First Results from the PARSEC and IPERCOOL Programs - Parallaxes, Proper Motions, and Binarity of Brown Dwarfs

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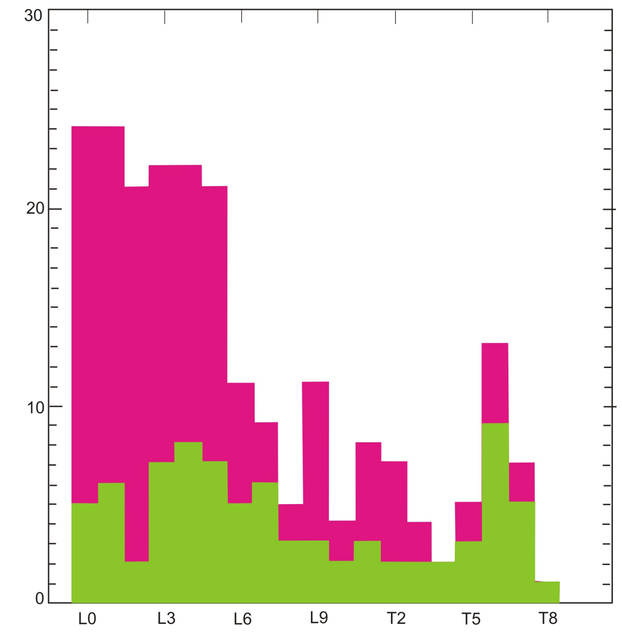
Building from the ESO 2.2m/WFI PARSEC Program started in April 2007, the Program IPERCOOL (Interpretation and Parameterization of Extremely Red Cool Dwarfs) brings together ON/MCT (Observatorio Nacional), OATo/INAF (Osservatorio Astronomico di Torino), SHAO (Shanghai Astronomical Observatory) and University of Hertfordshire for the observation, interpretation and analysis of brown dwarfs, in special the ultra cold L and T classes. Discovered as recently as 1995, brown dwarfs quickly established itself as a new area in astronomy. A key point of IPERCOOL is the **determination of parallaxes, proper motions, and multi-epoch two-band photometry for 140+ southern ultra cool objects**, multiplying by three the number of those with distance precisely known and detailing the HR diagram in the region. Most of these objects will **not** be observed by GAIA as they are too faint in the G band and those that are bright enough will be of similar precision to this program. The large field of the WFI camera and the targets distribution make for an unbiased sample of austral skies but for the thin galactic disk belt.

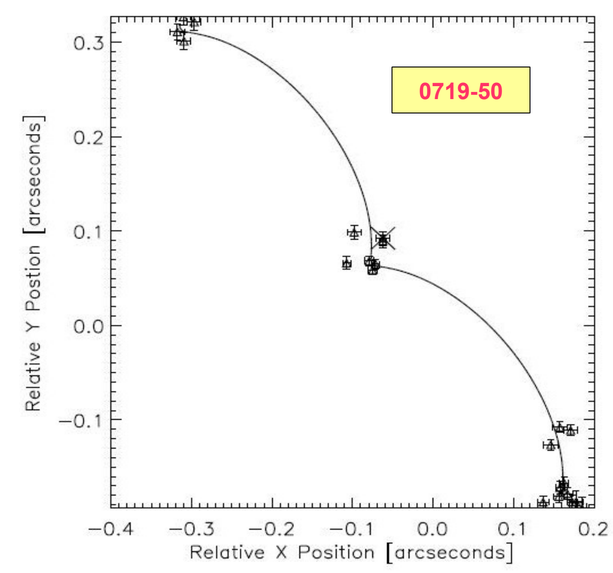


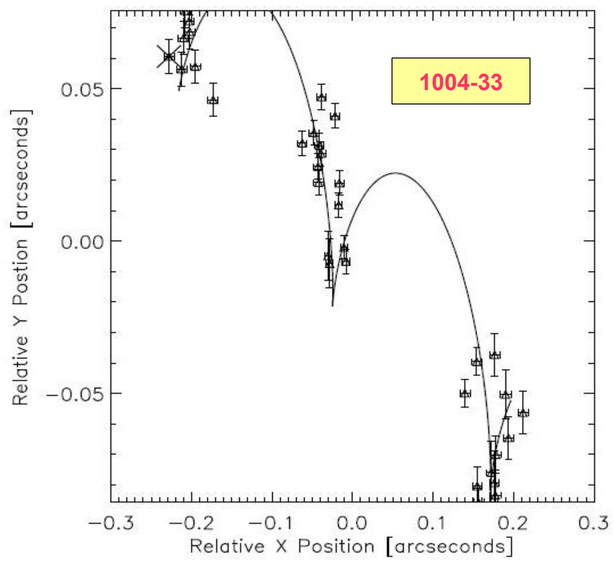
Parallaxes: The importance of parallaxes in astronomy is well known, however, these are objects with different properties to stars and our knowledge of them is still in it's infancy. We present preliminary parallaxes with a 4.2 mas median precision for 10 brown dwarfs, 2 of which are within 10pc (marked p). Those increase increase by 11% the present number of L dwarfs with published values. Of the 10 targets, 7 have been previously discussed in the literature: two were thought to be binary but the PARSEC observations show them to be single, one has been confirmed as a binary companion and another has been found to be part of a binary system (binaries marked b).

Table 3: Parallaxes and proper motions for a sample of PARSEC L-dwarfs.

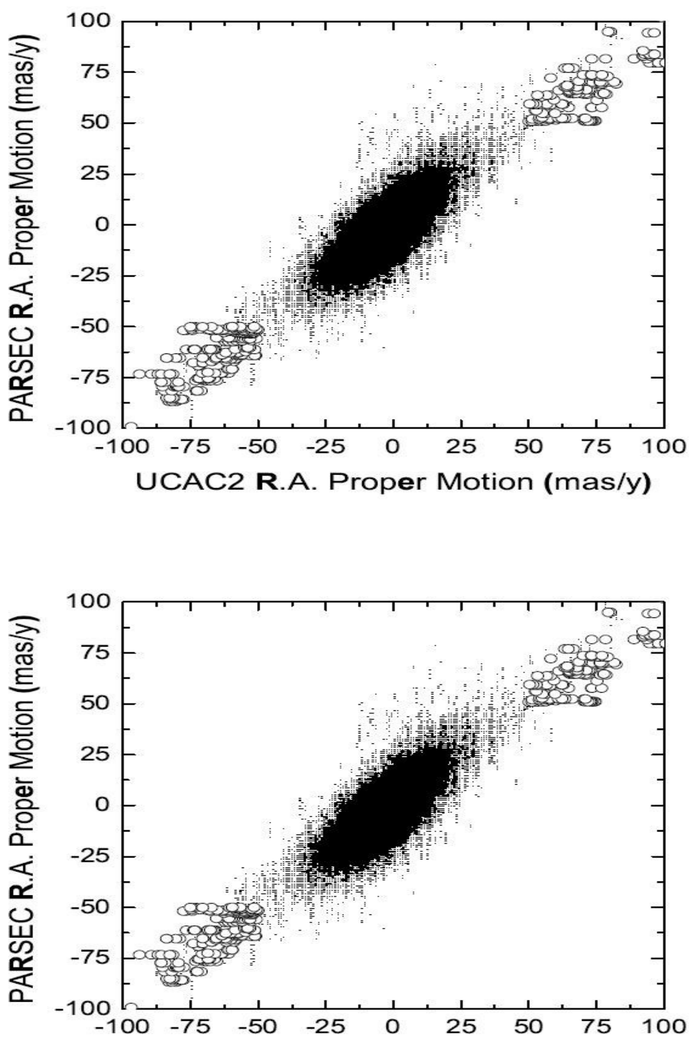
	ID	α h:m:s	δ d:':"	N_*, N_f	π mas	μ_α mas/yr	μ_δ mas/yr	ΔT yrs	COR mas
	0539-00	5:39:51.9	- 0:58:58.3	31, 12	82.0 ± 3.1	157.0 ± 4.8	321.6 ± 3.9	1.40	1.13
	0641-43	6:41:18.5	-43:22:28.0	14, 29	55.7 ± 5.7	215.9 ± 8.9	612.8 ± 9.0	1.95	1.00
b	0719-50	7:19:32.0	-50:51:41.3	22, 34	32.6 ± 2.4	198.1 ± 3.2	-61.4 ± 3.9	1.98	0.90
p	0835-08	8:35:42.2	- 8:19:21.7	9, 20	117.3 ± 11.2	-519.8 ± 7.7	285.4 ± 10.5	1.96	1.08
	0909-06	9:09:57.3	- 6:58:18.8	20, 23	42.5 ± 4.2	-184.0 ± 2.5	20.7 ± 3.0	2.08	1.19
b	1004-33	10:04:39.5	-33:35:21.9	16, 22	54.8 ± 5.6	243.5 ± 4.0	-253.2 ± 3.4	2.06	9.51
	1018-29	10:18:58.5	-29:09:54.2	32, 23	35.3 ± 3.2	-340.8 ± 1.8	-94.0 ± 2.7	2.08	1.01
	1539-05	15:39:42.1	- 5:20:41.5	17, 18	64.5 ± 3.4	603.1 ± 2.6	105.0 ± 3.4	2.06	1.12
p	1705-05	17:05:48.4	- 5:16:46.9	96, 17	44.5 ± 12.0	110.9 ± 12.1	-115.5 ± 7.1	1.98	0.59
	1750-00	17:50:24.5	- 0:16:13.6	29, 39	108.5 ± 2.6	-398.3 ± 3.1	195.3 ± 3.4	2.08	0.56

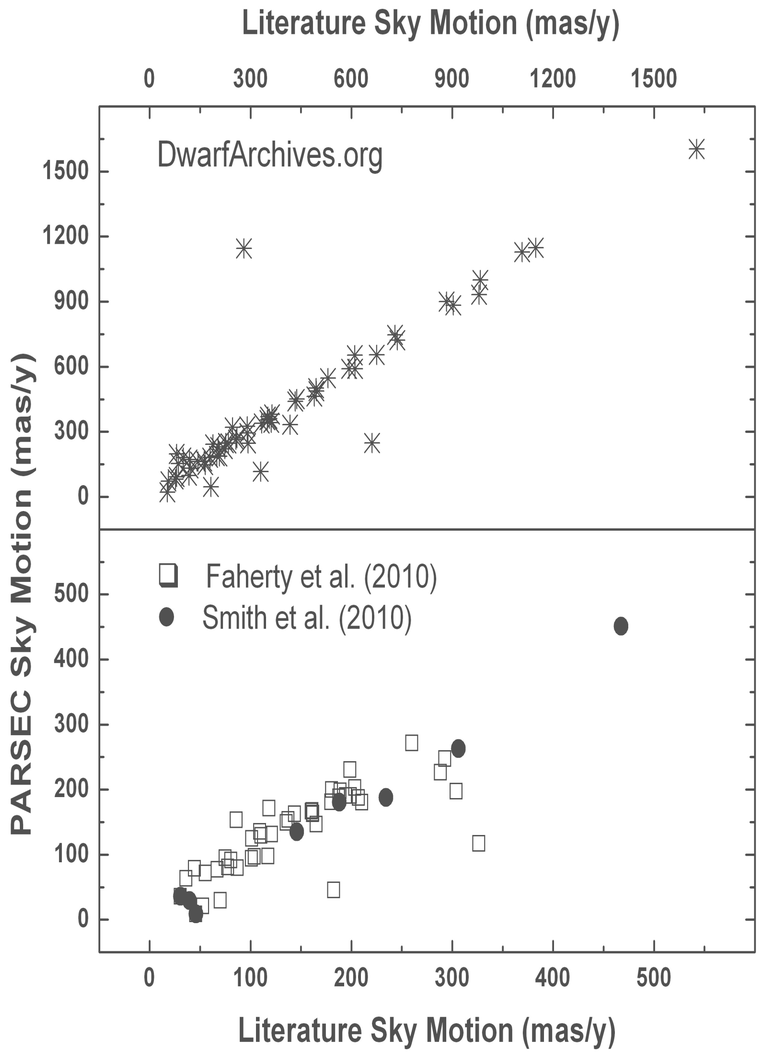
NOTE.—N_* = number of reference stars, N_f = number of frames, ΔT = epoch range, COR = correction to absolute parallax.





Proper Motion Catalog: The parallax determination of the targets uses only the upper third of CCD7; however, the reduction pipeline is applied to the entire mosaic of 8 CCDs. From this data we have constructed a proper motion catalogue, sampling the whole of the southern hemisphere with the exception of the lowest galactic latitudes where the number of known L/T dwarfs is significantly reduced. This proper motion survey can be used to search for companions to the targets, other fast moving - hence nearby - objects, and, combined with the magnitudes, to build a reduced proper motion diagram to search for brown dwarf candidates. This catalog contains proper motion determinations for 195,700 objects. Independently for each CCD and each observation we determine an astrometric reduction relative to the Second US Naval Observatory CCD Astrograph Catalog. The average number of reference stars is 20, with which polynomial functions are adjusted on right ascension and declination. Depending on the number of reference stars the polynomial degree is 2 or 3 and cross terms may be included. The rms errors of the solutions did not show any dependence on the type of polynomial employed. The histograms of the right ascension and declination proper motions distributions show that the mean value for is -2.8mas/yr (standard deviation=12.1mas), and -4.0mas/yr (standard deviation=12.3mas) for . This compares well with the corresponding values for the UCAC2 catalogue in the same regions, which are, -2.7mas/yr (standard deviation =14.6mas) for R.A., and -3.6mas/yr (standard deviation=30.1mas) for DEC. Zonal averages ($3^h \times 30°$) also produce similar means for the PARSEC program and the UCAC2 catalogue stars.





Identification of outliers: we plot the reduced proper motion, $H(K) = K + 5 \times \log(\mu_{tot}) + 5$, as a function of the $(z - K)$ color.

The z magnitudes come from a zero point correction to the instrumental magnitudes of the first observations, the *K* magnitudes are from the 2MASS. The points are anonymous field stars and the diamonds are the brown dwarf targets. The line shows the cut we used to identify possible brown dwarf candidates for spectroscopic follow-up.