GODDARD GRANT

IN-89-CR

147013

8 p.

Semi-Annual Report

For NASA Grant NAG5-971

National Aeronautics and Space Admnistration
IUE Guest Observer Program
Goddard Space Flight Center
Greenbelt, MD 20771

Ultraviolet Spectra of Subluminous Objects Found in the Kiso Schmidt Survey

and

Systematic Reanalysis of the Archived Ultraviolet Spectra of White Dwarfs Observed with the IUE Satellite under the Astrophysics Data Program (ADP)

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Duration: One Year

September 1, 1987 to August 31, 1988

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Date June 30, 1988

ABSTRACT

Recent research work connected with Grant NAG5-971 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 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 and (2) to carry out a systematic reanalysis of the archived IUE spectra of white dwarfs. This report presents information on the progress on the re-reduction of over 600 IUE white dwarf spectra and their subsequent analysis employing model atmospheres and the observation of the Kiso ultraviolet excess stars.

INTRODUCTION

The purpose of the research with the International Ultraviolet Explorer (IUE) being reported here has been in two parts. The first project to be described was the observation of 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 described in the papers by Wegner and McMahan (1987) and Wegner et al (1987a,b).

II. OBSERVATIONAL RESULTS

The recently proposed observations of the more interesting bright stars of the above Kiso sample were carried out successfully in February of 1988 under the auspices of NASA Grant NAG5-971 and are summarized in Table I.

Table I

Images of Kiso Objects Obtained under the Auspices of Grant NAG5-971

Image	Object	Date (1988)
LWP 12675	KUV18284+6650	February 16
LWP 12676	KUV03036-0043	February 16
LWP 12682	KUV13106+3157	February 17
LWP 12683	WD1104+602	February 17
LWP 12684	KUV02503-0238	February 17
LWP 12688	KUV15537+2006	February 18
LWP 12689	WD1615-154	February 18
LWP 12690	KUV08599+4130	February 18
LWP 12691	WD1406+590	February 18
SWP 32932	KUV18284+6650	February 16
SWP 32933	KUV03036-0043	February 16
SWP 32935	KUV15537+2006	February 17
SWP 32936	WD1104+602 (G197-4)	February 17
SWP 32937	KUV02503-0238	February 17
SWP 32939	KUV13106+3157	February 18
SWP 32940	KUV08599+4130	February 18

III. REANALYSIS OF ARCHIVED WHITE DWARF SPECTRA

In the last year, the re-reduction of archived IUE white dwarf spectra has progressed well and this phase of the research is nearly completed. Much of this work has been done by graduate student, Steven R. Swanson who has been supported by this grant. Initially, two trips were made to Goddard Space Flight Center to learn the use of the RDAF facility and to begin the archive reductions. More recently, all work had been done remotely from Dartmouth using the RDAF through the SPAN network.

In 1987, we counted 666 low resolution SWP, LWR, and LWP white dwarf spectra available in the IUE archives, but this number has continued to rise and currently is over 750. The plan for re-reduction of the white dwarf spectra with the RDAF has been as follows:

(1) All available photo-writes were inspected to assess the image quality. Lower quality spectra were re-reduced using the GEX Gaussian extraction routines.

(2) Well exposed images were reduced using SWPFIX. All SWP images obtained prior to 1981 had to be rerun using this routine to correct for the earlier faulty flux calibration.

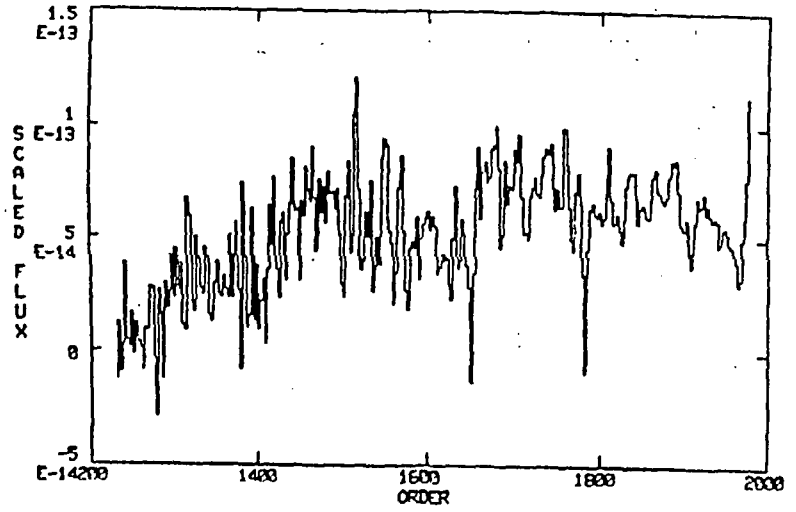
(3) The underexposed images were reduced using BSPOT to take out reseau artifacts. The well exposed images were corrected for this using PATCH.

(4) LWP spectra were corrected for camera degradation and consequently all LWP spectra are being re-reduced from the raw data.

(5) After completing the above steps, all spectra of a given star are rebinned and summed to obtain composites for each wavelength region and then merged.

(6) The merged data will then be rebinned to 50 Å bins and will cover a wavelength interval of 1200 - 3200 Å.

The ultimate goal of this phase of the research is to publish a catalog of the ultraviolet spectra of this binned data for the white dwarfs.



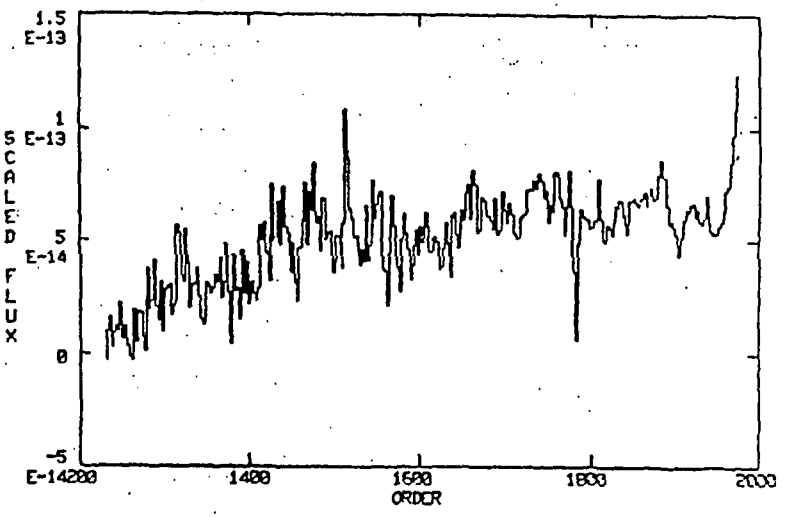


FIG. 1a - Comparison of image SWP1659 of the white dwarf G29-38 produced using different reduction programs. The original reductions in the IUE archives is shown on the left and our re-reduction using the RDAF routines is on the right.

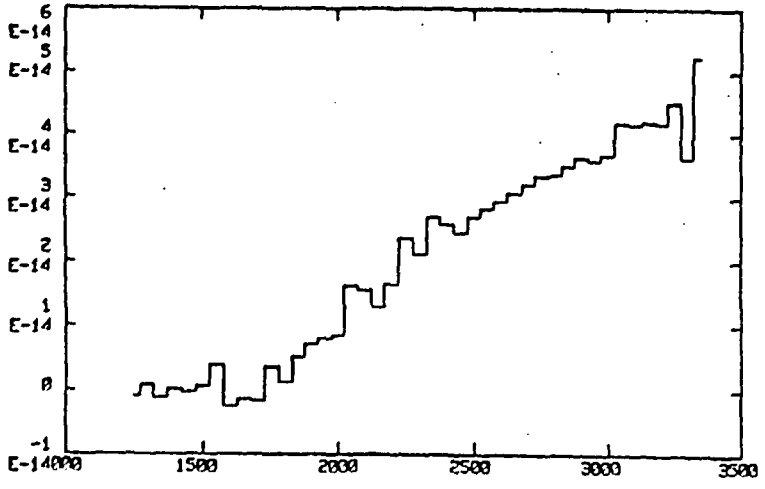


FIG. 1b - An example of re-reduced and merged spectra rebinned to 50Å bins. This represents a typical finished re-reduction.

Examples of the effect of the improved data reductions are shown in Figure 1. The first spectral scan shows the results for the originally extracted spectra as they exist in the IUE archives, and the second is the re-reduced spectrum of the object and the same original data, but utilizing the new RDAF reduction programs. Finally, the third graph indicates the appearance of a typical finished re-reduction.

III. MODEL ATMOSPHERES

It is also planned to obtain the atmospheric parameters for the white dwarfs using fits to model atmospheres. The following progress has been made towards achieving this goal. This is being done using the atmosphere code LUCIFER, originally developed by E. P. Nelan and described to some extent in Nelan and Wegner (1985). Some of this work is being done in collaboration with Nelan, but this program is also running at Dartmouth on a micro-Vax computer. Figure 2 shows some of the emergent fluxes for a selection of pure hydrogen DA model atmospheres at a fixed gravity of logg=7.6 and covering a range of effective temperature. Of particular interest for the IUE research is the behavior of the quasi-molecular absorptions in the ultraviolet.

IV. CONCLUSIONS

Since the last semi-annual report, work has been conducted on white dwarfs and other subluminous stars. The basic results of these investigations can be summarized briefly as follows:

(1) The ultraviolet spectra of additional hot subluminous stars in the Kiso Schmidt ultraviolet excess survey have been observed.

(2) The re-reduction of about 350 white dwarf spectra in the IUE archives is nearly completed and progress has been made on the determination of their atmospheric parameters using model atmospheres.

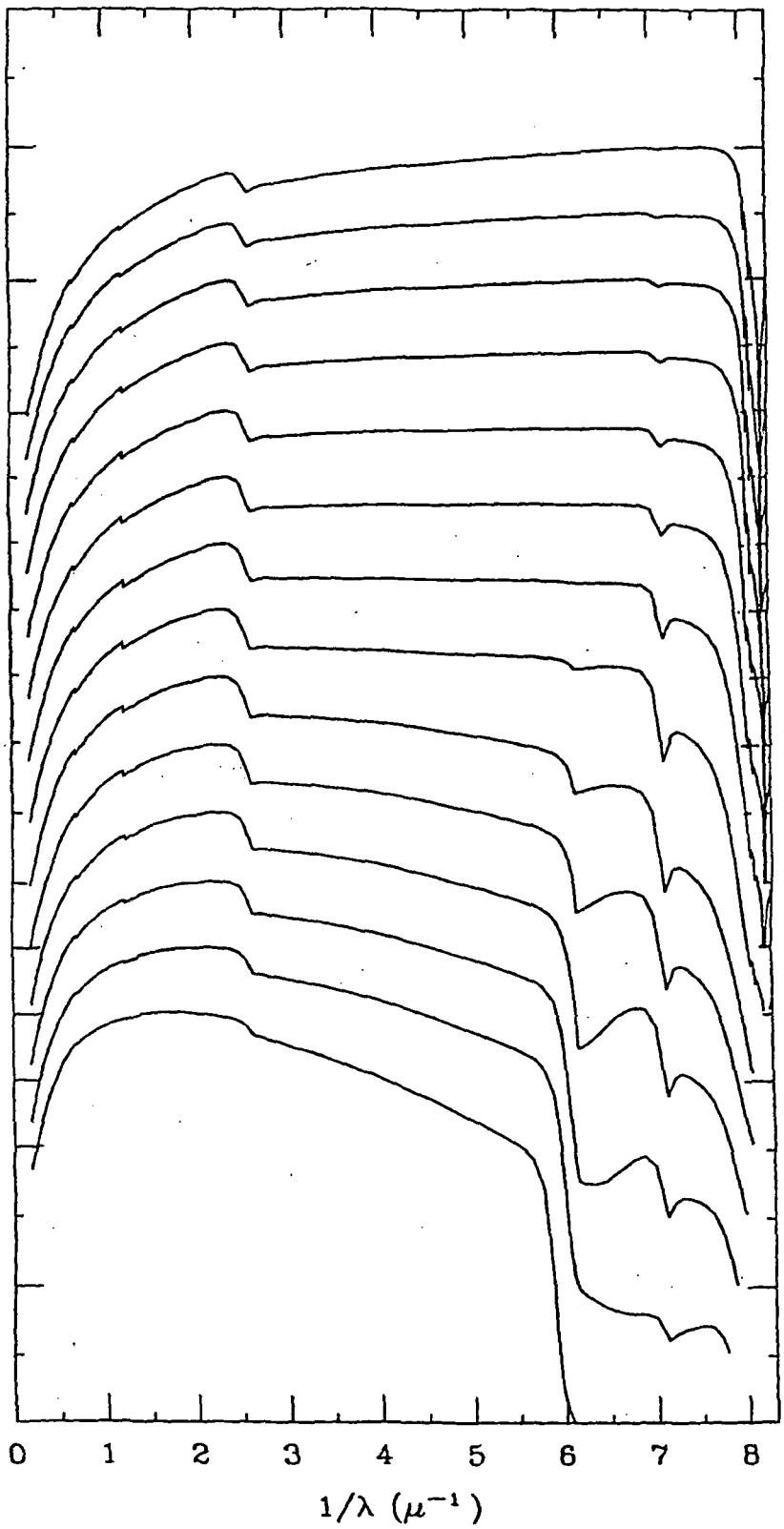


FIG. 2 - Examples of some of the pure hydrogen DA white dwarf atmospheres to be used with the IUE data. For these, log g = 7.6 and effective temperatures run from 8000 °K (top) to 21000 °K (bottom).

REFERENCES

Kondo, M., Noguchi, T., and Maehara, H., 1984, *Ann. Tokyo Astron. Obs.*, **20**, 130.

Nelan, E. P. and Wegner, G. 1985, *Astrophys. J. (Letters)*, **289**, L31.

Noguchi, T., Maehara, H., and Kondo, M., 1980, *Ann. Tokyo Astron. Obs.*, **20**, 130.

Wegner, G. and McMahan, R. K., 1985, *Astron. J.*, **90**, 1511.

Wegner, G. and McMahan, R. K., 1986, *Astron. J.*, **91**, 139.

Wegner, G. and McMahan, R. K., and Boley, F. I., 1987, *Astron. J.*, **94**, 1271.

Wegner, G., Boley, F. I., Swanson, S. R., and McMahan, R. K. 1987, in *IAU Coll. No. 95, The Second Conference on Faint Blue Stars*, A. G. D. Philip, D. S. Hayes, and J. W. Liebert, eds., (Schenectady: L. Davis Press), p. 501.

APPENDIX I

The attached reprints of papers contain material obtained with the IUE either from this grant or the earlier one, NAG5-287.

A. "Ultraviolet and Visual Spectroscopy of DB White Dwarfs," by G. Wegner and E. P. Nelan,1987, *Astrophys. J.*, **319**, 916-929.

B. "Spectroscopic Surveys of Faint Blue Stars," by G. Wegner, F. I. Boley, S. R. Swanson, and R. K. McMahan,1987, in *Proceedings IAU Colloquium No.95,The Second Conference on Faint Blue Stars*, A. G. D. Philip, D. S. Hayes, and J. W. Liebert, eds., (Schenectady: L. Davis Press),501-504.