Short Visit Grant ☒ or Exchange Visit Grant ☐

(please tick the relevant box)

Scientific Report

The scientific report (WORD or PDF file – maximum of eight A4 pages) should be submitted online within one month of the event. It will be published on the ESF website.

***Proposal Title*:** **Ultracool dwarfs for Gaia**

Application Reference N°: 7126

1) Purpose of the visit

We developed the current activities underway for the exploitation of the ultracool dwarfs (UCDs) being observed by Gaia. The expected list of UCDs and the scientific progress from the Gaia observations was discussed in detail in the GREAT meeting ``Gaia and the Unseen - The Brown Dwarf Question'' - Torino, March 2014 [2]. Following this meeting a number of collaborations were begun, for example to build a Spectroscopic database of all Gaia L Dwarfs including published material, submission of Xshooter/VLT and Osiris/GTC observing proposals and the development of methods for the the indirect identification of brown dwarfs in Gaia observations from IR excess in the Gaia spectra, to common proper motion systems and the prediction of microlensing events. This work has continued at a low level via remote discussions since that meeting, the proposed visit was to focus this work, make concrete plans for future development and to examine what we need to update in Gaia UCD list given the current Gaia performance.

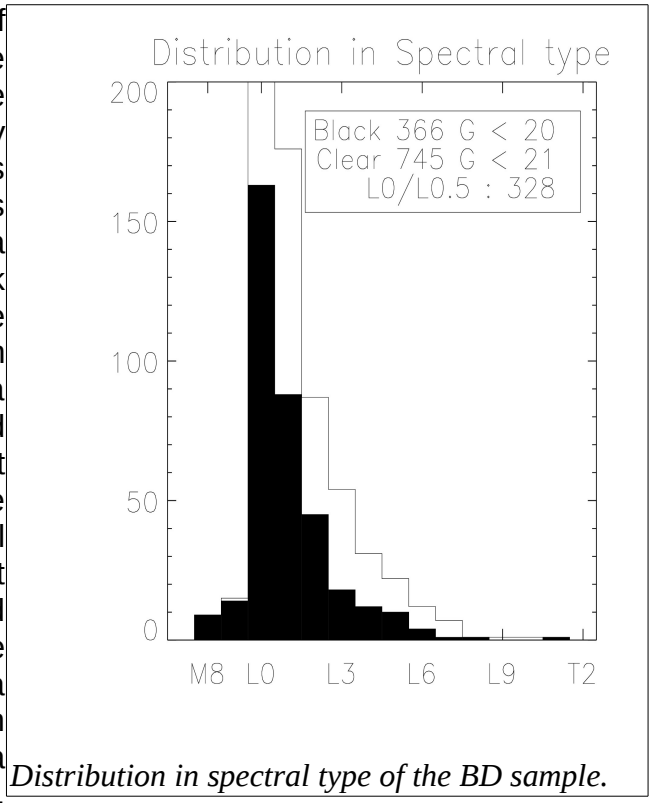
2) Description of the work carried out during the visit

Three major efforts were discussed:
1. The production of a catalog of Ultrcool dwarfs for the quality assurance of the CU8 astrophysical parameters routines.
2. The development of procedures for the identification of UCDs in the first Gaia data releases.

3. The development of routines within the CU8 effort to identify unresolved red + brown dwarfs systems using the expected IR excess.

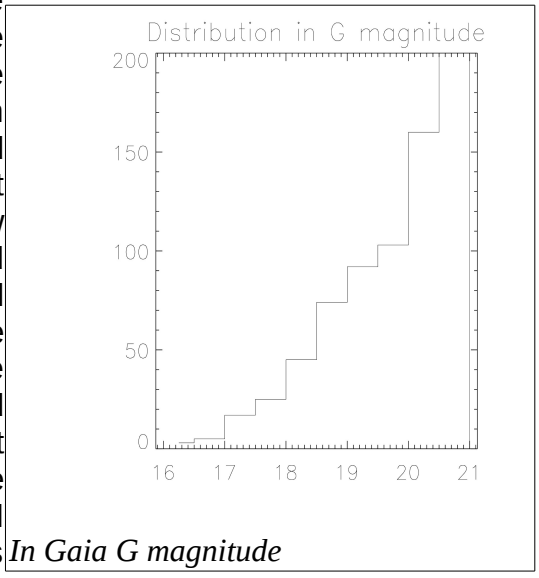
3) Description of the main results obtained

Ultracool dwarfs (UCDs) are a mix of objects with masses encompassing the smallest stars, brown dwarfs and the largest planets. We will arbritraly consider all dwarfs with spectral types later than M0 as UCD'S. These objects will be classified using just Gaia observations as part of the work package GWP-S-835-30000 in the astrophysical parameters coordination unit 8. The main inputs will be the Gaia astrometric parameters and the red and blue dispersed photometry. The current baseline for this process is to use models as opposed to a empirical sample to train the procedures. To test the success of the procedures and gauge the errors we will compare the results of the CU8 procedures to a a sample of published UCDs with empirical parameters based on a number of techniques and datasets. Here we describe the ongoing effort to identify this comparison sample begun during this visit.



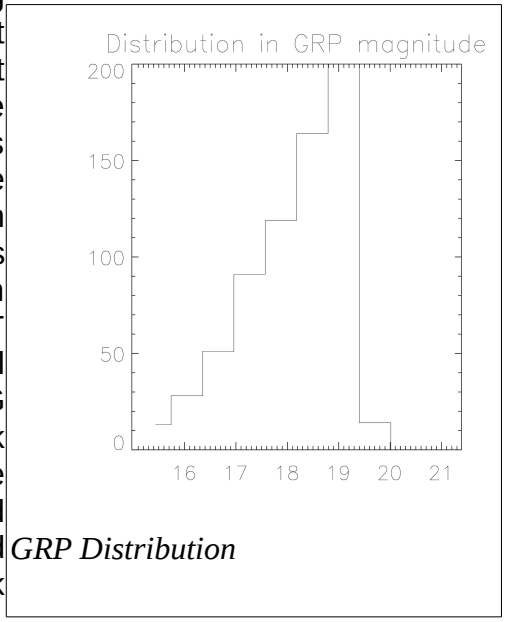
Distribution in spectral type of the BD sample.

The UCD lists will be split into 3 parts based on the predicted number in Gaia. We expect there to be millions of M0 dwarfs gradually decreasing until we have only a handful of early T dwarfs, so the selection of the comparison sample will take this into account. Hence for the M dwarfs we will concentrate on the brighter objects with good characterisation where bright is defined by the limit for the gaia RVS instrument currently around GRVS=16. There will be few (>M5) objects in this sample and we also need to provide faint comparison objects of all spectral types so the second part of the sample will be fainter M dwarfs across the whole of the spectral range from dedicated homogenous dataset with consistent characterisation and any well studied very late M dwarfs. For the final part of the list we will attempt to identify all known L and T dwarfs that will be observed by Gaia.



In Gaia G magnitude

The low mass part of the sample is being provided from the list developed by Smart (2014MmSAI..85..649S). The update to that work is that we have included the online ultracool list of Jonathan Gagné which has approximately 30\% more objects than the dwarfarchives list. We have in addition estimated the GBP and GRP magnitudes using the same procedure as the estimation of the G - that is adopting the colors of M/L/T dwarfs as provided by Hawley et al (2002AJ....123.3409) and the SDSS to G magnitude transformations of Jordi (LiveLink CJ-041). In the figures we show the distributions in spectral type G, GRP and GBP magnitudes. This list will be finished after the visit and a the subject of the Livelink document (LiveLink RLS-011).



GRP Distribution

The other two points were discussed and plans have been made to produce procedures and identification plots for the identification of UCDs combinging Gaia with other material and also identifying unresolved bianry systems for the training of dedicated procedures to identify them in Gaia spectra.

4) **Future collaboration with host institution (if applicable)**

The visitor and host have begun a number of projects that will be followed at a lower level over the next few months.

5) **Projected publications / articles resulting or to result from the grant *(ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant)***

The visitor is already producing a Livelink document describing the catalog being produced and the host is planning to apply to DPAC for an early journal publication on the propertities of UCDs using just Gaia data. These will be duly acknowledged.

6) **Other comments (if any)**