

COMMISSION 27 OF THE I. A. U.  
INFORMATION BULLETIN ON VARIABLE STARS

Number 2724

Konkoly Observatory  
Budapest  
21 May 1985

HU ISSN 0374 - 0676

SPECTRA OF 10 SYMBIOTIC STARS

The spectra were obtained in July and October 1982 using the D spectrograph at the Cassegrain focus of the 80 cm telescope at the Observatoire de Haute Provence. The spectra have a dispersion of  $93 \text{ \AA/mm}$  for  $H\gamma$ . The spectrograph is equipped with an RCA tube, and the spectra were recorded on heated Kodak IIaO plates in the region  $\lambda$  3600 - 5200  $\text{\AA}$ .

The exposure time for any given star in October was about twice as long as that used in July. We observed AG Peg, AG Dra and HBV 475 on 18<sup>th</sup> July 1982 only, AX Per and EG And on 26<sup>th</sup> October and MWC17 on 27<sup>th</sup> October 1982. The stars HM Sge, V 1016 Cyg, CI Cyg and Z And were observed both in July and in October using exposure times of the order of 30 minutes and 1½ hours.

The principal emission lines, together with the absorption bands which we detected in the ten spectra of symbiotic stars are presented in Tables I and II. Spectrophotometric analysis of these emissions and absorptions has yet to be performed.

HM Sge, V1016 Cyg : Have similar spectra both in July and October 1982. The emission lines associated with these stars have already been identified by Mammano and Ciatti (1975).

HBV 475 : We found fewer emission lines than in the two above mentioned stars. The forbidden lines are fewer in number.

AX Per, AG Peg : These two stars have some features in common but only AG Peg has FeII and [FeII] lines in emission.

Z And : On the date of our observations the [OIII] nebular lines did not appear, whilst the TiO bands appeared stronger in July.

Table I  
Emission lines in 1982 for 10 Symbiotic stars

$\lambda$ (Å)	Elements	Identification of lines in these stars
3587	He I(31)+[Fe VII] (3F)	V 1016 Cyg.
3784	H <sub>13</sub>	V 1016 Cyg, Z And (Oct), AG Peg.
3760	[Fe VII] (3F)	V 1016 Cyg, HM Sge, AX Per, Z And, AG Peg, CI Cyg, HBV 475.
3770	H <sub>11</sub>	HM Sge, V 1016 Cyg, AG Peg, detectable in CI Cyg (July) and Z And (October)
3798	H <sub>10</sub>	HM Sge, V 1016 Cyg, Z And, AG Peg and detectable in AX Per.
3835	H <sub>9</sub>	HM Sge, V 1016 Cyg, HBV 475, AG Peg, Z And, AX Per.
3869	[Ne III] (1F)	HM Sge, V 1016 Cyg, CI Cyg, AX Per, very weak in AG Peg.
3889	H <sub>8</sub> + HeI (2)	Strong in the stars, weak in AG Dra, absent in EG And.
3970	H <sub>ε</sub> + [Ne III]+Ca II	Strong in the stars, detectable in AG Dra, absent in EG And.
4026	He I (18)	HM Sge, V 1016 Cyg, HBV 475, Z And, AG Peg, very weak in AX Per.
4045	Hg	Atmospheric.
4069	[SII] (1F)	HM Sge, V 1016 Cyg, MWC 17, CI Cyg (Oct)
4076	[SII] (1F)	HM Sge, V 1016 Cyg.
4102	H <sub>δ</sub>	Present in the stars, except EG And,
4121	He I (16)	Z And (Oct), AG Peg.

Table I(cont.)

4144	He I (53)	AG Peg, Z And (Oct)
4179	Fe II (28)	V 1016 Cyg, HBV 475, Z And, AG Peg, HM Sge.
4200	He II (3)	V 1016 Cyg, HBV 475, Z And.
4233	Fe II (27)	V 1016 Cyg, Z And, HBV 475, MWC 17.
4244	[Fe II] (21F)	V 1016, Z And (July), MWC 17.
4276	[Fe II] (7F)	V 1016 Cyg.
4287	[Fe II] (7F)	V 1016 Cyg, MWC 17.
4340	H $\gamma$	in each star except EG And.
4359	[Fe II] (21F) + (7F)	MWC 17.
4363	[O III] (2F)	HM Sge, CI Cyg, V 1016 Cyg, HBV 475, AX Per, AG Peg.
4388	He I (51)	AG Peg, Z And, HBV 475, CI Cyg (July) and detectable in AX Per.
4415	[Fe II] (6F)	V 1016 Cyg, HM Sge, HBV 475, Z And, MWC 17, AG Peg.
4471	He I (14)	HM Sge, V 1016 Cyg, HBV 475, AG Peg, Z And, CI Cyg, AX Per, MWC 17.
4491	Fe II (37)	V 1016 Cyg, Z And, HBV 475, MWC 17.
4573	[Fe III] (3F)	HM Sge, V 1016 Cyg.
4583	Fe II (37) + (38)	HBV 475, Z And, MWC 17, V 1016 Cyg, AG Peg.
4629	Fe II (37)	MWC 17.
4634	N III (2)	HM Sge, V 1016 Cyg, HBV 475, CI Cyg, stronger in July, Z And, AG Peg, detectable in AX Per.
4640		
4650	C III (1)	CI Cyg (July), HBV 475.
4658	[Fe III] (3F)	HM Sge, V 1016 Cyg, MWC 17.
4686	He II (1)	V 1016 Cyg, HM Sge, HBV 475, AG Peg, Z And, AX Per, CI Cyg stronger in July, AG Dra.
4701	[Fe III] (3F)	V 1016 Cyg, HM Sge.

Table I (cont.)

4713	[Ne IV]+[A IV] (1F)	HM Sge, V 1016 Cyg.
4713	He I (12)	HBV 475, Z And (Oct), AG Peg, AX Per, CI Cyg stronger in July.
4725	[Ne IV] (1F)	HM Sge, V 1016 Cyg, AX Per.
4740	[A IV] (1F)	HM Sge, V 1016 Cyg.
4815	[Fe II] (20F)	V 1016 Cyg.
4861	H $\beta$	in each star including EG And.
4893	[Fe VII] (2F)	V 1016 Cyg.
4906	[Fe IV]+[Fe II] (20F)	V 1016 Cyg, HM Sge.
4922	He I (48)	HBV 475, V 1016 Cyg, HM Sge, CI Cyg (July) Z And, AG Peg, AX Per, very weak in AG Dra.
4922	Fe II (42)	MWC 17.
4942	[Fe VII] (2F)	V 1016 Cyg, HBV 475.
4959	[O III] (1F)	HM Sge, V 1016 Cyg, HBV 475, CI Cyg in July and October.
4969	[Fe VI] (2F)	HM Sge, V 1016 Cyg.
4989	[Fe VII] (2F)	V 1016 Cyg.
5007	[O III] (1F)	HM Sge, V 1016 Cyg, HBV 475, CI Cyg, AG Peg, MWC 17, AX Per.
5015	He I (4)	HBV 475, CI Cyg (July), Z And, AG Peg, AG Dra.
	He I (4)+Fe II (42)	MWC 17.
5146	[Fe VI] (2F)	HM Sge, V 1016 Cyg.
5158	[Fe VII] (2F)	V 1016 Cyg.
5177	[Fe VI] (2F)	HM Sge, V 1016 Cyg.

Table II

Absorption lines and bands in 1982 for 10 symbiotic stars

$\lambda(\text{\AA})$	Elements	Identification of lines and bands in these stars
4227	Ca I (2)	EG And, AX Per, Z And (July), CI Cyg, stronger in October but wider in July.
3933	Ca II (1)	HM Sge (Oct), V 1016 Cyg (Oct), AG Dra, MWC 17.
5166	Ti O (0-0)	EG And, Z And stronger in July, HBV 475.
4955	Ti O (1-0)	EG And, Z And stronger in July, AX Per, HBV 475.
4762	Ti O (2-0)	EG And, AX Per, Z And stronger in July CI Cyg, discernible in AG Peg.
4588	Ti O (3-0)	EG And, Z And stronger in July scarcely discernible in October, CI Cyg, HBV 475 discernible.
4462	Ti O (4-0)	EG And, AX Per, perhaps in Z And (July).
4808	Ti O (3-1)	EG And, AX Per, CI Cyg, Z And, stronger in July, discernible in AG Peg.
4300	CH (0-0)	EG And, MWC 17, AG Dra, AG Peg.

MWC 17	: Many FeII and [ FeII ] lines were seen from this star, HeII was absent.
AG Dra	: Few lines were seen, except for HI, HeI and HeII.
EG And	: The extremely weak emission spectrum is characterised only by H $\beta$ . In contrast, the absorption spectrum is very rich.
CI Cyg	: There were notable differences between the spectra obtained in July and October. The spectrum taken

on 26<sup>th</sup> October 82 coincides with the eclipse of the hot star in the system, (Gunther and Schweitzer, 1983). The HeII line was much less intense in October than in July despite the fact that the October exposure was three times longer. In October, the nebular CIII line did not appear in the spectrum, nor did the singlet lines of HeI at 5015, 4922 and 4388 Å.

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