III. High-Resolution Imaging of Nearby M dwarfs

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Abstract. We present preliminary results of our search for companions around nearby M dwarfs using FastCam, the "lucky imaging" instrument at the 1.5m Telescopio Carlos Sánchez (TCS). These observations are part of our efforts to select and characterize the sample of stars for CARMENES. We review the main results of our search around 216 stars with spectral types from M1V to M6V. We have found that the binary fraction in our sample is 12.0±2.4%. We have found four low-mass companions with periods lower than 10 years, which are benchmark objects to determine dynamical masses and compare with theoretical evolutionary models. These observations are important to discard very close companions that may induce spurious variations in the radial velocity of the primary and mimic the presence of planets.

Observations and Data analysis.
High resolution images were obtained using the "lucky imaging" instrument FastCam (Oscoz et al. 2008) at 1.5m TCS on 2011 October 24, 25, 26, and 2012 January 30,31 and March 25, 26, 27.
For each target we took 10000 images of 50ms. Individual images were bias-subtracted, aligned and properly combined using the brightest pixel. Astrometric calibration was done using binaries of well known separations from Scardia et al. (2006, 2008).

Preliminary Results.
Preliminary analysis show that 179 of the 216 observed M dwarfs are single, 10 have unrelated visual companions and 26 are probably multiple, among of which 20 are new. Some examples can be seen in Fig. 1. This indicates a binary fraction of 12.0±2.4%, slightly lower than found in recent similar works around early M dwarfs (Bergfors et al. 2009, Janson et al. 2012, Jódar et al. 2012). Interesting companions with orbital periods lower than 10 yr are indicated in Table 1.
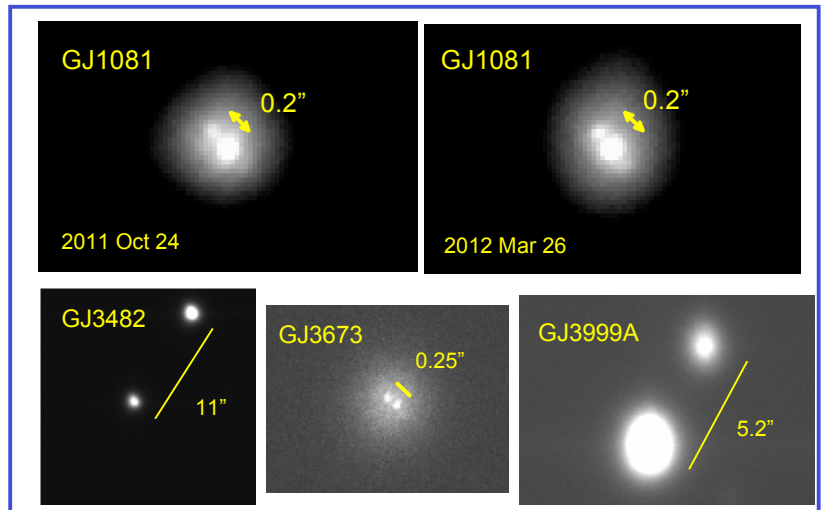

Figure 1. FastCam *I*-band images of binaries.
Top panel: confirmed common proper motion companion of GJ1081 observed at two different epochs. **Lower panel, left:** previously known companion of GJ3482; **middle:** possible physical companion of GJ3673; **right:** Unrelated visual companion around GJ3999A.
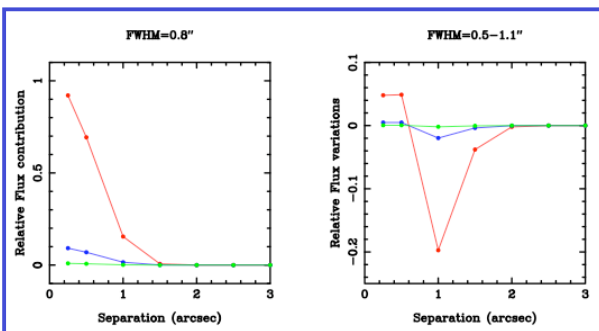

Figure 2. Flux contribution and variations induced by companions at different separations. Red, blue and green solid lines denote objects with a magnitude difference of 0, 2.5 and 5 mag, respectively.

Radial Velocity variations.
These observations will be used to discard very close companions (<5"), that produce radial velocity variations in their primaries due to photocentre deviations, illumination changes with seeing or by their own radial velocity variations. From Fig. 2, we can see that companions with Δmag <2.5 mag and sep.<2" will produce flux contributions >10% and flux variations >1%

Table 1. Physical properites of companions with period <10yr

Name	Separation (arcsec)	Separation (AU)	SpT1	M1 (Msol)	M2 (Msol)	Period (yr)
GJ3972	0.18	2.9	M2.5	0.45	0.45	5.2
GJ1081	0.20	3.1	M3.5	0.40	0.15	7.4
GJ3673	0.25	4.1	M3.5	0.40	0.40	9.0
GJ3919	0.21	3.7	M4.0	0.30	0.20	10.0

References.
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