CARMENES input catalogue of M dwarfs: High-resolution imaging with FastCam

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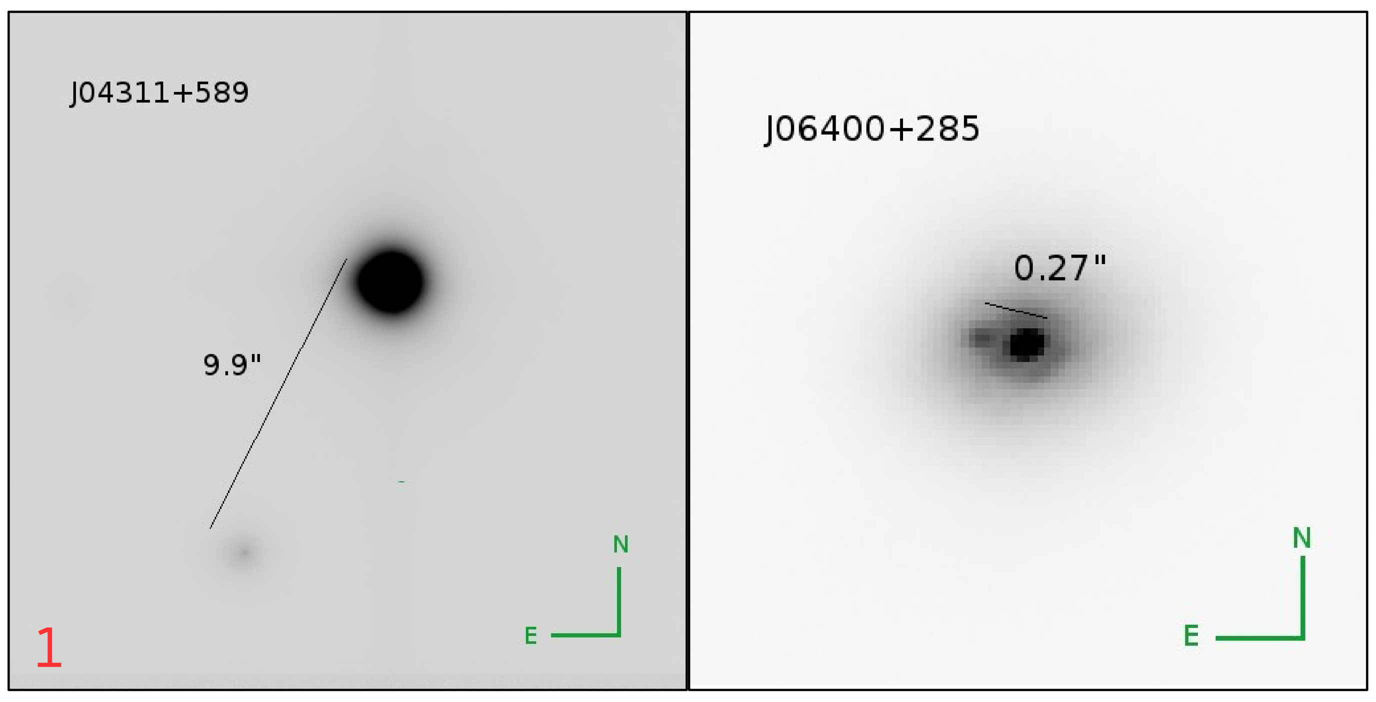
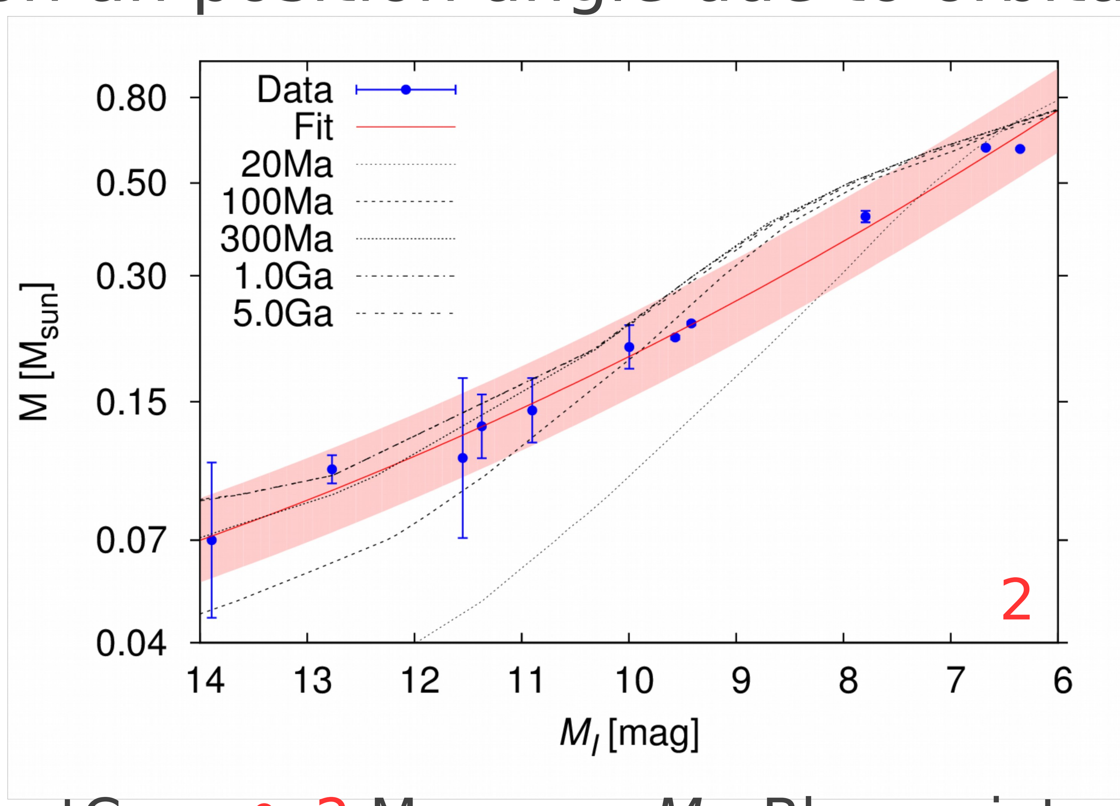
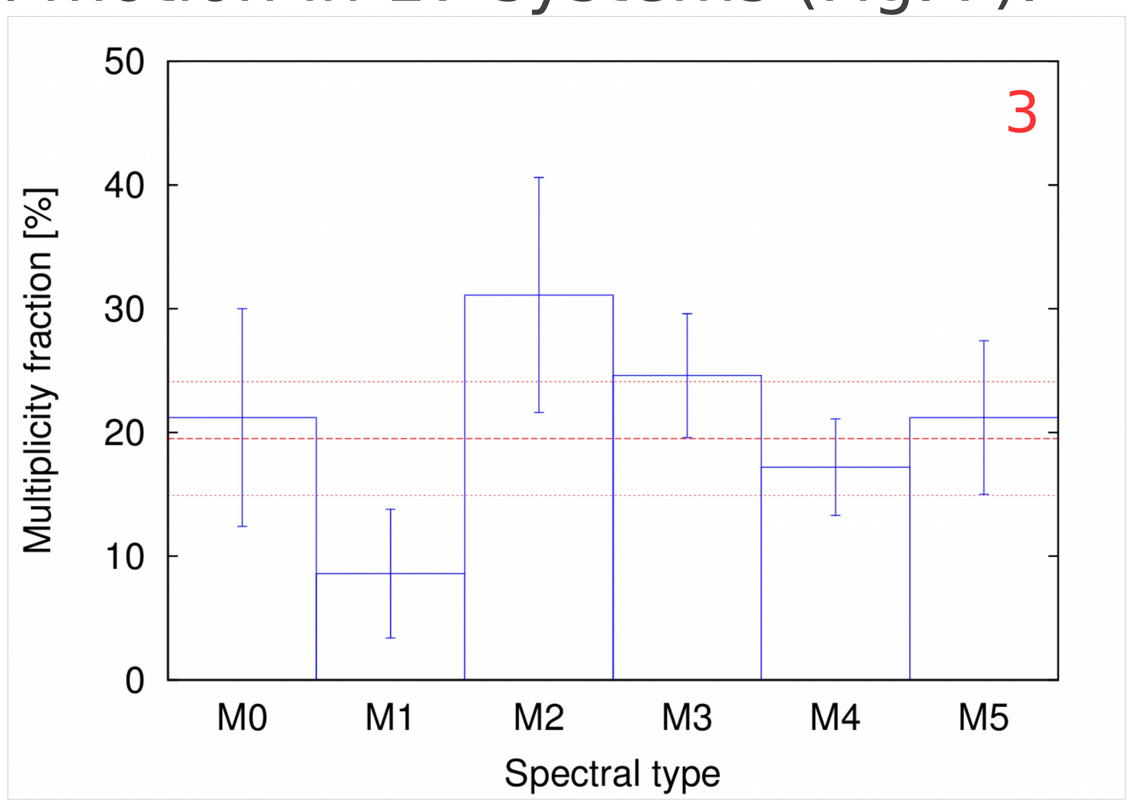
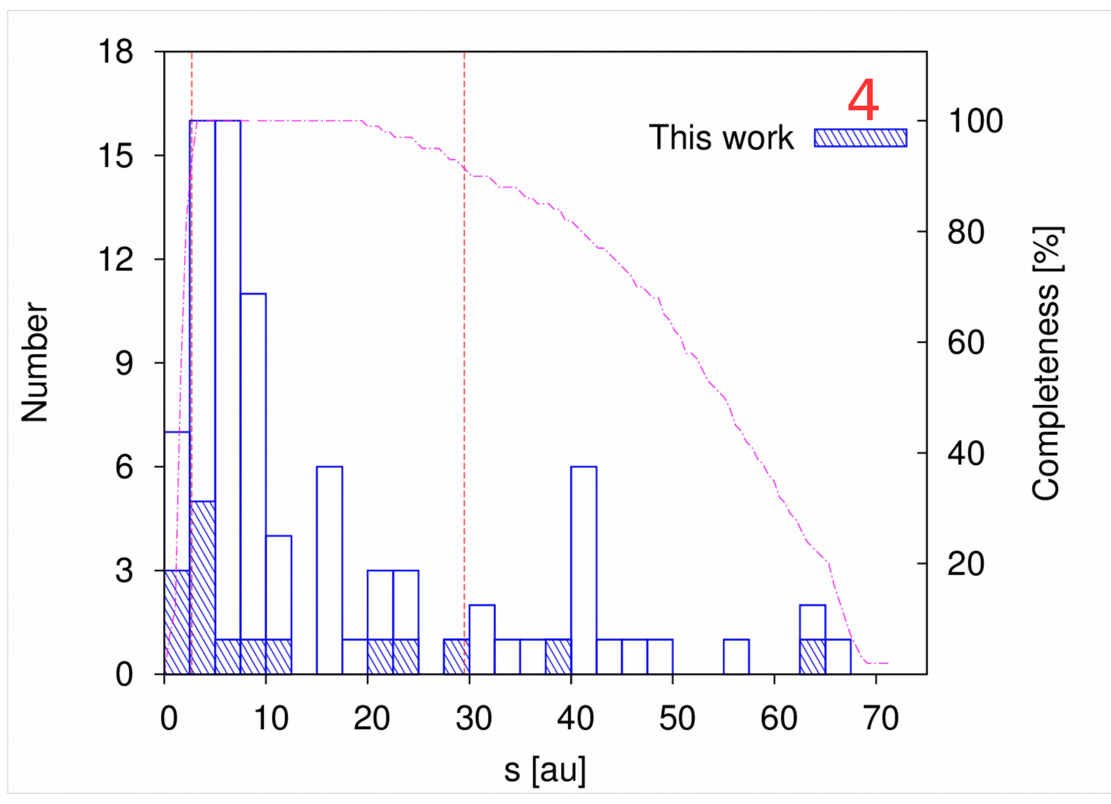
Aims. We aim to look for low-mass companions of M dwarfs and select the most appropriate CARMENES targets by discarding binary stars with very close companions that may induce spurious variations in the radial velocity of the primary and mimic the presence of planets.
Methods. We obtained high-resolution images in the I-band with the lucky imaging instrument FastCam at the 1.5m Telescopio Carlos Sánchez for 490 mid- to late-M dwarfs (Fig. 1). For all the detected pairs we measured angular separations, estimated the masses of the components from our own mass-M_I relation or BT-Settle evolutionary models for young stars (Fig. 2), and calculated orbital periods.
Results. From the 490 observed stars, we detected 80 companions in 76 systems, of which 30 are new discoveries. We found a multiplicity fraction in our observed sample of 16.5±2.0%. We built a volume limited sample and derived a bias corrected multiplicity fraction of 19.5±2.3% for angular separations from 2.0 to 5.0 arcsec (1.4-65.6 au) (Fig. 3). The distribution of the projected physical separations (s) of the pairs in the volume limited sample has a peak at 2.5–7.5 au (Fig. 4). For primaries earlier than M3.5V, our search is sensitive to mass ratios larger than 0.3. There is a higher density of pairs with mass ratios over 0.8 compared to those at lower mass ratios (Fig. 5). Binaries with projected physical separations shorter than 50 au also tend to be of equal mass (Fig. 6). For 26 of our systems, we estimated orbital periods shorter than 50 a, 10 of which are presented here for the first time. We measured variations in angular separation an position angle due to orbital motion in 17 systems (Fig. 7).

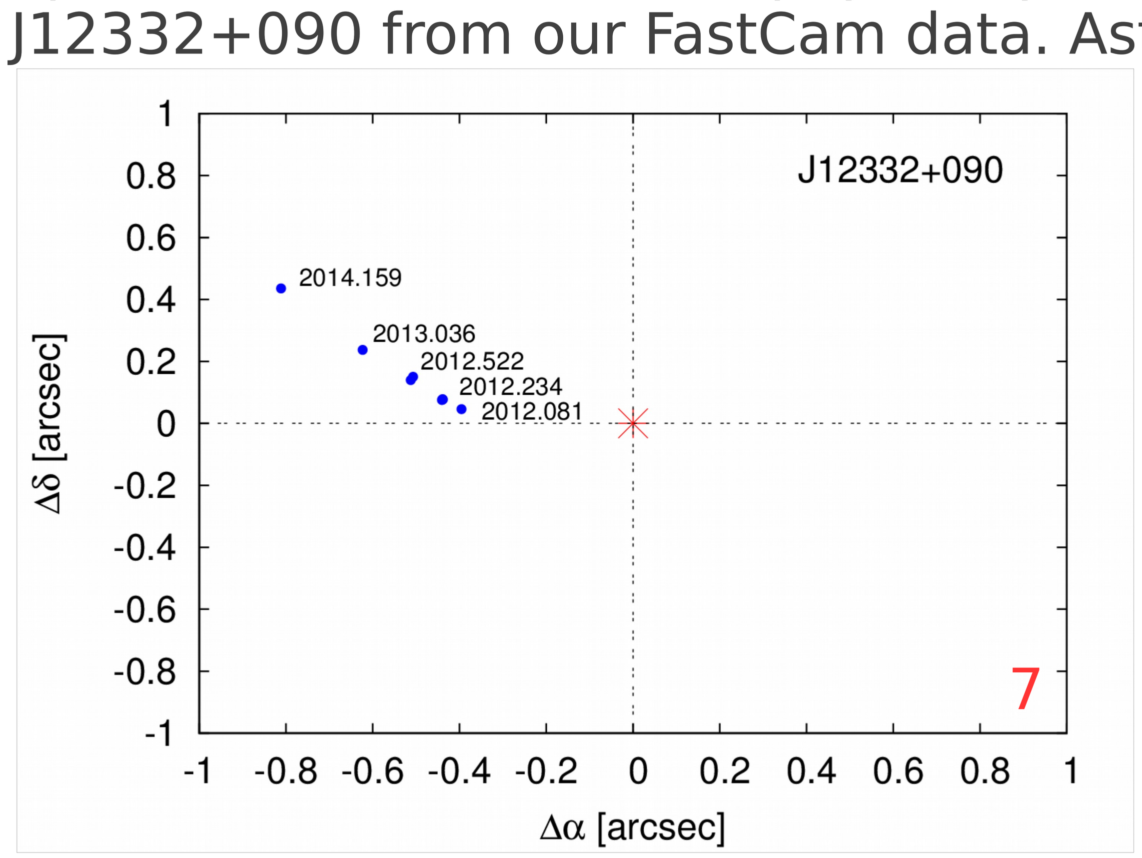


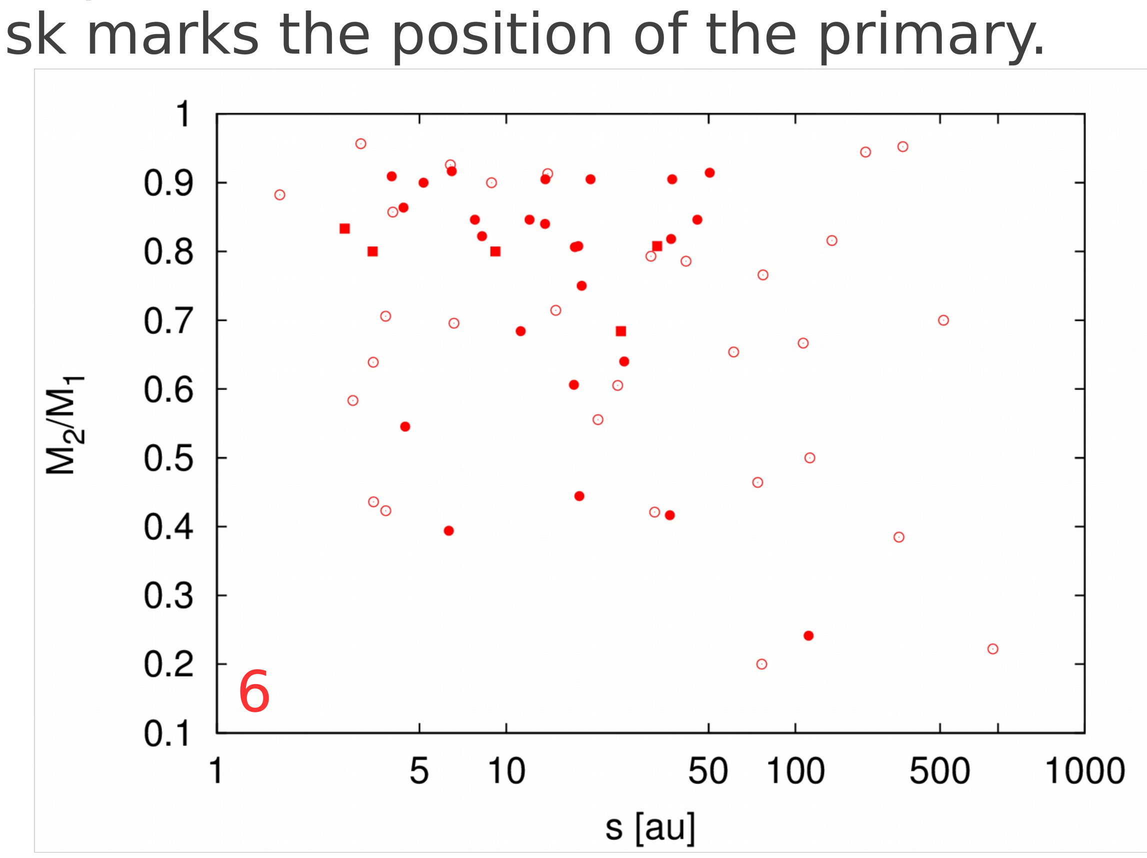


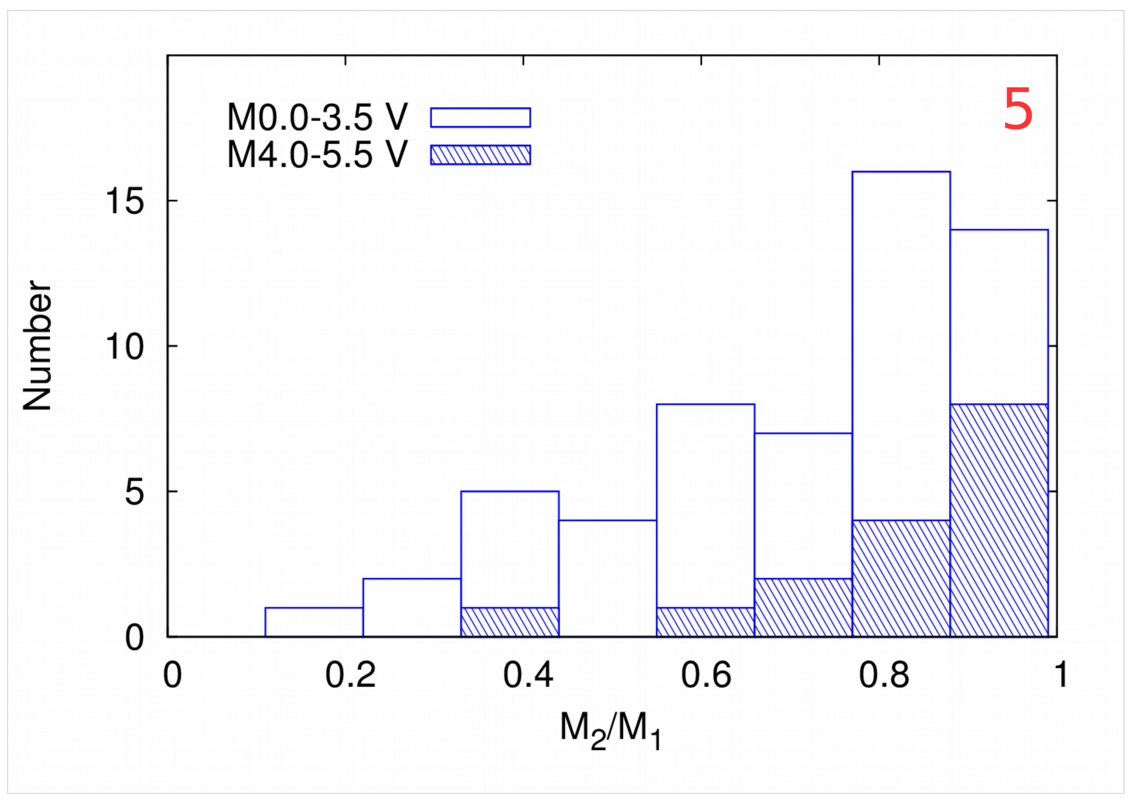


1.Selection of binary systems identified with FastCam • 2.Mass vs. M_I. Blue points represent the dynamical masses and absolute magnitudes taken from the literature. The red solid line and shadowed area represent the best fit ±2σ • 3.Multiplicity fraction as a function of spectral type in the volume limited sample. Horizontal dashed and dotted lines are the global multiplicity fraction and the ±2σ values • 4.Projected physical separation distribution of the binaries in the volume limited sampe. Vertical dashed lines mark the 90% completeness and the dash-dotted curve represents the completeness as a function of the projected physical separation • 5.Mass ratio distribution of our binaries. Empty and dashed bars differentiate the mass ratio distribution of M0.0–M3.5 and M4.0–M5.5 dwarfs • 6.Mass ratio vs. s. Filled circles are new physically bound pairs, small filled squares are unconfirmed related pairs, and open circles are known physically bound pairs • 7.Orbital variation of the pair J12332+090 from our FastCam data. Asterisk marks the position of the primary.









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