Ultraviolet Spectra of Two Magnetic White Dwarfs

and

Ultraviolet Spectra of Subluminous Objects Found in the Kiso Schmidt Survey

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ABSTRACT

During the last semi-annual period, the research work connected with Grant NAG5-287 from the National Aeronautics and Space Administration has been to carry out two projects in conjunction with the International Ultraviolet Explorer (IUE) satellite. These are: (1) to study the ultraviolet spectra of the two magnetic white dwarfs BPM25114 and K813-14, and (2) to look at the ultraviolet spectra of subluminous stars identified from visual wavelength spectroscopy that had been originally discovered from the Kiso Schmidt survey for ultraviolet excess stars.
INTRODUCTION

The purpose of the research with the *International Ultraviolet Explorer (IUE)* being reported here has been twofold. The first project to be discussed was to observe the ultraviolet spectra of hot subluminous stars that were originally found in the Kiso Schmidt ultraviolet excess survey by Noguchi, Maehara, and Kondo (1980) and Kondo, Noguchi, and Maehara (1984) which have been observed spectroscopically from the ground in a continuing study for which the papers: Wegner and McMahan (1985, 1986) and Wegner, McMahan, and Boley (1987) have already been published. The proposed observations progressed well and were completed during the period covered by this report and the new data obtained with the *IUE* under the auspices of NASA Grant NAG5-287 are summarized in Table I.

Observations of the ultraviolet spectra of the two magnetic DA white dwarfs BPM25114 and K813-14 using both the low resolution LWP and SWP cameras were also completed. This was proposed as a follow up on the work reported in Nelan and Wegner (1985) where the strong features found near λλ1600 and 1400 in the spectra of the cooler examples of the non-magnetic DA white dwarfs were attributed to the \( \text{H}_2 \) and \( \text{H}_2^+ \) quasi-molecules. The first object BPM25114 has an observed magnetic field of \( 4 \times 10^7 \) Gauss and the second, K813-14 has one of \( 3 \times 10^7 \) Gauss. These observations are summarized in Table II. The optical spectra of these objects and the derivations of the magnetic fields have been described in Wegner (1977), Martin and

II. OBSERVATIONAL RESULTS

The IUE ultraviolet spectra of the magnetic DA white dwarfs have continued to reveal the presence of the λλ1600 and 1400 absorptions which have been studied in earlier years in the spectra of the cooler examples of this class of stars. The SWP spectra of both objects are shown in Figures 1 and 2 and for comparison, like spectra of three non-magnetic DA stars of comparable effective temperature are given in Figures 3 and 4. Both BPM25114 and K813-14 have overall spectral energy distributions appropriate for cool DA white dwarfs with $T_{\text{eff}}$ near 10,000 K. Compared to the non-magnetic DA white dwarfs, the profiles of λλ1600 and 1400 appear to be deeper, presumably an effect produced by the magnetic fields in these objects.

The ultraviolet portions of the spectra of some of the Kiso ultraviolet excess objects are shown in Figures 5 and 6. Figure 5 shows the ultraviolet and visual portions of the spectrum of the V = 17.1 Kiso ultraviolet excess object KUV01584-0939 which appears to be a new cataclysmic type variable. In the visible portion of the spectrum it shows a strong blue continuum and marked He II emission notably near λλ 4686 and 5411 as well as emission features at the locations of the Balmer lines which could be due to either
He or H. Further observation shows spectroscopic variability in these features. Although obtained with only a one hour's integration, the IUE observation of this relatively faint object in the ultraviolet confirms the hot continuum and also reveals the presence of additional emission lines near $\lambda\lambda$ 1640 and 1243.

Figure 6 shows a further example of another of the recently observed objects. This object, K789-37 = PG12252-0757 was shown by Kilkenny (1986) to be a DZA white dwarf on the basis of ground based observations. The IUE spectroscopy shows that this star's ultraviolet spectrum is rich in metallic lines like some of the DZ stars analyzed recently by Zeidler-K.T., Weidemann, and Koester (1985), although it appears to be particularly interesting for studying accretion and mixing processes in the atmospheres of white dwarfs due to the presence of hydrogen in its visible spectrum. An atmospheric abundance analysis of this object using these data is planned.

III. CONCLUSIONS

During the first half of 1987, work has continued to be conducted on subluminous stars. The basic results of these investigations can be summarized briefly as follows:

1) Observations have been completed on the two magnetic cool DA white dwarfs and they all show the presence of the $\lambda\lambda$1400 and 1600 absorptions, although the relative strengths and wavelengths seem to be affected by the magnetic fields.

2) The ultraviolet spectra of a number of hot subluminous
stars in the Kiso Schmidt survey have been observed.

REFERENCES

APPENDIX I.

The following abstracts are of papers on the material discussed in this report that were presented at scientific meetings during the last semi-annual period.


**Ultraviolet IUE Spectroscopy of the Two Magnetic White Dwarfs BPM25114 and K813-14**

Gary Wegner (Dartmouth College)

Low resolution *IUE* spectroscopic observations of two magnetic white dwarfs have been obtained using both the SWP and LWP cameras. The first object BPM25114 has an observed magnetic field of $4 \times 10^7$ Gauss and the second, K813-14 has one of $3 \times 10^7$ Gauss. Both objects have overall spectral energy distributions appropriate for cool DA white dwarfs with $T_{\text{eff}}$ near 10,000 K and accordingly show strong $\lambda 1400$ and 1600 absorption in their spectra. Compared to non-magnetic DA white dwarfs of comparable effective temperature, there are some differences in the profiles, presumably produced by the magnetic fields in these objects.

This work was partially supported by the National Aeronautics and Space Administration through Grant NAG5-287 and the National Science Foundation Grant AST85-15219.
SPECTROSCOPIC SURVEYS OF FAINT BLUE STARS

Gary Wegner, Forrest I. Boley and Steven R. Swanson
Dartmouth College
Robert K. McMahan
Smithsonian Astrophysical Observatory

Since 1984, approximately 450 faint blue stars brighter than $m_v = 17.0$ magnitude, mostly from the Kiso Schmidt ultraviolet excess survey, have been observed spectroscopically at 8 Å resolution in the wavelength interval 4000 - 7000 Å. The intensified Reticon scanner of the Mark II spectrograph on the 1.3 m telescope of the McGraw-Hill Observatory has been used for the observations. As well, some of the spectra of the brighter more interesting objects have been observed in the ultraviolet using the low resolution mode of the IUE satellite. So far, these observations have yielded a substantial number of interesting systems for further study. Here, we concentrate on the stellar sources, present descriptions of the spectra of several of them, and discuss some preliminary statistical results. This work was partially supported by Grant AST85-15219 from the National Science Foundation and Grant NAGS-287 from the National Aeronautics and Space Administration.
Figure 1: The SWP spectrum of the magnetic white dwarf BPM25114.

Figure 2: The same spectral region, but for the magnetic white dwarf K813-14.
Figure 3: Examples of the SWP spectra of two non-magnetic DA white dwarfs.

Figure 4: Spectrum of an additional cool non-magnetic DA white dwarf.
Figure 5: The ultraviolet (left) and visible portions of the spectrum of KUV01584-0939. The ultraviolet was observed with the IUE and data for the visible region were obtained with the McGraw-Hill 1.3 m telescope.
Figure 6: The ultraviolet spectrum of the DZA white dwarf K789-37 as observed with the IUE. The portion of the spectrum derived from the SWP image is at the top and that from the LWP is below. Note the richness of spectral features in the spectrum of this object.
Table I

Kiso Objects Observed with the **IUE**
under the Auspices of Grant NAG5-287 for Project SDIGW

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### Table II

Log of Observations for the Two Magnetic White Dwarfs for Project WDIGW of Grant NAG5-287

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