ASTRONOMY & ASTROPHYSICS
SUPPLEMENT SERIES

MARCH 1987, PAGE 283

Astron. Astrophys. Suppl. Ser. **68,** 283-293 (1987)

The ultraviolet spectrum of the peculiar emission-line star GG Carinae : the line identifications (*)

E. Brandi ([1]) and E. Gosset ([2])

([1]) Observatorio Astronomico Universidad Nacional, Paseo del Bosque, 1900 La Plata, Argentina
([2]) Institut d'Astrophysique, Université de Liège, avenue de Cointe 5, B-4200 Cointe-Ougrée, Belgium

Received June 11, accepted August 19, 1986

Summary. — Line features as well as the continuum of GG Carinae in the ultraviolet wavelength domain were described by Brandi *et al.* (1986) on the basis of a series of high and low resolution IUE spectra for which the line identifications are detailed here. The present contribution is thus the complement to the above-mentioned paper and enables the disentangling of the complex and rich spectrum of GG Carinae.

Key words : stars : GG Carinae — lines : identification — stars : emission-line — stars : variable — ultraviolet spectra.

1. Introduction.

Recently, Gosset *et al.* (1984, 1985) have investigated the lightcurve and the radial velocity variations of the peculiar emission-line star GG Car. We refer to those two papers for the previous works on the subject. In their attempt to derive a physical model of the object, Gosset *et al.* (1984, 1985), and Brandi *et al.* (1986) pointed out several characteristics that ought to be taken into consideration :

(a) The spectrum of GG Car exhibits permitted and forbidden emission lines and P Cyg profiles for most of the Balmer lines during the whole lightcurve. These lines must originate in an envelope around the primary star and be accelerated outwards ;

(b) Since the radial velocities show different variations from line to line, as well as between absorption and emission components of the same transition, the stratified envelope is not spherically symmetric but rather is elongated ;

(c) Absorption lines of HeI as well as a second absorption component of the Balmer lines appear around phase 0.45 ($P = 31\overset{d}{.}020$), at the time that a possible partial occultation (« glitch ») in the lightcurve is observed ;

(d) Smaller scale variabilities are also probably present in the main trend of the light variation observed in GG Car, thus tending to confirm that at least one of the components could be a genuine variable (Kruytbosch, 1930) ;

(e) The radial velocities analysed in terms of a binary system give a mean eccentricity of 0.3 and a mass function of order 0.02, indicating that the star we see is the most massive of the system : these values are of course to be taken with caution, as indicated in Gosset *et al.* (1985).

On the basis of low and high resolution International Ultraviolet Explorer data, Brandi *et al.* (1986) present the first study of the star in the ultraviolet wavelength domain ; they describe and analyse the UV line spectra as well as the energy distribution. The present contribution complements that of Brandi *et al.* (1986) in that it disentangles the spectrum and gives an identification for the numerous lines (absorption, emission, P Cyg) that GG Car exhibits between 1232 and 3196 Å. A gap exists between 2100 and 2300 Å because of the severe interstellar absorption « bump » centred around 2200 Å, causing the continuum to drop to a very weak value in that zone ; further, much shorter gaps may exist corresponding to reseaux marks and/or to interorder discontinuities.

2. Observations.

The present investigation is based on three high resolution International Ultraviolet Explorer images. One, image SWP 8936, concerns the short wavelength region whereas the two others, images LWR 4920 and LWR 5741, concern the long wavelength one. A detailed log of those observations can be found in table I(a) of Brandi *et al.* (1986). The fact that the

(*) Based on observations made with the International Ultraviolet Explorer.

Send offprint requests to : E. Gosset.

phases of the different spectra are respectively 0.41, 0.38, 0.46, i.e. not very different and very near or within the « glitch » along the lightcurve (Gosset *et al.*, 1984, 1985) is to be pointed out. The identifications have been achieved with the aid of the tables of Moore (1950, 1952), Kelly and Palumbo (1973) and Kelly (1979). In addition, comparisons to the published identifications of the UV spectra of α Cygni (Barbier *et al.*, 1978) and of ζ Draconis and of τ Herculis (Underhill and Adelman, 1977) were performed.

The short wavelength spectrum presents many essentially undisplaced lines of interstellar origin which permit to set a zero velocity reference scale which in fact coincides with the IUE scale. The situation is not as clear for the long wavelength spectrum : the two observed spectra are shifted one with respect to the other, and it is impossible to attribute this shift either to a bad wavelength calibration or to the difference in phase (and thus in radial velocities) of the two observations. The image LWR 5741 leads to a spectrum for which the interstellar lines are almost undisplaced in the IUE scale. The observed wavelengths reported here are taken from this image. A line is assumed to be real if it is also present in the LWR 4920 image.

The results are given in tables I and II. Table I deals with the short wavelength spectrum and the successive columns give :

Column 1 : the observed vacuum wavelength.
Column 2 : a flag concerning the observed line :

E : emission line ;
X : affected by a reseaux mark ;
S : saturated i.e. almost zero flux for an absorption line or containing saturated pixels for an emission one ;
B : blended.

Column 3 : the atom or the ion responsible for the line.
Column 4 : the UV multiplet number.
Column 5 : an asterisk indicates a zero level line.
Column 6 : the laboratory vacuum wavelength of the transition.
Column 7 : remarks :
CS = circumstellar ([1]) ;
IS = interstellar ([1]) ;
? = identification is doubtful with respect to the observed intensity or position.

([1]) Distinction between CS and IS is explained in section 3.4 of Brandi *et al.* (1986).

Table II deals with the long wavelength spectrum. The columns have the same meaning as for table I except that the wavelengths are air wavelengths. It is also to be pointed out that the FeII lines that are double are, of course, all blended, but this has not been indicated in the table.

In a few areas the signal to noise ratio is poor, in others the spectrum is so crowded that the continuum level is hard to determine ; furthermore many absorption lines are saturated (as indicated in the Tabs.) or nearly so. These factors do not enable us to give significant intensity values in addition to the identification. Nevertheless, due to the existence of complex features (see for example Figs. 7, 12 and 13 of Brandi *et al.*, 1986), the identification was not obvious and we think that tables I and II will be of interest for subsequent analyses.

The richness of FeII lines is worth stressing : a detailed analysis of these lines will definitely be worth performing once enough atomic data and high(er) quality observations become available.

Furthermore a better phase coverage of the UV spectra would be the obvious next step in order to perform a more detailed study of the peculiar emission-line star GG Car, e.g. concerning the UV radial velocity curve.

Acknowledgements.

We are indebted to W. Wamsteker and A. Cassatella for having very rapidly provided us with the archive IUE data, to the referee M. Hack for her constructive remarks, and to M. Klutz for her preliminary work on the original IUE data.

One of the authors (EB) thanks the hospitality of the Institut d'Astrophysique at Liège where this work was carried out. Financial support from the Université de Liège and the IAU Exchange of Astronomers Program is gratefully acknowledged.

EG thanks the Fondation Mathieu de l'Université de Liège and the Fondation Liégeois de l'Académie Royale des Sciences de Belgique for financial support. Prof. M. Migeotte played a key role in making the latter grant available.

J.-P. Swings has read and improved this manuscript : may he find here the mark of our gratitude.

References

BARBIER, R., SWINGS, J.-P., DELCROIX, A., HORNACK, P., ROGERSON, J. B. : 1978, *Astron. Astrophys. Suppl. Ser.* **32,** 69.
BRANDI, E., GOSSET, E. and SWINGS, J.-P. : 1986, *Astron. Astrophys.*, in press.
GOSSET, E., SURDEJ, J. and SWINGS, J.-P. : 1984, *Astron. Astrophys. Suppl. Ser.* **55,** 411.
GOSSET, E., HUTSEMEKERS, D., SURDEJ, J. and SWINGS, J.-P. : 1985, *Astron. Astrophys.* **153,** 71.
KELLY, R. L. : 1979, *NASA Tech. Memo.*, Nr 80268.
KELLY, R. L. and PALUMBO, L. : 1973, *NRL Rept.*, Nr 7599.
KRUYTBOSCH, W. E. : 1930, *Bull. Astron. Inst. Neth.* **6,** 11.
MOORE, C. E. : 1950, *Nat. Bur. Standards,* Circ. 488, Sect. 1.
MOORE, C. E. : 1952, *Nat. Bur. Standards,* Circ. 488, Sect. 2.
UNDERHILL, A. B. and ADELMAN, S. J. : 1977, *Astrophys. J. Suppl. Ser.* **34,** 309.

TABLE I. — *The far ultraviolet spectrum of GG Car in the range 1230-2100 Å.*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
1232.45		NI 2	-		1233.036	
1232.80		NI 2	-		1233.250	
1236.65		NI 2	-		1236.799	?
1239.45	S	NI 2	-		1239.832	
1239.90	S	MG 2	-	*	1239.925	CS
1240.45	S	MG 2	-	*	1240.395	CS
1242.50		-				BROAD
1247.10	S	C 3	9		1247.383	BROAD
1249.40	S	SI 2	13.05		1250.09	
		SI 2	13.05		1250.43	
1250.00	S	S 2	1	*	1250.50	
1250.55	S	S 2	1	*	1250.50	CS
1253.20	S	S 2	1	*	1253.79	
1253.75	S	S 2	1	*	1253.79	CS
1258.90	S	S 2	1	*	1259.53	
1259.50	S	S 2	1	*	1259.53	CS
1259.80	S	SI 2	4	*	1260.421	
		FE 2	9	*	1260.542	
1260.55	S	SI 2	4	*	1260.421	CS
		FE 2	9	*	1260.542	CS
		C 1	9	*	1260.736	IS
1261.55		C 1	9		1261.426	IS
		C 1	9		1261.552	IS
1264.20	S	SI 2	4		1264.737	
1266.15		FE 2	9		1266.694	
1266.95	S	FE 2	9		1267.437	
1270.90		FE 2	9		1271.235	
1271.50	S,X	FE 2	9		1272.001	
1272.20	S	FE 2	9		1272.638	
1274.80		FE 2	9		1275.154	
1275.30	S	FE 2	9		1275.801	
1276.30		C 1	-		1276.287	IS
		C 1	-	*	1276.483	IS
1276.80		C 1	-	*	1276.750	IS
1277.25	S	C 1	7	*	1277.245	IS
		C 1	7	*	1277.282	IS
1277.60		FE 2	9		1277.667	
		C 1	7	*	1277.513	IS
1278.70		C 1	7		1277.550	IS
1279.00		-				
1279.50		C 1	6	*	1279.056	IS
		C 1	6		1279.229	IS
1279.90		C 1	6		1279.498	IS
1280.15		C 1	5	*	1279.890	IS
		C 1	5	*	1280.135	IS
1280.70	X	C 1	5		1280.333	IS
		C 1	5	*	1280.597	IS
1283.90		C 1	5		1280.847	IS
1286.10		NI 2	-		1284.327	
		TI 3	2	*	1286.228	
1288.95		TI 3	2		1286.365	
1289.80		TI 3	2		1289.299	
		FE 2	88		1290.204	
1291.05		FE 2	87		1291.594	
		TI 3	2	*	1291.622	
1291.60		TI 3	2	*	1291.622	CS
1293.00		FE 2	88		1293.543	
1294.20	S	TI 3	1,2		1294.698	
		FE 2	87		1294.914	
1295.50		TI 3	1	*	1295.883	
		FE 2	86		1296.088	
1295.70		TI 3	1	*	1295.883	CS
1296.30		S 1	9	*	1296.174	IS
1298.30	S	TI 3	1	*	1298.659	
		SI 3	4		1298.891	
1298.90		TI 3	1	*	1298.659	CS
1301.50	S	O 1	2	*	1302.1686	
1302.20	S,X	O 1	2	*	1302.1686	CS
		S 1	9		1302.337	
1303.00		S 1	9		1302.863	
		S 1	9		1303.111	
		SI 3	4		1303.320	
1303.80	S	SI 2	3	*	1304.372	
1304.25	S	O 1	2		1304.8575	
1304.90	E	O 1	2		1304.8575	
1305.50	S	O 1	2		1306.0286	
1306.10	E	O 1	2		1306.0286	
1308.75	S	SI 2	3		1309.277	
1310.30		P 2	2		1310.70	
1310.65		P 2	2		1310.70	IS ?
1312.10	X	SI 3	10		1312.590	
1316.75	S	S 1	8	*	1316.542	IS
		S 1	8	*	1316.618	IS
1317.30		NI 2	10	*	1317.220	
1322.80		NI 2	10	*	1317.220	CS
1323.40		NI 2	-		1323.417	
1323.80		S 1	8		1323.5153	IS
		S 1	8		1323.5220	IS
		C 2	11		1323.8617	
		C 2	11		1323.9059	
		C 2	11		1323.9513	
1327.15		C 2	11		1323.9955	
1328.90	S	TI 3	4		1327.59	
1329.15		C 1	4	*	1328.8332	IS
		C 1	4	*	1329.0863	IS
		C 1	4	*	1329.1001	IS
1329.60		C 1	4	*	1329.1230	IS
1334.50	S	C 1	4		1329.5775	IS
		C 1	4		1329.6005	IS
1335.70		C 2	1	*	1334.5323	BROAD
1344.00	S	P 3	1	*	1334.87	
1346.30		C 2	1		1335.6627	
1347.30		C 2	1		1335.7007	
1358.55		C 2	1		1335.7007	IS
1360.40		P 3	1		1344.34	
1360.95		SI 2	7		1346.873	
1361.45		CL 1	2	*	1347.2397	IS
1362.40		CU 2	3	*	1358.773	
		FE 2	111		1360.870	
		-				
		-				
		SI 3	46		1361.597	

TABLE I *(continued).*

1364.10		C 1	39		1364.164		1434.40		FE 2	-		1434.994			
		FE 2	103		1364.575		1437.80		FE 2	-		1438.13			
1365.95		FE 2	-		1366.720		1444.50		NI 3	-		1445.374	?		
1366.30		-					1446.20		NI 3	35		1446.748			
1367.65							1448.00		FE 2	-		1448.393			
1369.70	S	FE 2	-		1368.098		1449.50		NI 2	-	*	1450.005			
1370.20		NI 2	8	*	1370.136		1453.90		FE 2	-		1454.308			
1370.55	S	NI 2	8	*	1370.136	CS	1454.30	S	NI 2	7	*	1454.852			
1371.80		FE 2	-		1371.024		1454.80		NI 2	7	*	1454.852	CS		
1373.30		FE 2	-		1372.29		1456.05		FE 2	-		1456.47			
1373.60		FE 2	-		1373.717		1458.90		FE 2	193		1459.311			
1374.80		NI 2	9		1374.075		1464.55		FE 2	193		1465.043			
1375.30		FE 2	-		1375.172		1466.80		NI 2	-	*	1467.265			
1376.00		NI 2	-		1375.822		1467.20		NI 2	6	*	1467.762			
1380.00		FE 2	-		1376.672		1473.30	S,X	FE 2	193		1473.834			
1380.80		P 3	7		1380.46		1474.00		S 1	3	*	1473.995	IS		
		FE 2	152		1381.250		1474.40		S 1	3	*	1474.380	IS		
1381.30		NI 2	8		1381.295		1474.60		S 1	3	*	1474.572	IS		
		S 1	7	*	1381.552	IS	1483.20		S 1	3		1483.039	IS		
1385.60		P 3	7		1381.76				S 1	3		1483.233	IS		
1386.80		S 1	7		1385.510	IS	1487.20		S 1	3		1487.150	IS		
1388.10		FE 2	-		1387.22		1492.00		FE 2	-		1492.56			
1392.90		S 1	7	*	1388.435	IS	1494.10		FE 2	-		1494.59			
1393.70	B	SI 4	1	*	1393.755	BROAD	1496.00		FE 2	-		1496.523			
1397.00		SI 4	1	*	1393.755	CS	1498.20		TI 3	3		1498.697			
1398.60		FE 2	350		1397.572										
		NI 2	8		1399.026										

1402.00						BROAD	1500.00	S	NI 2	7		1500.437			
1402.80	B	SI 4	1	*	1402.770		1501.70	S	NI 2	-	*	1502.150			
1405.10		SI 4	1	*	1402.770	CS	1510.20		NI 2	6		1510.859			
1405.30		FE 2	-		1405.604		1511.40		FE 3	-		1512.192			
1406.90		FE 2	-		1405.797		1515.30		FE 3	-		1512.346			
1408.00		FE 2	-		1407.46				FE 2	-		1515.89			
1410.50		FE 2	-		1408.478		1525.95	S	FE 2	-		1515.93			
1411.00		NI 2	-		1411.071		1526.70	S,X	SI 2	2	*	1526.7076			
1412.40		FE 2	-		1411.47		1532.80	S	SI 2	2	*	1526.7076	CS		
1413.10	S,X	FE 2	47		1412.834				P 2	1	*	1532.51			
1413.90	S	FE 2	69		1413.699		1535.40		SI 2	2		1533.432			
1414.30	X	NI 3	-		1414.389	? GA 2 (2)	1536.30		P 2	1		1535.90			
						1414.44 ?			FE 3	-		1536.421			
		FE 2	-		1414.89		1541.90		FE 3	-		1536.640			
1415.30		FE 2	-		1415.75		1544.30		P 2	1		1542.29			
1416.40		SI 3	9		1417.237		1548.20	S,B	FE 2	-		1544.78			
1417.20		FE 2	-		1417.727		1548.50	S	C 4	1	*	1548.185	CS		
		FE 2	143		1417.744								BROAD		
1418.40		FE 2	-		1418.855		1550.80	B	C 4	1	*	1548.185			
1420.30		FE 2	-		1420.911		1558.30		C 4	1	*	1550.774			
1422.00		TI 3	-		1422.405		1559.80		C 4	1	*	1550.774	CS		
		FE 2	-		1422.53		1560.40		FE 2	45		1559.084			
1422.80		NI 2	-		1423.212		1560.75		FE 2	45		1560.260			
1423.55		FE 2	47		1424.047				C 1	3	*	1560.3095	IS		
1424.20	S	FE 2	47		1424.716		1561.50		C 1	3	*	1560.6832	IS		
1430.30		FE 2	-		1430.780				C 1	3	*	1560.7079	IS		
		FE 2	-		1430.895		1563.20	S	C 1	3		1561.3407	IS		
1432.60		-							C 1	3		1561.367	IS		
									C 1	3		1561.4382	IS		
									FE 2	45		1563.788			

TABLE I *(continued)*.

1564.80		FE 2	46		1565.374		1639.65		FE 2	43		1640.150							
		NI 2	–		1565.399		1641.10		FE 2	68		1641.759							
1566.30		FE 2	44		1566.819		1641.90		NI 2	–		1642.351							
1567.50		FE 2	45		1568.016				FE 2	–		1642.43							
1569.00		FE 2	44		1569.674		1643.00	S	FE 2	–		1642.50							
1569.80		FE 2	45		1570.242		1644.45		FE 2	42		1643.576							
1572.20		FE 2	45		1572.750		1645.60		–										
1573.40	S	FE 2	45		1573.825		1646.60		FE 2	68		1646.182							
1574.30	S	FE 2	44		1574.768		1648.90	S	FE 2	68		1647.159							
		FE 2	45		1574.923				FE 2	42		1649.423							
1576.65	S	FE 2	45		1577.166		1650.10		FE 2	68		1649.572							
1577.70	S	FE 2	–		1578.497		1653.40		FE 2	68		1650.704							
1580.15		FE 2	44		1580.625		1653.90		FE 2	68		1654.111							
1580.80	X	FE 2	44		1581.274		1654.50		FE 2	42		1654.476							
1584.30	X	FE 2	44		1584.949		1656.30		FE 2	68		1655.042							
1585.50		FE 2	–		1585.985		1657.00	S	C 1	2	*	1656.2665	IS						
1587.80		FE 2	44		1588.286				C 1	2	*	1656.9282	IS						
1598.80		NI 2	–		1599.251		1657.45		C 1	2		1657.0078	IS						
		NI 2	–		1599.282		1658.05	S	C 1	2	*	1657.3797	IS						
1599.30		FE 2	–		1600.02				C 1	2	*	1657.9070	IS						
1600.00		–					1658.85	X	C 1	2		1658.1222	IS						
1600.80		FE 3	118		1601.211		1660.80		FE 2	41		1658.771							
		FE 3	118		1601.289		1661.70		FE 2	40		1659.483							
1602.00		FE 2	316		1602.588		1662.60		FE 2	41		1661.347							
1602.40		NI 2	–		1602.973		1670.00	S	FE 2	42		1662.369							
1602.90		NI 2	–		1603.410		1670.40		FE 2	40		1663.221							
		NI 2	–		1603.555				FE 2	40		1670.742							
									AL 2	2	*	1670.787							
									FE 2	40		1671.010							
1605.10		NI 2	–		1605.910		1670.80	S,X	AL 2	2	*	1670.787	CS						
1606.20		NI 2	–		1606.469		1672.90	S	FE 2	102		1673.462							
		NI 2	–		1606.729		1673.70		FE 2	41		1674.254							
1607.70	S	FE 2	8	*	1608.456		1674.15		FE 2	40		1674.716							
1608.45	S	FE 2	8	*	1608.456	CS	1676.30		FE 2	41		1676.853							
1610.35	X	FE 2	43		1610.921		1677.35		FE 2	–		1677.847							
1612.10	S,X	FE 2	43		1612.802		1678.90		FE 2	102		1679.381							
1613.20		NI 2	–		1613.820		1680.55		FE 2	–		1681.12							
1614.40		NI 2	–		1614.824		1685.45		FE 2	41		1685.954							
1616.50		NI 2	–		1617.088		1685.90	S	FE 2	40		1686.455							
		NI 2	–		1617.299				FE 2	39		1686.692							
1617.80	S	FE 2	8		1618.470		1687.30		NI 3	25		1687.897							
1619.30		NI 2	–		1619.857		1687.75	X	FE 2	102		1688.280							
1621.10	S	FE 2	8		1621.685		1689.25		FE 2	41		1688.401							
1622.50	S	FE 2	43		1623.091		1690.20		FE 2	85		1689.828							
1624.80		FE 2	43		1625.520		1690.70		FE 2	85		1690.759							
1625.40		FE 2	8		1625.909		1692.00		FE 2	41		1691.271							
1628.60	S	FE 2	8		1629.154		1693.35		NI 3	16		1692.514							
1630.50	S	FE 2	8		1631.120		1694.30		FE 2	38		1692.516							
1632.00		FE 2	43		1632.668		1694.80		FE 2	41		1693.936							
1633.25	S	FE 2	43		1633.908		1696.15		FE 3	–		1695.036							
1633.70	S	FE 2	8		1634.345				NI 2	–		1695.594							
1634.80	S	FE 2	68		1635.398		1697.50		FE 2	84		1696.463							
1635.65		FE 2	8		1636.321		1698.70		FE 2	38		1696.794							
1636.70		FE 2	42		1637.397		1701.40		FE 2	40		1698.190							
1638.90		FE 2	8		1639.403				FE 2	85		1699.193							
									FE 2	85		1701.952							
									FE 2	38		1702.043							

TABLE I *(continued).*

1702.80		NI 2	5	*	1703.408		1771.90		FE 2	99		1772.509			
1703.50		NI 2	5	*	1703.408	CS	1773.40		NI 2	3	*	1773.949			
1704.00		FE 2	39		1704.652		1773.80		NI 2	3	*	1773.949	CS		
1705.60		FE 2	38		1706.142		1775.40		FE 3	-		1775.983			
1706.80	S	FE 2	84		1707.399		1775.80		NI 3	-		1776.068			
1707.75		FE 2	84		1708.250		1779.20		-						
1708.10		FE 2	38		1708.621		1782.70		-						
1709.10	S	FE 2	37		1709.560		1784.60		FE 2	191		1785.262			
		NI 2	4	*	1709.598		1785.30	E	FE 2	191		1785.262			
		FE 2	84		1709.670		1786.10		FE 2	191		1786.738			
1709.60		NI 2	4	*	1709.598	CS	1786.80	E	FE 2	191		1786.738			
1712.30		FE 2	38		1712.997		1787.35		FE 2	191		1788.072			
1714.85	S	FE 2	84		1715.032		1787.90		NI 2	5		1788.485			
		NI 3	16		1715.303		1790.80		NI 3	14		1791.644			
		FE 2	84		1715.503		1792.80		FE 2	99		1793.367			
1716.00		FE 2	39		1716.577		1793.50		-						
1717.55		FE 2	38		1718.123		1794.15		NI 3	14		1794.904			
		NI 3	15		1718.365		1794.60		FE 2	-		1795.11			
1718.55		FE 2	-		1718.986		1797.60		FE 2	142		1798.156			
		NI 3	16		1719.458		1799.80		FE 2	-		1800.45			
1719.40	S,X	FE 2	84		1720.042		1801.30	S,X	FE 3	-		1801.766			
1719.90	X	FE 2	38		1720.616		1803.90		NI 3	-		1804.394			
1722.00		NI 3	16		1722.283		1807.30	S	S 1	2	*	1807.311	IS		
1724.30		FE 2	39		1724.854				FE 2	66		1807.746			
		FE 2	37		1724.966		1808.00		SI 2	1	*	1808.0117			
		AL 2	6		1724.984				SI 2	1	*	1808.0117	CS		
1725.75		FE 2	38		1726.391										
1730.40		FE 2	110		1731.038										
1731.30		FE 2	-		1731.891										
1732.80		NI 3	15		1733.129		1808.70		FE 2	142		1809.316			
		FE 2	110		1733.375		1811.40		NI 2	24		1812.065			
1733.40		FE 2	-		1733.87		1815.00		FE 2	66		1815.761			
1734.20		MG 2	-		1734.852		1816.20		SI 2	1		1816.9278			
1737.60	S,X	NI 3	15		1738.252		1816.85		SI 2	1		1817.451			
1740.95		NI 2	5	*	1741.547		1817.80	X	FE 2	66		1818.509			
1741.70		NI 2	5	*	1741.547	CS	1819.00		FE 3	-		1819.480			
1742.10		NI 2	5	*	1741.547	IS ?	1820.40		S 1	2		1820.343	IS		
1746.10		FE 2	101		1746.818		1821.50	X	FE 2	66		1822.150			
1746.80		NI 3	15		1747.011		1822.00		-						
1747.80		NI 2	5		1748.285		1822.80		NI 3	20		1823.061			
1748.50		NI 2	5		1748.285	IS ?	1823.30		FE 2	-		1823.888			
1751.30	S	NI 2	4	*	1751.911		1824.60		FE 2	66		1825.316			
1752.00		NI 2	4	*	1751.911	CS	1826.35		S 1	2		1826.245	IS		
1752.20		NI 2	4	*	1751.911	IS ?	1827.15		FE 2	65		1826.991			
1754.25		NI 2	4		1754.808		1829.20		FE 2	66		1827.736			
1755.00		NI 2	4		1754.808	IS ?			NI 3	20		1830.006			
1759.70		AL 2	5		1760.1044				NI 3	20		1830.075			
1760.80		FE 2	101		1761.379		1830.60		FE 2	66		1830.861			
		AL 2	5		1761.975		1831.20		FE 2	-		1831.261			
1763.25		AL 2	5		1763.8692		1831.95		FE 2	66		1831.724			
1763.50		AL 2	5		1763.9521		1832.45		FE 2	65		1832.494			
1764.40		NI 3	14		1764.688		1835.30		FE 2	66		1833.071			
1767.25		AL 2	5		1767.7308		1837.50		FE 2	98		1835.874			
		NI 3	14		1767.938		1841.00		FE 3	117		1838.309			
1769.00	X	NI 3	14		1769.643				FE 2	65		1841.701			

TABLE I *(continued)*.

1842.20							
1845.00		FE 3	117		1843.502		
		FE 3	117		1845.304		
1846.00		FE 3	97		1845.521		
1848.10		FE 2	98		1846.573		
1849.00		FE 2	141		1848.771		
1851.00		FE 3	53		1849.960		
1853.85	S	FE 2	65		1851.517		
1854.60	S	AL 3	1	*	1854.716		
1856.20		AL 3	1	*	1854.716	CS	
1857.80		–					
1859.00	B	AL 2	4		1858.026		
1859.30	X	FE 2	65		1859.741		
1861.85		FE 2	97		1860.055		
		AL 2	4		1862.311		
1862.65		AL 3	1	*	1862.790		
1864.15		AL 3	1	*	1862.790	CS	
		FE 2	126		1864.656		
1865.80		FE 2	126		1864.743		
		FE 3	52		1866.305		
1869.00		FE 3	52		1866.554		
1870.30		FE 3	52		1869.828		
1871.90		FE 3	52		1871.152		
		FE 3	–		1872.515		
1874.35		FE 2	–		1872.65		
1876.20		FE 2	65		1874.931		
1876.70		FE 2	97		1876.838		
		FE 2	125		1877.467		
1877.20							
1878.30		FE 3	63		1877.989		
1879.45		–					
1880.40		FE 2	141		1880.046		
		FE 3	62		1880.620		
1881.80		FE 2	126		1880.976		
1884.40		FE 3	62		1882.047		
1886.00		FE 3	96		1885.125		
		FE 3	–		1886.61		
1886.70		FE 3	52		1886.757		
1887.00		FE 3	53		1887.197		
1888.10		FE 3	52		1887.471		
1890.00		FE 2	125		1888.733		
1891.90		FE 3	52		1890.669		
1893.40		FE 3	52		1892.140		
1894.60	X	FE 2	125		1894.006		
		FE 3	34		1895.456		
1896.30		FE 2	124		1895.675		
1897.90		FE 3	83		1896.803		
1898.40		FE 2	140		1898.538		
1900.40		FE 3	96		1899.318		
1902.10		FE 3	95		1901.096		
1905.00		FE 3	–		1902.902		
1906.20		FE 3	96		1905.818		
1907.20		FE 3	108		1906.457		
		FE 3	83		1907.577		
1910.10		FE 3	83		1907.741		
		FE 3	57		1910.401		
		FE 2	124		1910.669		
1913.10	S,X						
		FE 3	57		1913.622		
1914.30		FE 3	34		1914.056		
1916.40	B	FE 3	51		1915.083		
1917.80		FE 2	96		1917.337		
		FE 2	138		1918.114		
1922.10		FE 3	57		1918.284		
		FE 3	51		1922.789		
1925.25		FE 2	138		1922.797		
		FE 2	123		1925.983		
1928.30		FE 3	57		1926.013		
1929.70		FE 3	34		1926.304		
1934.60		FE 2	–		1929.194		
		FE 3	51		1930.387		
1935.90	X	FE 2	96		1935.296		
1936.70		FE 2	96		1936.799		
1939.50		FE 3	51		1937.345		
1940.70		FE 3	61		1940.018		
1942.90		FE 3	79		1941.633		
1944.80		FE 3	51		1943.481		
		FE 3	61		1945.342		
1950.30	X	FE 3	68		1951.007		
1952.00		NI 3	24		1952.540		
1952.80		FE 3	68		1953.322		
1953.60		FE 3	61		1954.223		
1962.50		FE 2	170		1963.110		
1963.80		FE 3	61		1964.260		
		FE 2	170		1964.342		
1971.90		FE 3	–		1972.245		
1972.20							
1974.80		FE 3	–		1972.638		
1975.50		–					
1978.15		FE 3	54		1976.126		
1979.30		FE 3	54		1978.417		
1981.40		FE 3	–		1980.392		
1993.00		FE 3	54		1982.076		
1994.90		FE 3	50		1994.073		
		FE 3	50		1995.266		
1995.80		FE 3	50		1995.563		
1998.60		FE 3	50		1996.420		
		FE 2	187		1999.430		
2000.20		FE 2	186		1999.462		
2025.35	S	FE 2	122		2001.015		
		ZN 2	1	*	2026.137		
2026.15		MG 1	2	*	2026.477		
2026.50		ZN 2	1	*	2026.137	CS	
2029.10		MG 1	2	*	2026.477	CS	
2032.30		FE 2	93		2029.834		
2055.00		FE 2	94		2033.060		
2055.60		FE 2	109		2055.927		
2056.10		CR 2	1	*	2056.25		
2061.80		CR 2	1	*	2056.25	CS	
		CR 2	1	*	2062.20		
2062.10		ZN 2	1	*	2062.662		
2062.75		CR 2	1	*	2062.20	CS	
		ZN 2	1	*	2062.662	CS	
2065.40							
2066.10		CR 2	1	*	2066.12		
		CR 2	1	*	2066.12	CS	
2068.00		FE 2	109		2066.663		
2090.00		FE 2	137		2068.576		
		FE 3	124		2090.721		
2093.30		FE 3	67		2090.806		
2097.35		FE 3	77		2094.172		
		FE 3	67		2098.149		
		FE 2	80		2098.176		
		FE 2	120		2098.176		
		FE 3	66		2098.361		

TABLE II. — *The near ultraviolet spectrum of GG Car in the range 2300-3200 Å.*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
2302.00	S					
		NI 2	11		2302.996	
2311.70	S					
		NI 2	27		2312.240	
2312.30	S					
		NI 2	58		2312.916	
2315.00	S,X					
		NI 2	11		2316.039	
2326.60	S					
		FE 2	3		2327.396	
2330.10	S					
		FE 2	35		2331.308	
2331.90	S					
		FE 2	3		2332.799	
2333.50						
		NI 2	20		2334.584	
2333.70	X					
		NI 2	20		2334.584	
2335.80	S					
		NI 2	50		2336.712	
2336.20						
		NI 2	50		2336.712	
2337.00	S					
		FE 2	3		2338.007	
2337.40						
		FE 2	3		2338.007	
2340.40						
		NI 2	50		2341.202	
2340.80						
		NI 2	50		2341.202	
2342.30	B,S					
		FE 2	3	*	2343.494	
2342.90	B,S					
		FE 2	3	*	2343.494	
2343.40	S					
		FE 2	3	*	2343.494	CS
2344.90	S					
		NI 2	58		2345.267	
2347.20	S					
		FE 2	36		2348.113	
		FE 2	3		2348.299	
2347.80						
		FE 2	36		2348.113	
		FE 2	3		2348.299	
2353.50						
2355.30		FE 2	35		2354.889	
		NI 2	22		2356.403	
2355.90						
		NI 2	22		2356.403	
2358.10	B					BROAD
		FE 2	165		2359.111	
		FE 2	165		2359.118	
		FE 2	3		2359.118	
		FE 2	35		2359.997	
		FE 2	36		2360.293	
2358.70	B					BROAD
		FE 2	165		2359.111	
		FE 2	165		2359.118	
		FE 2	3		2359.118	
		FE 2	35		2359.997	
		FE 2	36		2360.293	
2360.80						
		FE 2	35		2362.020	
2361.00						
		FE 2	35		2362.020	
2363.80						
		FE 2	3		2364.826	
2365.20						
		FE 2	35		2366.591	
		FE 2	2	*	2366.864	
2365.60						
		FE 2	35		2366.591	
		FE 2	2	*	2366.864	
2367.70						
		FE 2	36		2368.595	
2369.30	S					
		FE 2	35		2370.499	
2369.50	S					
		FE 2	35		2370.499	
2372.30						
		FE 2	2	*	2373.735	
2372.60						
		FE 2	2	*	2373.735	
2373.90	S					
		FE 2	2	*	2373.735	CS
2378.30	X					
		FE 2	36		2379.273	
2379.80	B					
		FE 2	3		2380.762	
2380.10	B					
		FE 2	3		2380.762	
2380.90	B,S					
		FE 2	2	*	2382.036	
2381.80	B,S					
		FE 2	2		2383.060	
2382.00	B,S					
		FE 2	2		2383.060	
2383.40	B					
		FE 2	36		2384.388	
2383.90	B					
		FE 2	36		2384.388	
2387.20	S					
		FE 2	2		2388.628	
2387.50	S					
		FE 2	2		2388.628	
2390.50						
		FE 2	35		2391.478	
2394.00						
		NI 2	20		2394.518	
		FE 2	2		2395.420	
2394.20						
		FE 2	2		2395.420	
		FE 2	2		2395.624	
2394.70						
		FE 2	2		2395.624	
2398.20	S,X					
		FE 2	36		2399.241	
		FE 2	2		2399.241	
2401.10						
		FE 2	36		2402.597	
2403.60	S					
		FE 2	2		2404.431	
		FE 2	2		2404.885	
2404.20	S					
		FE 2	2		2404.431	
		FE 2	2		2404.885	
2405.50						
		FE 2	2		2406.660	
2406.00						
		FE 2	2		2406.660	
2409.20	S					
		FE 2	2		2410.518	
2409.60	S					
		FE 2	2		2410.518	
		FE 2	2		2411.068	
2410.10	S					
		FE 2	2		2411.068	
2412.00	S					
		FE 2	2		2413.310	
2412.30	S					
		FE 2	2		2413.310	
2415.20						
		NI 2	20		2416.134	
2416.90						
		FE 2	244		2417.871	
2423.20	S					
		FE 2	180		2424.144	
		FE 2	180		2424.592	
2427.30	S					
		FE 2	301		2428.292	
2429.00						
		FE 2	180		2430.078	
2431.50						
		FE 2	180		2432.262	
2433.70	S					
		FE 2	180		2434.591	
		FE 2	301		2434.648	
2436.90						
		NI 2	19		2437.892	
2437.40						
		NI 2	19		2437.892	
2438.30						
		FE 2	209		2439.302	
2443.50	S					
		FE 2	148		2444.515	
2444.90	S					
		FE 2	148		2445.573	
2446.80						
		FE 2	320		2447.755	
2457.60						
		FE 2	209		2458.784	
2460.20	S					
		FE 2	209		2461.283	
2460.70						
		FE 2	209		2461.860	
2462.20						
		FE 2	208		2463.292	
2462.80						
		FE 2	208		2464.009	
2464.10						
		FE 2	208		2464.904	
		FE 2	148		2465.199	
2465.00						
		FE 2	208		2465.912	
2465.70						
		FE 2	179		2466.671	
		FE 2	179		2466.819	
2469.70	S					
		FE 2	179		2470.670	
2471.45						
		FE 2	179		2472.428	
2472.20	B					
		NI 2	19		2473.148	

TABLE II *(continued)*.

2472.50	B				2546.20						
		FE 2	148	2473.321			NI 2	57		2547.188	
2473.80							FE 2	158		2547.338	
		FE 2	208	2474.766	2547.50	B					
2477.70							FE 2	158		2548.589	
		FE 2	161	2478.449	2548.50	B					
		FE 2	179	2478.571			FE 2	177		2549.395	
2479.00							FE 2	177		2549.461	
		FE 2	179	2480.115			FE 2	240		2550.027	
2481.20					2549.70						
		FE 2	161	2482.117			FE 2	158		2550.575	
		FE 2	207	2482.657			FE 2	240		2550.683	
2482.80					2554.50						
		NI 2	61	2484.204			FE 2	177		2555.067	
		FE 2	243	2484.241			FE 2	177		2555.453	
		FE 2	400	2484.441	2559.20						
2483.30							FE 2	205		2559.774	
		NI 2	61	2484.204			FE 2	221		2560.281	
		FE 2	243	2484.241	2561.00	B,S					
		FE 2	400	2484.441			FE 2	64		2562.535	
2485.40					2561.50	B,S					
		FE 2	208	2486.343			FE 2	64		2562.535	
2488.70					2562.40	B					
		FE 2	161	2489.482			FE 2	64		2563.477	
2489.80					2562.90	B					
		FE 2	179	2490.858			FE 2	64		2563.477	
2490.40					2564.90	B					BLEND 2565.90
		FE 2	207	2491.396			NI 2	62		2565.923	
2492.10					2565.90						
		FE 2	207	2493.184			FE 2	64		2566.912	
		FE 2	161	2493.184	2566.20						
		FE 2	161	2493.262			FE 2	64		2566.912	
2496.80					2567.20						
		FE 2	207	2497.819			FE 2	145		2568.409	
2497.90					2569.90						
		FE 2	161	2498.897			TI 2	9		2571.036	
2499.90					2572.25						
		FE 2	357	2500.924			FE 2	205		2573.211	
2501.40					2573.50						
		FE 2	207	2502.393			FE 2	144		2574.362	
2502.70					2574.20	E ?					
		FE 2	161	2503.560			FE 2	144		2574.362	
2505.20					2576.15	S					
		FE 2	207	2506.094			MN 2	1		2576.105	IS
2510.00				BROAD	2576.50						
		NI 2	18	2510.871			FE 2	64		2577.919	
		FE 2	161	2511.761	2576.80						
2513.40							FE 2	64		2577.919	
		FE 2	285	2514.383	2577.70	E ?					
		NI 2	61	2514.627			FE 2	64		2577.919	
2515.30					2581.55	S					
		TI 3	7	2516.053			FE 2	64		2582.580	
2516.10					2581.70	S					
		FE 2	147	2517.131			FE 2	64		2582.580	
2518.20					2582.60	E					
		FE 2	268	2519.046			FE 2	64		2582.580	
2520.10					2584.40	S					
		FE 2	268	2521.092			FE 2	1	*	2585.876	
2520.80					2584.80	S					
		FE 2	330	2521.816			FE 2	1	*	2585.876	
2522.00		-			2585.90	S					
2524.30	B						FE 2	1	*	2585.876	CS
		FE 2	159	2525.388	2587.10						
2525.20	B						FE 2	326		2587.945	
		FE 2	145	2526.294	2590.20						
2528.50							FE 2	64		2591.542	
		FE 2	177	2529.549	2590.80						
2529.50	E						FE 2	64		2591.542	
		FE 2	177	2529.549	2591.70						
2532.40	S						FE 2	318		2592.781	
		FE 2	159	2533.627	2592.20						
2533.30	S						FE 2	64		2593.722	
		FE 2	159	2534.416	2592.70						
2534.50							FE 2	64		2593.722	
		FE 2	177	2535.486	2593.85						
2535.80							MN 2	1	*	2593.724	IS
		FE 2	159	2536.803	2596.90	S					
		FE 2	159	2536.845			FE 2	1		2598.369	
2537.70	S				2597.10	S					
		FE 2	158	2538.799			FE 2	1		2598.369	
		FE 2	158	2538.909	2597.90	S					
		FE 2	158	2538.993			FE 2	1	*	2599.395	
2538.60	E				2598.20	S					
		FE 2	158	2538.799			FE 2	1	*	2599.395	
		FE 2	158	2538.909	2599.40	S					
		FE 2	158	2538.993			FE 2	1	*	2599.395	CS
2539.60					2605.60	S					
		FE 2	177	2540.661			MN 2	1	*	2605.682	IS
		FE 2	177	2541.101	2605.80	S					
2540.60							FE 2	1		2607.086	
		FE 2	158	2541.836	2607.10	E					
2542.50							FE 2	1		2607.086	
		FE 2	159	2543.377	2610.10	B,S					
		FE 2	177	2543.430			FE 2	173		2611.339	
2544.10					2610.40						
		FE 2	147	2544.972			FE 2	1		2611.873	
2545.60					2610.60						
		FE 2	177	2546.670			FE 2	1		2611.873	
					2611.70	E					
							FE 2	1		2611.873	

TABLE II *(continued).*

2612.40		FE 2	1	2613.820		2724.80	E,X	FE 2	62	2724.884	
2612.70		FE 2	1	2613.820		2726.10		FE 2	200	2727.383	
2613.90	E	FE 2	1	2613.820		2726.30		FE 2	63	2727.538	
2616.40		FE 2	1	2617.618		2727.40	E	FE 2	200	2727.383	
2616.80		FE 2	1	2617.618		2729.50		FE 2	63	2727.538	
2617.40	E	FE 2	1	2617.618		2729.80		FE 2	63	2727.538	
2619.50		FE 2	1	2620.408		2730.40	E	FE 2	62	2730.734	
		FE 2	171	2620.695		2735.70		FE 2	62	2730.734	
2620.20		FE 2	1	2621.669		2736.00		FE 2	62	2730.734	
2620.50		FE 2	1	2621.669		2736.90	E	FE 2	63	2736.968	
2621.50	E	FE 2	1	2621.669		2738.10		FE 2	63	2736.968	
2622.60		FE 2	171	2623.726		2738.40		FE 2	63	2736.968	
2624.20		FE 2	1	2625.667		2739.50	E	FE 2	63	2739.546	
2624.50		FE 2	1	2625.667		2741.80		FE 2	63	2739.546	
2625.60	E	FE 2	1	2625.667		2742.20		FE 2	63	2739.546	
2627.00		FE 2	1	2628.293		2743.20	E	FE 2	62	2743.196	
2627.20		FE 2	1	2628.293		2745.10		FE 2	62	2743.196	
2628.00	E	FE 2	1	2628.293		2745.40		FE 2	62	2743.196	
2628.70	B	FE 2	171	2629.590				FE 2	62	2746.483	
		FE 2	171	2630.071		2745.70		FE 2	62	2746.483	
2630.00	S,X,B	FE 2	1	2631.047		2746.55	E	FE 2	63	2746.978	
		FE 2	1	2631.322		2747.60		FE 2	63	2746.978	
2631.30	E	FE 2	1	2631.047		2747.80	S	FE 2	62	2746.483	
		FE 2	1	2631.322				FE 2	63	2746.978	
2663.20		FE 2	263	2664.663				FE 2	63	2749.178	
2663.60		FE 2	263	2664.663				FE 2	63	2749.178	
2664.50	E	FE 2	263	2664.663				FE 2	62	2749.320	
								FE 2	63	2749.485	

2665.60		FE 2	263	2666.636		2748.50		FE 2	62	2749.320	
2666.00		FE 2	263	2666.636		2749.10	E	FE 2	63	2749.485	
2666.60	E	FE 2	263	2666.636				FE 2	63	2749.178	
2683.10		FE 2	283	2684.754		2751.90		FE 2	62	2749.320	
2683.60		FE 2	283	2684.754		2752.30	S,X	FE 2	63	2749.485	
2691.00		FE 2	283	2692.602		2754.20		FE 2	235	2753.287	
		FE 2	62	2692.834		2754.40		FE 2	235	2753.287	
2691.40		FE 2	283	2692.602		2755.60	E,S	FE 2	62	2755.734	
		FE 2	62	2692.834		2760.20		FE 2	62	2755.734	
2692.40	E	FE 2	62	2692.834		2760.60		FE 2	62	2755.734	
2702.80		FE 2	261	2703.988		2766.10		FE 2	63	2761.812	
2703.40		FE 2	261	2703.988		2766.30		FE 2	63	2761.812	
2703.80	E	FE 2	261	2703.988		2767.20	E	FE 2	235	2767.500	
2705.40		FE 2	341	2706.566		2767.80		FE 2	235	2767.500	
2707.90		FE 2	218	2709.054		2768.00		FE 2	235	2767.500	
2710.80		-			FE 2 (201) ?			FE 2	63	2768.934	
2713.20		FE 2	63	2714.413		2768.90	E	FE 2	63	2768.934	
2713.40		FE 2	63	2714.413		2777.80		FE 2	200	2769.153	
2714.10	E	FE 2	63	2714.413		2778.10		FE 2	63	2768.934	
2715.00		FE 2	261	2716.217		2779.00	E	FE 2	234	2779.299	
2715.60		FE 2	261	2716.217		2782.30		FE 2	234	2779.299	
		FE 2	62	2716.701		2782.50		FE 2	234	2779.299	
2715.80	E	FE 2	261	2716.217				FE 2	337	2783.410	
		FE 2	62	2716.701		2783.60	E	FE 2	234	2783.691	
2723.40		FE 2	62	2724.884		2790.10		FE 2	295	2783.959	
2723.70		NI 2	-	2724.725				FE 2	234	2783.691	
		FE 2	62	2724.884				MG 2	3	2790.771	

TABLE II *(continued).*

2792.80		FE 2	198		2793.888	
2794.20	S	MG 2	1	*	2795.523	
2795.55	S	MG 2	1	*	2795.523	CS
2796.30	E,S	MG 2	1	*	2795.523	
2797.40		MG 2	3		2797.984	
2801.30	S	MG 2	1	*	2802.697	
2802.70	S	MG 2	1	*	2802.697	CS
2803.40	E	MG 2	1	*	2802.697	
2830.30		FE 2	217		2831.561	
2834.45		FE 2	216		2835.711	
2839.30		FE 2	217		2840.649	
		FE 2	280		2840.758	
2842.10		FE 2	294		2843.485	
2851.10		MG 1	1	*	2852.127	
2852.20	S,X	MG 1	1	*	2852.127	CS
2854.50		FE 2	196		2855.689	
		FE 2	195		2856.147	
2857.10		FE 2	279		2858.340	
		FE 2	195		2858.340	
2879.20		FE 2	61		2880.757	
2879.70		FE 2	61		2880.757	
2893.90		FE 2	257		2895.071	
2921.50		FE 2	293		2922.023	
2925.00		FE 2	60		2926.586	
2925.30		FE 2	60		2926.586	
2926.40	E	FE 2	60		2926.586	

2935.70		MG 2	2		2936.501	
2943.20		FE 2	78		2944.397	
2946.30	X	FE 2	78		2947.658	
2946.50	X	FE 2	78		2947.658	
2947.30	E	FE 2	78		2947.658	
2947.80		FE 2	277		2949.178	
2952.50		FE 2	60		2953.774	
2953.60	E	FE 2	60		2953.774	
2963.40		FE 2	78		2964.629	
		FE 2	78		2965.035	
2964.50	E	FE 2	78		2964.629	
		FE 2	78		2965.035	
2968.80		FE 2	60		2970.517	
2969.30		FE 2	60		2970.517	
		FE 2	276		2970.682	
2970.60	E	FE 2	60		2970.517	
2983.50		FE 2	78		2984.824	
		FE 2	78		2985.545	
2984.30		FE 2	78		2985.545	
2984.90	E	FE 2	78		2984.824	
		FE 2	78		2985.545	
3001.00		FE 2	78		3002.650	
3001.30		FE 2	78		3002.650	
3002.40	E	FE 2	78		3002.650	
3106.20	E	FE 2	V68		3106.559	
3195.75	E	FE 2	V7		3196.070	