

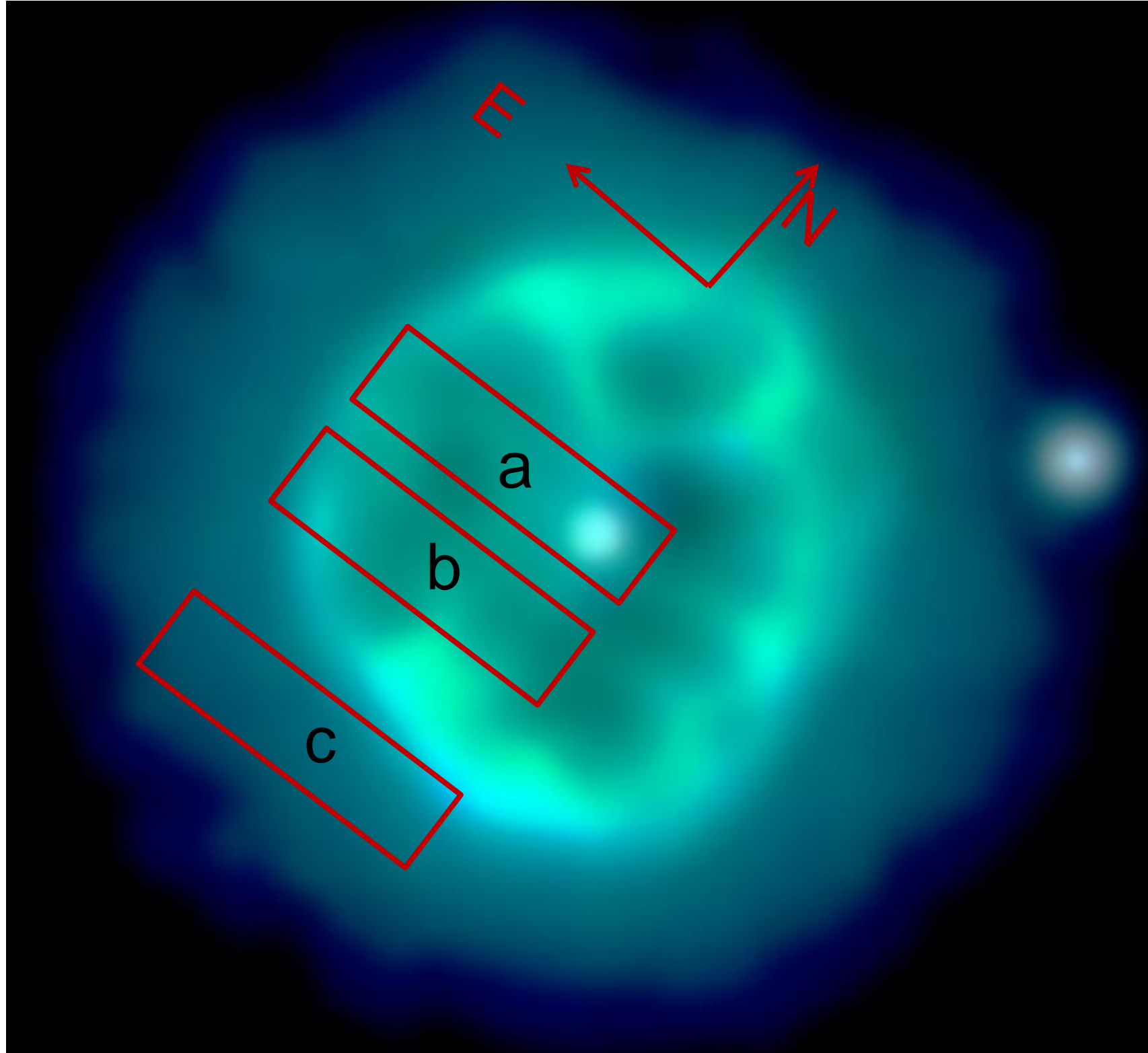


THE PLANETARY NEBULA NGC 1535

Celia Rosa Fierro Santillán

Escuela Superior de Física y Matemáticas, Instituto Politécnico Nacional, México

Abstract: With optical observations were found six different regions in the nebular gas of NGC 1535. These regions differ not only in position but also in its main physical parameters: electron temperature, electron density and degree of ionization. These regions will be used in a later work to perform a comparative study of the chemical composition of this nebula.



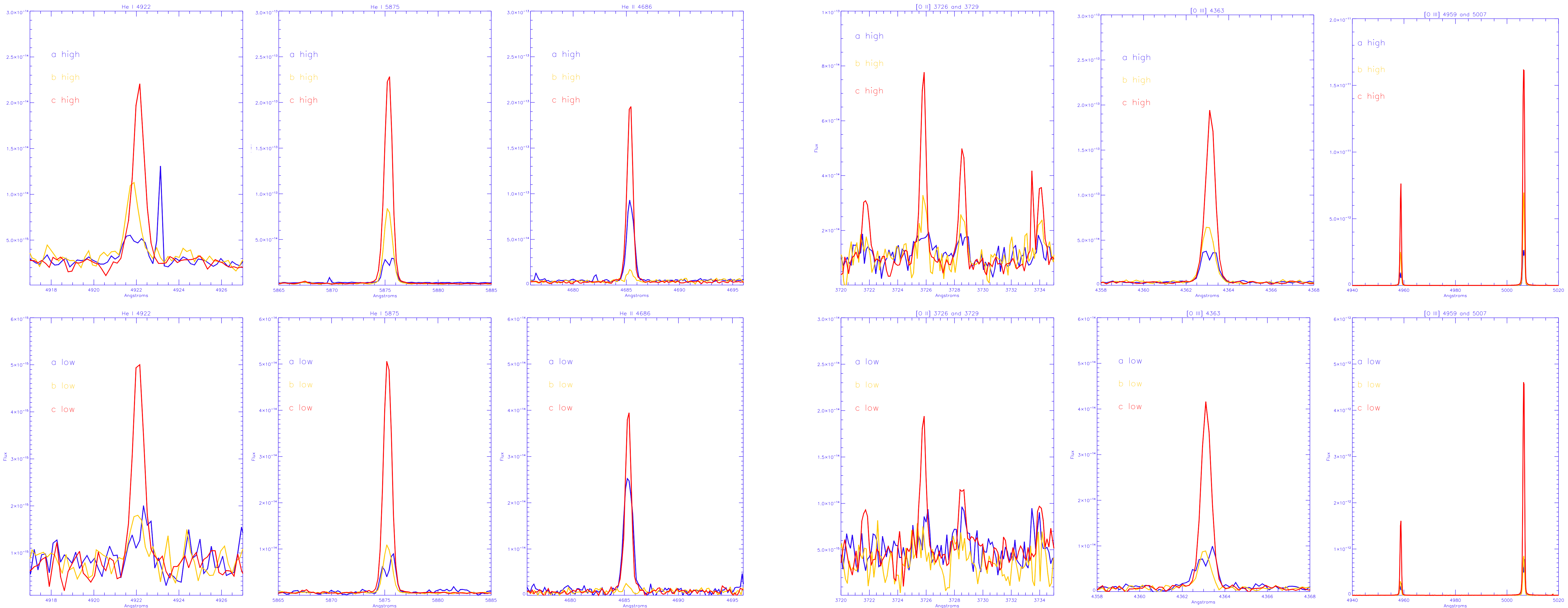
Observations: The optical spectra of NGC 1536 were obtained in two nights in 2010, November 2 and 5 with the Echelle spectrograph REOSC attached in the 2.1 m Telescope of the Observatorio Astronómico Nacional at San Pedro Mártir, Baja California, México. The spectral resolution is about 20 000. In order to obtain good spectra of the central star and several regions in the planetary nebula, a slit of 13 x 3 arc sec was oriented in the E-W direction. The slit was placed on the central star (a region) and the shifted 3 arc sec to the South (b region), and 10 arc sec to the South (c region).

Regions: In order to obtain spatial information on the planetary nebula each spectrum of 13 x 3 arc sec was divided in slices of about 1 x 3 arc sec; the resultant spectra were classified using the ionization degree of the nebular gas, from the ratio

$$\frac{[\text{O III}]}{[\text{O II}]} = \frac{I(\lambda 4363) + I(\lambda 4959) + I(\lambda 5007)}{I(\lambda 3726) + I(\lambda 3729)}$$

The six resultantes regions are:

- a-high: slit in the position a (on the CS) with $200 \leq [\text{O III}] / [\text{O II}] \leq 280$
- a-low :slit in the position a with $120 \leq [\text{O III}] / [\text{O II}] \leq 200$
- b-high: slit in the position b (3 arc sec to S of the CS) with $200 \leq [\text{O III}] / [\text{O II}] \leq 340$
- b-low :slit in the position b with $120 \leq [\text{O III}] / [\text{O II}] \leq 200$
- c-high: slit in the position c (10 arc sec to S of the CS) with $180 \leq [\text{O III}] / [\text{O II}] \leq 200$
- c-low : slit in the position c with $120 \leq [\text{O III}] / [\text{O II}] \leq 180$



He I and He II lines showing the differences in the ionization degree of each region.

[O II] and [O III] lines showing the differences in the ionization degree of each region.

Line intensities when $I(\text{H}_\beta) = 100.0$

R E G I O N S

λ_0	Ion	a_high	a_low	b_high	b_low	c_high	c_low
6562.46	H I	278.09	275.48	288.40	278.33	277.68	283.84
4861.08	H I	100.00	100.00	100.00	100.00	100.00	100.00
4340.50	H I	46.73	49.87	46.50	45.52	43.07	43.66
4101.77	H I	25.06	29.34	24.89	24.47	24.41	24.49
4921.93	He I	0.96	1.21	1.25	1.49	1.16	1.09
5875.62	He I	11.20	10.15	16.06	16.05	12.81	13.11
4541.37	He II	0.56	1.36	0.39	13.10	0.40	0.32
4686.68	He II	25.95	39.00	1.95	1.63	12.44	11.88
3726.03	[O II]	4.35	5.30	3.16	8.26	5.86	5.94
3728.83	[O II]	2.70	7.54	2.29	6.59	3.54	4.41
4363.20	[O III]	10.79	16.03	10.40	9.88	11.90	12.32
4958.91	[O III]	396.15	388.32	406.48	399.05	402.87	414.46
5006.81	[O III]	1280.85	1347.77	1247.27	1122.28	1128.84	1330.79
5754.34	[N II]	0.11	0.61	0.06	0.32	0.04	0.05
6547.77	[N II]	0.16	1.12	0.27	0.40	0.37	0.37
6583.02	[N II]	0.66	1.48	0.78	0.91	1.15	1.22
5517.65	[Cl III]	0.13	0.44	0.28	1.00	0.14	0.21
5538.00	[Cl III]	0.32	0.59	0.19	0.40	0.14	0.17
4711.58	[Ar IV]	5.11	3.31	4.13	4.52	4.96	3.60
4740.30	[Ar IV]	6.78	3.45	3.32	2.77	2.89	3.36

Ionization degree, Te and Ne line diagnostics

R E G I O N S

Diagnostic	a_high	a_low	b_high	b_low	c_high	c_low
He II / He I	2.18	3.55	0.14	0.84	0.92	0.86
[O III] / [O II]	239.82	136.51	305.24	109.81	164.20	169.74
Te [O III]	10 200	12 450	10 950	10 850	11 750	11 600
Te [N II]	-	-	-	-	16 750	19 100
Ne[O II]	1 310	-	1 000	700	1 700	1 000
Ne[Cl III]	-	6 900	-	-	2 700	750
Ne [Ar IV]	9 600	5 350	1 450	-	2 400	3 300