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Spectrophotom
of the DQ
Her type
Nova V5668
Sgr (2015)
6th TIGRE
Workshop

Ilse Alejandra
Aguilar
Segoviano

Nova
¿What is a Nova?
Light Curve

Nova V5668
Sgr

Metodology
Interpolation of
Data

Results
Techniques for the
Absolute Flux
Calibration Process
Comparison between
Second Maximum
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comparison between
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Spectrophotometry of the DQ Her type Nova V5668 Sgr (2015)
6th TIGRE Workshop

Ilse Alejandra Aguilar Segoviano

Universidad de Guanajuato
Departamento de Astronomía

14 June 2018

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Introduction

- A *Nova* is a mass eyection due to a thermonuclear explosion on the surface of a white dwarf in a binary system.

- On March 15th it was observed in Sagitari the Nova V5668 Sgr with the TIGRE in Guanajuato; Gto. Mexico.

- In the light curve of the Nova there are 5 maximum. This maximum are a consequence of variations in the continumm in the nova light curve.

- We want to find what is the reason of the variations in the continumm and emission lines and its distributions.

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In the light curve of Nova V5668 Sgr,variations are observed in the 90 days after it was discovered on March 15, 2015, five phases of decay were identified.
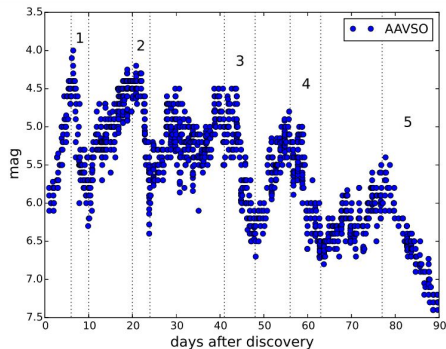

Figure: Light Curve of Nova V5668.

https://www.aavso.org/lcg

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Motivations

- The light curve of Nova V5668 Sgr has five falls and variations in the continuum, these behaviors are typical of DQ Herculis light Curve.

- When the light curve decreases, the continumm decreases too.

- To find the continuum distribution, it's necessary calibrate in absolute flux the spectra of the Nova using photometric and spectroscopic techniques.

- The distribution of the continuum and the emission lines, telling us if happen in the envelope or in the white dwarf.

This technique helps to measure the flux of our object of interest as a small fraction of the flux of the standard star. We choose the Star HD141004 to the calibration process This star was observed with TIGRE before of nova observations in the same conditions.
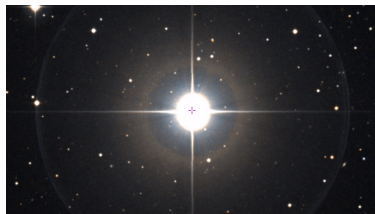

Figure: Star HD141004

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Metodology
Data Interpolation

To obtain the flux of the nova and of the star, we use the filters B ($3600\mathring{A} < \lambda < 5600\mathring{A}$) and I ($7000\mathring{A} < \lambda < 9200\mathring{A}$).

After that, it's necessary adjust the data of nova and the star with a python program which makes the integration under the curve using PyAstronomy subrutines.

```python
from PyAstronomy import pyasl
from PyAstronomy import pyaC
import numpy as np
import matplotlib.pylab as plt
from pylab import *
#x=filtro
#y=filtro
#xx=tigre
#Values at wich to interpolate
x, y = np.loadtxt('B.txt', skiprows=0, unpack=True)
xx, xz = np.loadtxt('Sci_HD141004_B_2015_04_05_03_23_41.txt', skiprows=0, unpack=True)
#integracion donde x=longitud de onda, y = filtro,a y b=limites
a = 3790
b = 5700


print(x)
yy = pyasl.intep(x, y, xx, boundsError=False)

z = yy*xz

print("ibtrapz:", pyaC.ibtrapz(xx, z, a, b))
plt.plot(xx, z, color="brown")
legend(loc='upper right')
xlabel(r"wavelength [$\AA$]",fontsize=16)
ylabel("relative flux",fontsize=16)
plt.show()
```

Metodology
Results of the Integration of Nova and Star Data
B and I Filters.

Espectro	Filtro	Integración	Tiempo de exposción	Magnitud	AirMass
Nova B 05 Abril	B	74.965	600	4.73	1.597581
Nova R 05 Abril	I	30.600	600	3.82	1.597581
HD141004B 05 Abril	B	39.244	1204.033	5.03	1.084412
HD141004R 05 Abril	I	36.374	1204.033	3.6	1.084412
Nova B 11 Abril	B	7.323	600	5.55	1.567694
Nova R 11 Abril	I	5.104	600	4.6	1.597694
HD141004B 11 Abril	B	30.507	1611.5466	5.03	1.029017
HD141004R 11 Abril	I	30.625	1611.5466	3.6	1.029017
Nova B 28 Abril	B	18.986	600	6.12	1.968959
Nova R 28 Abril	I	17.316	600	4.92	1.968959
HD141004B 28 Abril	B	54.822	689.9851	5.03	1.033191
HD141004R 28 Abril	I	67.800	689.9851	3.6	1.033191
Nova B 01 Mayo	B	11.846	600	6.61	1.944489
Nova R 01 Mayo	I	10.276	600	5.18	1.944489
HD141004B 01 Mayo	B	70.957	480	5.03	1.03106
HD141004R 01 Mayo	I	58.218	480	3.6	1.03106

Figure: Data of Nova and Standard Star

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Results
Absolute Flux Calibration

In the observations, there are some factors that affects to this observation.

For that reason we use a photometric techinique to represent the change in the star night by night.

This techinique consist in relate the spectra of the star and the nova to get a ratio night by night.

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Results
Absolute Flux Calibration

The results for each observation day are shown in the following table:

Noche de Observación	Filtro	$\frac{\int_{filtro} F_{nom.nova}}{\int_{filtro} F_{nom.\star}}$	$\int_{filtro} F_{nom.\star}$	$f_{nom.de\star}$ noche a noche	$f_{corr.filtro}$
05 Abril 2015	B	0.66493955	0.0579	1	1.1409
	I	0.03947368	0.0304	1	20.6910
11 Abril 2015	B	0.071254702	0.04519	1.2812	8.6956
	I	0.095736434	0.0258	1.1782	4.1600
28 Abril 2015	B	0.105043563	0.08149	0.7105	3.4885
	I	0.218674071	0.05762	0.5276	1.3557
01 Mayo 2015	B	0.045258215	0.1065	0.5436	5.1572
	I	0.114648437	0.05120	0.5937	2.0366

Figure: Obtaining and comparing nominal flux between Nova V5668 Sgr and Estrella HD141004 to obtain corrected flux.

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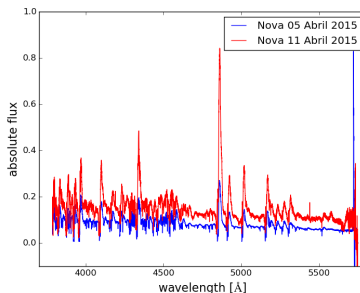Aguilar
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Results
Absolute Flux Calibration

As a last step for this spectrophotometric technique, the factors that relate to the flux of the star and the corrected flux in the filter are the following:

Filtro \ Día	05 Abril 2015	11 Abril 2015	28 Abril 2015	01 Mayo 2015
B	1.1408	11.1379	2.4786	2.8035
I	20.6910	4.9015	0.7152	1.2091

Figure: Register of factors of the Nova V5668 Sgr for calibration in absolute flux.

These factors are those that calibrate the spectra in absolute fluxes.

Results

Comparison between Second Maximuum and Second Minimuum
B Filter

Figure: Spectrum comparison of the Nova V5668 Sgr in absolute flux for the second maximum and second minimum in filter B.

Gráficas
$\Delta m = 0.6883$

AAVSO
$\Delta m = 0.82$

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Nova
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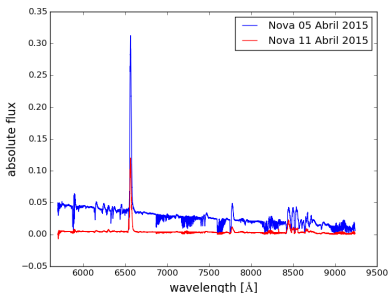Light Curve

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Results
Comparison between Second Maximuum and Second Minimuum
I Filter

Figure: Spectra comparison of the Nova V5668 Sgr in absolute flux for the second maximum and second minimum in filter I.

Gráficas
$\Delta m = 3.8056$

AAVSO
$\Delta m = 0.78$

Results
Comparison between Third maximum and Third Minimum
B Filter

Figure: Spectra comparison of the Nova V5668 Sgr in absolute flux for the second maximum and second minimum in filter I

Gráficas
$\Delta m = 0.4569$

AAVSO
$\Delta m = 0.49$

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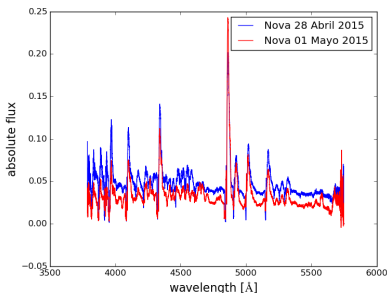Nova V5668
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Results
Comparison between third maximum and third minimum
I Filter

Figure: Spectra comparison of the Nova V5668 Sgr in absolute flux for the third maximum and second minimum in filter I.

Gráficas
$\Delta m = 0.4826$

AAVSO
$\Delta m = 0.26$

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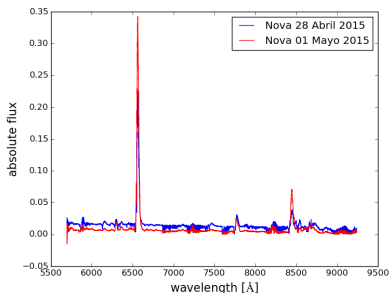Aguilar
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Error Discussion

In the calibration processes, we don't use some factors that only are used in observations.

To prove the contiuum change, the contribution from the continuum was obtained; and of the emission lines by calculating the area or equivalent width in the emission lines.

Día Observación	$\text{Área}_{Contínuo}$	$\text{Área}_{Líneas}$	% Contínuo	%Líneas	Escala en Proporción
05 Abril 2015	2.11	4.7	31.03 %	68.97 %	1:2.22
11 Abril 2015	0.87	1.61	35.24 %	64.76 %	1:1.83
28 Abril 2015	1.10	2.91	27.40 %	72.59 %	1:2.64
01 Mayo 2015	2.14	7.92	21.33 %	78.66 %	1:3.68

Figure: Contributions of the continuum and the emission lines in the spectra of the Nova V5668 Sgr on the days corresponding to the second maximum and minimum and the third maximum and minimum e filter I.

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Conclusions

- The Nova V5668 Sgr presents the characteristics of a classic nova in its light curve; At first there are variations and then a phase is observed in which the brightness is almost constant.

- In the absolute flux calibration charts, the magnitudes for the maximum and minimum were obtained and a notable difference of the flux change for the second maximum and minimum can be observed, this difference could even be part of the error in the data; besides that the emission lines would change.

- The comparison made for the difference of magnitudes between the maximum and minimum is within the values presented by the difference of magnitudes in the curve of light (between 1 and 2 magnitudes).

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Thank You!

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