Estudio óptico del Sistema Binario de rayos X Swift J0243.6+6124

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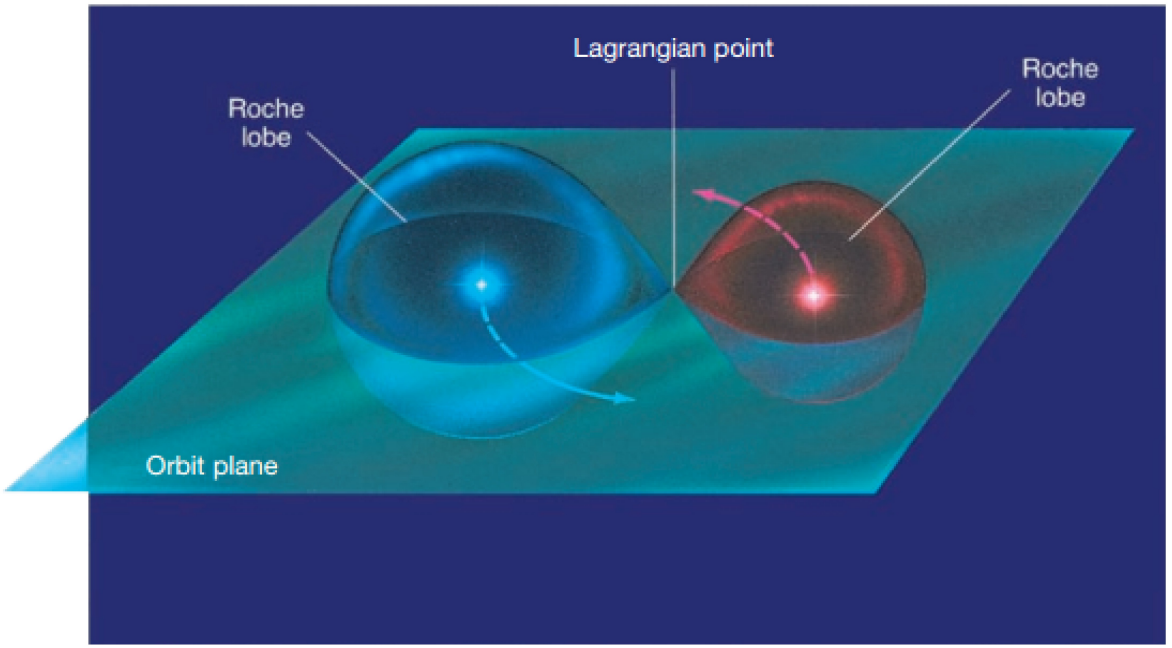
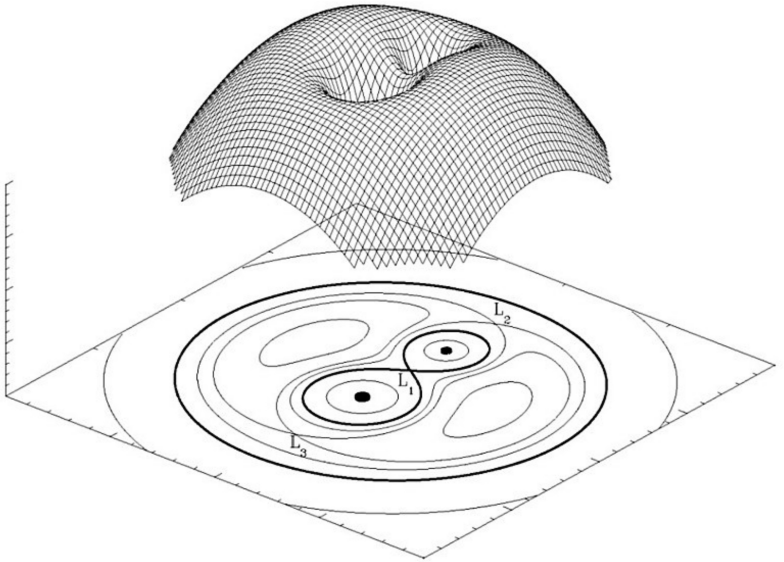
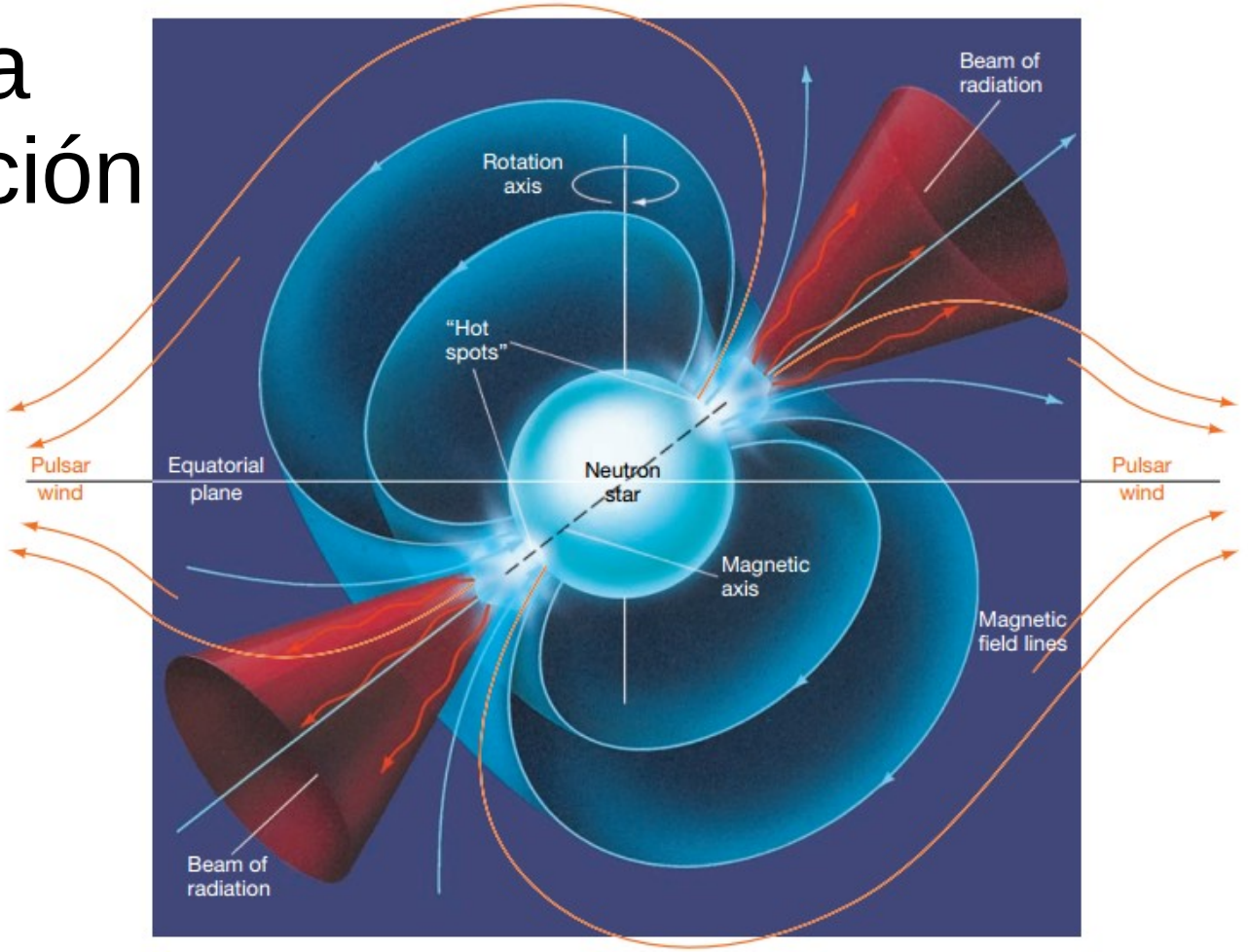
Febrero 2021
Bogotá DC

Sistemas Binarios



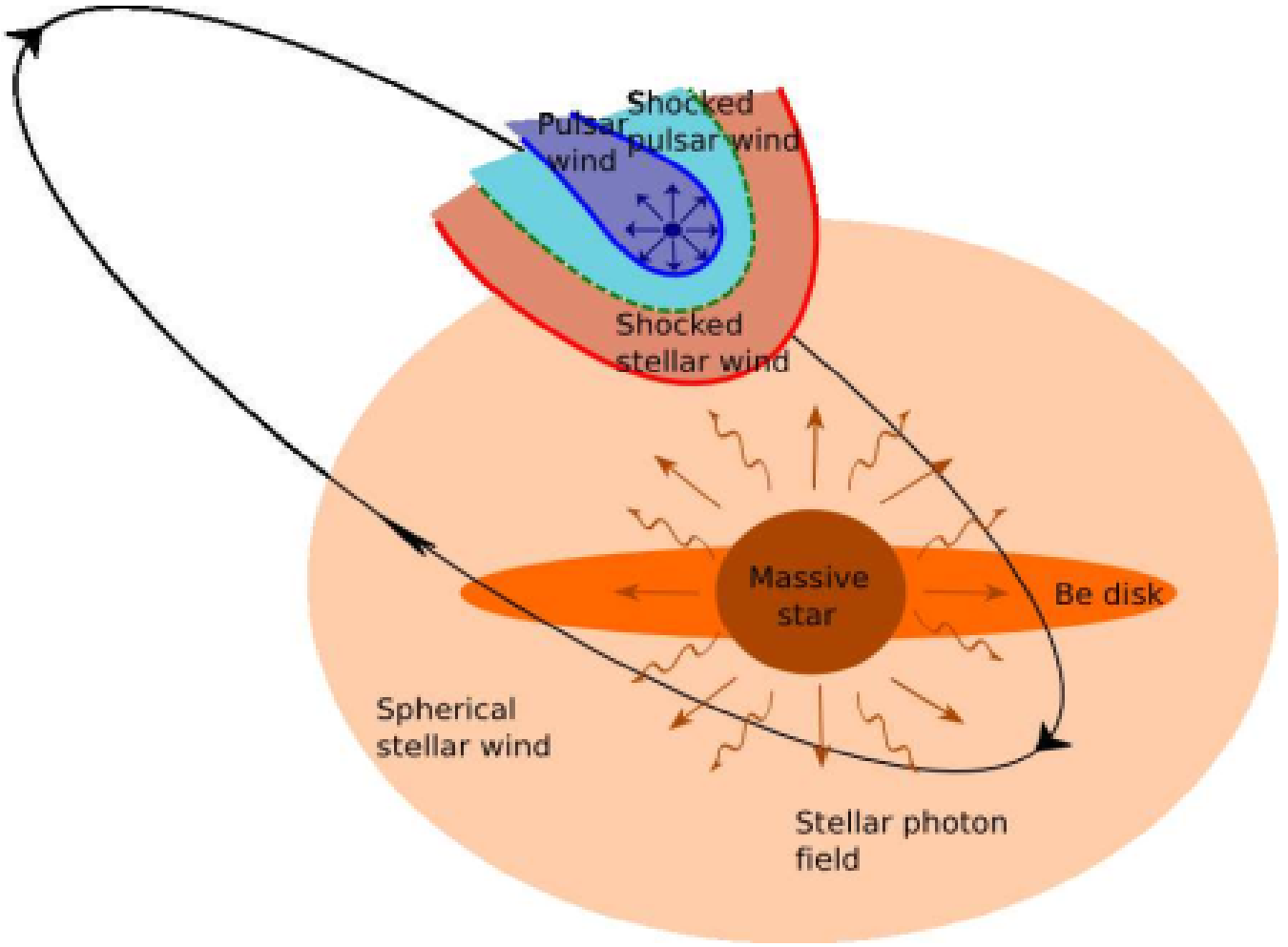


Sistemas a consideración



https://gizmodo.com/that-so-called-alien-megastructure-could-just-be-a-dist-1738979646

Modelo de interacción



Tomado de [1]

Tipos de Binarias de rayos X

Tipo I

$L_X \cong 10^{36\text{-}37}$ erg s^{-1}

Periodos de emisión cortos en relación al periodo orbital

Ver [3]

Tipo II

$L_X \geq 10^{37}$ erg s^{-1}

Periodos de emisión de fracción significativa del periodo orbital

Binarias de rayos γ

system	pulsar	star	P_{orb}	e	radio	H_α	X	GeV	TeV
PSR B1259-63	X	O9.5Ve	1237	0.87	O	O	O	O	O
LSI + 61° 303	(X)	B0Ve	26.5	0.54	O/V	O/V	O/V	O/V	O/(V)
LS 5039		O6.5V	3.9	0.35	O		O	O	O
HESS J0632+057		B0Ve	321	0.83	O	O/V	O		O
1FGL J1018.6-5856		O6V	16.6	?	O		O	O	O

Tomado de [1]

Optical counterpart to Swift J0243.6+6124

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Received ; accepted

ABSTRACT

Context. Swift J0243.6+6124 is a unique system. It is the first and only ultra-luminous X-ray source in our Galaxy. It is the first and only high-mass Be X-ray pulsar showing radio jet emission. It was discovered during a giant X-ray outburst in October 2017. While there are numerous studies in the X-ray band, very little is known about the optical counterpart.
Aims. Our aim is to characterize the variability timescales in the optical and infrared bands in order to understand the nature of this intriguing system.
Methods. We performed optical spectroscopic observations to determine the spectral type. Long-term photometric light curves together with the equivalent width of the Hα line were used to monitor the state of the circumstellar disk. We used *BVRI* photometry to estimate the interstellar absorption and distance to the source. Continuous photometric monitoring in the *B* and *V* bands allowed us to search for intra-night variability.
Results. The optical counterpart to Swift J0243.6+6124 is a V = 12.9, O9.5Ve star, located at a distance of $\sim$ 5 kpc. The optical extinction in the direction of the source is A_V = 3.6 mag. The rotational velocity of the O-type star is 210 km s^{-1}. The long-term optical variability agrees with the growth and subsequent dissipation of the Be circumstellar disk after the giant X-ray outburst. The optical and X-ray luminosity are strongly correlated during the outburst, suggesting a common origin. We did not detect short-term periodic variability that could be associated with nonradial pulsations from the Be star photosphere
Conclusions. The long-term optical and infrared pattern of variability of Swift J0243.6+6124 is typical of Be/X-ray binaries. However, the absence of nonradial pulsations is unusual and adds another peculiar trait to this unique source.

Key words. stars: individual: Swift J0243.6+6124, – X-rays: binaries – stars: neutron – stars: binaries close –stars: emission line, Be

Ver [2]

Observaciones

Espectroscopía

skinakas.physics.uoc

William Herschel Telescope

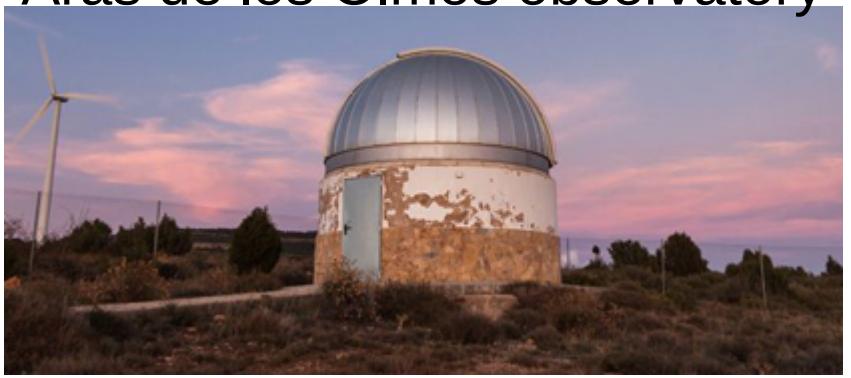
H. Raab

Fotometría

Skinakas Observatory (IRAF)

ASAS-SN light curve

Aras de los Olmos observatory



www.turismoenaras.es/observatorios-astronomicos-de-aras-de-los-olmos/

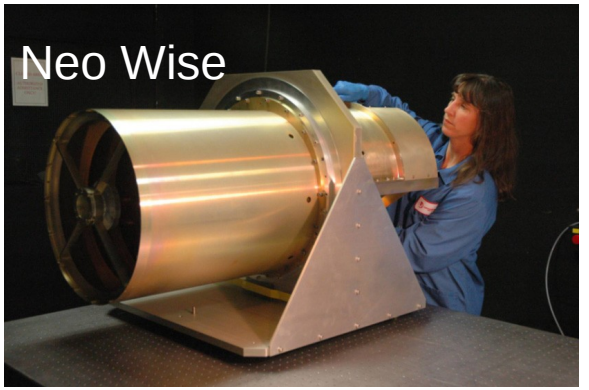
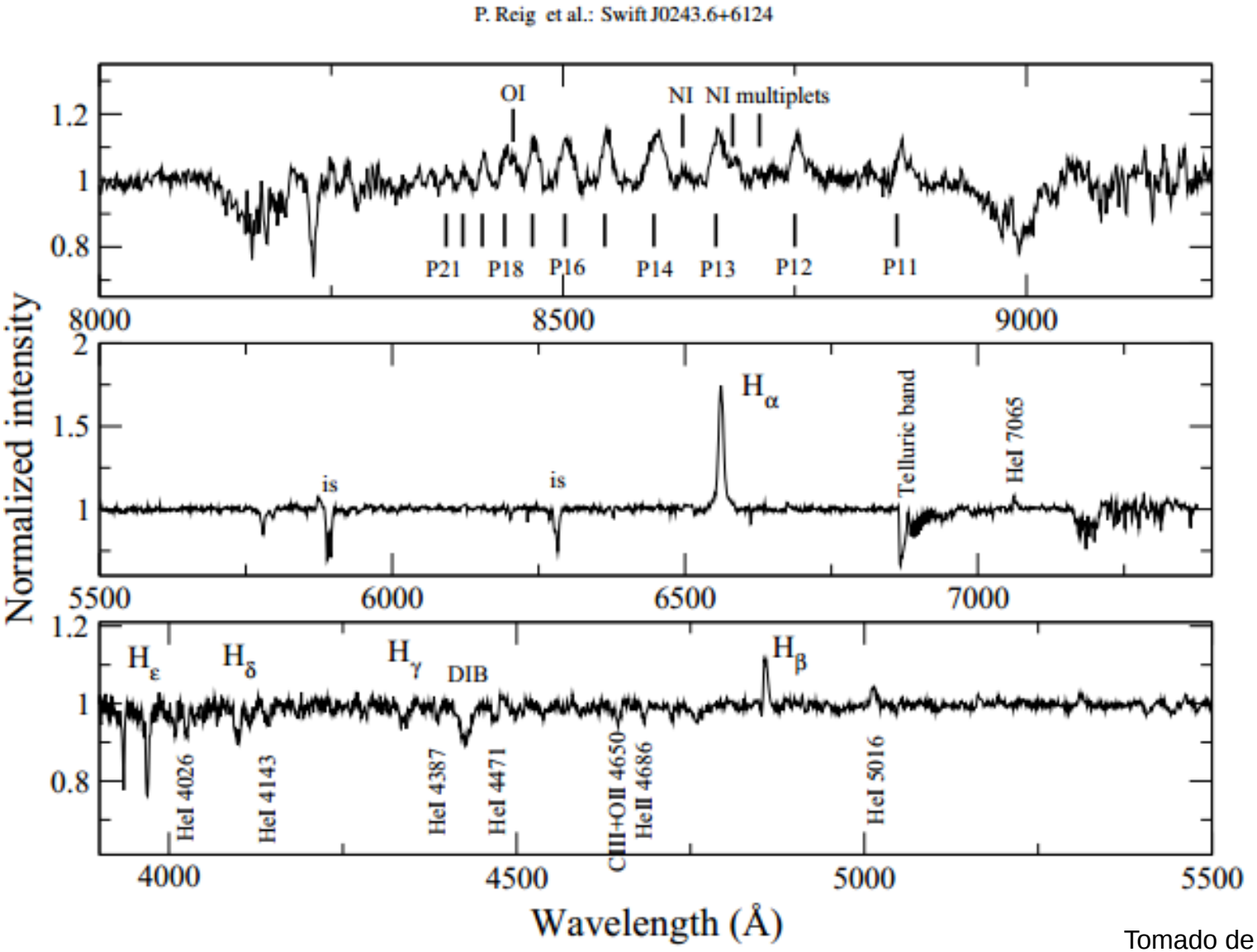
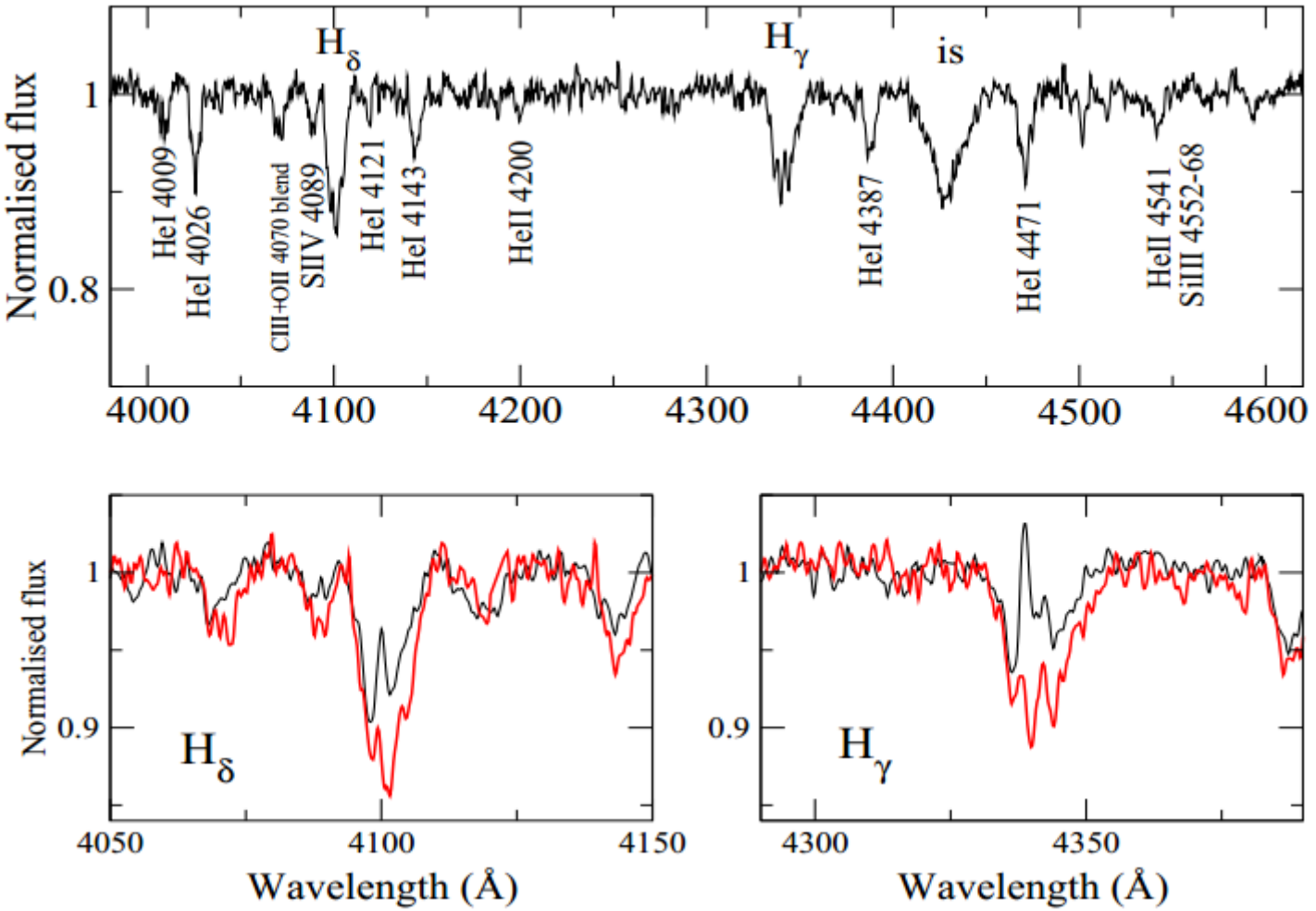


Image Credit: NASA/JPL-Caltech/L-3 SSG-Tinsley

Resultados: Tipo espectral de la estrella



Tomado de [2]



Photometry (mag.)					
Date	JD (2,400,000+)	*B*	*V*	*R*	*I*
30-07-2019	58695.584	13.86 ± 0.01	12.91 ± 0.01	12.24 ± 0.01	11.55 ± 0.02
11-09-2019	58738.594	13.83 ± 0.03	12.86 ± 0.01	12.18 ± 0.01	11.45 ± 0.02

Tomado de [2]

Walborn & Fitzpatrick (1990) and Gray & Corbally (2009)

Resultados: Distancia al sistema

$$V - M_V - A_V = 5\log(d) - 5$$

$$A_V = R \times E(B-V) = 3.41$$

$$E(B-V) = (B-V)_{\rm obs} - (B-V)_0$$

5780Å y 6613Å

$$(B-V)_{\rm obs} = 0.95 \pm 0.02$$

$$(B-V)_{\rm obs} = 0.97 \pm 0.02$$

O9.5V $(B-V)_0 = -0.29 \pm 0.02$.

$$E(B-V) = 1.24 \pm 0.02$$

$$E(B-V) = 1.1 \pm 0.2$$

$$A_V = R \times E(B-V) = 3.84 \text{ mag}$$

$$A_V = R \times E(B-V) = 3.41$$

$$V = 12.90 \pm 0.02$$

O9.5V $M_V = -4.2$

$$d_G = 6.8^{+1.5}_{-1.1} \text{ kpc.}$$

$d = 4.5 \pm 0.5$ kpc.

Tomado de [2]

Resultados: Velocidad de rotación

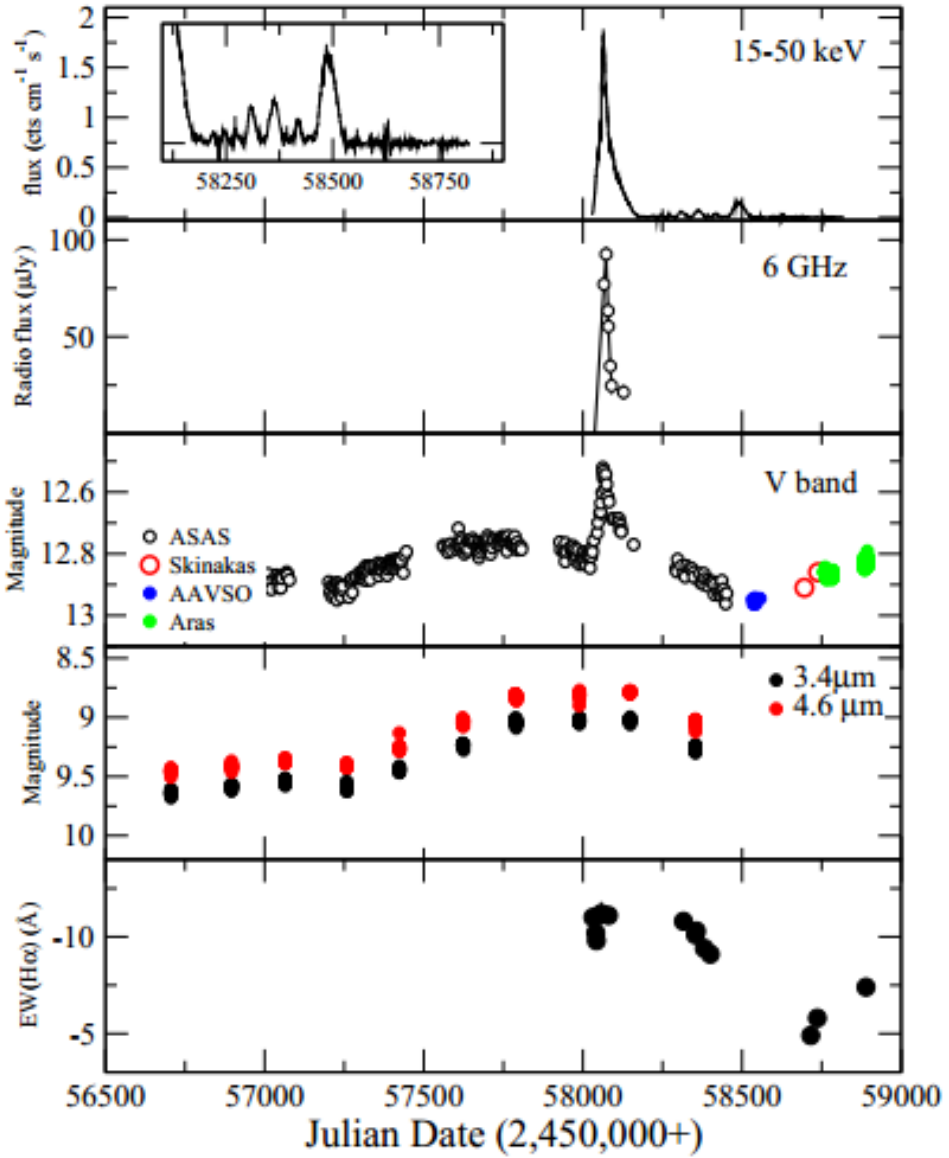
4026 Å, 4143 Å, 4387 Å, y 4471 Å de HeI

$$v \sin i = 210 \pm 20 \text{ km s}^{-1}$$

X-ray source	Optical counterpart	Spectral type	Disk-loss episodes	P_{orb} (days)	$v \sin i$ (km s^{-1})	Reference
Swift J0243.6+6124	–	O9.5V	no	27.8	210±20	This work
4U 0115+634	V635 Cas	B0.2V	yes	24.3	300±50	1
RX J0146.9+6121	LS I +61 235	B1V	no	–	200±30	2
V 0332+53	BQ Cam	O8-9V	no	34.2	<150	3
X-Per	HD 24534	O9.5III	yes	250	215±10	4,5
RX J0440.9+4431	LS V +44 17	B1III-V	yes	150	235±15	6,7
1A 0535+262	HD 245770	O9.7III	yes	111	225±10	8,9
IGR J06074+2205	–	B0.5IV	yes	–	260±20	10
RX J0812.4-3114	LS 992	B0.5III-V	yes	81.3	240±20	11
1A 1118-615	Hen 3-640	O9.5IV	no	24	~300	12,13
4U 1145-619	V801 Cen	B0.2III	no	187	280±30	14,15
4U 1258-61	V850 Cen	B2V	yes	132	<600	16
SAX J2103.5+4545	–	B0V	yes	12.7	240±20	17
IGR J21343+4738	–	B1IV	yes	–	365±15	18
SAX 2239.3+6116	–	B0V	no	262.6	195±20	19

Tomado de [2]

Discusión



Tomado de [2]

Conclusiones

El sistema Swift J0243.6+6124 esta conformado por estrella O9.5Ve, de magnitud V=12.9, localizada a 5kPc, la velocidad de rotación es de 210 km/s.
El radio del disco está sobre el periastro. Después del suceso de emisión de rayos X el disco se debilitó, pero no despareció y está posiblemente en etapa de crecimiento.

Referencias

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[2] Reig, P., Fabregat, J., & Alfonso-Garzón, J. (2020). Optical counterpart to Swift J0243. 6+ 6124. Astronomy & Astrophysics, 640, A35.

[3] Franchini, A., & Martin, R. G. (2019). Type I Outbursts in Low-eccentricity Be/X-Ray Binaries. The Astrophysical Journal Letters, 881(2), L32.

[4] Zamanov, R. K., Reig, P., Martí, J., Coe, M. J., Fabregat, J., Tomov, N. A., & Valchev, T. (2001). Comparison of the Hα circumstellar disks in Be/X-ray binaries and Be stars. Astronomy & Astrophysics, 367(3), 884-890.