The White Dwarf Population in IPHAS

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ABSTRACT

The Isaac Newton Telescope/Wide Field Camera Photometric Hα survey of the Northern Galactic Plane (IPHAS) surveys the entire Northern Galactic Plane in r', i', and Hα down to r'= 20. Although initially designed to detect Hα emitting sources, IPHAS has proven very useful for detecting sources with strong Balmer line absorption. Hydrogen-rich white dwarfs (WDs) with temperatures in the range 10 000 to 20 000 K (where the Hα line is strongest) can be detected by IPHAS with a very high level of confidence. What fraction of the WD population is hydrogen-rich and in this temperature range is relatively well understood. An IPHAS selected sample with well defined temperature limits will therefore allow an independent determination of the local WD density at low Galactic latitudes where the known sample is highly incomplete, but which is crucial for obtaining correct space densities and scale heights.

1. THE INT GALACTIC PLANE Hα SURVEY: IPHAS

IPHAS is a 1800-deg^2 CCD survey of the Northern Milky Way spanning $-5^\circ < b < +5^\circ$ and reaching down to r'$\sim$ 20(10σ) [1]. The main scientific targets of the survey are Hα emitting sources such as:

- compact planetary and symbiotic nebulae,
- luminous blue variables (P Cygni and η Car like objects),
- rapidly evolving post-AGB stars,
- Be stars of all types (including young Herbig stars, and B[e] supergiants),
- clusters of T Tau stars,
- a range of interacting binary stars (symbiotics, 'supersoft' compact binaries, WD/NS/BH accreting binaries generally).

But we are also sensitive to sources with w Hα absorption such as:

- Hydrogen-rich WDs,
- and early-A stars.

2. SEARCHING FOR WDs IN THE GALACTIC PLANE

The currently known white dwarf sample is incomplete for distances as small as 13pc [2], which results in a large uncertainty on their space density. There is a strong deficit of known white dwarfs in the Galactic plane, due mainly to the fact that most have been discovered as a by product of extragalactic surveys. By detecting white dwarfs in the Galactic plane we attempt to solve this incompleteness.

The Fig below presents model spectra for 6 hydrogen-rich white dwarfs with gravity $\log g = 7.5$ and effective temperatures T_{eff} = 10 000 to 60 000 in 10 000K steps. The bandpasses of the three filters used for IPHAS (r', i', and Hα) together with U and g', are also plotted. The different continuum levels and Hα depths mainly depend on WD temperature and allow us to distinguish WDs from other stars in the IPHAS colour-colour plane, as well as WDs of different temperatures.

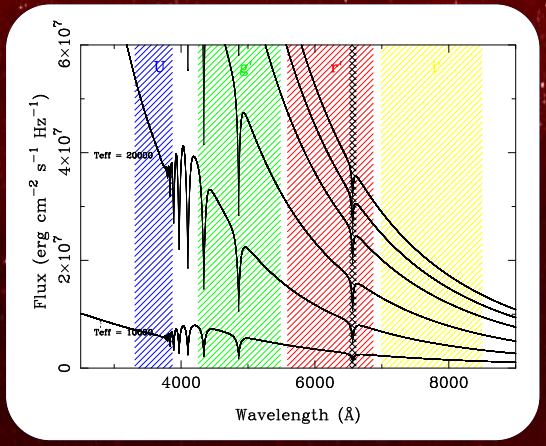
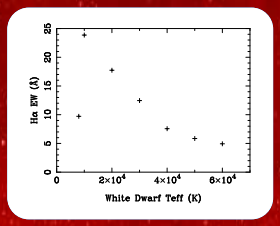
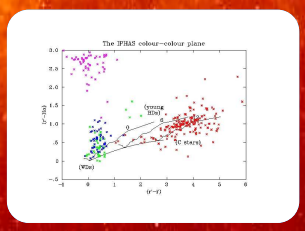
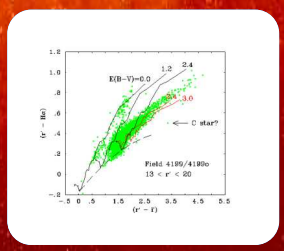


Fig.2 shows the equivalent width (EW) of the Hα absorption line for WDs of different temperatures. The largest EW corresponds to WDs with temperatures between 10 000 and 20 000K. These are the WDs that are easily detected in the IPHAS survey.



In Fig.3 (left panel) we present an IPHAS colour-colour diagram with known sources. Purple sources are planetary nebulae, green are Be stars, blue are WD accreting binaries (Cataclysmic Variables) and red are long period variables. The positions where we expect to find WDs, Carbon stars and young Brown dwarfs are also indicated. The WDs are clearly separated from the rest of the stellar sources in the survey. Also depicted is the early-A star reddening curve running along the bottom, the unreddened main sequence (marked with 0) and the AV=6 and AV=12 main sequences. On the right panel we show an example field where two WD candidates are clearly seen (figure from [1].)





3. HOW MANY WHITE DWARFS?

By using a sample of hydrogen-rich WDs from the SDSS, we identified the colour-colour box in which unreddened hydrogen-rich WDs would lie. We searched the IPHAS data taken up to August 2004 (60% of the full survey) and find an average of **0.6 WD per deg^2**. The numbers vary for different observing epochs due to several factors such as the varying quality of the observations, the fact that IPHAS does not have yet a global photometric solution and the different reddening in the fields.
By implementing a search method like that described by Witham et al. (2006) [3] we can account for the global colour shifts in the colour-colour diagrams and determine more accurately the number of WDs per deg^2.

4. FUTURE

- Spectroscopic identification of WD candidates using already approved time.
- U, and g' observations, and r' re-observations of IPHAS fields have already started (the UVEX survey). The bluer bands will allow the identification of WDs in a broader temperature range. The r' re-observations will provide proper motion information to identify the closer WDs.
- The 5-band (u', g', r', i', Hα) Southern Hemisphere counterpart of IPHAS has been approved as an ESO public survey and will start in late 2007. The telescope + instrument used for this survey will be the VLT Survey Telescope + OmegaCAM.

[1] Janet E. Drew & the IPHAS collaboration, 2005, MNRAS, 362, 753
[2] Schröder et al., 2004, MNRAS, 354, 727
[3] Witham et al., 2006, MNRAS, 369, 581

IPHAS is carried out with the Isaac Newton Telescope and the Wide Field Camera.