Red and brown dwarfs in the ultraviolet

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Why red and brown dwarfs?

“Red dwarfs” = field M- and early-L-type stars

“Brown dwarfs” = field late-L- and T-type dwarfs and young late-M- and L-type substellar objects in star-forming regions, open clusters and moving groups
Related talks

Javier López-Santiago: The size of stellar coronae from flaring events

Néstor Sánchez: Young stellar candidates toward the Orion region selected from GALEX

Fátima López-Martínez: Magnetoospheric properties of T Tauri stars through C II], Fe II] and Si II] ultraviolet emission lines

Jordi Torra: Gaia data are coming
Field M dwarf spectroscopy

Alonso-Floriano et al. (2014)
Field M dwarf spectroscopy
Hidalgo (2014)
Field M dwarf spectroscopy
Martínez-Rodríguez (2014)
Field M dwarf X-rays
González-Álvarez (2014)
Field M dwarf X-rays
González-Álvarez (2014)
Field M dwarf photometry
Holgado (2014)
UV excess & activity
Herczeg & Hillenbrand (2007)
Field M dwarf activity

Possible origin of UV excesses, Hα and other Fátima’s emission lines, X-rays, Javi’s flares… and all activity features:
- Close binarity (orbital $P = \text{rotation } P$)
- Youth (as in Néstor Orion young stars: accretion and angular momentum evolution $\rightarrow$ related to planet formation)
A high-resolution search for M dwarfs with Exoearths with Near-infrared and optical Echelle Spectrographs
Starting pipeline

Hello?
Hello, is there anybody out there?

The spectrograph has yet not arrived at Calar Alto.
Ok, I'm waiting ...

Meanwhile, I show you a simulated spectrum ...

J. Lalande (1732-1807)
WSO-UV synergy 1

NUV and FUV photometry of the brightest, latest, single M dwarfs with $\delta > -23$ deg → Targets for CARMENES exoplanet hunting

Complement GALEX: SEDs, UV excesses, the CARMENCITA legacy catalogue...

+Monitoring: flares, accurate periods... and perhaps transits (Enric’s talk)
Field M dwarf photometry
Holgado (2014)
Gaia and brown dwarfs from Spain

- Red española de Explotación de Gaia (RecGaia)

- Network coordinated from Barcelona; researchers from virtually all astronomy centres in Spain

- Several research lines, including ‘very low-mass stars, brown dwarfs and exoplanets’ (BajaMasa, low mass), with 20+ investigators
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
WSO-UV synergy 2

NUV and FUV photometry of the brightest ultracool dwarfs (SpT > M6V)
Complement GALEX: SEDs, UV excesses
VO public catalogue with homogeneous astrometry, photometry, spectroscopy, astrophysical parameters (exoplanets.eu, dwarfarchive.org): MAIA
Gaia and brown dwarfs from Spain

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Abstract. Gaia will not observe 50,000 brown dwarfs, but about 100 times less. However, these ≤ 300 brown dwarfs will be benchmarks for many substellar topics. It is possible to identify them in advance and make the list public to all astronomers worldwide through a virtual observatory-compliant “Gaia brown dwarf” catalogue. This M-, L- and T-dwarf Archive of Interest for Astrophysics would tabulate precise Gaia astrometry, multiband photometry, high- and low-resolution spectroscopy and homogeneously derived astrophysical parameters. Spanish observatories may play a key role in the catalogue preparation.

Key words. Astronomical databases: miscellaneous – Catalogues – Stars: brown dwarfs – Stars: late-type
WSO-UV @ σ Orionis

ISSIS/WSO-UV and σ Orionis: brown dwarfs in the ultraviolet (4)

Age $\tau \sim 3$ Ma
Distance $d \sim 385$ pc
Radius $\rho \sim 30$ arcmin
Extinction $A_V < 0.3$ mag
Important because...

A well-studied **mass function**, esp. in the low-mass stellar and substellar domain

Brown dwarfs and “isolated planetary-mass objects” (IPMOs)
WSO-UV @ σ Orionis

V2728 Ori (Mayrit 495216) : X-shooter/VLT (Rigliaco et al. 2011)
• Default observation:
  o One brown dwarf per pointing (no survey)
  o $NUV \ t_{\text{exp}} \geq 900$ s
  o Open filters ($Mg\ II \ \lambda 280$ nm?)
  o $FUV$ impossible!

• Extend SED from $ugriz$ to the $NUV$: colour-colour diagrams $\Rightarrow$ UV excess & accretion indication
WSO-UV synergy 3

• A programme:
  o $N$ brown dwarfs and very low-mass stars ($NUV$, open, 900 s)
  o + 33% overheads ~1.2 ks per field
  o Total time = $1.2N$ ks
  o XMM-Newton comparison: 24-36 ks $\Rightarrow N = 20-30$ targets (statistics)
WSO-UV @ σ Orionis
(and many other clusters!)

“Brown dwarfs in UV: a Letter;
IPMOs in UV: a Science or a Nature”

M-, L- and T-dwarf Archive of Interest for Astrophysics