host star is indicated with a black arrow.

the sky between the constellations Virgo and Libra at a distance of 53 ± 4 pc (Hipparcos, Perryman & ESA 1997). According to Fischer et al. (2007) HD 125612 shows only weak chromospheric activity ($\log R'_{HK} = -4.85$), and its chromospheric age of 3.3 ± 2 Gyr is comparable with the age determined with evolutionary models (0.16 to 5.6 Gyr). In our ongoing multiplicity study of exoplanet host stars, HD 125612 was observed the first time in June 2007 with SofI/NTT. All our SofI images are astrometrically calibrated with the 2MASS point source catalogue (Skrutskie et al. 2006), as summarized in Table 1.

Our reduced SofI *H*-band image of HD 125612 is shown in Fig. 1. The total integration time of this image is 10 min taken with the standard set-up of our programme (for further details see e.g. Mugrauer et al. 2007a). Several faint companion candidates down to $H \sim 18$ mag ($S/N = 10$) are detected around the exoplanet host star, which is located in the center of the image.

HD 125612 was imaged by 2MASS in April 1998, i.e. more than 9 years before our SofI 1st epoch observation. HD 125612 exhibits a high proper motion ($\mu_{RA} = -64.47 \pm 1.57$ mas/yr $\mu_{Dec} = -65.64 \pm 1.03$ mas/yr) which is well known from Hipparcos. By comparing the 2MASS with our SofI image we derive the proper motion of all companion candidates detected in our SofI, and also in the less sensitive 2MASS image (see Fig. 2).

The majority of detected objects only exhibits small or negligible proper motion. Hence, all these candidates are unrelated background objects only randomly located close to the line of sight in the direction of the exoplanet host star. In contrast, one candidate located about 89.98 arcsec (~4750 AU of projected separation) south-east of HD 125612 clearly shares the proper motion of HD 125612. This newly found co-moving companion, indicated with a black arrow in Fig. 1, will be denoted as HD 125612 B and the exoplanet host star as HD 125612 A, from here on.

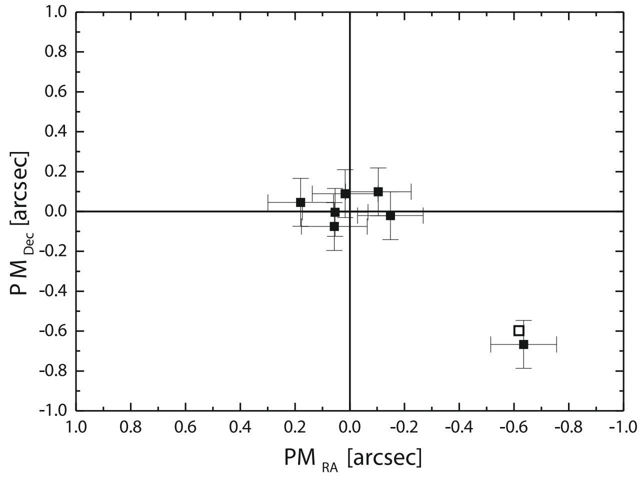

Fig. 2. The derived motion of all companion candidates detected in our SofI *H*-band image and also imaged by 2MASS around the exoplanet host star. The proper and parallactic motion of HD 125612 for the give epoch difference is indicated with a black square.

Table 2. The separations and position angles of HD 125612 B and HD 212301 B relative to their primaries – the exoplanet host stars HD 125612 A, and HD 212301 A. In the columns $sep_{if\ bg}$ and $PA_{if\ bg}$ we show the expected separation and position angle in the case that both companions are non-moving background objects.

	Epoch	Sep_{obs} (arcsec)	$Sep_{if\ bg}$ (arcsec)
HD 125612 B	2MA 04/98	89.957 ± 0.055	89.957 ± 0.055
	NTT 06/07	89.994 ± 0.066	89.574 ± 0.056
HD 212301 B	2MA 12/99	4.34 ± 0.23	4.34 ± 0.23
	NTT 06/07	4.36 ± 0.06	5.05 ± 0.23
	NTT 01/08	4.43 ± 0.06	5.08 ± 0.23
	Epoch	PA [°]	$PA_{if\ bg}$ [°]
HD 125612 B	2MA 04/98	162.696 ± 0.070	162.696 ± 0.070
	NTT 06/07	162.682 ± 0.052	162.205 ± 0.071
HD 212301 B	2MA 12/99	275.7 ± 3.0	275.7 ± 3.0
	NTT 06/07	275.1 ± 0.5	283.0 ± 3.0
	NTT 01/08	275.8 ± 0.5	283.3 ± 3.0

We also measure the separation and the position angle of HD 125612 B relative to its primary in the 2MASS, as well as in our SofI *H*-band image. This relative astrometry of the companion is summarized in Table 2. Neither separation nor position angle of HD 125612 B change significantly during the more than 9 years of epoch difference, as is expected for a co-moving companion.

The proper motion of HD 125612 B is also listed in the USNO-B1.0 catalogue (Monet et al. 2003) ($\mu_{RA} = -64 \pm 1$ mas/yr, $\mu_{Dec} = -58 \pm 4$ mas/yr) and is fully consistent with the Hipparcos proper motion of the exoplanet host star. This is further proof of the astrometric companionship of HD 125612 B to the exoplanet host star.

We determine the *H*-band photometry of HD 125612 B in our SofI image and obtain $H = 11.761 \pm 0.034$ mag, which is fully consistent with its 2MASS photometry $H = 11.773 \pm 0.023$ mag. In addition, the 2MASS point source catalogue also lists the *J*-, and K_S-band photometry of HD 125612 B ($J = 12.381 \pm 0.0244$ mag, and $K_S = 11.514 \pm 0.024$ mag). The

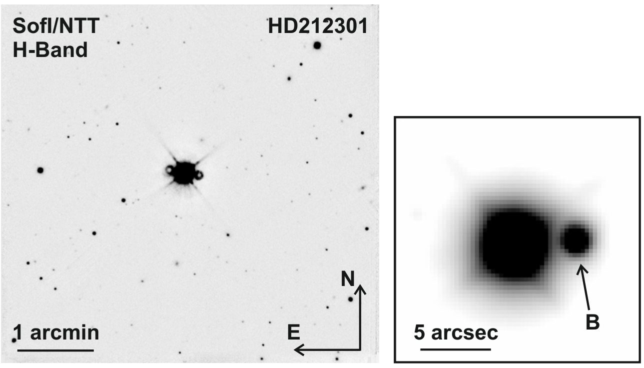

Fig. 3. *Left*: our 1st epoch SofI *H*-band image of the exoplanet host star HD 212301. *Right*: detail of the whole SofI image, showing the central region around the exoplanet host star, using a logarithmic scaling. A close companion candidate is detected only 4 arcsec north-west of HD 212301, marked with a black arrow.

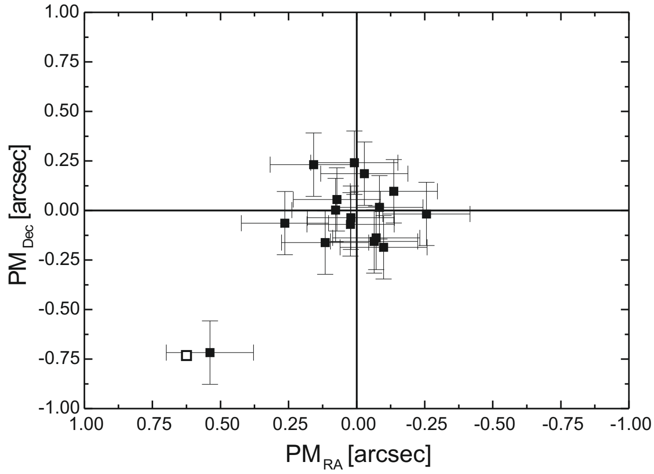

Fig. 4. The derived proper motion of all companion candidates detected around the exoplanet host star HD 212301 in our 2nd epoch SofI, and the deconvolved 2MASS *H*-band image. The proper and parallactic motion of the exoplanet host star for the give epoch difference is indicated with a black square.

well-known Hipparcos distance of the exoplanet host star, and the given 2MASS apparent magnitudes of HD 125612 B, finally yield the absolute photometry of the companion: $M_J = 8.77 \pm 0.16$ mag, $M_H = 8.16 \pm 0.16$ mag, $M_{K_s} = 7.90 \pm 0.16$ mag.

According to the evolutionary models for low-mass stars from Baraffe et al. (1998) the derived absolute photometry of HD 125612 B is consistent with a $0.184 \pm 0.012\,M_\odot$ star for an assumed age between 1 and 5 Gyr. According to the magnitude-spectral type relation from Reid et al. (2004), the absolute photometry of HD 125612 B is consistent with an M 4 dwarf. The spectral type estimation has to be confirmed by follow-up spectroscopy (see next section).

2.2. HD 212301

The exoplanet host star HD 212301 is a 1.9 to 5.4 Gyr (Holmberg et al. 2007) old F8 dwarf ($1.27 \pm 0.02\,M_\odot$, Lo Curto et al. 2006), which is located at a distance of 53 ± 2 pc, (Hipparcos, Perryman & ESA 1997) in the constellation Octans.

We observed HD 212301 twice with SofI in *H*-band, with a total integration time of 10 min in June 2007 as well as in January 2008. Our 1st epoch SofI image is shown in Fig. 3. Several faint companion candidates, down to $H = 18$ mag ($S/N = 10$), are detected around the bright exoplanet host star. We could also identify a close candidate, located in both SofI images only about 4.38 arcsec (~230 AU of projected separation) north-west of the HD 212301.

In order to check if this close candidate is also detected by 2MASS, we carefully inspected the 2MASS *J*-, *H*-, and K_S-band images. We found that in all 2MASS images the PSF of HD 212301 appears elongated in the direction where the close candidate is located. In contrast, the PSF of objects found around the star in the 2MASS images all exhibit radially symmetric PSFs. We deconvolved all 2MASS images, using the PSFs of objects detected around HD 212301 as a reference. The object functions of the exoplanet host star in the *J*- and K_S-band remain elongated, while in the *H*-band the two separated object functions of HD 212301 and its close companion candidate could be reconstructed.

By comparing our two SofI images of HD 212301 with the deconvolved 2MASS *H*-band image taken at the end of 1999, we can determine the proper motion of all detected objects. Due to the high proper motion of HD 212301 ($\mu_{RA} = 76.11 \pm 0.85$ mas/yr and $\mu_{Dec} = -91.64 \pm 0.63$ mas/yr, from Hipparcos) and the long epoch difference of more than seven years between the 2MASS and our SofI images, real companions of HD 212301 can easily be identified as co-moving objects. The derived proper motions of all candidates between the 2MASS and our 2nd epoch SofI observation are shown in Fig. 4.

Only the close companion candidate clearly shares the proper motion of the exoplanet host star. Hence, this is a new co-moving companion of HD 212301, called HD 212301 B from here on.

Beside the proper motion of HD 212301 B we also determined its relative astrometry to its primary in all observing epochs, summarized in Table 2. The separation and position angle of HD 212301 B do not change significantly over time, as expected for a co-moving companion.

Because of its small angular separation HD 212301 B is not resolved in the 2MASS *J*, and K_S-band images. Therefore, we obtained additional photometry with SofI in June 2007 and observed HD 212301 B in *J*, and K_S broad, as well as in the Br_γ narrow band filter. Within a jitter box of 20 arcsec we obtained three images in *J* and K_S and five images in Br_γ which are each the average of 50 exposures with an integration time of 1.2 s, and obtained $J = 11.056 \pm 0.086$ mag, and $K_s = 10.210 \pm 0.058$ mag. In the *H*-band we obtained $H = 10.516 \pm 0.041$ mag in our 1st, and $H = 10.587 \pm 0.053$ mag in the 2nd SofI imaging epoch. The K_S band magnitude of the exoplanet host star is listed in the 2MASS point source catalogue ($K_S = 6.466 \pm 0.021$ mag). Together with our SofI K_S-band photometry of HD 212301 B this yields a magnitude difference between HD 212301 A and B of $\Delta K_S = 3.744 \pm 0.061$ mag. This result is confirmed by the magnitude difference between HD 212301 B and the exoplanet host star $\Delta Br_\gamma = 3.67 \pm 0.06$ mag, as measured in our SofI $Br\gamma$ image. In addition, we also determined the photometry of HD 212301 B in the deconvolved 2MASS *H*-band image and obtained $H_{2Mass} = 10.71 \pm 0.17$ mag which is consistent with our SofI *H*-band photometry of the co-moving companion.

With the measured apparent photometry of HD 212301 B, and the well known distance of the exoplanet host star we derive its absolute photometry, which is $M_J = 7.45 \pm 0.12$, $M_H = 6.94 \pm 0.09$, and $M_{K_s} = 6.60 \pm 0.10$.

With the evolutionary models of Baraffe et al. (1998) and the derived absolute photometry of HD 212301 B we determine the mass of the companion to be $0.35 \pm 0.02\,M_\odot$, for an assumed age

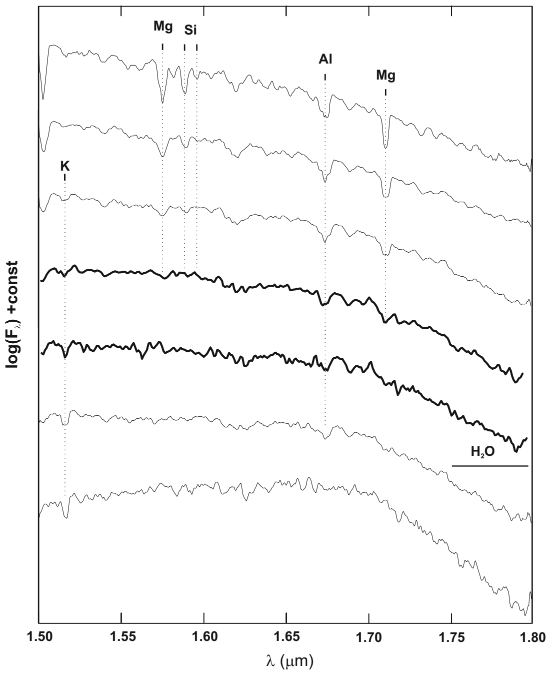

Fig. 5. The H-band SofI spectra of HD 125612 B and HD 212301 B together with comparison spectra of dwarfs from the IRTF Spectral Library (Cushing et al. 2005). The most prominent spectral atomic and molecular features are indicated.

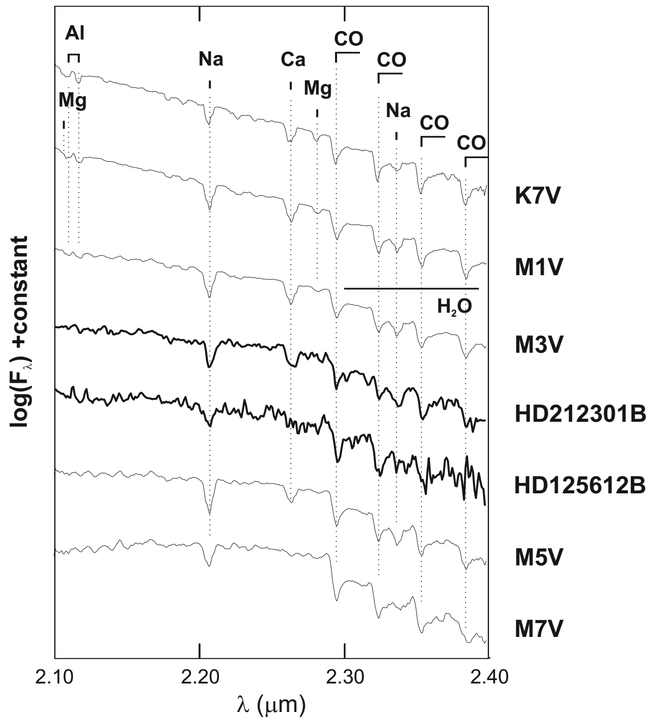

Fig. 6. The K-band SofI spectra of HD 125612 B and HD 212301 B together with comparison spectra of dwarfs from the IRTF spectral library (Cushing et al. 2005). The most prominent spectral atomic and molecular features are indicated.

of between 0.5 and 5 Gyr. According to the magnitude-spectral type relation from Reid et al. (2004) we expect the spectral type of the companion to be M 3V, which has to be confirmed with follow-up spectroscopy (see the following section).

3. Spectroscopy

In June 2007, we obtained H- and K-band follow-up spectroscopy of the two co-moving companions HD 125612 B and HD 212301 B with SofI. We used the grism *RED* in combination with a 1 arcsec slit which offers a resolving power $\lambda/\Delta\lambda = 588$ and dispersion of 10.22 Å per pixel. For both co-moving companions we always took 10 frames each with an integration time of 60 s. Between individual exposures a nodding of 45 arcsec between two positions along the slit, as well as a 5 arcsec random jitter was applied. For wavelength calibration we took spectra of a Xenon lamp. Standard IRAF routines for spectroscopy were used for data reduction. Telluric features in the reduced spectra were removed by dividing with spectra of telluric standard stars, whose spectra were always taken directly after the spectroscopy of the companions, with airmass difference between science and calibration spectra of less than 0.1. We took spectra of HIP 73881 (B2−3V) in the case of HD 125612 B, and HIP 100170 (B2V) for HIP 212301, respectively. The spectral response function of SofI was determined using the spectra of the telluric standards, as well as flux-calibrated spectra from the spectral library of Pickles (1998).

The flux-calibrated H- and K-band spectra of HD 125612 B and HD 212301 B are shown in Figs. 5 and 6. The spectra of both companions are compared with template spectra from the IRTF spectral library (Cushing et al. 2005), smoothed to the same resolution as our SofI spectra ($\Delta\lambda/\lambda = 1/588$).

In the H-band spectrum of HD 212301 B the most prominent features are those of aluminium at 1.674 μm, magnesium at 1.711 μm and weaker at 1.576 μm, potassium at 1.517 μm, and the faintly detected silicon line at 1.589 μm. All detected spectral features, as well as the continuum shape of the spectrum compare well with the M 3V template spectrum. In contrast, the continuum of the spectrum of HD 125612 B is more consistent with that of an M 5 dwarf. In addition the potassium line in the spectrum of HD 125612 B is stronger than that of the spectrum of HD 212301 B, which indicates a slightly later spectral type of between M 3 and M 5V.

In the K-band, the spectra of both companions show the prominent absorption line doublet of sodium at 2.208 μm, and the molecular absorption bands of CO at wavelengths longer than 2.294 μm, typical of M 3 to M 5 dwarfs. In contrast, the calcium absorption line doublet at 2.265 μm which is well detected in the spectrum of HD 212301 B cannot be identified in the spectrum of HD 125612 B. Because all atomic absorption features weaken to later spectral types this indicates that the spectrum of HD 125612 B, is slightly later than that of HD 212301 B mostly consistent with a M 4 to M 5 dwarf.

According to our SofI spectroscopy we can conclude that HD 125126 B and HD 212301 B are both mid M dwarfs (M 3 to M 5V). Our SofI spectroscopy fully confirms the spectral type estimation of both companions obtained from their apparent photometry, assuming that they are dwarfs located at the distances of the exoplanet host stars (M 4V for HD 125612 B, and M 3V for HD 212301 B). Hence, the companionship of HD 125612 B and HD 212301 B, which was first revealed with astrometry (common proper motion), is finally confirmed by photometry and spectroscopy.

4. Discussion

As described in detail in the last sections HD 125612 B is a wide M 4 dwarf companion with a mass of ~0.18 $M_{\odot}$ which is separated by about 4750 AU from its primary, the exoplanet host star

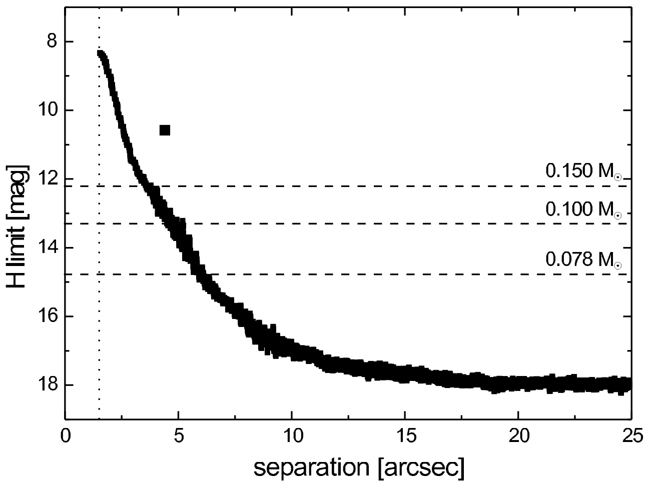

Fig. 7. The average detection limit ($S/N = 10$) in our SofI images of the exoplanet host stars HD 125612 A and HD 212301 A plotted for a range of angular separations up to 25 arcsec. The detected co-moving companion HD 212301 B is indicated as a black square.

HD 125612 A. In contrast, HD 212301 B is a close M 3 dwarf (0.35 $M_\odot$) companion, located at a separation of about 230 AU from its primary.

The typical SofI detection limit for both exoplanet host stars is shown in Fig. 7. At an angular separation of less than 1.5 arcsec (~80 AU) saturation occurs, i.e. companions cannot be detected in this region. According to the evolutionary models from Baraffe et al. (1998) all stellar companions (mass > 0.078 $M_{\rm Jup}$) are detectable beyond 6 arcsec (~320 AU) around both stars, for assumed ages between 1 and 5 Gyr. In the background limited region beyond about 15 arcsec (~800 AU) a sensitivity of $H = 18$ mag ($S/N = 10$) is reached, i.e. companions with absolute magnitudes down to $M_{\rm H} = 14.4$ mag can be imaged in this region. This allows the detection of brown dwarf companions with masses down to 37 to 65 $M_{\rm Jup}$. Companions with angular separations of up to about 143 arcsec (~7500 AU of projected separation) can be detected together with the exoplanet host stars in our SofI images.

HD 125612 was observed only in the 1st epoch with SofI. A 2nd epoch follow-up imaging could not be carried out in 2008 due to bad weather. For HD 212301 we obtained a 2nd epoch image in January 2008 but only to confirm the detection of the companion HD 212301 B and to rule out that it is a fast moving foreground object e.g. a planetoid in the solar system. The expected total motion of the companion between both observing epochs is only about 40 mas, too small to be clearly detected with SofI in its large field mode. Hence, follow up SofI imaging is needed for both stars with sufficient epoch difference to check the companionship of all faint companion candidates not imaged by 2MASS.

Nevertheless, we can already exclude additional companions around both exoplanet host stars based on the 2MASS detection limit. According to Skrutskie et al. (2006) the 2MASS H-band limit is 15.1 mag at $S/N = 10$, the limit for all detected sources with accurate astrometry. As determined by us, this limit is reached in the 2MASS images beyond about 20 arcsec (~1060 AU) around both stars. According to the evolutionary models from Baraffe et al. (1998) and an assumed age of 1 to 5 Gyr companions with masses down to 63 and 74 $M_{\rm Jup}$ can be detected in 2MASS. All stellar companions (mass > 0.078 $M_{\rm Jup}$) can be detected beyond about 13 arcsec (~690 AU) around both stars.

In addition, we can also rule out companions that should not be on long-term stable orbits around the exoplanet host stars in both binary systems. According to Holman & Wiegert (1999) only companions with semi-major axes smaller than the critical semi-major axis exhibit long-term stable orbits. In the case of the HD 125612 AB system (HD 125612 A (~1.1 $M_\odot$), HD 125612 B (~0.18 $M_\odot$), 4750 AU of projected separation) we expect the long-term stable zone to extend up to ~650 AU (12.4 arcsec of angular separation), assuming that HD 125612 B is on a circular orbit, whose semi-major axis corresponds to the observed projected separation of the companion. This value can be considered as an upper separation limit for additional long-term stable companions. In the case of an eccentric orbit of HD 125612 B the extent of this long-term stable zone should be smaller. Indeed, there is one faint companion candidate in our SofI image detected about 10 arcsec west of HD 125612 A. Follow-up imaging is needed to test the companionship of this faint companion candidate.

In the case of the HD 212301 AB system (primary mass of about 1.27 $M_\odot$, secondary mass of ~0.35 $M_\odot$, with a projected separation of ~230 AU) we derive an extent of the long-term stable zone of only ~38 AU, i.e. about 0.7 arcsec of angular separation. No objects are detected within this given angular radius around HD 212301 A in our SofI images.

The binaries HD 125612 AB and HD 212301 AB are two new members of the growing list of exoplanet host multiple star systems. Today 250 exoplanet host stars are known and ongoing multiplicity studies so far have found 43 of them to be components of a multiple star system (see the Appendix for summary). Hence, the multiplicity-rate of the exoplanet host stars is at least 17%.

Acknowledgements. We would like to thank the technical staff of the ESO NTT. We made use of the 2MASS public data releases as well as the Simbad database operated at the Observatoire Strasbourg.

Appendix A: Presently known exoplanet host star systems

Currently, 43 confirmed star systems are known that harbor at least one exoplanet; 37 of them are binaries, and the remaining 6 are triples. There is only one system known with a directly detected wide substellar companion, namely HD 3651 AB (Mugrauer et al. 2006b).

A.1. Exoplanet host binary star systems

55 Cnc AB[1], 83 Leo BA, GJ 3021 AB, GJ 777 AB, Gl 86 AB, HD 114762 AB, HD 142 AB, HD 195019 AB, υ And AB, HD 222582 AB, HD 27442 AB, HD 46375 AB, τ Boo AB, HD 80606 AB, HD 41004 AB, HD 19994 AB, HD 11964 AB (for details see e.g. Mugrauer et al. 2007a); HD 147513 AB (Mayor et al. 2004); HD 75289 AB (Mugrauer et al. 2004a); HD 89744 AB (Mugrauer et al. 2004b); HD 16141 AB, HD 114729 AB, and HD 213240 AB (all described in detail in Mugrauer et al. 2005); HD 38529 AB, and HD 188015 AB (both reported by Raghavan et al. 2006); HD 189733 AB (Bakos et al. 2006); HD 142022 AB (Eggenberger et al. 2006); HD 196885 AB (Chauvin et al. 2007); HD 20782 AB, and

[1] For all exoplanet host star systems listed, the first component is always the exoplanet host star, the second one is its stellar companion.

HD 109749 AB (both described by Desidera & Barbieri 2007); γ Cep AB (whose B component was directly detected first by Neuhäuser et al. 2007, who also clarified the true nature of this component); HD 101903 AB (Mugrauer et al. 2007b); HD 177830 AB (Eggenberger et al. 2007); ADS 16402 BA (Bakos et al. 2007); HD 156846 AB (Tamuz et al. 2008); HD 125612 AB, and HD 212301 AB (both presented in this work).

A.2. Exoplanet host triple star systems

HD 178911 B+AC, HD 40979 A+BC, 16 Cyg B+AC, and HD 219449 A+BC (see Mugrauer et al. 2007a, for details); HD 196050 A+BC (see Mugrauer et al. 2005b; Eggenberger et al. 2007); HD 65216 A+BC (Mugrauer et al. 2007b).

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