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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 $\lambda\lambda$1600 and 1400 in the spectra of the cooler examples of the non-magnetic DA white dwarfs were attributed to the H_2 and H_2^+ quasi-molecules. The first object BPM25114 has an observed magnetic field of 4×10^7 Gauss and the second, K813-14 has one of 3×10^7 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

Wickramasinge (1978), Wickramasinghe and Martin (1979), Liebert *et al.* (1985) and Wegner and McMahan (1985).

II. OBSERVATIONAL RESULTS

The *IUE* ultraviolet spectra of the magnetic DA white dwarfs have continued to reveal the presence of the $\lambda\lambda$1600 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_{eff} near 10,000 K. Compared to the non-magnetic DA white dwarfs,the profiles of $\lambda\lambda$1600 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 $\lambda\lambda$ 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 λλ 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 λλ1400 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.

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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.

A. Joint Meeting of the American Astronomical Society and the Canadian Astronomical Society, June 18, 1987 in Vancouver, B. C., Canada (*Bull. of the A.A.S.*, **19**, 756 [1987]).

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 4×10^7 Gauss and the second, K813-14 has one of 3×10^7 Gauss. Both objects have overall spectral energy distributions appropriate for cool DA white dwarfs with T_{eff} near $10{,}000^{\circ}K$ and accordingly show strong $\lambda\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.

B. IAU Colloquium No. 95, "The Second Conference on Faint Blue Stars," June 1, 1987 in Tucson, Arizona.

SPECTROSCOPIC SURVEYS OF FAINT BLUE STARS

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Robert K. McMahan

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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 NAG5-287 from the National Aeronautics and Space Administration.

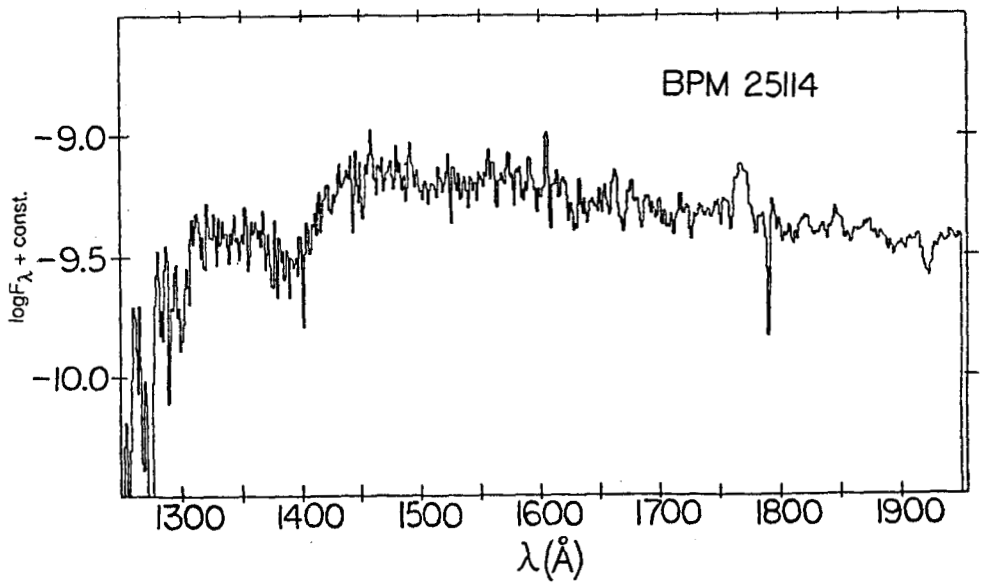
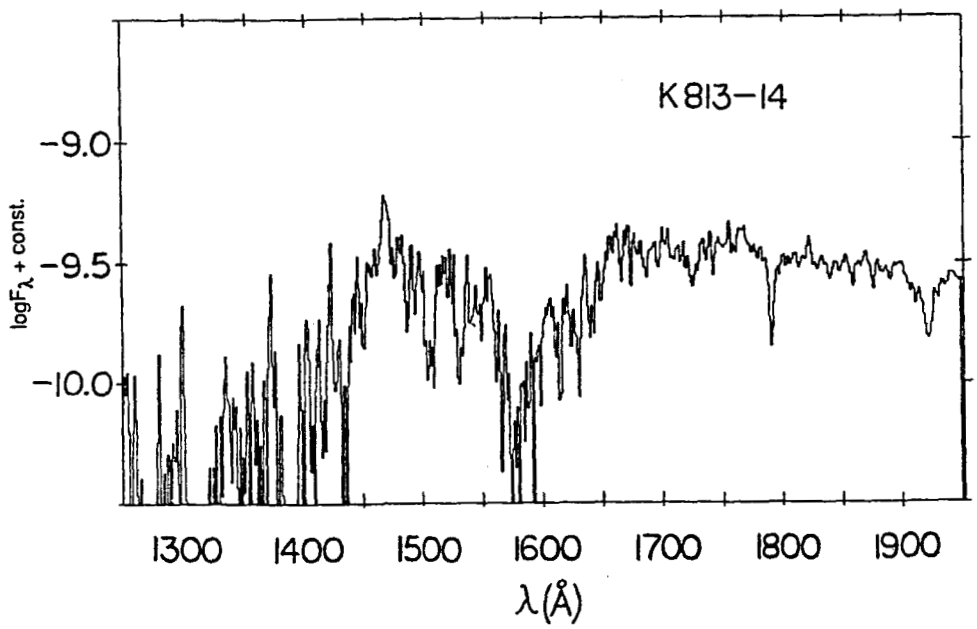


Figure 1: The SWP spectrum of the magnetic white dwarf BPM25114.

Figure 2: The same spectral region, but for the magnetic white dwarf K813-14.



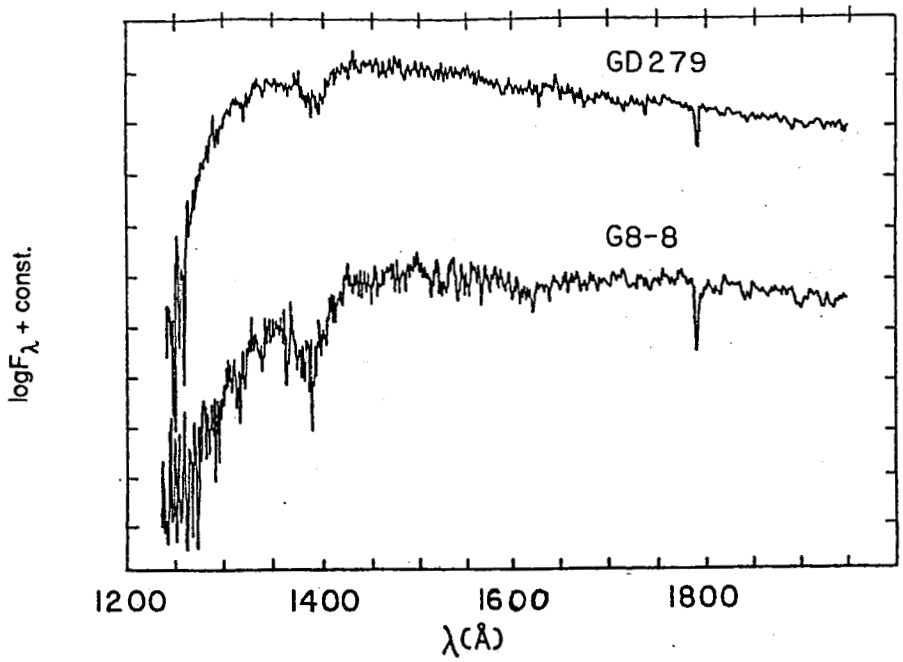


Figure 3: Examples of the SWP spectra of two non-magnetic DA white dwarfs.

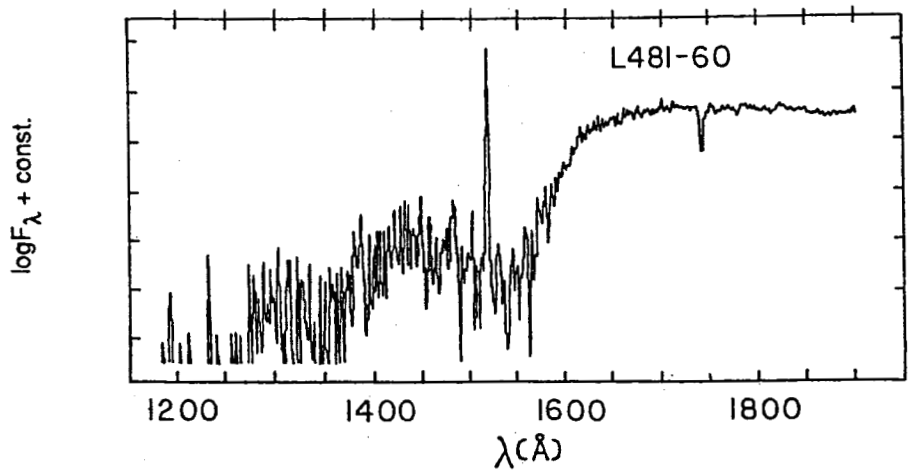


Figure 4: Spectrum of an additional cool non-magnetic DA white dwarf.

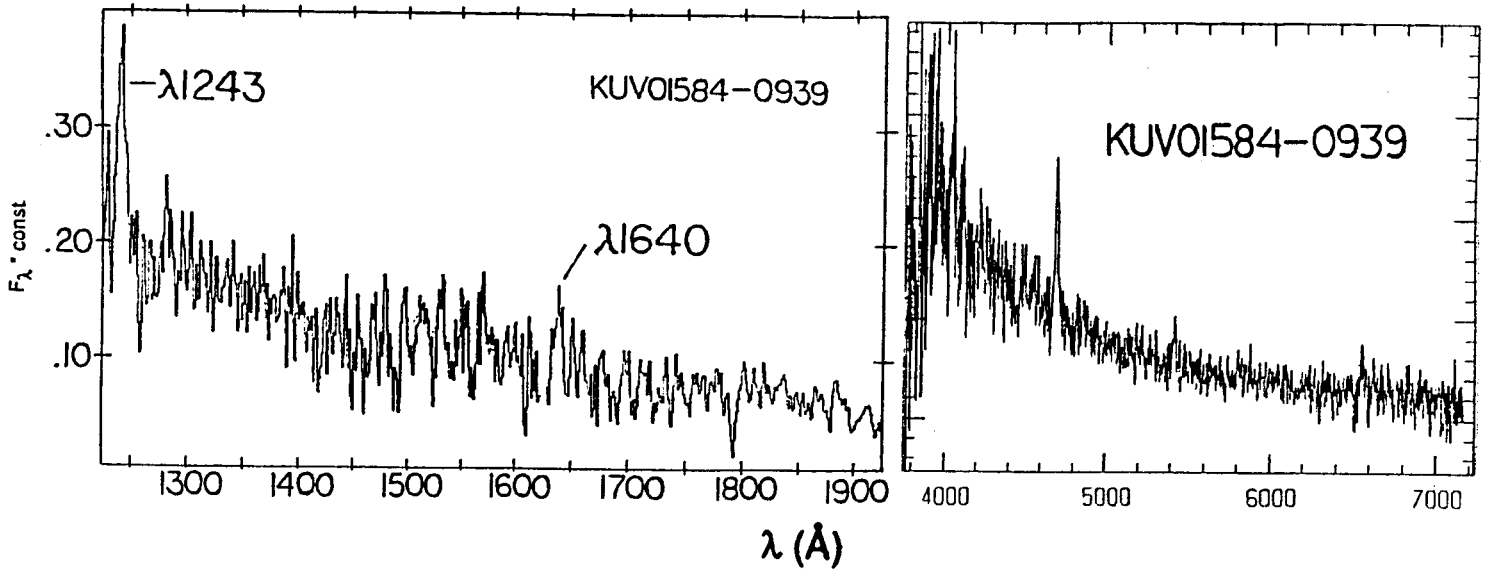


Figure 5: The ultraviolet (left) and visible portions of the spectrum of KUV01584-0939. The ultraviolet was observed with the IUE *and data for the visible region were obtained with the McGraw-Hill 1.3 m telescope.*

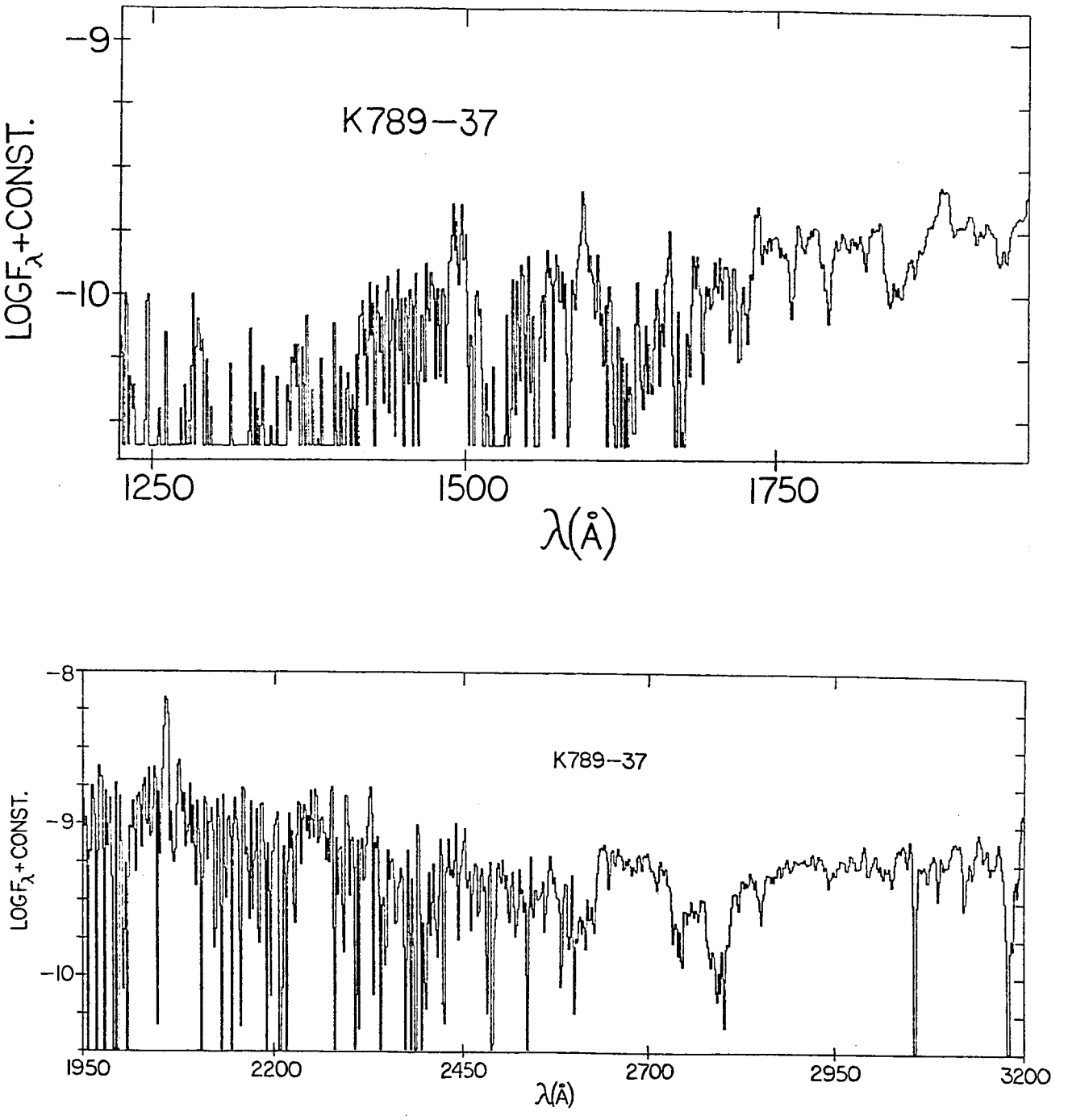


Figure 6: The ultraviolet spectrum of the DZA white dwarf K789-37 as observed with the IUE. The portion of the spectrum derived from the SWP image is at the top and that from the LWP is below. Note the richness of spectral features in the spectrum of this object.

Table I

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

Object	Date of IUE Observation	Image Number
K685-09	December 30, 1986	LWP9825
K685-09	December 30, 1986	SWP29994
K345-30	December 30, 1986	LWP9826
K345-30	December 30, 1986	SWP29995
K494-04	December 30, 1986	LWP9827
K494-04	December 30, 1986	SWP29996
K433-03	December 31, 1986	LWP9828
K789-37	December 31, 1986	LWP9830
K789-37	January 1, 1987	LWP9836
K789-37	January 1, 1987	SWP30001
K433-03	January 1, 1987	SWP30002
K1037-11	January 4, 1987	SWP30020
K433-05	February 24, 1987	SWP30374

Table II

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

Object	Date of IUE Observation	Image Number
K813-14	January 4, 1987	LWP9856
K813-14	January 5, 1987	SWP30025
BPM25114	February 24, 1987	LWP10187
BPM25114	February 25, 1987	SWP30386