The Stellar-Substellar transition seen by Gaia

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Context

Ultra-cool dwarfs (UCDs) are red, cool and low-luminosity objects, with spectral types later than M7. They encompass the stellar-substellar boundary, and their faintness make them an elusive population. In the solar neighbourhood, their census is incomplete, despite representing an important fraction of local objects in the Milky Way. Numerous new UCD candidates have been identified thanks to the Gaia survey, and can be used to constrain the characteristics of that stellar population.

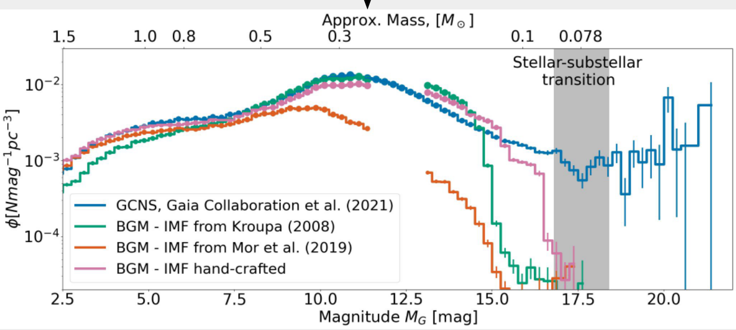
Counting the UCDs

Goal : to constrain the mass and number distribution of very-low mass stars and brown dwarfs.

We have access to an unprecedented data set from the *Gaia* satellite to fulfil that goal :
→*Gaia* Catalogue of Nearby Stars[1] : **Source census** of the objects up to **100 pc from the Sun**.
→Contains **photometry, astrometry,** and **distance** of more than **300 000 objects**.
→Can be used to study the **luminosity distribution** of stars, including the faintest of them, and of brown dwarfs.

To model the number and mass distribution of stars in the solar neighbourhood, we use the **Besançon Galaxy Model**[2,3,4].
To produce **synthetic observations** of the sky as seen by a survey, it uses:
→**Galactic theories** to simulate the history and density distribution of the Galaxy.
→**Stellar evolutionary and atmosphere models** to simulate the characteristics of stars.
→**Interstellar dust maps** to simulate the effects of dust on the colours of stars.

BGM + Gaia

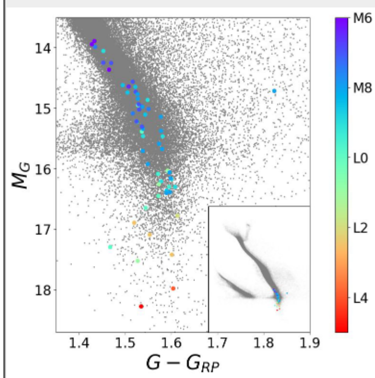


The Besançon Galaxy Model permits to study the effect of the **Initial Mass Function** – the distribution of masses of the stars at their birth, IMF – on the **observed luminosity distribution of stars and brown dwarfs**. Put in comparison with *Gaia* data, it allows **constraining on the number of UCDs** in our galactic environment!

Observing the UCDs

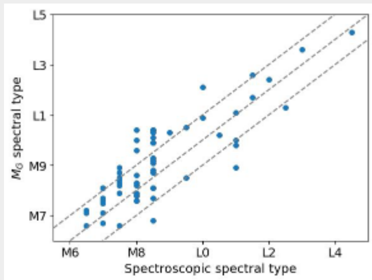
Goal : to study more in depth UCDs candidates revealed by *Gaia*, and to confirm their nature.

Thousands of UCD candidates[5,6,7] have been identified through *Gaia* **astrometry and photometry**. To confirm their classification as UCDs and to identify their characteristics, we have obtained **low-resolution near-infrared spectra** of **60 nearby candidates** using the SOFI[8] spectrometer (NTT, la Silla).

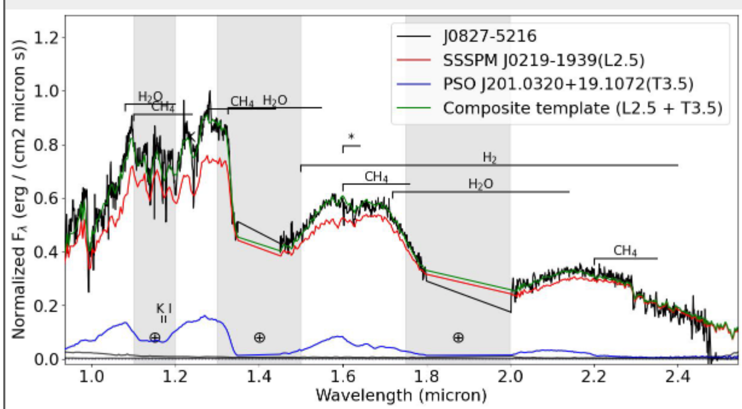


Classification and location on a colour – absolute magnitude diagram of the observed UCD candidates, superimposed on the Gaia Catalogue of Nearby Stars in grey.
All observed candidates are confirmed to be UCDs.

The *Gaia* G-absolute magnitude classification is **in accordance** with our spectroscopic classification **within a subtype**. This gives **confidence** on the classification of the thousands of **UCD candidates observed by *Gaia*.**



We identify in **seven spectra** signs of **unresolved binarity**[9]**.** The sources, detected as single UCDs by *Gaia*, are found to be **binary systems candidates**, composed of a **very-low mass star**/an **early brown dwarf** and of a **cooler T-dwarf** companion.



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