Searching for New Hot Subdwarfs by means of the Virtual Observatory

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Abstract The Virtual Observatory (from now on VO[1]) has already proved to have a strong capability to detect new blue stars. In particular, the recent detection of a helium hot subdwarf star (He-sdB) [5] opens the door to a massive search of such objects by means of VO archives and utilities. Hot subdwarf stars are compact objects in an intermediate state of evolution between the Red Giant Branch and the White Dwarf phase [6]. Interestingly, a fraction of these objects present stellar pulsations, which permits studying their inner structure and thus gain a better understanding of their evolutionary history.

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[1] http://www.ivoa.net

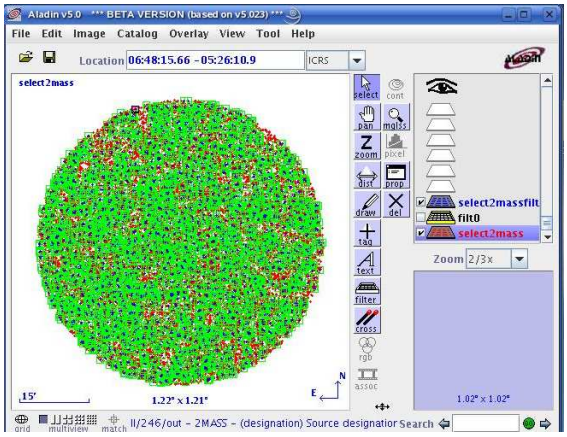

Fig. 1 2MASS objects are shown in red. Inside the green squares, in blue, 2MASS objects filtered by $J-K<0.5$ and $6<J<15$. 3025 fulfill the criteria.

1 Objectives

Our aim is detecting non previously catalogued hot subdwarf stars by using VO tools. We have started our search within the fields of view of the asteroseismological satellites CoRoT and KEPLER.

2 Methods

We used Aladin [2] tools to select potential hot subdwarfs within a chosen field of view. The selection criterion is based in culling candidates with a photometric signature similar to that of already catalogued objects with derived photometric indices. We proceeded as follows:

- We used 2MASS [1] database to select blue objects with colour indices $J-K<0.5$ within the typical range for subdwarfs $6<J<15$ [8].
- We used Tycho [2] database to select from the previous candidates, those with a counterpart in Tycho-2 catalogue laying closer than $3.5''$, and satisfying $V_T-K<0.5$.
- We used the Subdwarf Database [7] to check these filtered objects were not already catalogued as hot subdwarfs.
- We used a catalogue of OB stars [3] to check that within the previous filtered objects there were no main sequence stars of these spectral types.

We show an example of Aladin's graphical interface in Figs. 1-4, for a field of view of 1°. The running of the corresponding script to identify subdwarf candidates takes about 17 s.

[2] http://www.aladin.u-strasbg.fr/aladin.gml

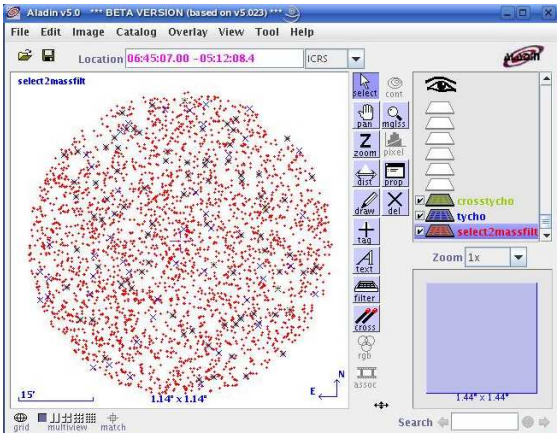

Fig. 2 Cross-correlation of the selected objects in the previous step (in red) with TYCHO objects (in blue). Cross-correlated objects are shown in green. This filtering mechanism yields 85 objects.

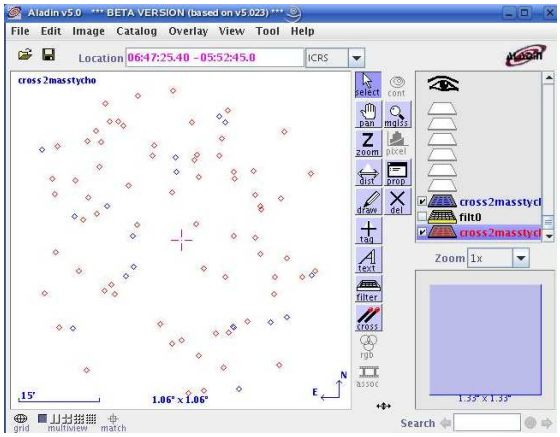

Fig. 3 We apply the filter $V_T - K < 0.5$ (objects in blue) to the previously filter objects (in red). This procedure yields a selection of 17 objects.

3 Ongoing and Future Work

The obtained hot subdwarf candidates will be confirmed in future spectroscopy campaigns. Besides, we have started to use data mining techniques to better distinguish between subdwarfs and other spectral types like white dwarfs and cataclysmic variables. We have started with a SDSS [4] data sample of subdwarfs, white dwarfs and cataclysmic variables. Each one of these objects is described by its SDSS filter magnitude u, g, r, i, z, and all the possible colour combinations.

In a first analysis three types of classifiers were used: Näives-Bayes, SVM (Support Vector Machine) with lineal and polynomial 3 degree kernel and NN (Nearest Neighbour) with 1 and 5 neighbours. The resulting confusion matrix shows that the chosen parameters do not properly discriminate between the three spectral types. Therefore, work is in progress to achieve more efficient selection criteria.

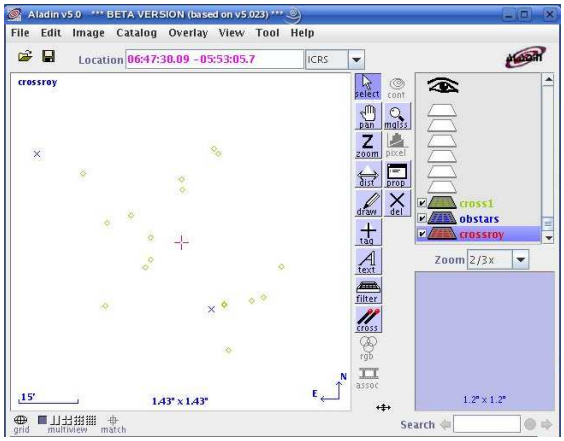

Fig. 4 The objects filtered in the previous step were cross-matched with the Subdwarf Catalogue, but none of them are classified as a subdwarf, they are marked in red. They were also compared to the list of OB stars in the field, shown in blue. In this case, no one is classified as an OB star, and so green superimposed to red colour is used for hot subdwarf candidates. The procedure yiels 17 objects in this case.

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