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EUVE OBSERVATIONS OF LATE-TYPE STARS WITH MINIMUM LEVELS OF ACTIVITY

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ABSTRACT The Extreme Ultraviolet Explorer (EUVE) mission recently completed an all-sky survey in the 60–740 Å wavelength range. Here we present preliminary results for the extreme ultraviolet (EUV) emission from the least active late-type dwarfs and giants. These stars are the slowest rotators, which have acoustic waves that may dominate the atmospheric heating process. The vast majority of these stars were not detected during the survey. Gl 33 (also known as HD 4628) was detected during the EUVE Deep Survey at a high significance level. The flux determined is compared with recent computations of acoustic models.

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INTRODUCTION

Observations obtained with the International Ultraviolet Explorer (IUE) over the past 15 years have shown the existence of a well defined color dependent lower limit when the Mg II h and k surface flux is plotted as a function of stellar spectral type. The lower limit is defined by the basal stars, which have the minimum levels of chromospheric activity. The lower limit indicates that a fundamental heating mechanism exists in the chromosphere of late-type stars. Several authors have suggested that the minimum flux is a measure of the acoustically heated component in stellar chromospheres (Schrijver 1987; Mathioudakis and Doyle 1992; Mullan and Cheng 1993).

Here we present preliminary results on the coronal emission of low activity late-type stars in the 60–180 Å wavelength range. The data were collected during the Extreme Ultraviolet Explorer (EUVE) all-sky survey.

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OBSERVATIONS

EUVE was launched in June, 1992, and using three scanning telescopes conducted a sensitive survey of the extreme ultraviolet sky in four wavebands centered at approximately 80 Å (Lex/B), 170 Å (Al/Ti/C), 400 Å (Dagwood) and 550 Å (Sn/SiO). The exposure time varied from around 400 s on the ecliptic equator to 20,000 s at the ecliptic pole. During the all-sky survey a fourth telescope, the Deep Survey Scanner, did a more sensitive survey in a $2^o \times 180^o$ strip along the ecliptic. The Deep Survey was done in the Lex/B and Al/C bands. The larger effective areas combined with longer exposure times gave the Deep Survey a higher sensitivity by approximately a factor of ten compared with the all-sky survey. The EUVE instrumentation and mission plan have been described by Bowyer and Malina (1991). The selection of the stars examined in this study was based on their chromospheric activity. These are the so-called basal stars. They define the minimum levels of chromospheric emission.

TABLE I A list of the stars examined. For each star we give its Gliese or HD number, spectral type, count rate and surface flux in the Lex/B band. For the non-detection we list 3 σ upper limits (UL). Note the case of Gl 33 which was detected with the Deep Survey Scanner.

Gliese/HD (No.)	Spect. Type	Count Rate (counts s^{-1})	$\log F_{Lex/B}$ (ergs cm^{-2} s^{-1})
Gl 33	dK4	0.012	4.6 10 σ
Gl 105B	dM4.5	0.010	5.40 UL
HD 6860	M0 III	0.025	2.94 UL
Gl 340.2	dK0	0.017	6.20 UL
HD 79940	F5 III	0.009	4.88 3 σ
HD 81797	K3 II-III	0.036	3.75 UL
HD 123139	K0 III	0.028	3.70 UL
HD 124752	dK1	0.008	6.20 UL
Gl 581	dM5	0.250	6.40 UL
Gl 628	dM4	0.013	5.05 UL
Gl 688	dK3	0.042	5.63 UL
HD 164058	K5 III	0.009	2.92 UL
Gl 780	dG8	0.015	4.30 UL
Gl 783	dK3	0.018	4.73 UL
Gl 813	dM3	0.022	6.43 UL
Gl 821	dM3	0.011	5.58 UL
HD 211416	K3 III	0.012	3.50 UL
Gl 875	dM1	0.024	5.92 UL
Gl 892	dK3	0.016	4.78 UL

RESULTS AND DISCUSSION

In Table 1 we list the stars examined, their count rates, and surface fluxes in the Lex/B band (60–180 Å). Fluxes were determined from the count rates using the Raymond and Smith (1977) line emissivities. Most of the stars were not detected at the 3 σ level. For the non-detections we list 3 σ upper limits. The K dwarf Gl 33 was detected during the Deep Survey at a low count rate and high significance level (Fig 1). Mullan and Cheng (1994) have recently examined the possibility of acoustic heating in the corona of late-type dwarfs.

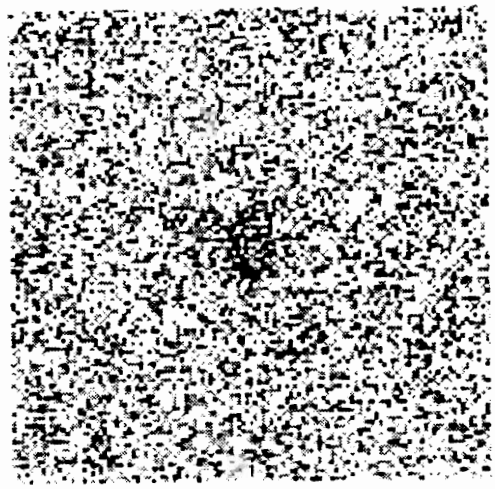

FIGURE I The low activity dwarf Gl 33. The image was taken with the EUVE Deep Survey Scanner in the Lex/B band (60–180 Å).

Their work shows that acoustic waves are capable of maintaining a corona in the least active dwarfs. The observational signature of such a corona would be gas with temperature up to 10^6 K where the flux would range between $10^4 - 10^5$ erg cm^{-2} sec^{-1}. The fluxes/upper limits presented here are consistent with their calculations.

The work of Hammer and Ulmschneider (1991) has shown that for the giants it is extremely difficult to sustain a corona with acoustic shock waves. Only one of the low activity giants examined in this study was detected at the 3 σ level. If this detection is confirmed it would imply the existence of a basal magnetic heating mechanism in the corona of low gravity stars.

ACKNOWLEDGMENTS

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