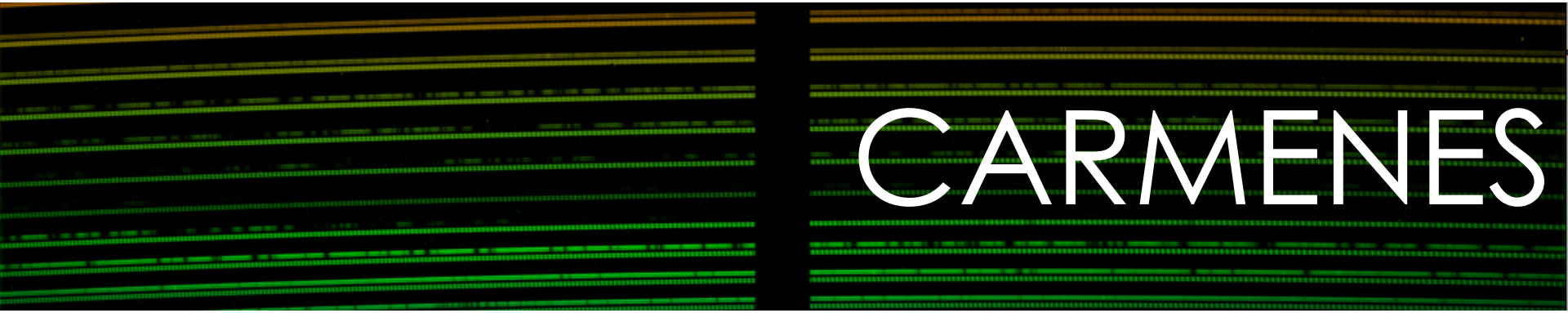
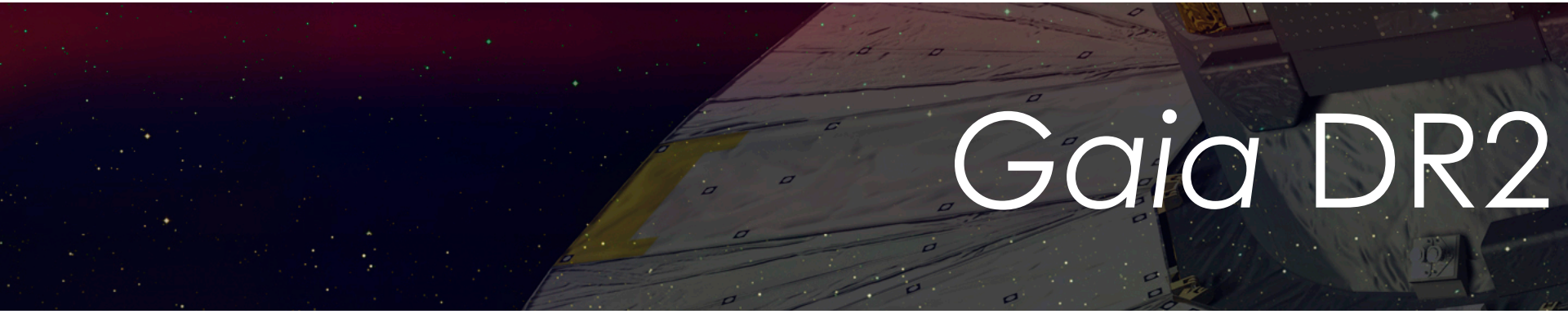


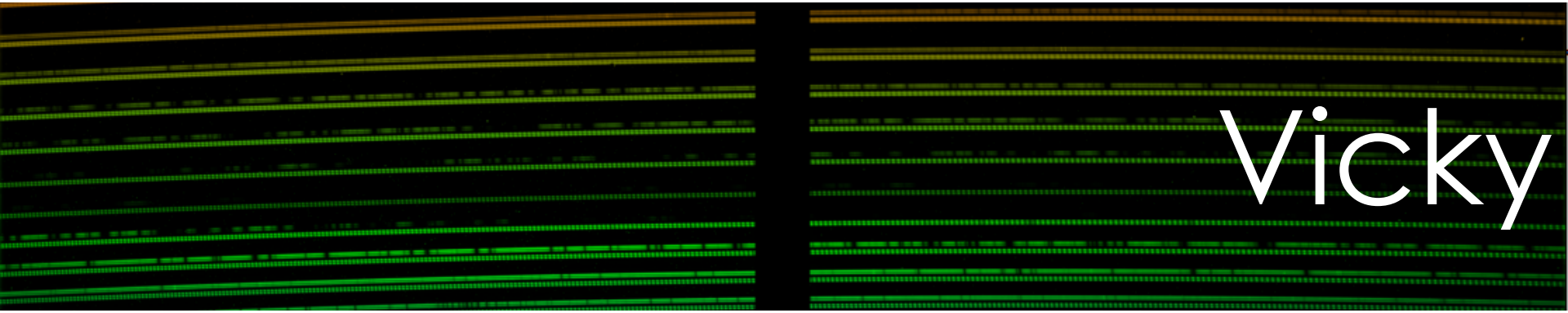
CARMENES

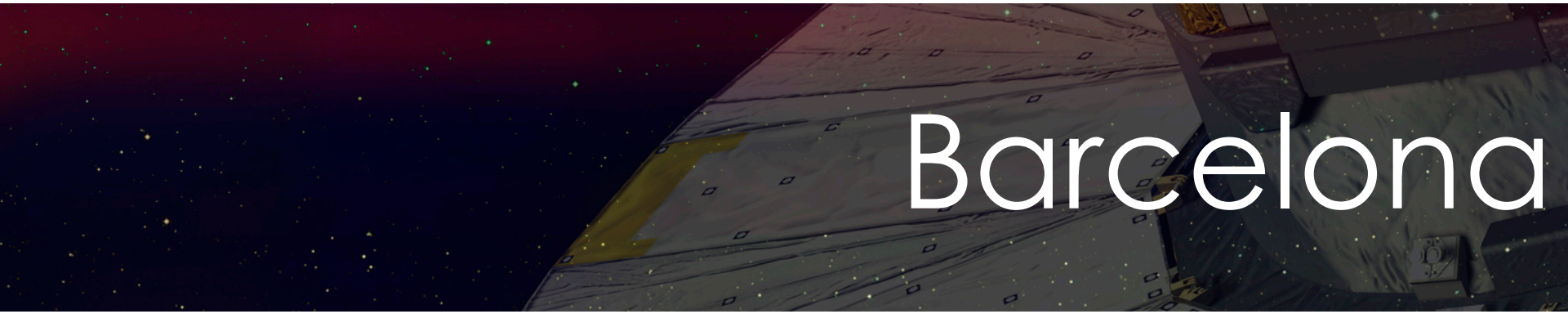
σ Orionis



Gaia DR2

José A. Caballero
Centro de Astrobiología





Woody Allen

Bardem, Cruz, Johansson, Hall…

BajaMasa RecGaia research lines

- **EXOS:** exoplanetary systems
  - EXOS-1: astrometry of known systems
  - EXOS-2: radial velocity of new systems
  - EXOS-3: detailed characterisation
- **MLT:** ultracool dwarfs
  - MLT-1: late M (H-R diagrams, kinematics…)
  - MLT-2: L and T (isolated or companions)
- **YBD:** young brown dwarfs
  - Bottom of the (I)MF in young open clusters and stellar associations

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Gaia & BDs 2017

The Gaia ultracool dwarf sample – I. Known L and T dwarfs in the first Gaia data release
Smart, Marocco, Caballero et al.
2017MNRAS.469.401S

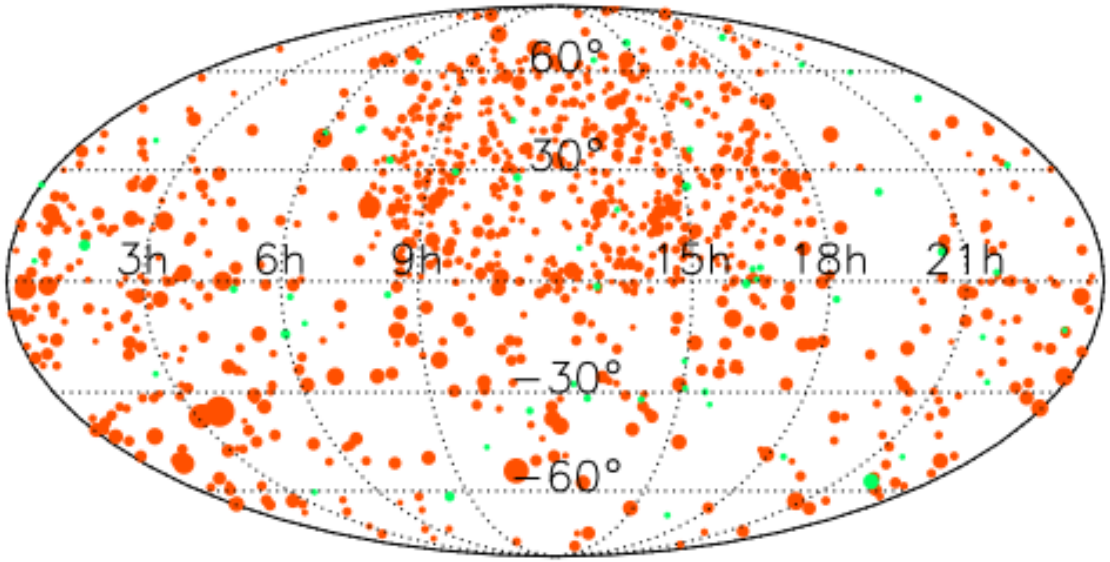

Figure 4. The equatorial distribution of 1010 L (red) and 58 T (green) dwarfs with $G_{\rm est} < 21.5$ mag. The size of the symbol indicates the $G_{\rm est}$ magnitude – larger is brighter.

Gaia & BDs 2017

The Gaia ultracool dwarf sample – I. Known L and T dwarfs in the first Gaia data release
Smart, Marocco, Caballero et al.
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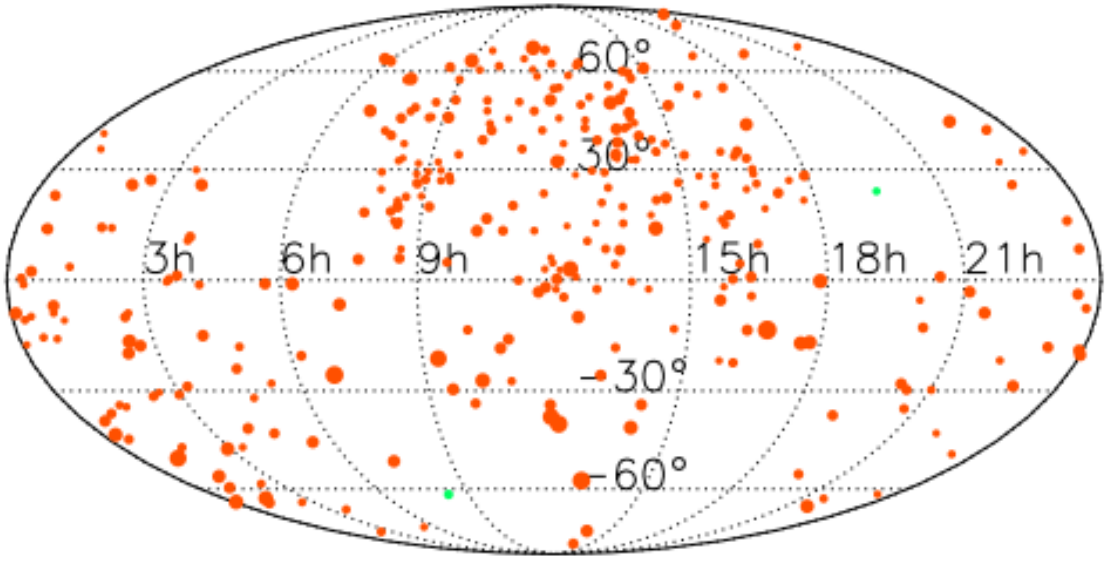
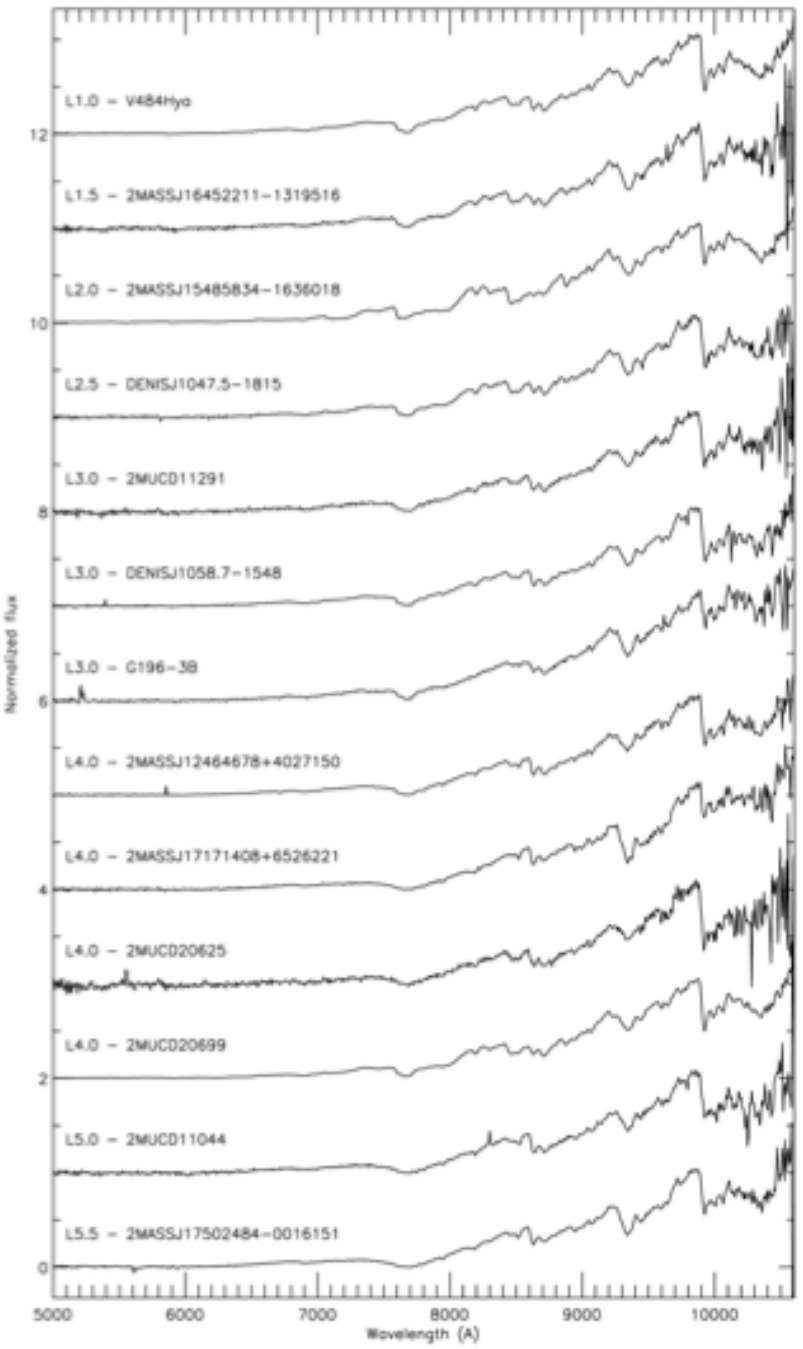
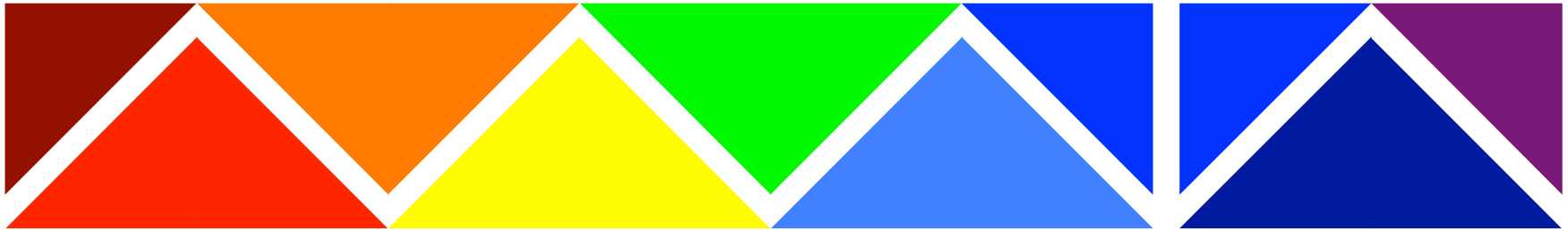


Figure 6. Same as Fig. 4, but for the 321 L (red) and T (green) dwarfs with an entry in *Gaia* DR1.

Gaia & BDs 2018

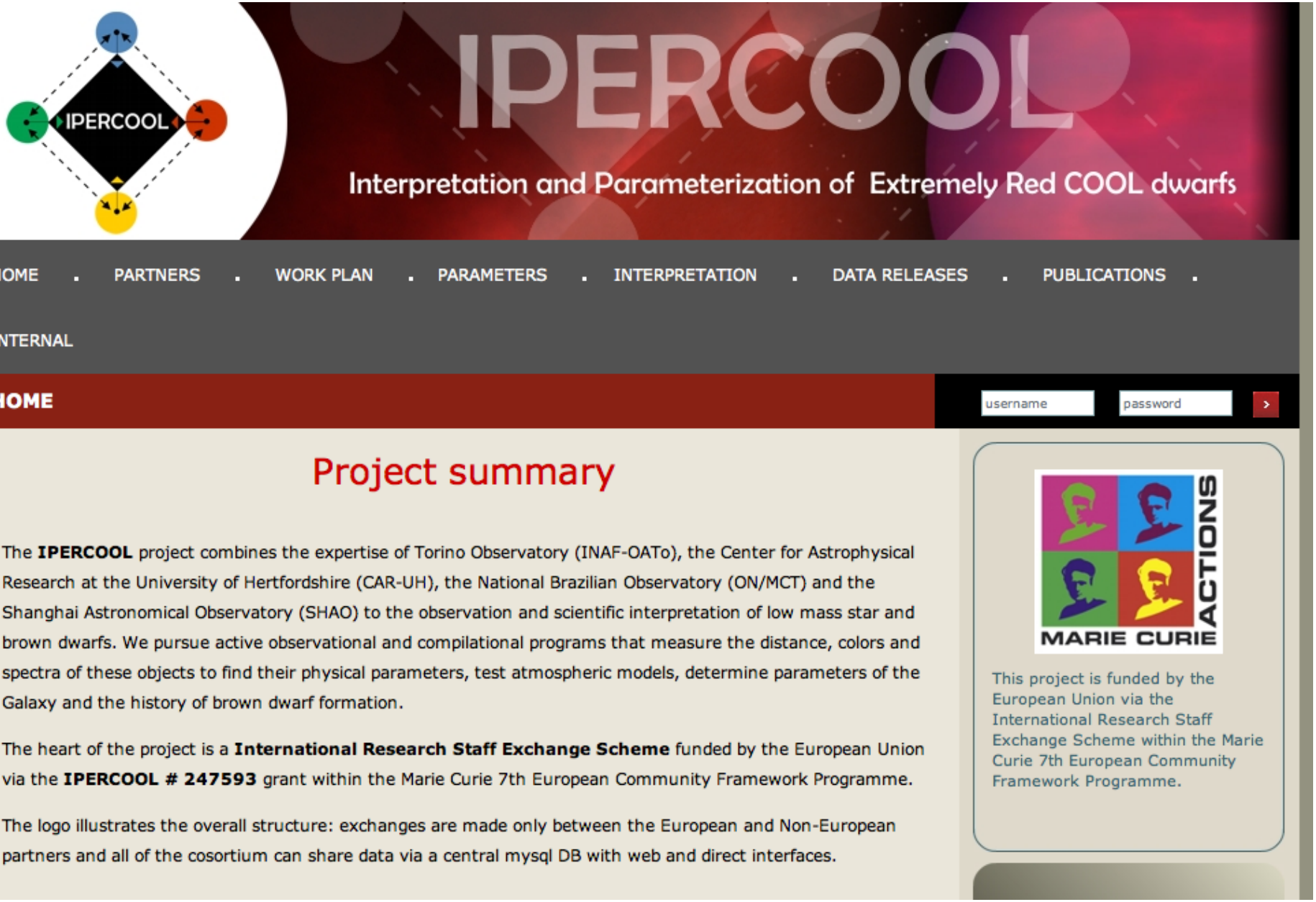
The Gaia ultracool dwarf sample – II. Known L and T dwarfs in the ***second*** *Gaia data release*
Smart et al.
2018, MNRAS
to be submitted





MAIA

Gaia, brown dwarfs and cool neighbours: an **M-, L- and T-dwarf Archive of Interest for Astrophysics**



IPERCOOL → MAIA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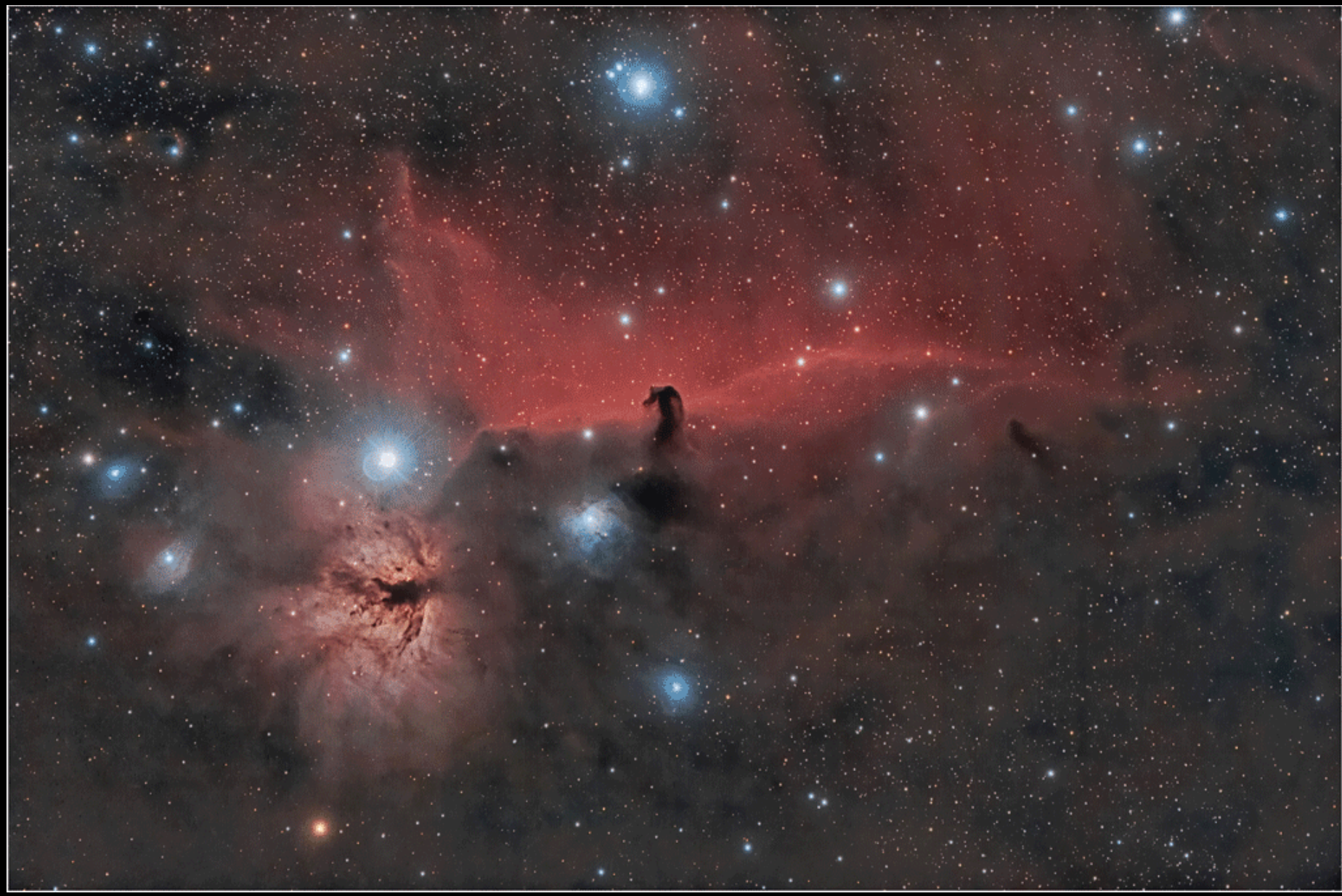
MARIE SKŁODOWSKA-CURIE RESEARCH AND INNOVATION STAFF EXCHANGE (RISE)
H2020-MSCA-RISE-2015
Opening Date 06-01-2015
Budget €80,000,000
Status Open
Deadline Date 28-04-2015 17:00:00 (Brussels local time)
Programme Horizon 2020
Main Pillar Excellent Science
OJ reference OJ C361 of 11 December 2013
Call description
Call documents
Get support
Call updates
13-03-2015 17:02:37
A revised RISE 2015 - FAQs (under Call documents) has been updated and published.
+ More
Topics and submission service

RISE H2020

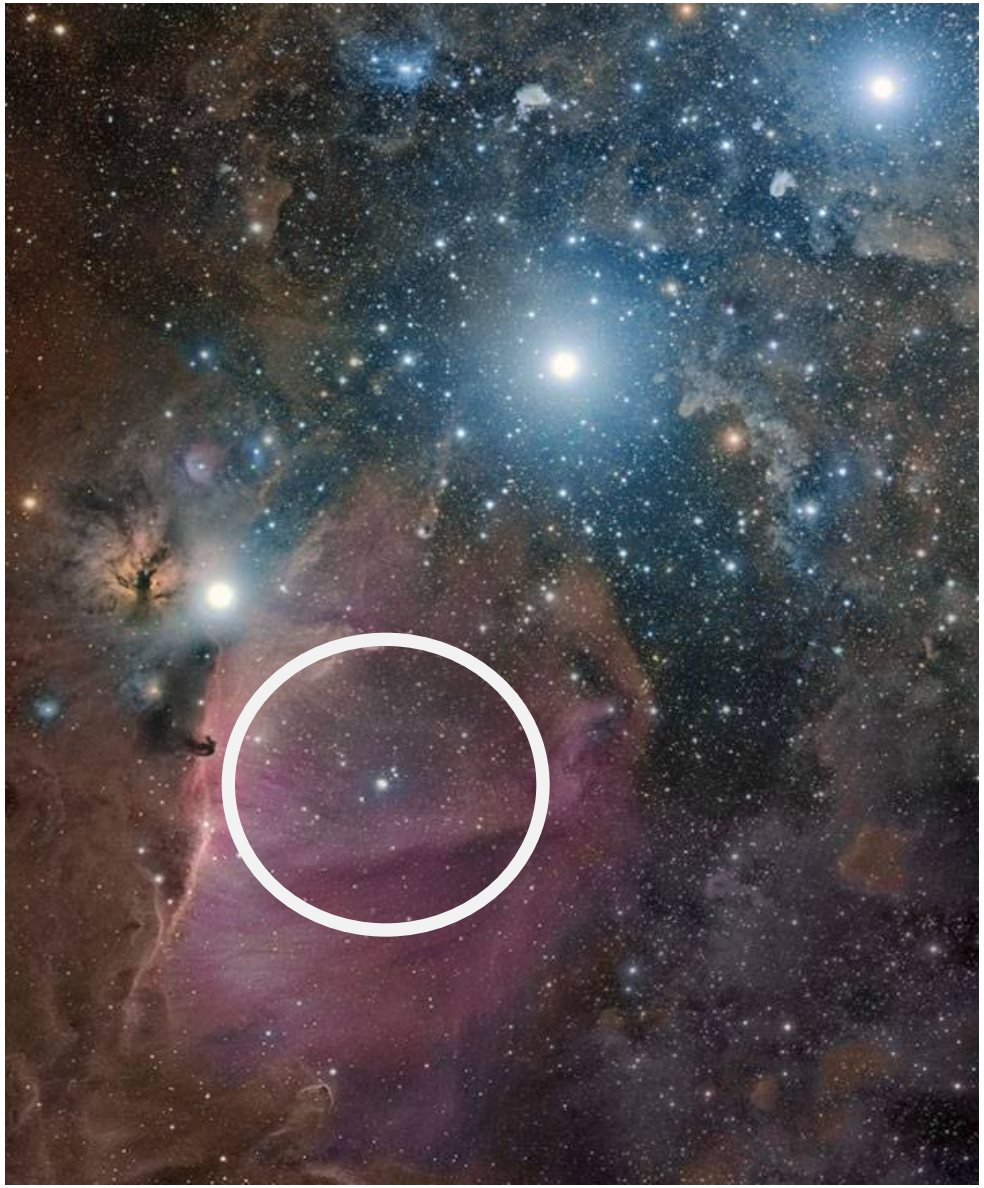
The East of the Orion Belt (Alnitak, σ Orionis, The Horsehead, The Flame...)



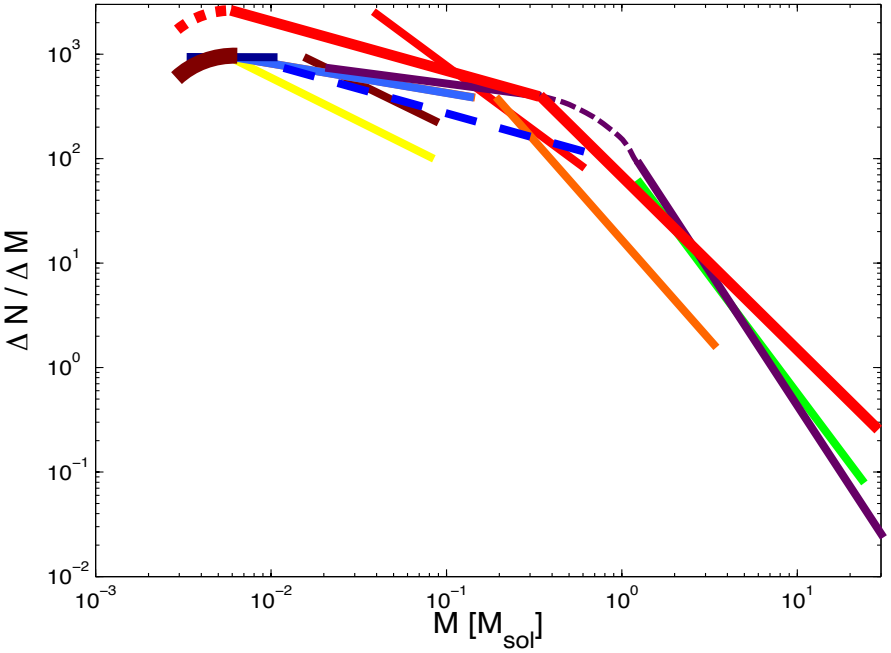
Raúl Alcaraz Gómez, AstronomíA & Caballero et al.

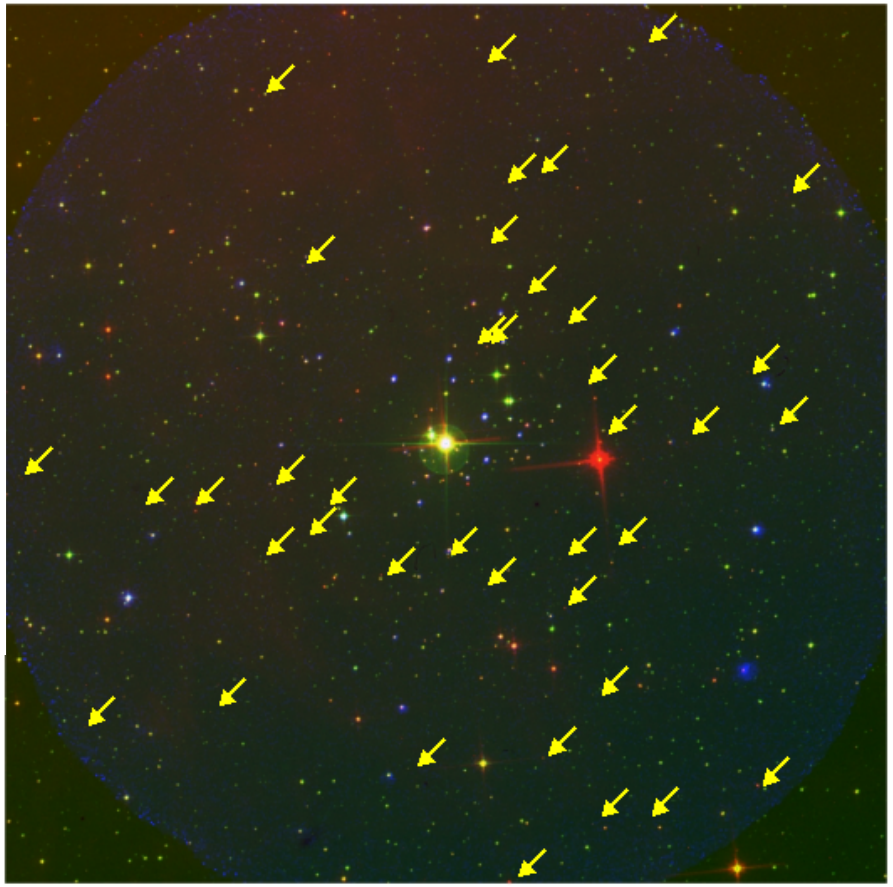
σ Orionis: basic parameters

Ori OB1b
(or not?)
Age τ ~ 3 Ma
(2-4 Ma)
Distance d ~ 385 pc
(352-440 pc)
Radius ρ ~ 30 arcmin
(20-arcmin core)
Extinction A_V < 0.3 mag
(very low $E(B-V)$)
Solar metallicity
([Fe/H] = 0.0)



The σ Orionis (initial) mass function





Distance d ~ 385 pc (?)
Proper motion μ < 10 mas a^{-1}

A precise (and accurate?) distance to σ Ori

- Simón-Díaz, Caballero et al. (2011, 2015) → Hi-res spectroscopy
- Schaefer et al. (2016) → Optical interferometry
- d = 387.5 ± 1.3 pc

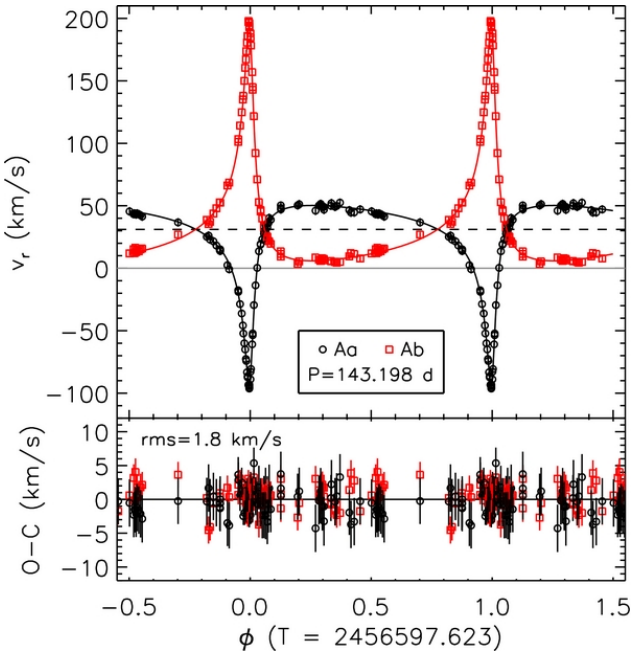
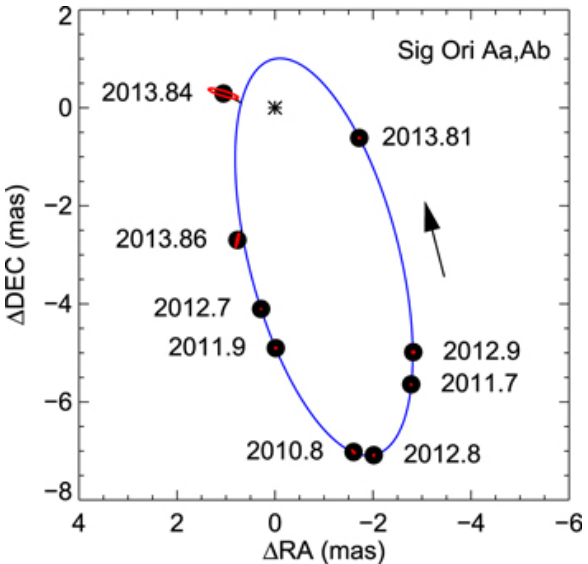


Table 11
Derived Properties for σ Orionis Aa,Ab, and B

Parameter	Value
M_{Aa} ($M_\odot$)	16.99 ± 0.20
M_{Ab} ($M_\odot$)	12.81 ± 0.18
M_B ($M_\odot$)	11.54 ± 1.15
π (mas)	2.5806 ± 0.0088
d (pc)	387.51 ± 1.32

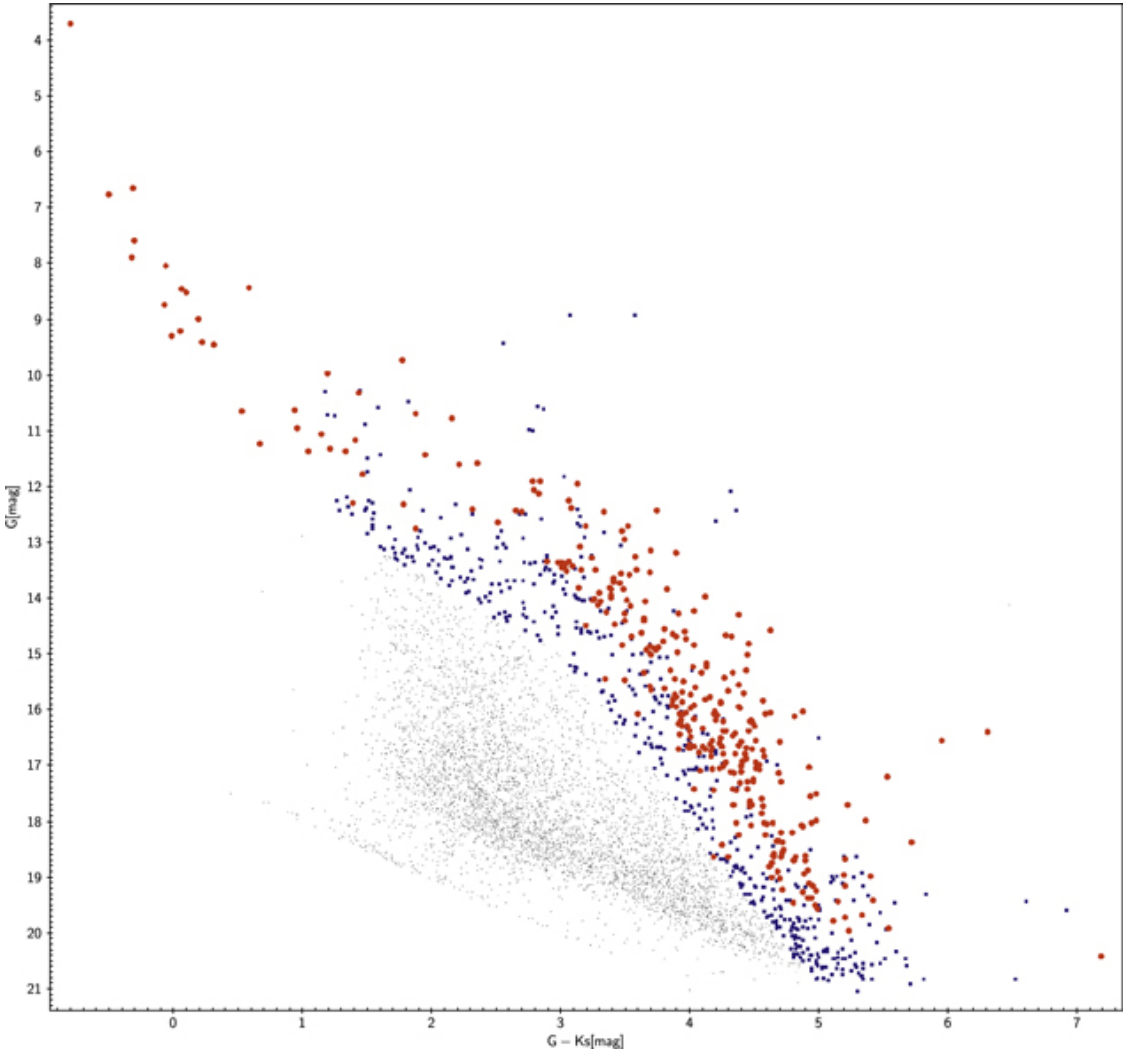


Gaia DR2 & σ Orionis

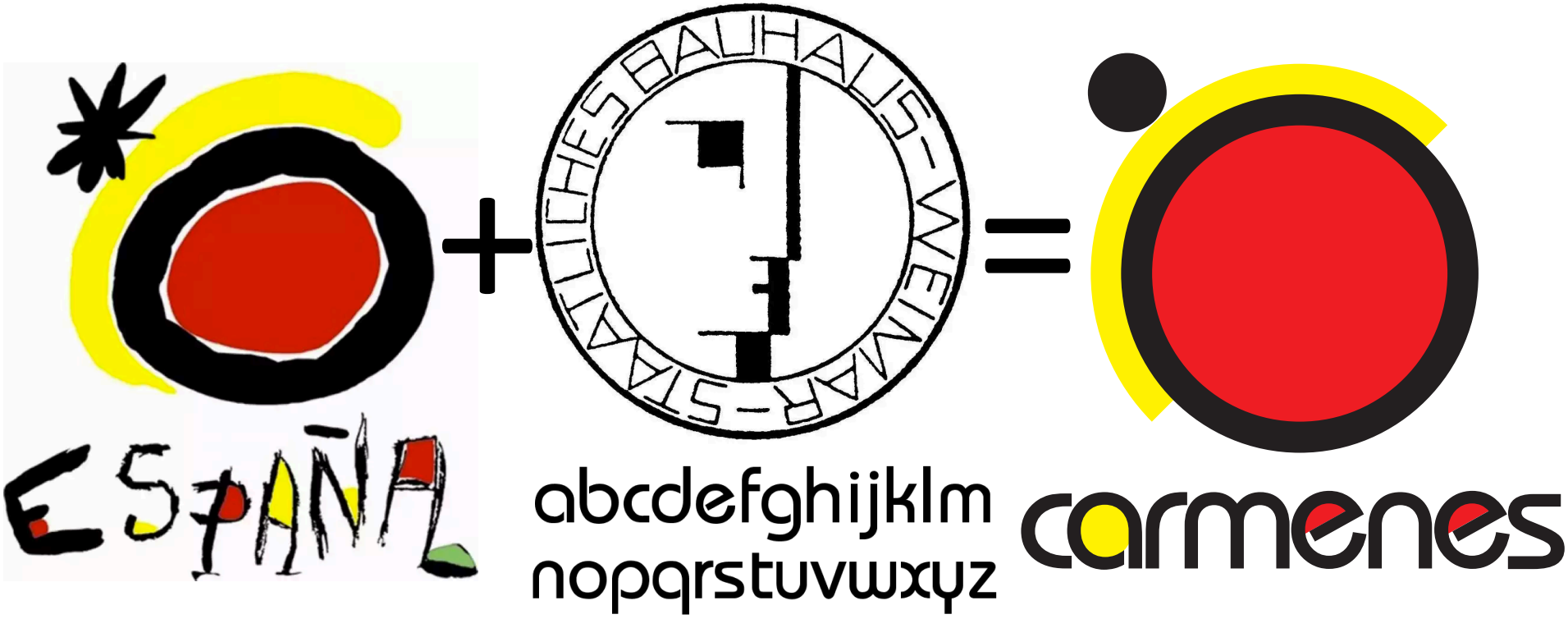
Colour-magnitude diagram from 17 M_{sol} to ~0.05 M_{sol}

d = 391 ± 3 pc, discard numerous AFG-type stars with **discordant proper motion and parallax** → Impact on IMF (and star-to-brown dwarf ratio, disc frequency, spatial distribution…)

Caballero 2018RNAAS…2…25C



carmenes



MAX-PLANCK-GESELLSCHAFT CSIC ICE Institut für Astrophysik Göttingen TLS hs Unión Europea Fondo Europeo de Desarrollo Regional "Una manera de hacer Europa" Calar Alto KTS DFG DLR

Calar
Alto high-
Resolution search for
M dwarfs with
Exoearths with
Near-infrared and visible
Echelle
Spectrographs

carmenes

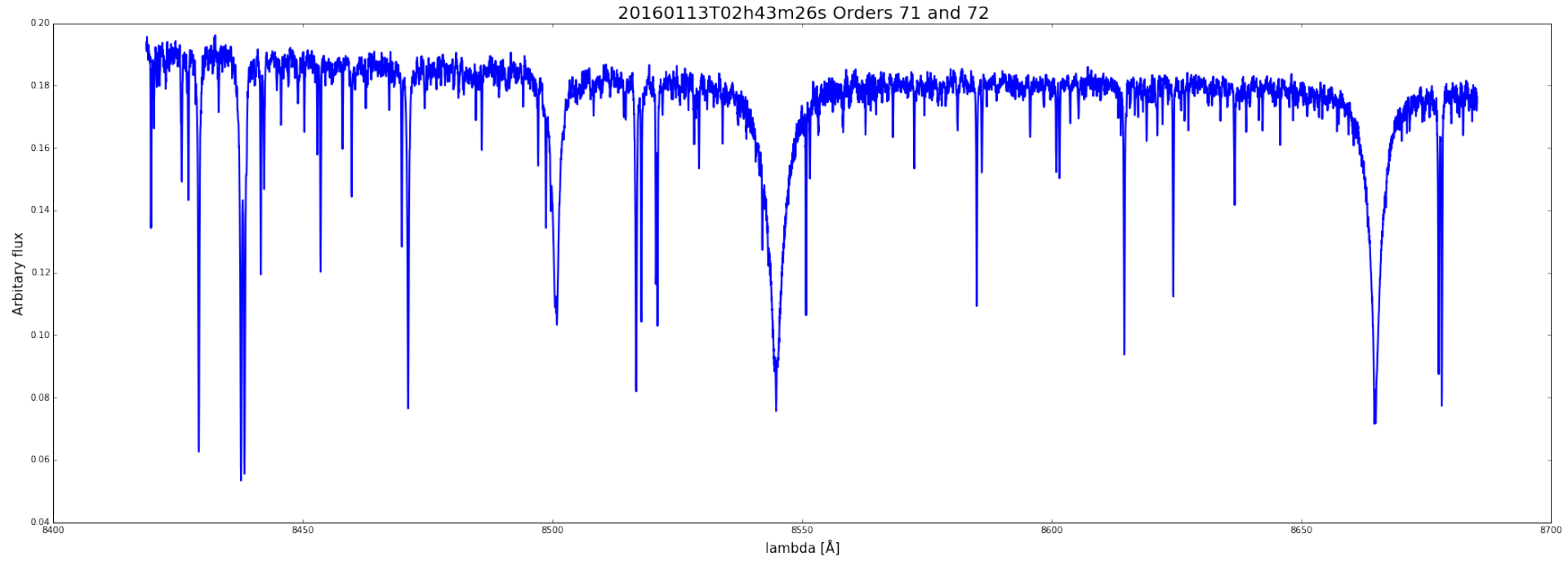
← **Calar Alto…**
3.5 m Zeiss Telescope
2168 m, +37.2236° N
Almería, Spain

Calar
Alto high-
Resolution search for
M dwarfs with
Exoearths with
Near-infrared and visible
Echelle
Spectrographs

↓ high-Resolution…

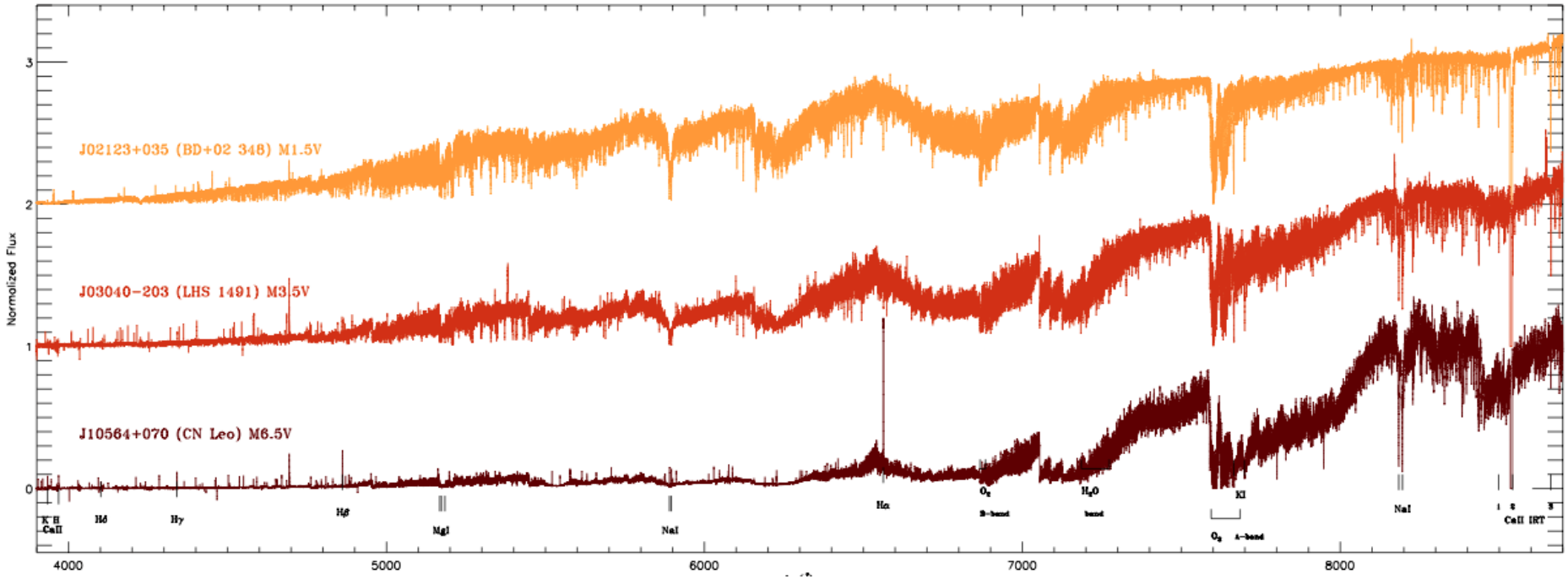
R (= λ/Δλ) = 80,400 – 94,600

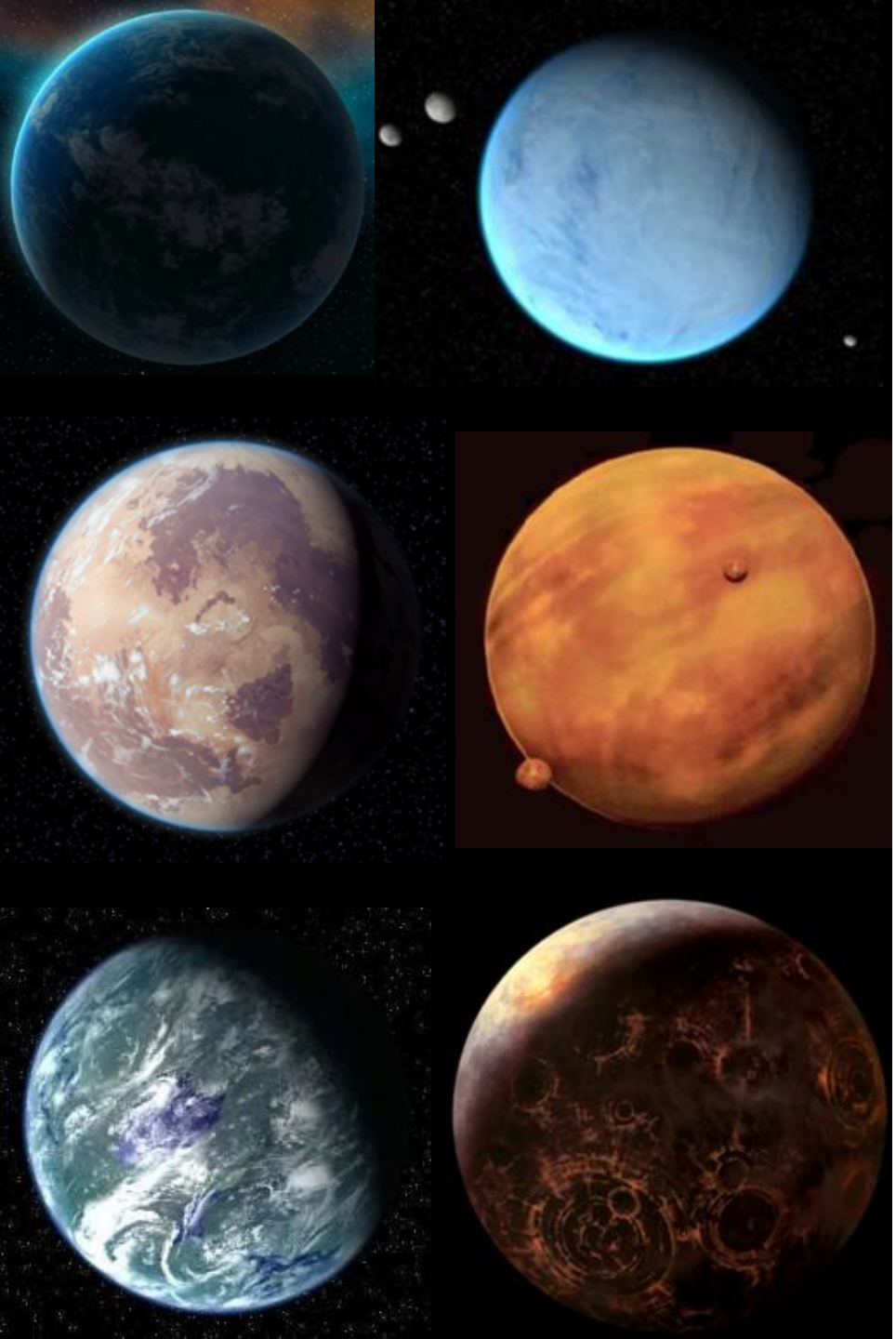
Example: Ca IRT λ850-866 nm (*Gaia*, RAVE)



Calar
Alto high-
Resolution search for
M dwarfs with
Exoearths with
Near-infrared and visible
Echelle
Spectrographs

↓ search for M dwarfs with…
M0.0-9.5V, 3900-2200 K
Barnard's, Luyten's, vB 8





Calar
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Resolution search for
M dwarfs with
Exoearths with
Near-infrared and visible
Echelle
Spectrographs

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← **Exoearths with…**

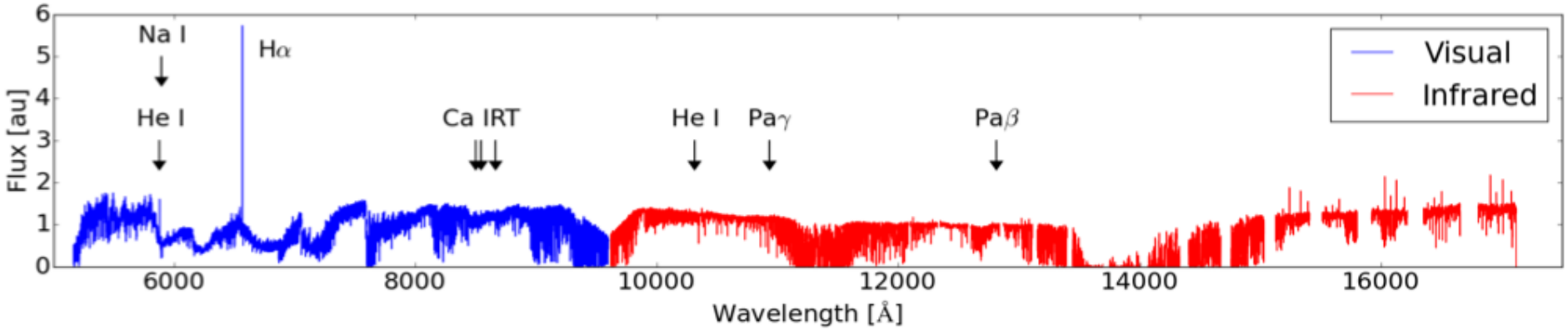
M = 0.8-2.0 M_{Earth}, T_{eq} = 0-80°C (classical HZ definition – EUV, flare)

Calar
Alto high-
Resolution search for
M dwarfs with
Exoearths with
Near-infrared and visible
Echelle
Spectrographs

↓ Near-infrared and visible…

VIS: 0.52-0.96 µm, e2v CCD231-84

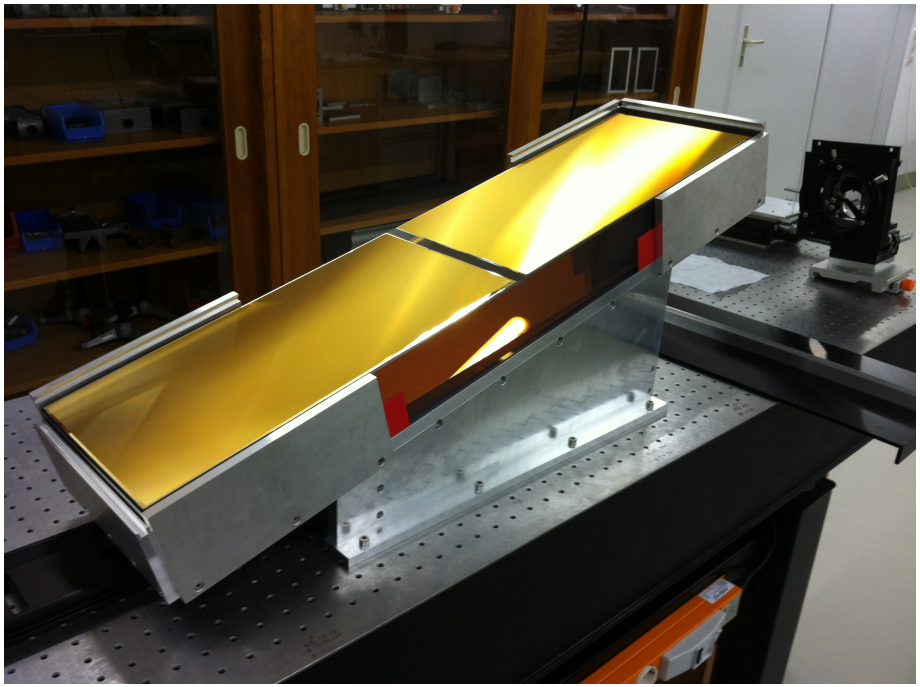
NIR: 0.96-1.71 µm, 2x Hawaii-2RG

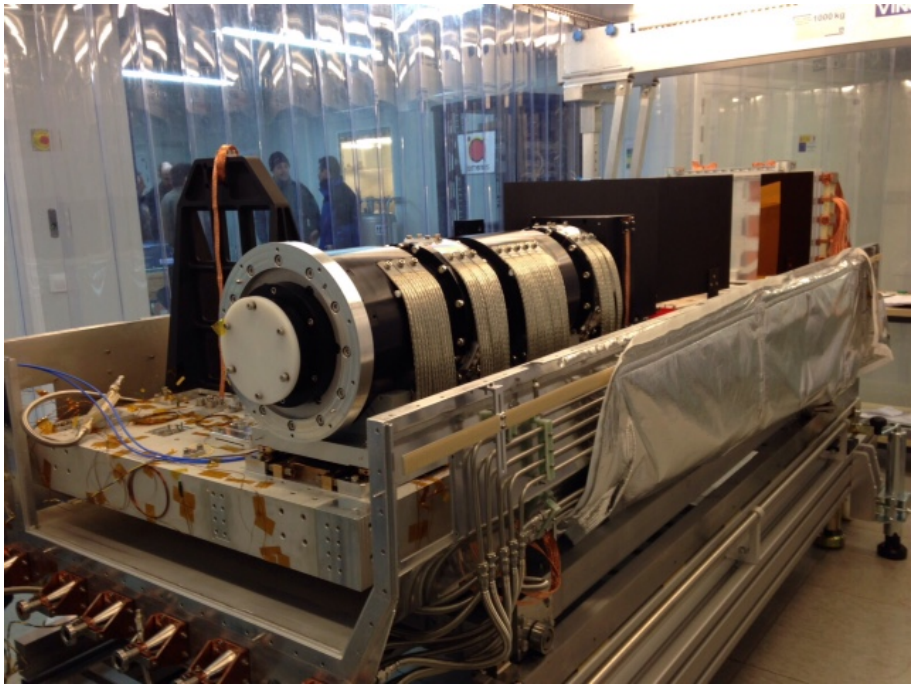


(YZ CMi, M4.5Ve)

Calar
Alto high-
Resolution search for
M dwarfs with
Exoearths with
Near-infrared and visible
Echelle
Spectrographs

Echelle…
2 x Richardson Gratings R4 (31.6 mm^{-1}) each channel

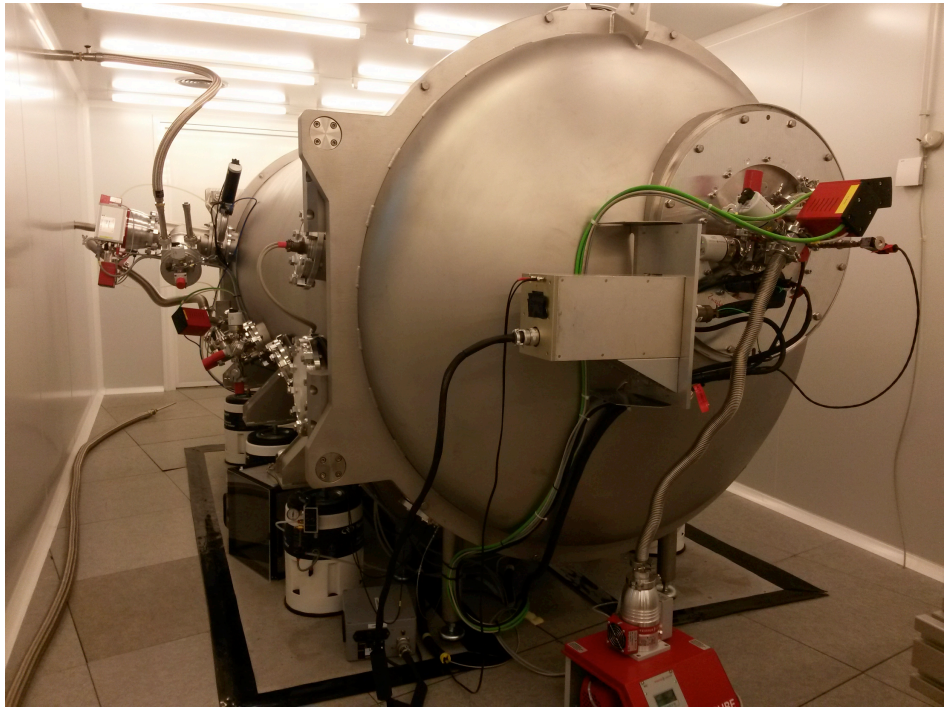


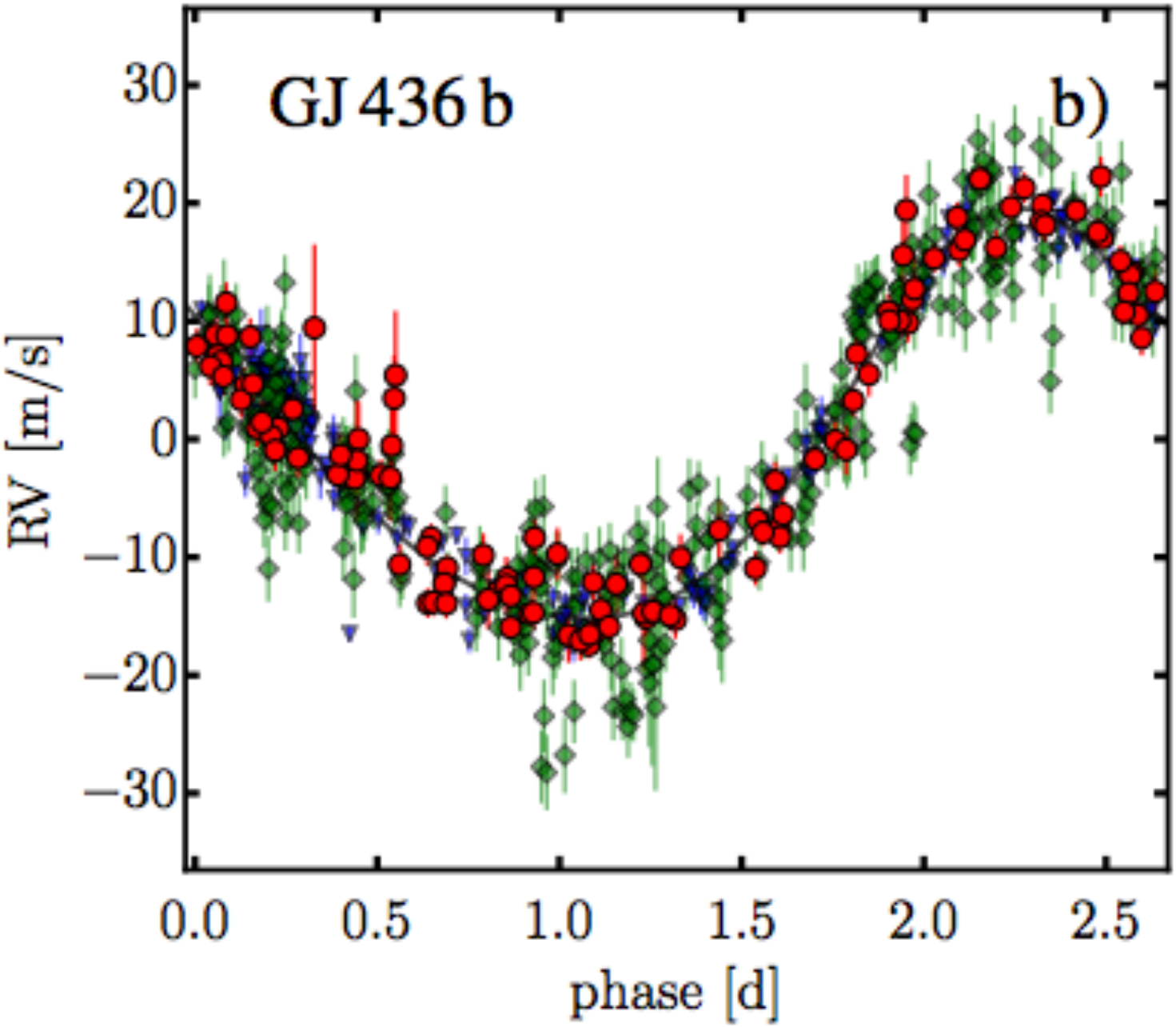


carmenes

Calar
Alto high-
Resolution search for
M dwarfs with
Exoearths with
Near-infrared and visible
Echelle
Spectrographs

Spectrographs.
VIS: 285.000±0.005 K
NIR: 140.000±0.005 K
Fibre-fed in coudé room




GJ 436 b
b)
RV [m/s]
30
20
10
0
−10
−20
−30
0.0
0.5
1.0
1.5
2.0
2.5
phase [d]

Carmencita

carmenes

Carmencita (1894)

Herbs, species and… paella!

CARMENCITA: CARMENES **C**ool dwarf **I**nformation and da**T**a **A**rchive

CARMENES input catalogue of **~2200 nearby bright M dwarfs** ($\delta > -23$ deg)

~300 GTO targets

TOPCAT(1): Table Browser

Table Browser for 1: carmencita.084.csv

	#Karmn	Comp	Flags	SS	Name	GJ	SpT	Ref01	RA_J2016	DE_J2016
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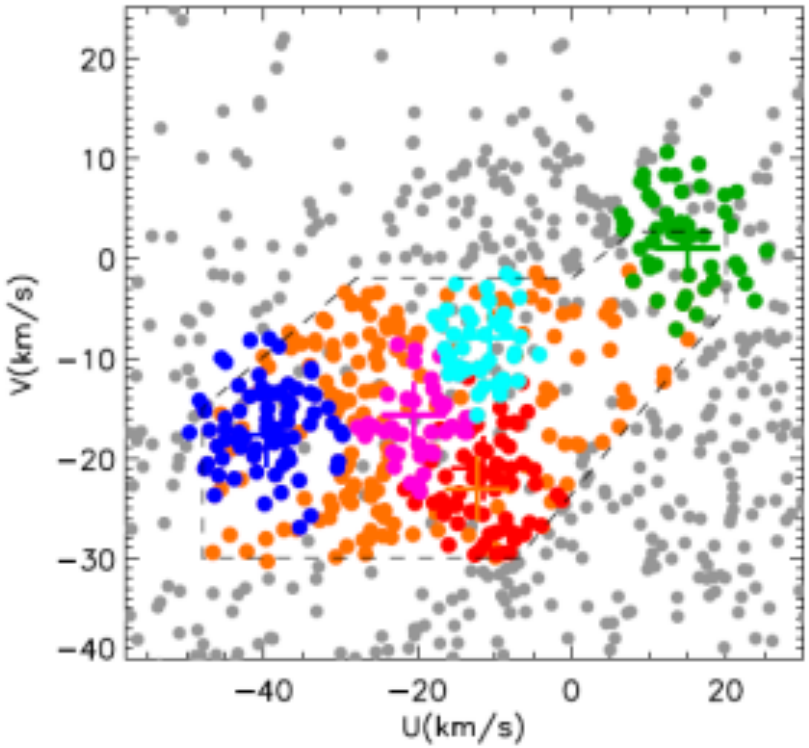
2	J00012+139S	B	..F		BD+13 5195B		M0.0 V	Lep13	00:01:12.89	+13:58:22.0
3	J00026+383	-	..F		2M J00024011+3821453		M4.0 V	Fri13	00:02:40.02	+38:21:44.8
4	J00033+046	-	..F		StKM 1-2199		M1.5 V	Lep13	00:03:18.97	+04:41:11.5
5	J00051+457	C		S3	GJ 2	2	M1.0 V	PMSU	00:05:12.18	+45:47:09.1
6	J00056+458	B	J..	SX	HD 38B	4B	M0.0 V	Cve12	00:05:42.31	+45:48:34.9
7	J00067-075	-		S1	GJ 1002	1002	M5.5 V	PMSU	00:06:42.34	-07:32:46.3
8	J00077+603	AB	B..	SX	G 217-032		M4.0 V+	AF15a	00:07:43.42	+60:22:53.8
9	J00078+676	-	..F		2M J00075079+6736255		M2.0 V	Lep13	00:07:50.68	+67:36:23.9
10	J00079+080	-	..F		LP 524-065	3007	M3.0 V	PMSU	00:07:58.67	+08:00:12.1
11	J00081+479	AB	S..	SX	1RXS J000806.3+475659		M4.0 V+	Lep13	00:08:06.23	+47:57:02.6
12	J00084+174	-	..F		MCC 351	3008	M0.0 V	PMSU	00:08:27.19	+17:25:26.4
13	J00088+208	AB	B..	SX	LP 404-033	3010	M4.5 V+	PMSU	00:08:53.60	+20:50:20.7
14	J00110+052	-	..F		G 031-029		M1.0 V	Lep13	00:11:04.89	+05:12:33.1
15	J00115+591	-	..F		LSR J0011+5908		M5.5 V	AF15a	00:11:29.84	+59:08:20.4
16	J00118+229	-	..F		LP 348-040		M3.5 V	AF15a	00:11:53.19	+22:59:00.9
17	J00119+330	-	..F		G 130-053		M3.5 V	AF15a	00:11:55.80	+33:03:11.1
18	J00122+304	-	..F		2M J00121341+3028443		M4.5 V	AF15a	00:12:13.48	+30:28:43.9
19	J00131+703	-	..f	S3	TYC 4298-613-1		M2.0 V	Lep13	00:13:11.70	+70:23:55.1
20	J00132+693	AB	B..	SX	GJ 11 AB	11AB	M3.0 V+	PMSU	00:13:18.09	+69:19:32.3
21	J00133+275	-	..F		2M J00131951+2733310		M4.5 V	AF15a	00:13:19.54	+27:33:29.1
22	J00136+806	A	..f	S3	G 242-048	3014	M1.5 V	AF15a	00:13:40.56	+80:40:00.0
23	J00137+806	B	V.F	SX	LP 012-304	3015	M5.0 V	PMSU	00:13:44.83	+80:39:52.4
24	J00154-161	AB	Bm.	SX	GJ 1005 AB	1005AB	M4.0 V+	PMSU	00:15:28.73	-16:08:11.3
25	J00156+722	-	..F		G 242-049		M2.0 V	Lep13	00:15:37.67	+72:17:03.8
26	J00158+135	-	..f	S2	GJ 12	12	M3.0 V	PMSU	00:15:49.91	+13:33:27.4
27	J00159-166	AB	B..	SX	BPS CS 31060-0015		M4.1 V+	Shk09	00:15:57.93	-16:36:57.8
28	J00162+198E	B		S1	LP 404-062	1006B	M4.0 V	AF15a	00:16:16.94	+19:51:38.6
29	J00162+198W	Aab	S..	SX	EZ Psc	1006A	M4.0 V6+	AF15a	00:16:15.49	+19:51:24.7
30	J00169+051		..F		GJ 1007	1007	M4.5 V	PMSU	00:16:56.19	+05:07:15.7
31	J00169+200	AB	B.F	SX	G 131-047	3022	M3.5 V+	PMSU	00:16:57.06	+20:03:55.4
32	J00173+291	-	..f	S3	Ross 680	3023	M2.0 V	PMSU	00:17:21.09	+29:11:05.0
33	J00176-086	-	..F		BD-09 40	3025	M0.0 V	PMSU	00:17:41.23	-08:40:55.6
34	J00179+209	A	..F		LP 404-081		M1.0 V	Lep13	00:17:58.89	+20:57:18.8
35	J00182+102	-	..f	S3	GJ 16	16	M1.5 V	PMSU	00:18:16.59	+10:12:09.6
36	J00183+440	A		S3	GX And	15A	M1.0 V	AF15a	00:18:27.07	+44:01:29.1
37	J00184+440	B		S2	GQ And	15B	M3.5 V	PMSU	00:18:30.00	+44:01:44.5
38	J00188+278	-	..F		LP 292-066	3027	M4.0 V	PMSU	00:18:54.02	+27:48:48.1
39	J00201-170	-	.mF		LP 764-108	2003	M1.0 V(k)+	Gra06	00:20:08.54	-17:03:41.1
40	J00204+330	-	..F		LP 292-067	3028	M5.5 V	PMSU	00:20:30.66	+33:04:53.6

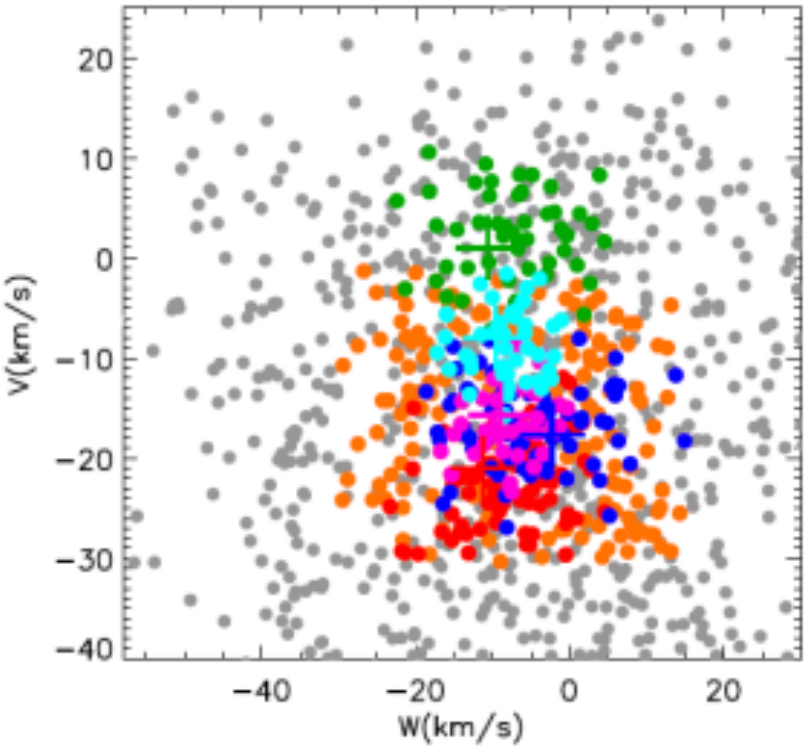
Carmencita legacy (2200 stars)

Karmn | Comp | Flags | SS | Name | GJ | SpT | **RA_J2000** | **DE_J2000** | **muRA_masa-1** | **muDE_masa-1** | **Vr_kms-1** | **pi_mas** | **d_pc** | **U_kms-1** | **V_kms-1** | **W_kms-1** | FUV_mag | NUV_mag | u_mag | BT_mag | **BP_mag** | B_mag | g_mag | **G_mag** | VT_mag | V_mag | **RP_mag** | Ra_mag | r_mag | i_mag | z_mag | IN_mag | J_mag | H_mag | Ks_mag | W1_mag | W2_mag | W3_mag | W4_mag | WideCompanion | WideWDS | Widerho_arcsec | WideCompanionSpT | WideCompanionJ_mag | WideCompanionFeH | CloseMultiplicity | CloseWDS | Closerho_arcsec | pEWHalpha_A | 1RXS | CRT_s-1 | HR1 | HR2 | vsini_kms-1 | P_d | Flare | **Populartion** | **MovingGroup** | Teff_K | logg | **R_Rsol** | **L_Lsol** | **M_Msol** | Metallicity | Age_Ga | LoRes_spectrum | HiRes_spectrum | LoRes_image | HiRes_image | RV | Planet | Origin | Class | Notes

More Carmencita:

- Wide multiplicity, FGK primaries + M secondaries → Metallicity (Montes et al.)
- Wide multiplicity, white dwarfs + M…
- UVW space velocities → Young moving groups → Age! (planet formation)



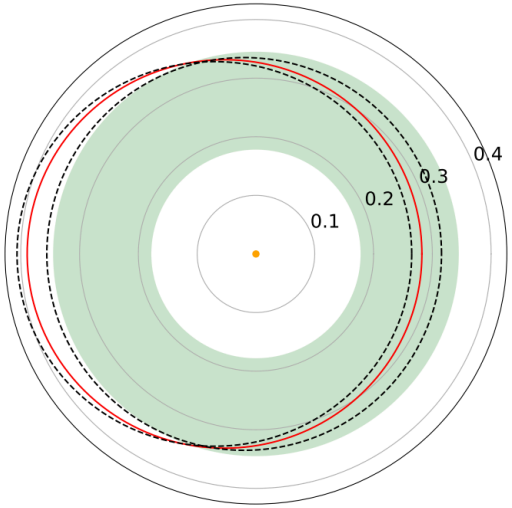


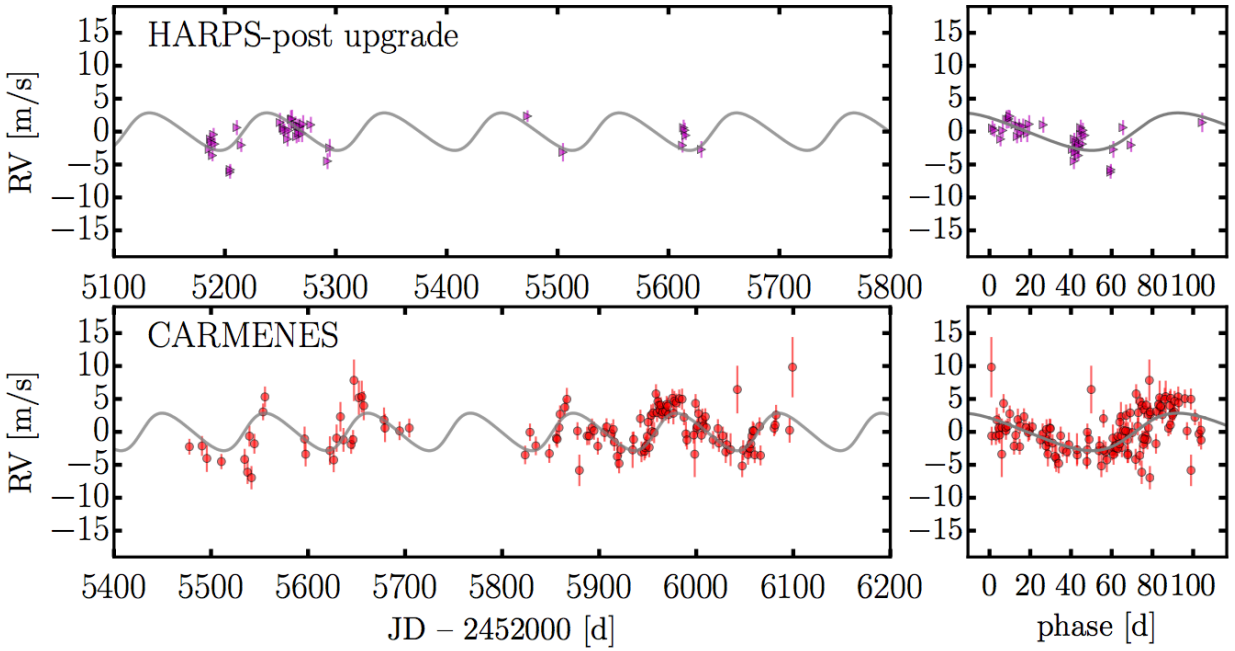
Stellar parameters of exoplanet hosts

The CARMENES search for exoplanets around M dwarfs

A Neptune-mass planet in the habitable zone around HD

A. Kaminski[1], T. Trifonov[2], J. A. Caballero[3], A. Quirrenbach[1], I. Ribas[4,5], A. Reiners[6], P. J. Amado[7], M. Zechmeister[6], L. Tal-Or[8,6], X. Bonfils[9,10], M. Mayor[11], N. Astudillo-Defru[12], F. Bauer[7,6], V. J. S. Béjar[13,14], C. Cifuentes[15], J. Colomé[4,5], M. Cortés-Contreras[3], D. Delfosse[9,10], E. Díez-Alonso[15], S. Dreizler[6], T. Forveille[9,10], E. W. Guenther[16], A. P. Hatzes[16], T. Henning[2], S. V. Jeffers[6], M. Kürster[2], M. Lafarga[4,5], R. Luque[13,14,1], H. Mandel[1], D. Montes[15], J. C. Morales[4,5], V. M. Passegger[17], S. Pedraz[18], M. Perger[4,5], S. Reffert[1], S. Sadegi[1], A. Schweitzer[17], W. Seifert[1], O. Stahl[1], and S. Udry[11]

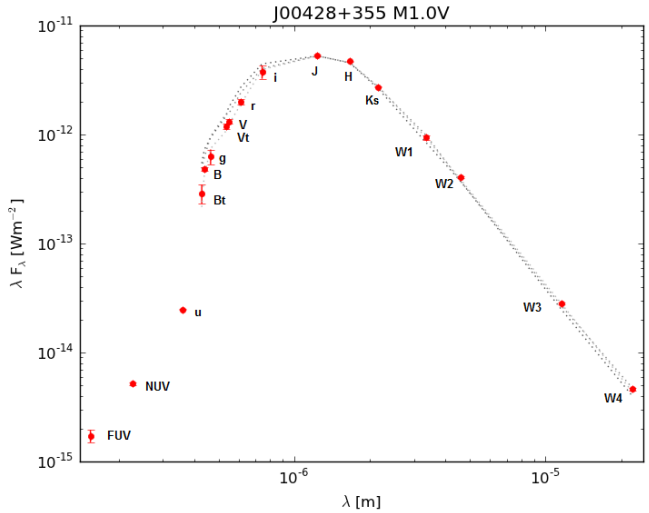


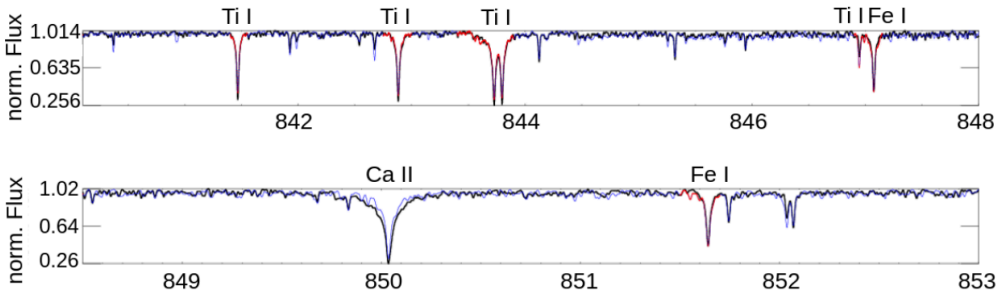


Stellar parameters of exoplanet hosts

Table 1: Basic information on the host star.

		Ref.[a]
Karmn[b]		
Wolf		
GJ		
BD		
Var. name		
Sp. type	M2.5 V	AF15
G [mag]	8.0976±0.011	*Gaia*
J [mag]	5.583±0.030	2MASS
d [pc]	5.9116±0.018	*Gaia*
$\mu_\alpha \cos\delta$ [mas a^{-1}]	–579.043±0.088[c]	*Gaia*
μ_δ [mas a^{-1}]	–1332.743±0.081[c]	*Gaia*
V_r [km s^{-1}]	+35.678	Rei18
U [km s^{-1}]	+53.2	This work
V [km s^{-1}]	–7.6	This work
W [km s^{-1}]	–5.0	This work
$v \sin i$ [km s^{-1}]	<2	Rei18
$T_{\rm eff}$ [K]	3557±51	Pas18
$\log g$	4.86±0.07	Pas18
[Fe/H]	0.00±0.16	Pas18
L [L$_\odot$]	0.0296±0.0007	This work
R [R$_\odot$]	0.453±0.019	This work
$M_\star$ [M$_\odot$]	0.45±0.04	This work
pEW(Hα) [Å]	+0.3±0.1	Jef18
$P_{\rm rot}$ [d]	46.04±0.20	DA17
Kinematic pop.	Thin disc	CC16

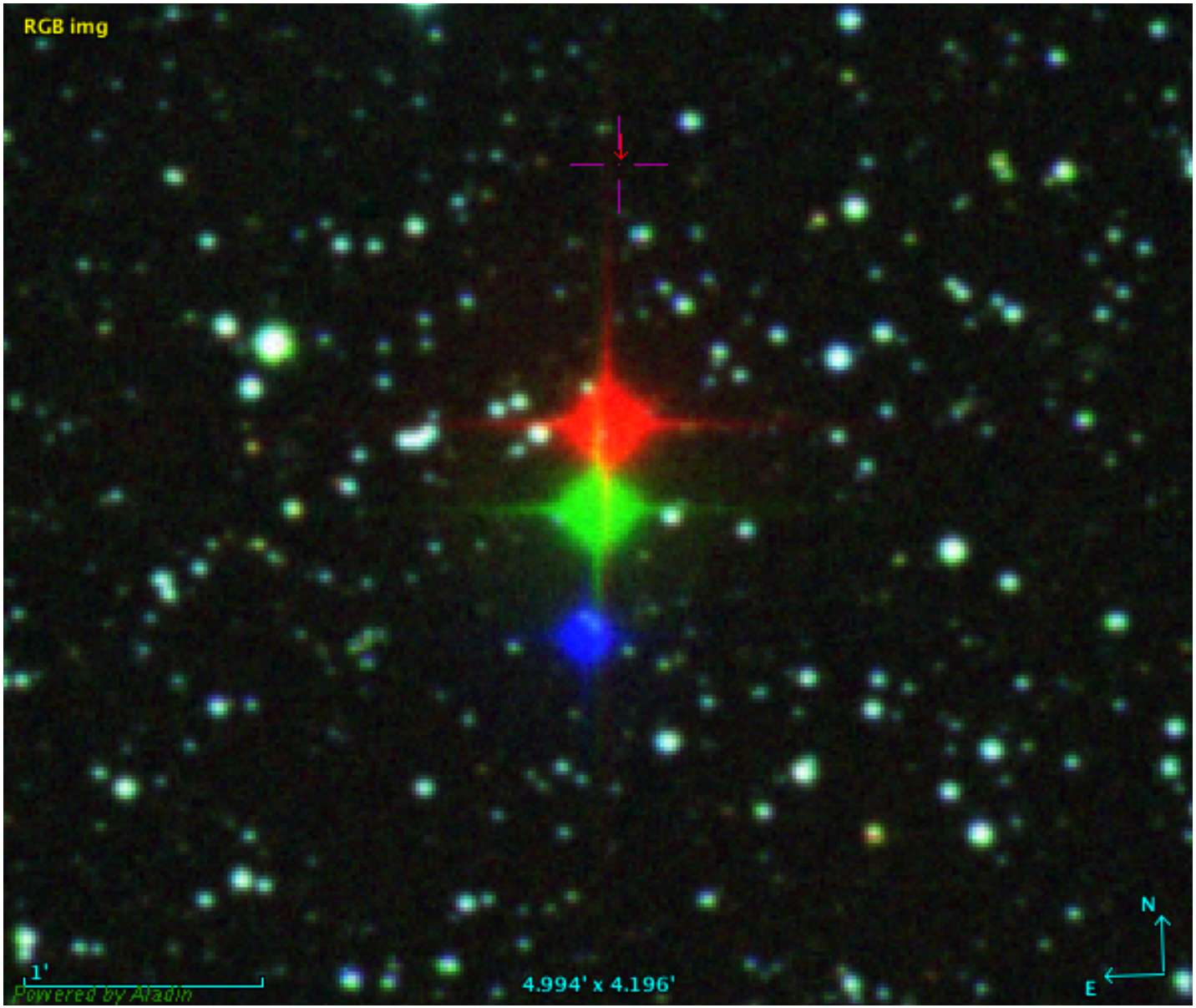




$$L = 4\,\pi\,R^2\,\sigma\,T_{\rm eff}^{\,4}$$

$$M_*\text{-}R$$

And many more…

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