Origin and evolution of the black hole binary XTE J1118+480

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High-Resolution Spectra:

Chemical analysis and refined orbital parameters

BH-LMXBs	INSTRUMENT	REFERENCES
A0620-00	8m-VLT/UVES *R*~43,000	González Hernández et al. (2004, 2010)
Nova Sco 94	10m-KeckI/HIRES 8m-VLT/UVES	Israelian et al. (1999) González Hernández et al. (2008a)
XTEJ1118+480	10m-KeckII/ESI *R*~6,000	González Hernández et al. (2006, 2008b)
V404 Cygni	10m-KeckI/HIRES *R*~45,000	González Hernández et al. (2011a)
NS-LMXBs	**INSTRUMENT**	**REFERENCES**
CEN X-4	8m-VLT/UVES *R*~43,000	González Hernández et al. (2005) Casares et al. (2007)
Cygnus X-2	4.2m-WHT/UES *R*~30,000	Casares et al. (2010)

XTE J1118+480

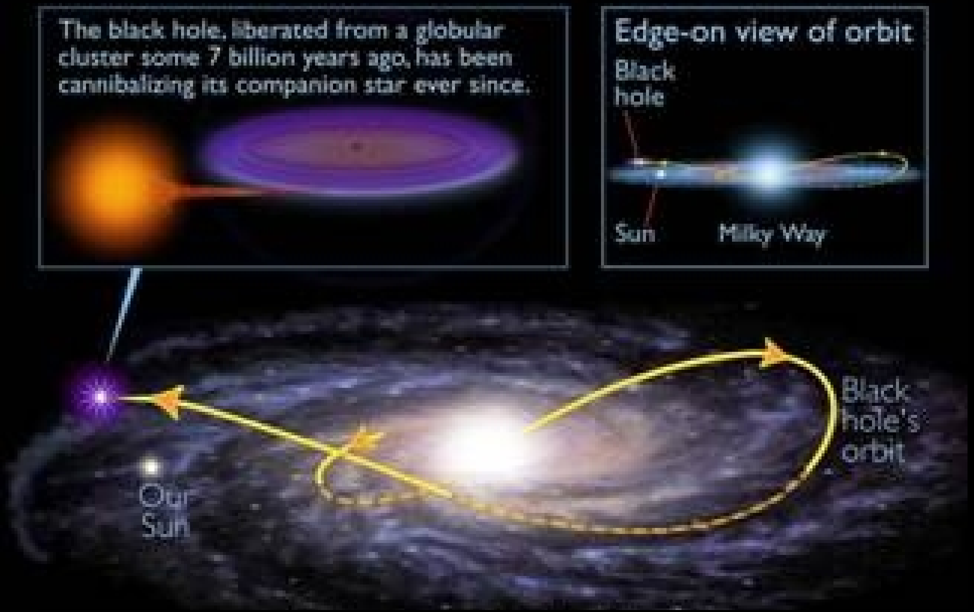
X-ray binary with:

-Black hole of ~ 8 M_{Sun}

-Galactic latitude ~ 62º

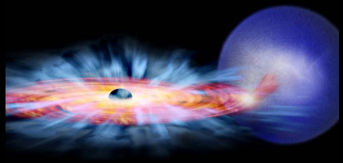
- Height over the Galactic plane: 1.6 kpc

-Galactic Velocities (U, V, W)= (-105,-98,-21)



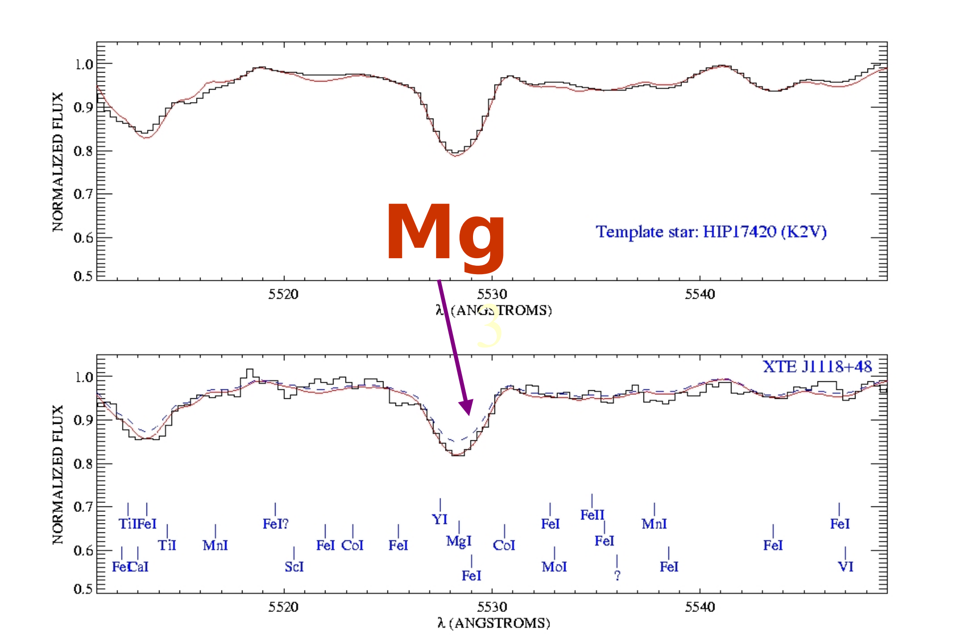
Kinematics of XTE J1118+480

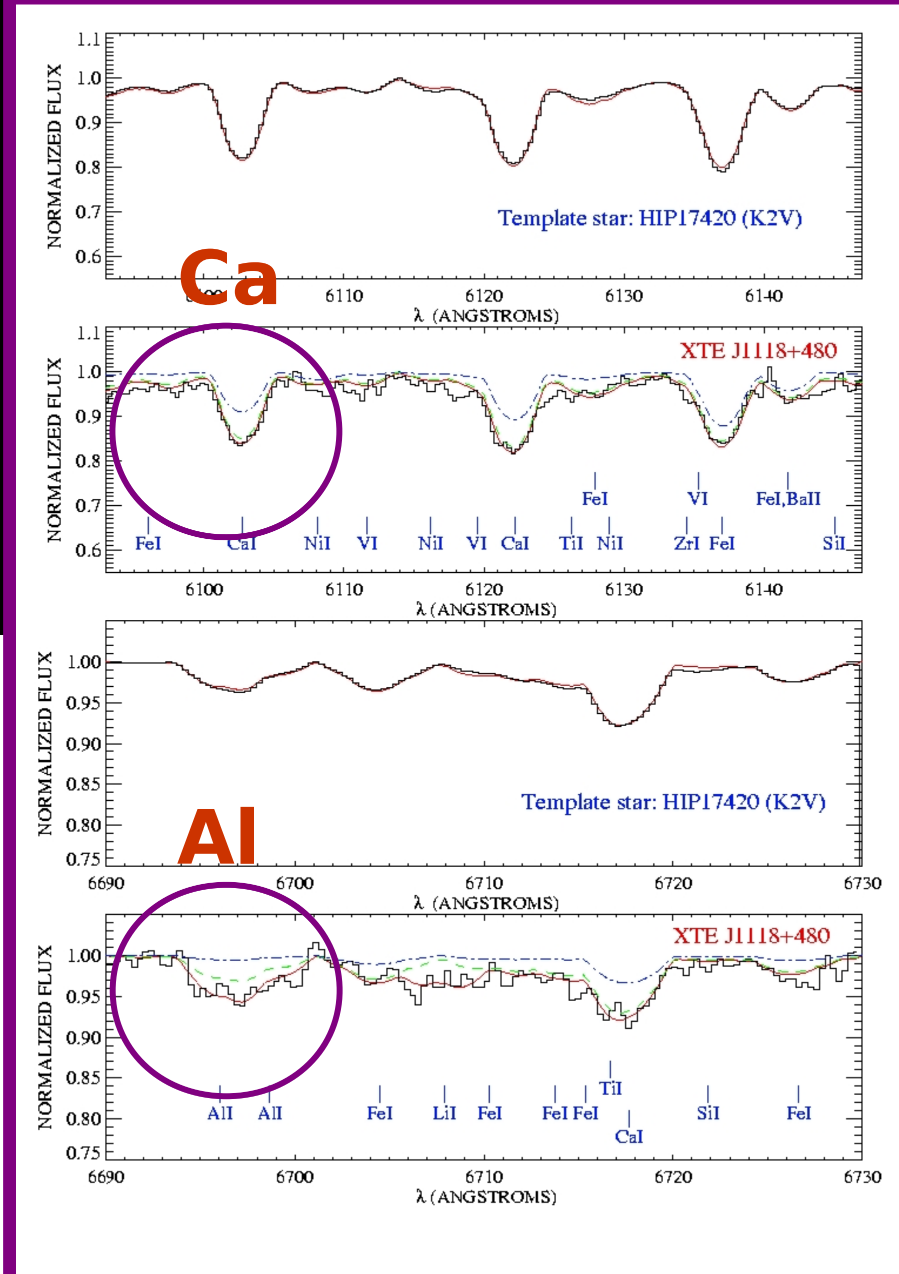
Mirabel et al. (2001)



Chemical abundances

XTE J1118+480





González Hernández et al. (2006) **KeckII/ESI spectra**

XTE J1118+480

However, the high metallicity of the secondary star:

[Fe/H] ~ +0.2 dex (~2 times more metals than in the sun)

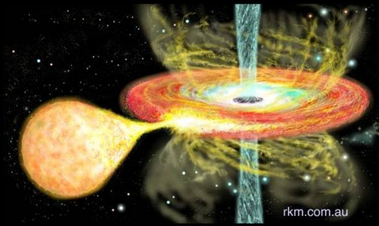
- The black hole problably formed in a supernova or hypernova explosion that lauched the system into its present orbit from the formation region in the Galactic thin disc (Galactic plane)

- A comparison of the chemical abundances of the secondary star with supernova and hypernova models of different metallicities probably confirms this conclusion

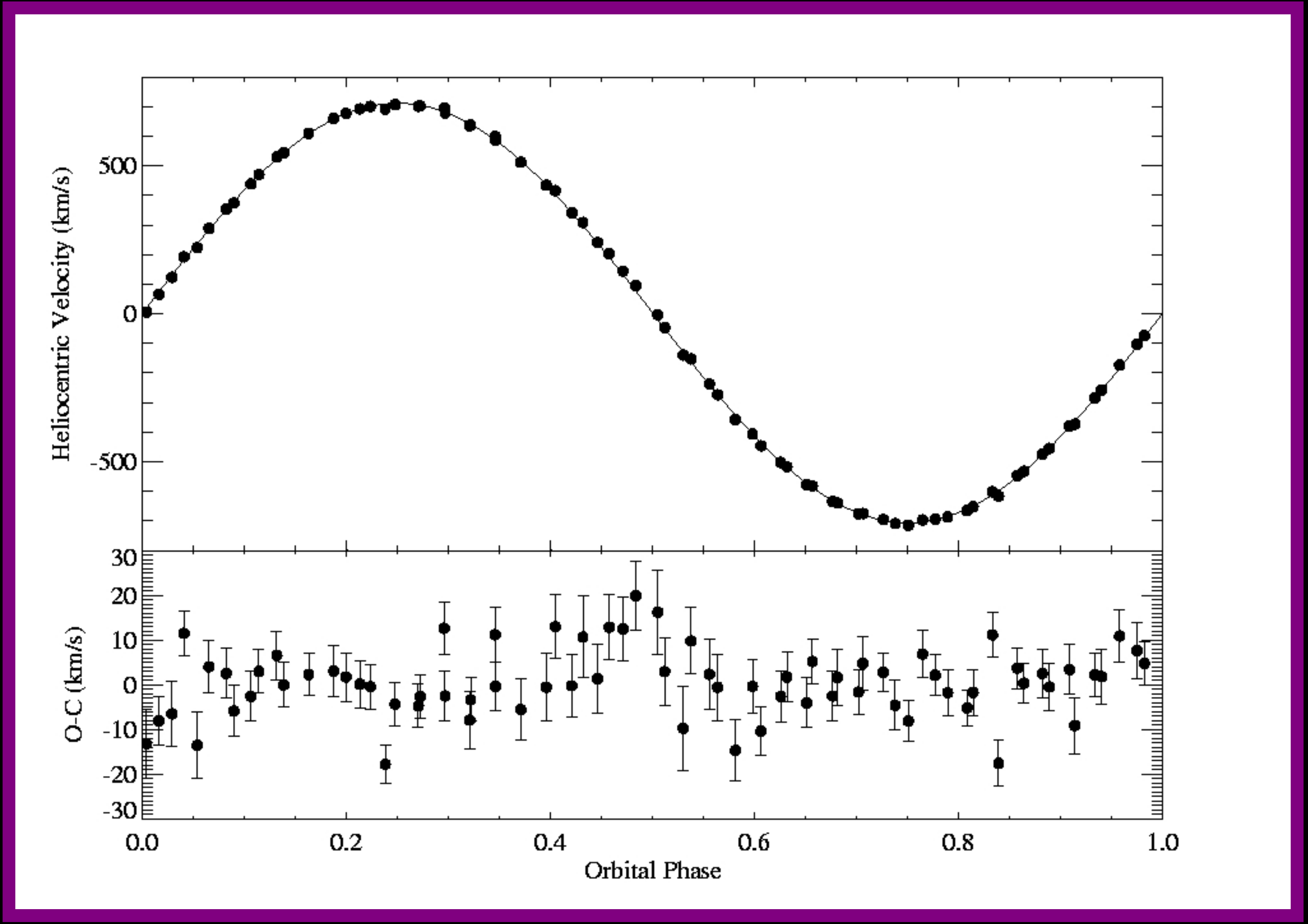
González Hernández et al. (2006, 2008b)

-This implies a lower limit to the kinematic age ~ 11 Myr implying an upper-limit to the asymptotic AdS curvature radius of L < 80 μm (Psaltis 2007)

XTE J1118+480



KeckII/ESI radial velocity curve from 74 spectra

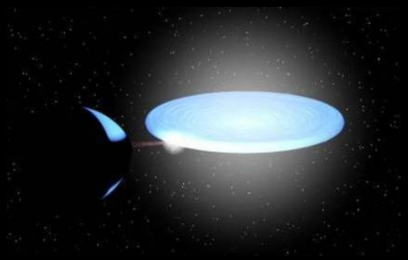


one night in 2004

***R*~ 6,000**

González Hernández et al. (2008b)

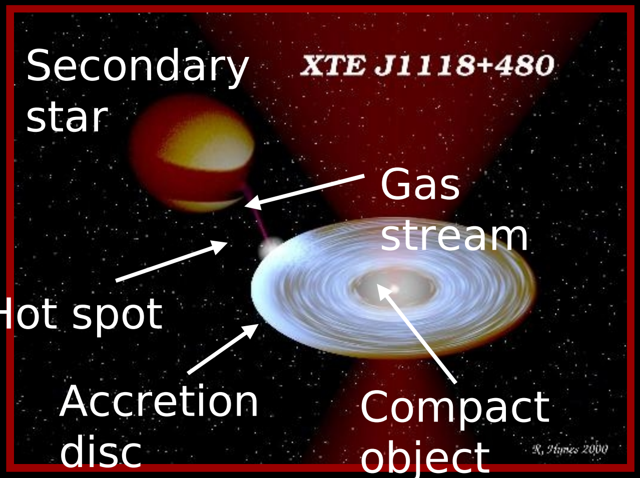
Refined orbital parameters



i = 68° +- 2° (Gelino et al. 2006)

P_{orb} = 0.1699339 + − 0.0000002 days (Torres et al. 2004)

- $v\sin i = 100^{+3}_{-11}$ km/s
- k_2 = 708.8 +- 1.4 km/s
- $q = M_2 / M_{BH}$ = 0.027+- 0.009
- $f(M)$ = 6.27 +- 0.04 M_{SUN}
- $M_{BH} = 8.30^{+0.28}_{-0.14}$ M_{SUN}
- M_2 = 0.22 +- 0.07 M_{SUN}
- a_c = 2.63 +- 0.03 R_{SUN}



González Hernández et al. (2008b, 2011a)

Angular momentum losses: XTE J1118+480

1. Magnetic Braking:

If γ =0 (maximum strength)

and j_w= 1 (specific angular momentum lost by the mass loss from the system)

Then, $(dP/dt)_{MB}$ = -0.14 ms/yr

2. Mass loss

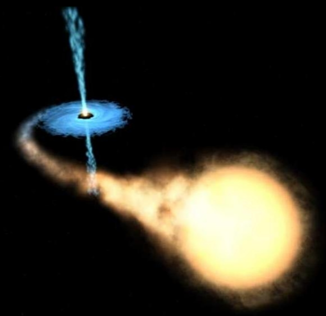
β = 0 (all the mass lost by the companion is lost)

j_w= 1

Then, $(dP/dt)_{MB}$ = -0.8 ms/yr

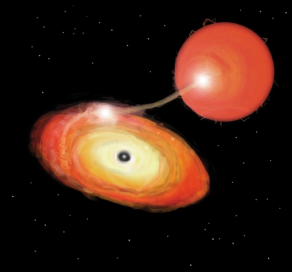
3. Gravitational radiation:

$(dP/dt)_{GR}$ = -0.01 ms/yr



4. Relativistic Jets: $(dJ/dt)_{JETS}$ / $(dJ/dt)_{MB}$ = 0.001

Relativistic precession



- Usually we assume e=0

- If we leave the eccentricity as free parameter

e= 0.0034 +- 0.0037 (consistent with zero)

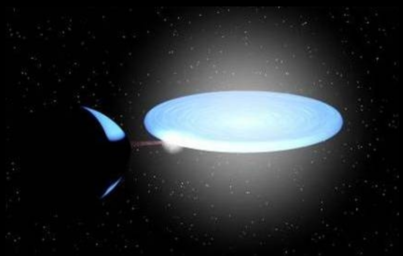
- Periastron precession due to the General Relativity :

1. Secular precession period ~ 23 yr

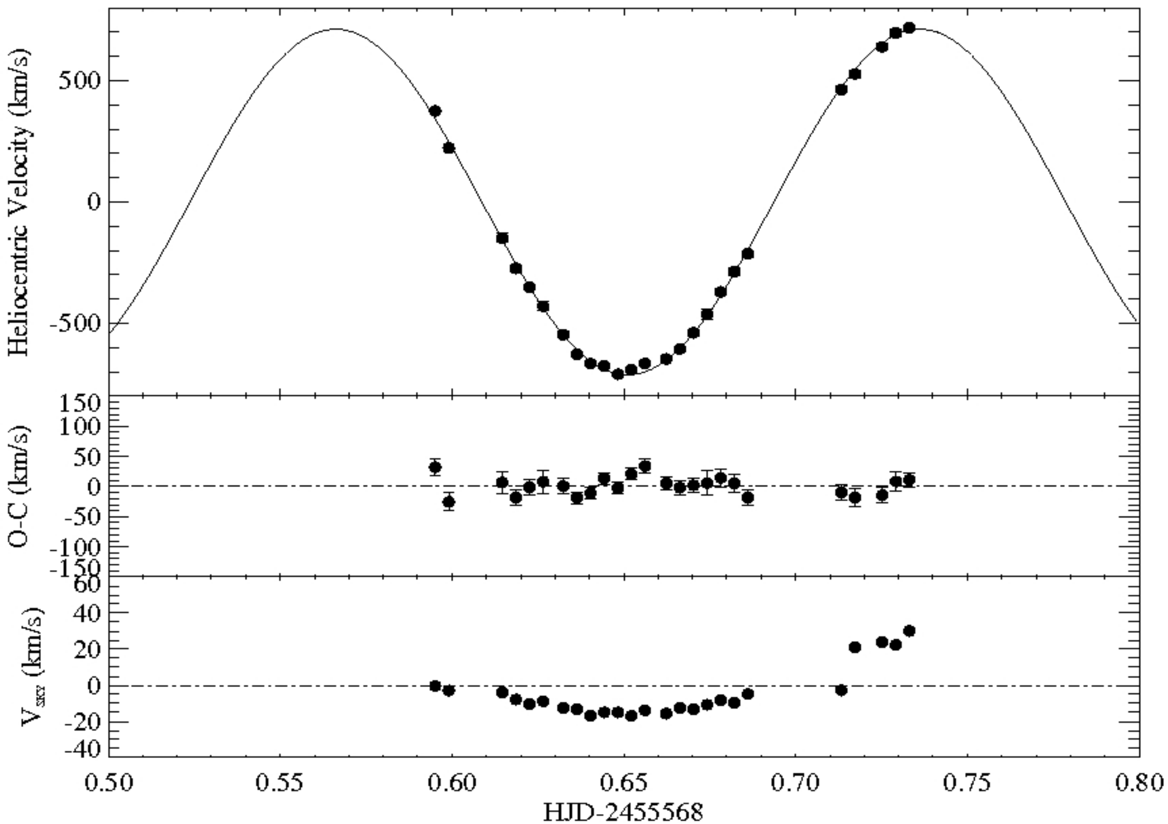
2. Apparent orbital period change :

$(dP/dt)_{\text{precession}} \sim -0.5 \pm 0.5$ **ms/yr**

XTE J1118+480



10.4m-GTC/OSIRIS radial velocity curve from 27 spectra



first night January 2011

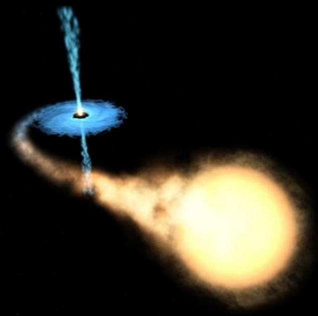
***R*~ 2,500**

We have two additional nights:

data not processed

González Hernández et al. (2011b, in preparation)

XTE J1118+480



- These data can provide

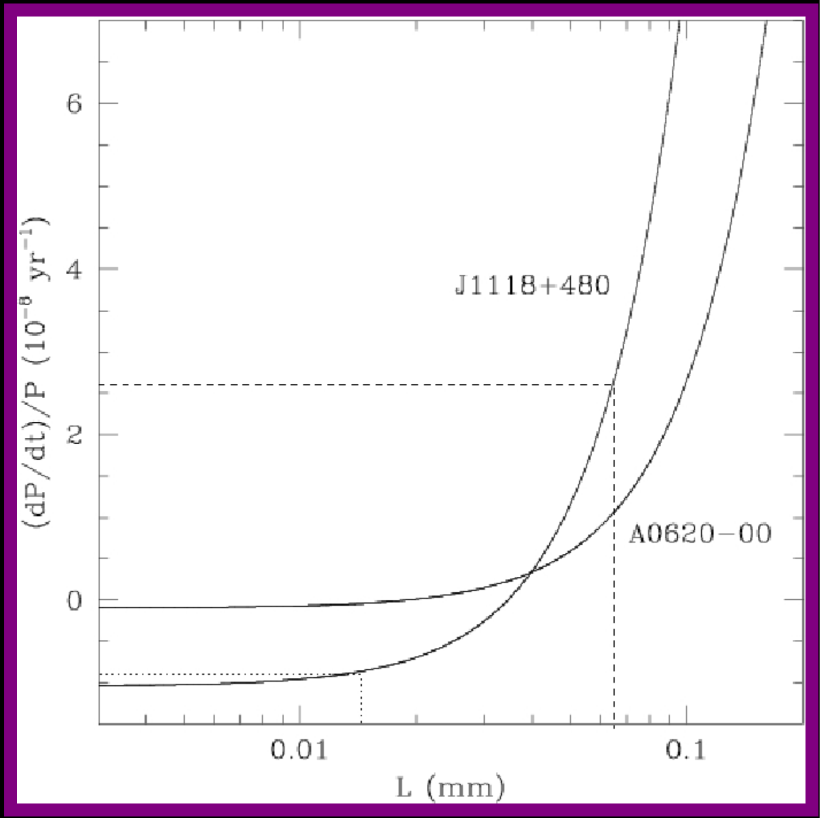
 3 points of T_0

times at the inferior conjunction of the secondary star

- The preliminary analysis points to a negative period derivative

(dP/dt) < 0

- This will set a tighter upper-bound in the parameter *L*



Johannsen et al. (2009)

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