Characterisation of the CARMENES input catalogue (CARMENCITA)

José A. Caballero
CAB, Villafranca
What is CARMENES?

a) An instrument
b) A consortium
c) A science project
d) All of the above
What is CARMENES?

a) An instrument (for the 3.5 m telescope on Calar Alto)
b) A consortium (of over 90 people in 11 centres in Spain and Germany)
c) A science project (to be carried out during guaranteed time – 600+ nights)
d) All of the above
What is *not* CARMENES?

HARPS (ESO, La Silla): *the* exoplanet hunter

Radial velocity; optical spectrograph
What is not CARMENES?

HARPS’ press release last week: Many Billions of Rocky Planets in the Habitable Zones around Red Dwarfs in the Milky Way (Bonfils et al. 2012)
What is not CARMENES?

HARPS $\Delta \lambda = 533$-691 nm

But M dwarfs are faint in the optical!
What does CARMENES mean?

Calar Alto high Resolution search for M dwarfs with Exoeartths with Near-infrared and optical Echelle Spectrographs
CARMENES, the instrument

Two stabilised échelle spectrographs (R=82,000):

**NIR**

(Δλ≈0.9-1.7μm)

**VIS**

(Δλ≈0.5-1.0μm)

*Figure 2. General view of the CARMENES NIR Optical Bench fully assembled.*
CARMENES, the consortium

MPIA (Heidelberg) • IAA (Granada) • LSW (Heidelberg) • ICE (Barcelona) • IAG (Göttingen) • IAC (Tenerife) • TLS (Tautenburg) • UCM (Madrid) • HS (Hamburg) • CAB (Madrid)

CAHA (50% MPG + 50% CSIC)

Germany + Spain ≥ 5.0 MEUR
CARMENES, the project

“[...] Conducting a five-year exoplanet survey targeting ~ 300 M stars with the completed instrument is an integral part of the project [...]” (2010SPIE.7735E..37Q)
CARMENES, science prep.

Our aim: to define the best target sample
The best target sample?

- Comprehensive stellar characterisation and data compilation...
- **CARMENCITA:** CARMENES Cool dwarf Information and daTa Archive
- “CARMENES input catalogue”
**CARMENCITA: pseudocode**

Selection criteria:
- $\delta > -23$ deg (-13 deg)
- Single (no SB, no companion $\rho < 5$ arcsec)
- The **brightest** M dwarfs with the **latest** SpTs

<table>
<thead>
<tr>
<th>SpT</th>
<th>$\alpha$ Heaven</th>
<th>$\beta$ Limbo</th>
<th>$\gamma$ Hell</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\geq$ M6 V</td>
<td>$&lt;10.5$</td>
<td>10.5-11.0</td>
<td>11.0-11.5</td>
</tr>
<tr>
<td>M5 V</td>
<td>$&lt;10.0$</td>
<td>10.0-10.5</td>
<td>10.5-11.0</td>
</tr>
<tr>
<td>M4 V</td>
<td>$&lt;9.5$</td>
<td>9.5-10.0</td>
<td>10.0-10.5</td>
</tr>
<tr>
<td>M3 V</td>
<td>$&lt;9.0$</td>
<td>9.0-9.5</td>
<td>9.5-10.0</td>
</tr>
<tr>
<td>M2 V</td>
<td>$&lt;8.5$</td>
<td>8.5-9.0</td>
<td>9.0-9.5</td>
</tr>
<tr>
<td>M1 V</td>
<td>$&lt;8.0$</td>
<td>8.0-8.5</td>
<td>8.5-9.0</td>
</tr>
<tr>
<td>M0 V</td>
<td>$&lt;7.5$</td>
<td>7.5-8.0</td>
<td>8.0-8.5</td>
</tr>
</tbody>
</table>
CARMENCITA: input

- First iteration: RECONS (77) and PMSU (1579)
- Second iteration: Luyten, Gliese & Jahreiss, Irwin et al., Bochanski et al., Lépine & Gaidos and further bibliographic search
- Third iteration (in parallel): VO searches (Aberasturi et al.)
CARMENCITA: which data

| Karmn | Comp | Class | Flags | Name | GJ | SpT | Ref01 | RA_J2000 | DE_J2000 | Ref02 | Ra_mag | Ref03 | IN_mag | Ref04 | J_mag | eJ_mag | H_mag | eH_mag | Ks_mag | eKs_mag | QFlag | Ref05 | WideCompanion | WideWDS | Widerho_arcsec | eWiderho_arcsec | Ref06 | WideCompanionSpT | WideCompanionJ_mag | WideCompanionFeH | Ref07 | CloseMultiplicity | CloseWDS | Closerho_arcsec | eCloserho_arcsec | Ref08 | pi_mas | epi_mas | Ref09 | d_pc | ed_pc | Ref10 | pEWHalpha_A | Ref11 | 1RXS | CRT_s-1 | eCRT_s-1 | HR1 | eHR1 | HR2 | eHR2 | Ref12 | vsini_kms-1 | evsini_kms-1 | Ref13 | Vr_kms-1 | eVr_kms-1 | Ref14 | TiO5 | CaH2 | Ref15 | OtherActivityIndicators | Flare | Ref16 | P_d | Ref17 | muRA_masa-1 | emuRA_masa-1 | muDE_masa-1 | emuDE_masa-1 | Ref18 | MV_mag | Ref19 | U_kms-1 | eU_kms-1 | V_kms-1 | eV_kms-1 | W_kms-1 | eW_kms-1 | Ref20 | RV | Planet | Ref21 | Origin | Notes |
CARMENCITA: preparation

- **Low-resolution spectroscopy** (CAFOS): SpT, pEW(Hα)
CARMENCITA: preparation

- High-resolution spectroscopy (CAFÉ, FEROS): $V_r$, $v\sin i$, other activity indicators, spectroscopic multiplicity ($N > 1$)
CARMENCITA: preparation

- **High-resolution imaging**: close resolved multiplicity
- Compilation from the literature
- Recent data (Hormuth et al., Pérez-Garrido et al.)
- Our own observations with FastCam (and AstraLux)

Rica et al. (2012, MNRAS)
CARMENCITA: output

- The most comprehensive M dwarf catalogue (by far...)
- Full dataset provided in an easy way to the CARMENES Science Working Group
- Next to everybody in the consortium
- Eventually public (CARMENES legacy)
# Carmencita

## CARMENCITA

### Database
Formerly Alpha, Beta and Gamma

More data • Ascii file • XML file (for Aladin)

<table>
<thead>
<tr>
<th>id</th>
<th>Karm</th>
<th>Classe</th>
<th>Name</th>
<th>GJ</th>
<th>SpT</th>
<th>RA_J2000</th>
<th>DE_J2000</th>
<th>J_mag</th>
<th>pEWalpha_A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>J00967-075</td>
<td>Alpha</td>
<td>GJ 1002</td>
<td>1002</td>
<td>M5.5 V</td>
<td>00:06:43.26</td>
<td>-07:32:14.7</td>
<td>8.323</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>J00975+080</td>
<td>Beta</td>
<td>LHS 1022</td>
<td>3007</td>
<td>M3.0 V</td>
<td>00:07:59.09</td>
<td>+08:00:19.1</td>
<td>9.382</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>J00988+208</td>
<td>Alpha</td>
<td>LP 404-33</td>
<td>3010</td>
<td>M4.5 V</td>
<td>00:08:53.92</td>
<td>+20:50:25.2</td>
<td>8.870</td>
<td>4.980</td>
</tr>
<tr>
<td>4</td>
<td>J00132+693</td>
<td>Gamma</td>
<td>GJ 11 AB</td>
<td>11AB</td>
<td>M3.0 V+N</td>
<td>00:13:15.79</td>
<td>+62:10:37.2</td>
<td>8.556</td>
<td>0.000</td>
</tr>
<tr>
<td>5</td>
<td>J00136+800</td>
<td>Alpha</td>
<td>G 242-048 A</td>
<td>3015A</td>
<td>M1.5 V</td>
<td>00:13:36.31</td>
<td>+80:39:50.9</td>
<td>7.756</td>
<td>0.000</td>
</tr>
<tr>
<td>6</td>
<td>J00137+808</td>
<td>Gamma</td>
<td>G 242-048 B</td>
<td>3015B</td>
<td>M5.0 V</td>
<td>00:13:43.06</td>
<td>+80:39:49.4</td>
<td>10.536</td>
<td>3.200</td>
</tr>
<tr>
<td>Object</td>
<td>Type</td>
<td>Star</td>
<td>Mass</td>
<td>Distance</td>
<td>Uncertainty</td>
<td>Element</td>
<td>Magnitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------</td>
<td>----------</td>
<td>-------</td>
<td>-------</td>
<td>----------</td>
<td>-------------</td>
<td>----------</td>
<td>-----------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J23541+515</td>
<td>Gamma</td>
<td>G 217-023</td>
<td>4373</td>
<td>M3.5 V</td>
<td>23:54:10:40</td>
<td>+51:41:30:9</td>
<td>0.574</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J23544+081</td>
<td>Beta</td>
<td>G 030-028</td>
<td>4374</td>
<td>M3.0 V</td>
<td>23:54:26:30</td>
<td>+03:03:43:5</td>
<td>0.243</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J23554+039</td>
<td>Gamma</td>
<td>LHS 4048</td>
<td>4376</td>
<td>M3.5 V</td>
<td>23:55:25:92</td>
<td>-03:59:00:0</td>
<td>9.066</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J23573-129N</td>
<td>Gamma</td>
<td>LP 704-14 Beb</td>
<td>4370Bab</td>
<td>M4.0 V+</td>
<td>23:57:10:35</td>
<td>-12:58:40:7</td>
<td>0.128</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J23578+386</td>
<td>Gamma</td>
<td>LP 291-34</td>
<td>4381</td>
<td>M3.0 V</td>
<td>23:57:46:90</td>
<td>+30:37:46:9</td>
<td>0.081</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J23598+477</td>
<td>Gamma</td>
<td>LHS 4057</td>
<td>4385</td>
<td>M5.0 V</td>
<td>23:58:48:44</td>
<td>+47:45:44:8</td>
<td>10.866</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
CARMENCITA will link to...

• customised finding charts
• ascii astro-photometric file of close stars for A&G-ing
• all preliminary science data (lo-res, mid-res spectroscopy, hi-res imaging – reduced)
• Simbad, VizieR, WDS, any other relevant catalogue
• and the CARMENES spectra archive! (López del Fresno et al.)
But in the meantime...

- A lot of work to do!
- Proposals, observations, reduction, data mining, analysis, give format, coordination, and put everything together...
Summary

• **CARMENCITA: CARMENES Cool dwarf Information and daTa Archive**
• Stellar characterisation and data compilation: huge amount of information, useful for many scientists
• Necessary to define the best target sample (300)
• Eventually public (CARMENES legacy)
Schedule

- **Pre-selection**: January 2009
- **CDR**: October 2009
- **pCDR**: July 2010
- **Green light**: November 2010
- **PDR**: July 2011
- **FDR**: Nov 2012 (optics-FDR Apr 2012)
- **AIV**: 2013
- **First light, commissioning**: early 2014
- **Start survey**: mid 2014
Advantages

• Simultaneous near-infrared and visible observations

• Both high resolution and wide spectral coverage

• Dedication to stable high-precision radial-velocity survey of exoplanets around M dwarfs

• Long guaranteed time for the completion of the project

• Avoid the complications of cryogenics

• Early first light