Istituto Nazionale di Astrofisica

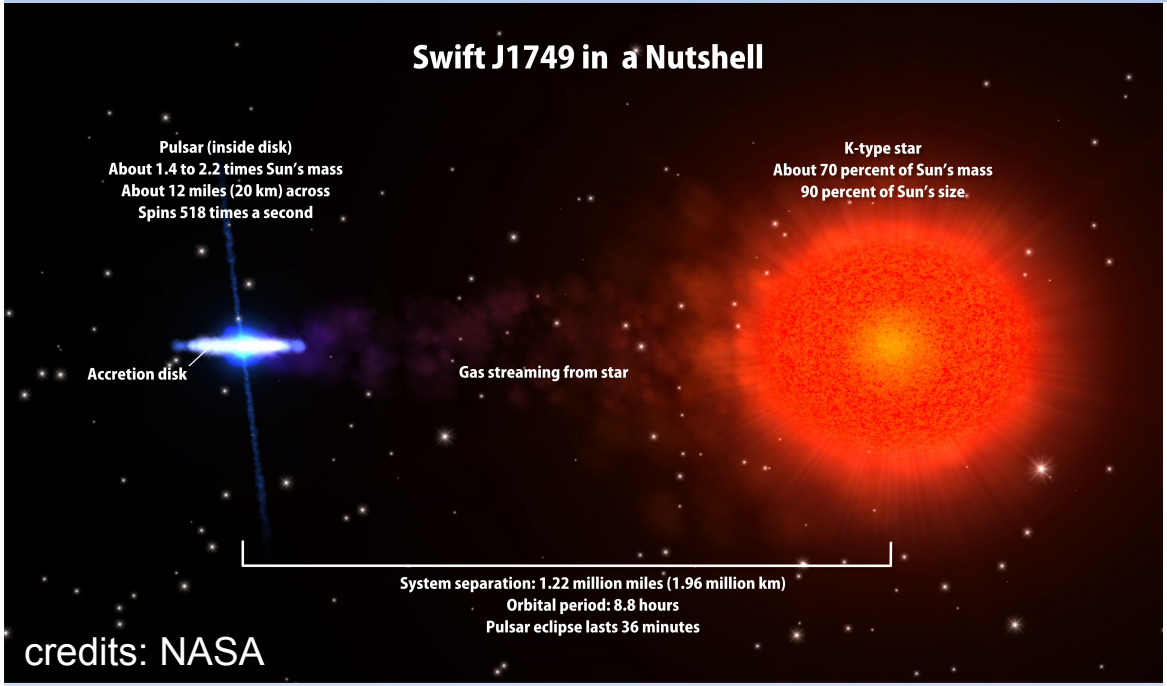
Osservatorio Astronomico di Brera

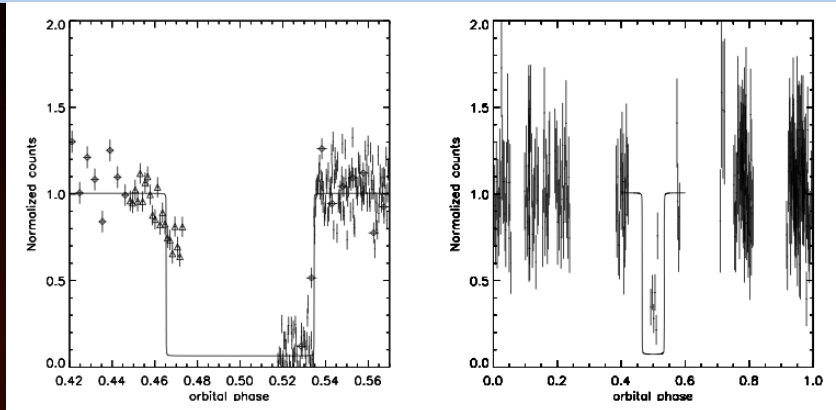
A candidate NIR counterpart for the eclipsing accreting millisecond X-ray pulsar Swift J1749.4-2807

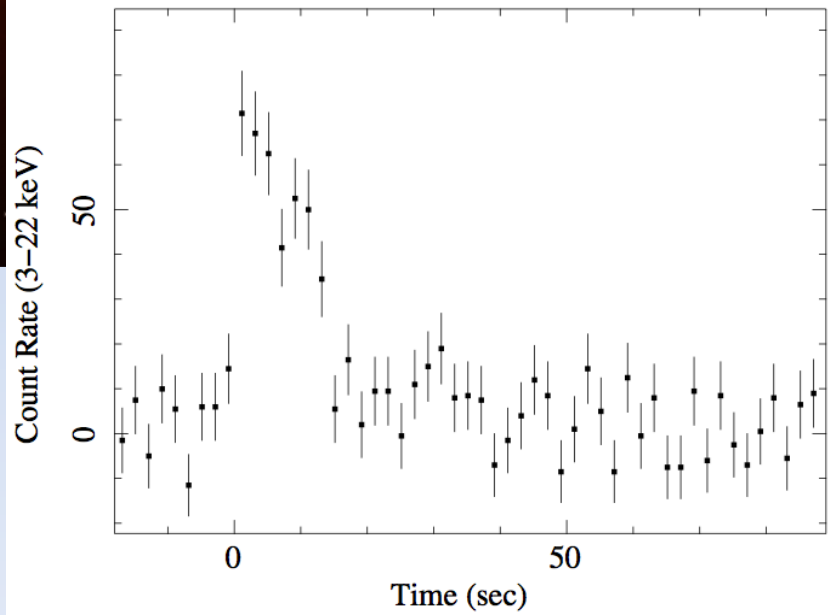
Paolo D'Avanzo

INAF – Osservatorio Astronomico di Brera

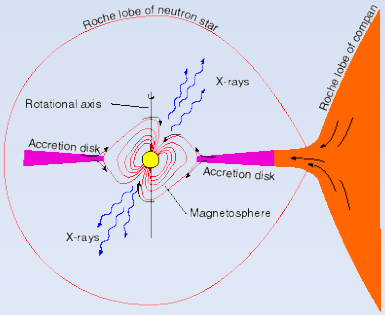
Swift J1749.4-2807 an eclipsing AMXP







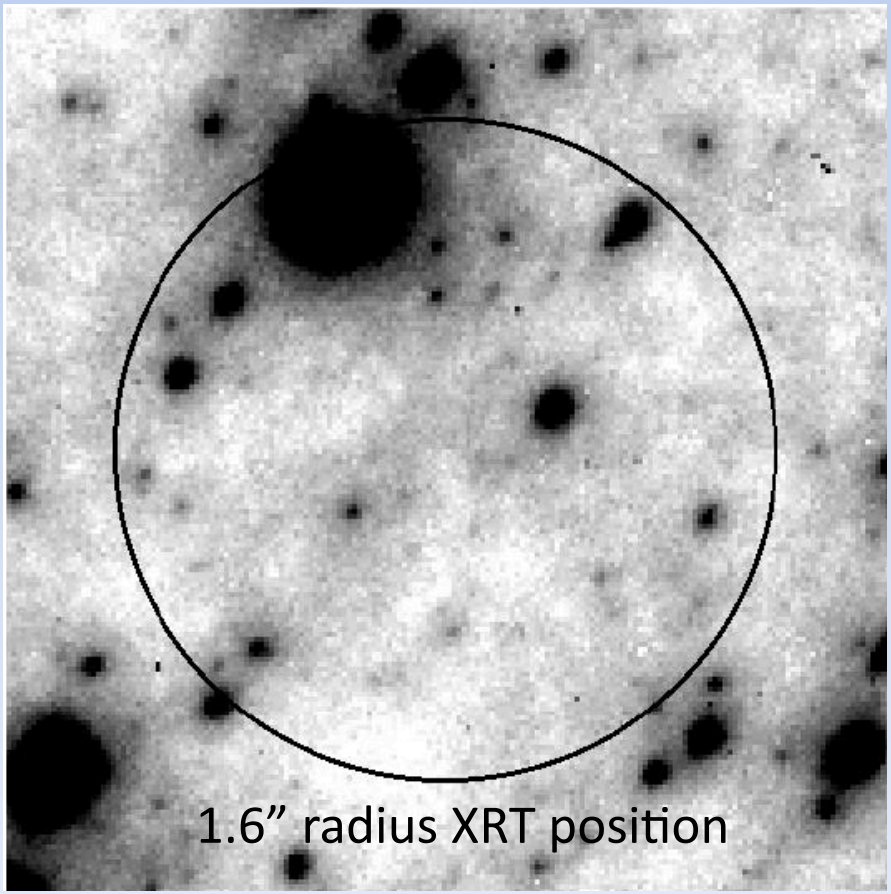
Discovered as AMXP in April 2010



P_{spin} = 518 Hz (1.9 ms)
P_{orb} = 8.82 h
X-ray eclipses
Type I X-ray burst
D = 6.7 kpc (UL)

Markwardt & Strohmayer 2010; Ferrigno et al. 2011; Altamirano et al. 2011

Swift J1749.4-2807 in quiescence
VLT-NACO campaign #1



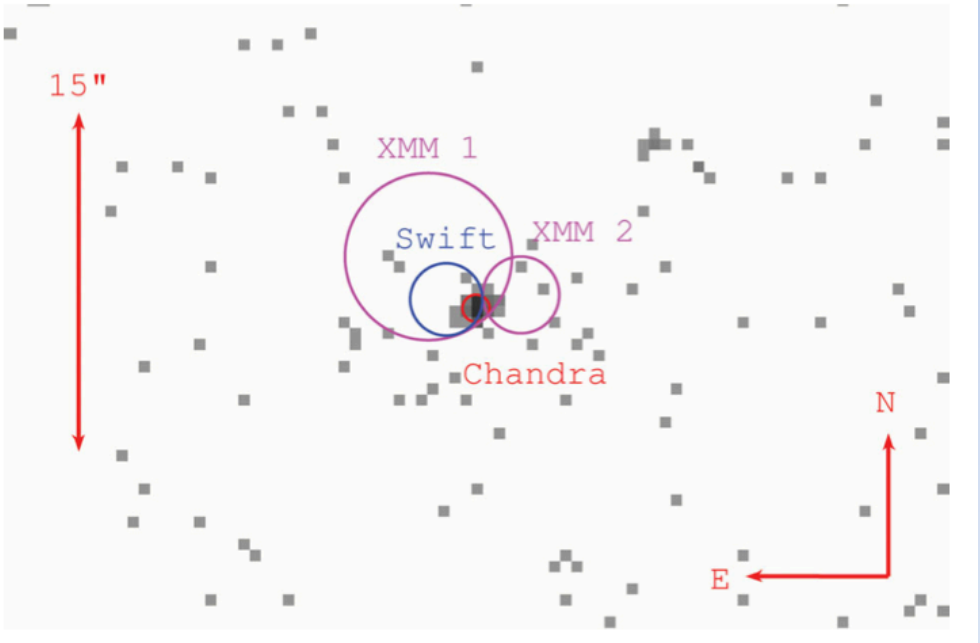
2 epochs of VLT-NACO AO imaging taken on 2010 Aug

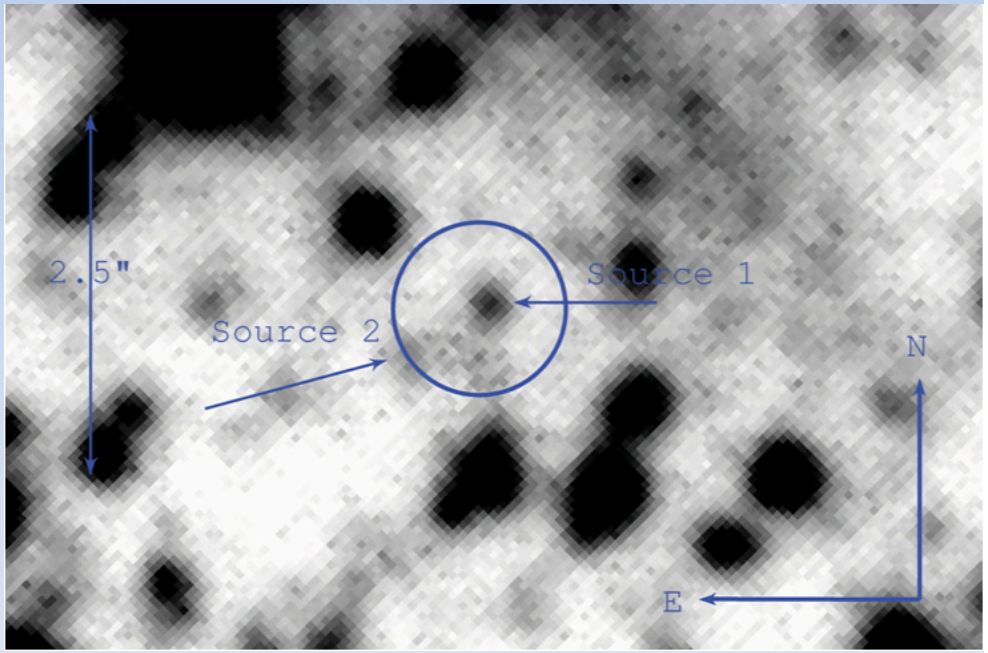
41 sources inside XRT (1.6”) error circle

No convincing candidate

D’Avanzo et al. 2011

Swift J1749.4-2807 in quiescence
possible counterparts from Chandra and Gemini



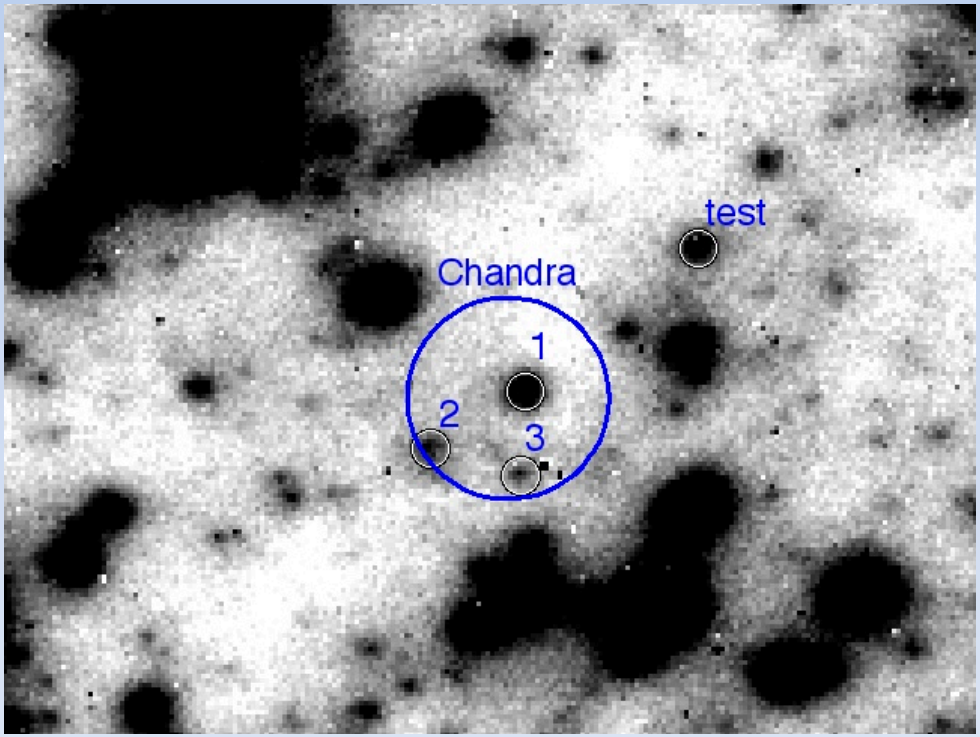


Chandra X-ray source (0.6" radius)
F(0.5-10 keV) =2e-13 erg/cm2/s
L_X =1e33 erg/s (@ 6.7 kpc)

Gemini NIRI K-band: two candidates
K_1 = 18.4 mag
K_2 = 19.2 mag

Jonker et al. 2013

Swift J1749.4-2807 in quiescence
VLT-NACO campaign #1

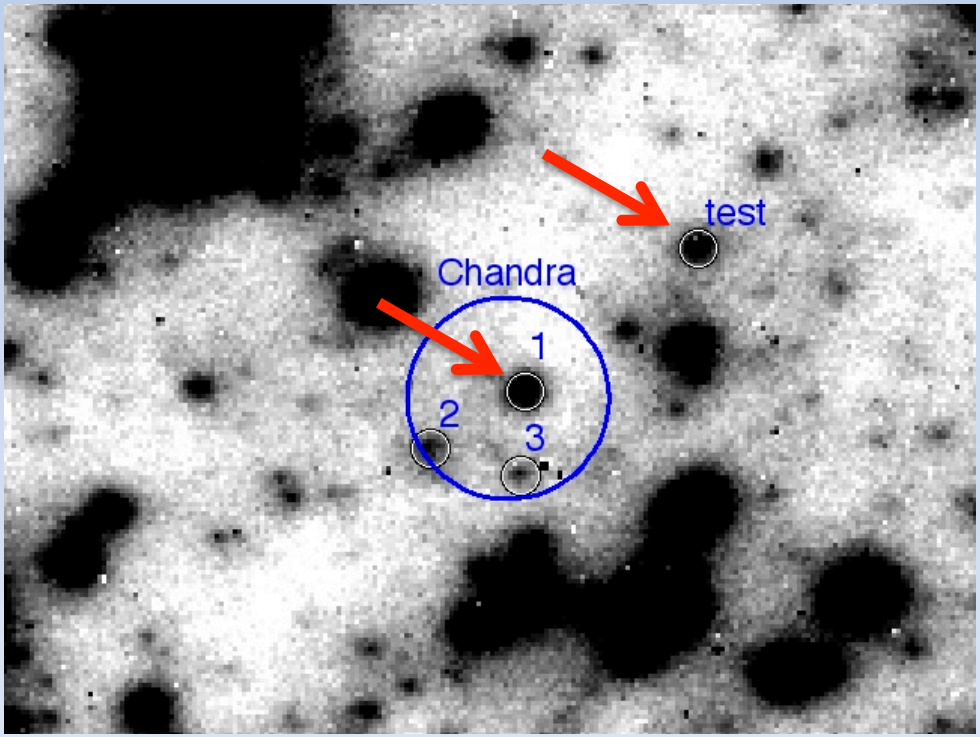


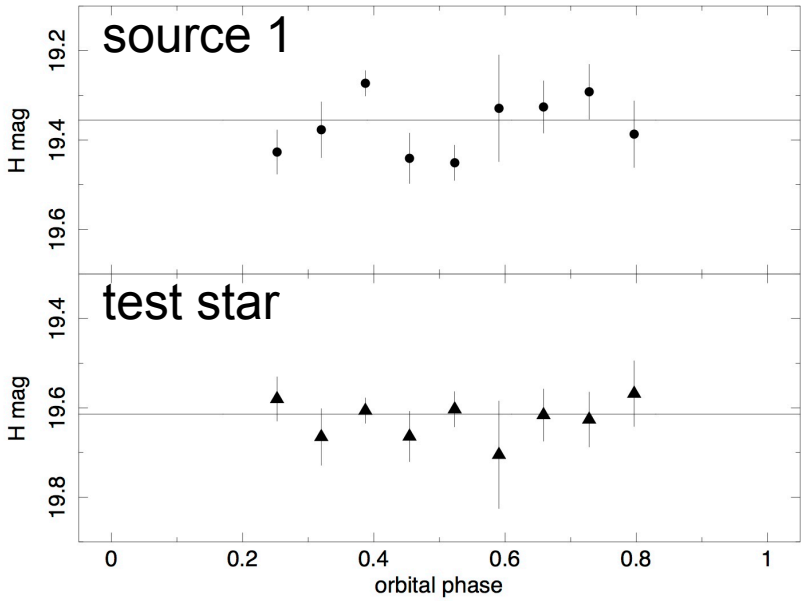
5 hours of VLT-NACO AO imaging taken on 2012 Jul

~ 60% of the orbital period covered

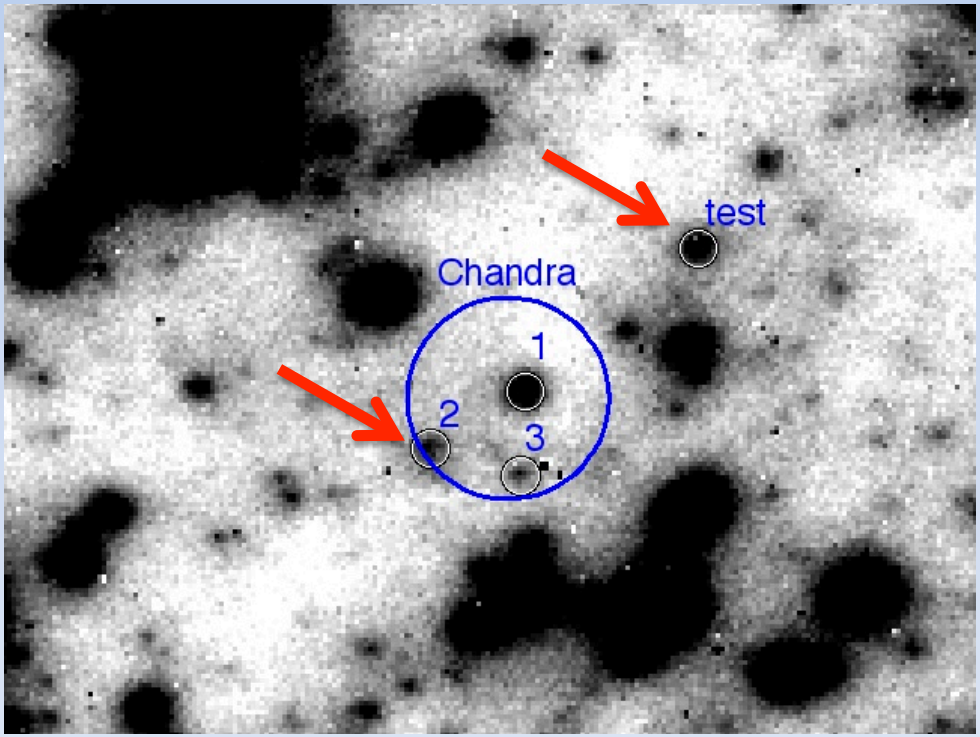
3 sources inside Chandra (0.6”) error circle

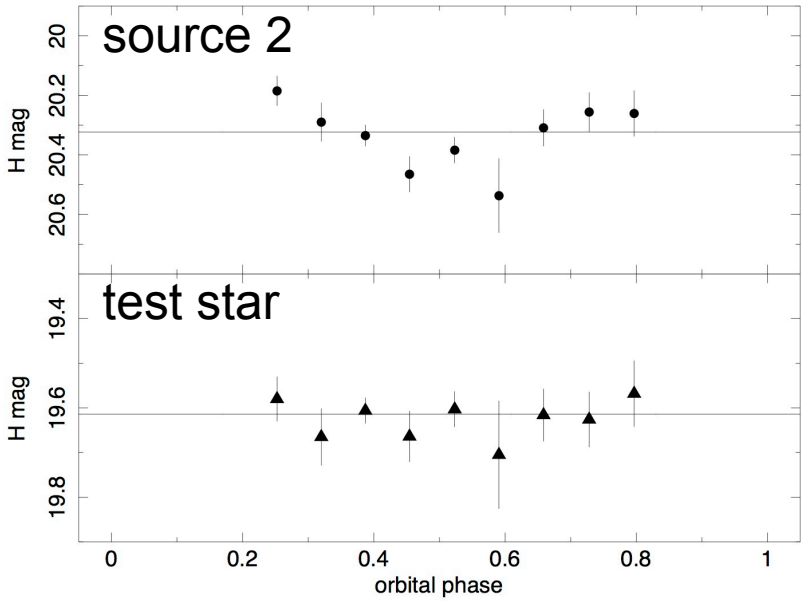
Swift J1749.4-2807
VLT-NACO campaign #2



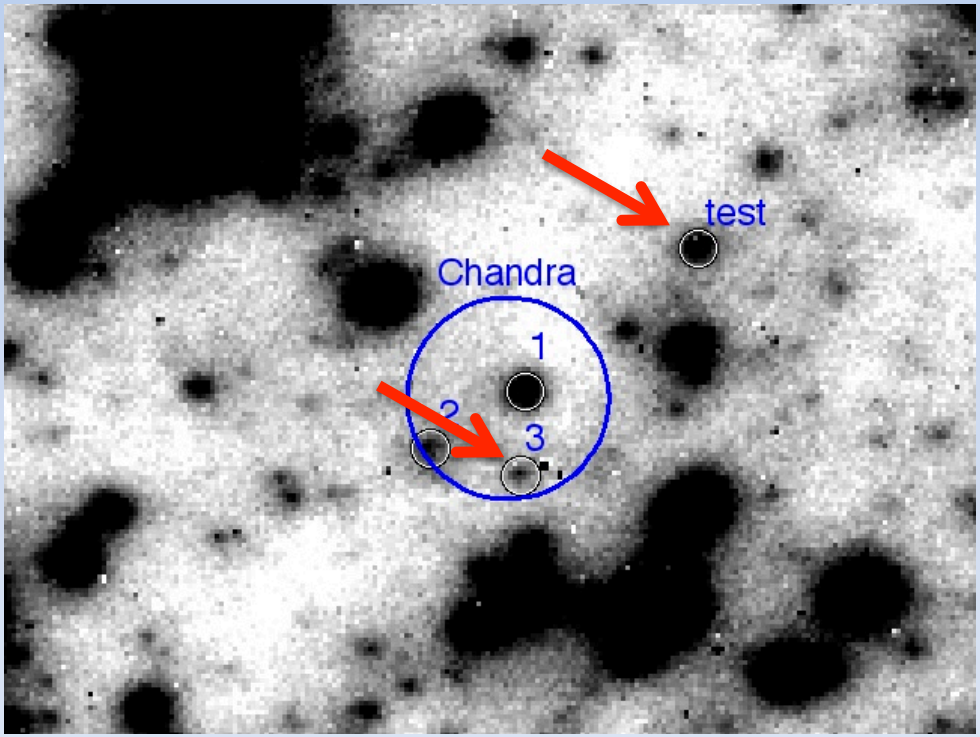


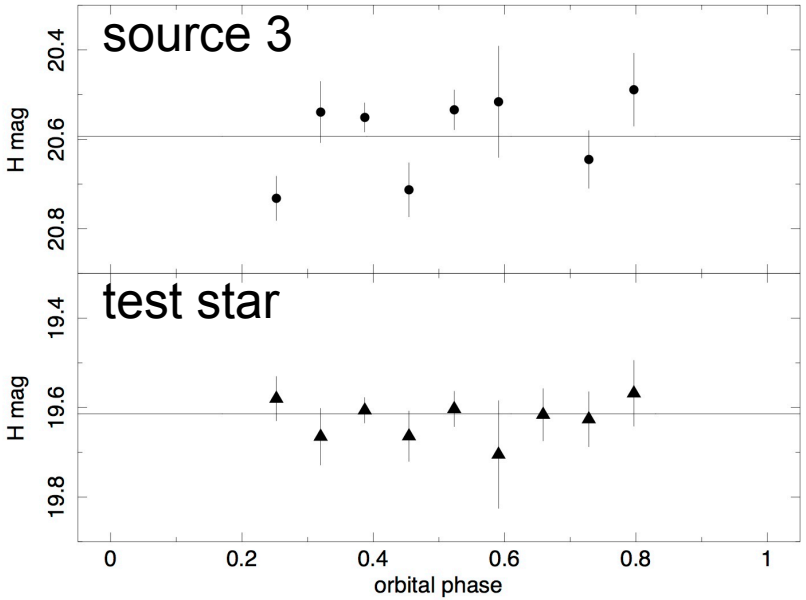
Swift J1749.4-2807
VLT-NACO campaign #2



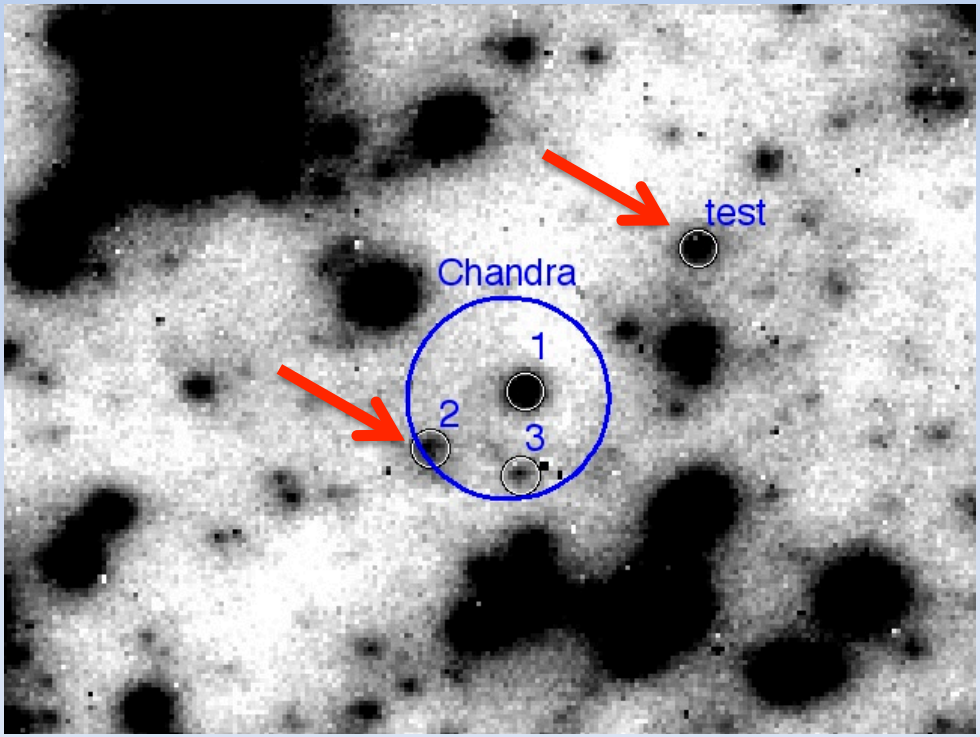


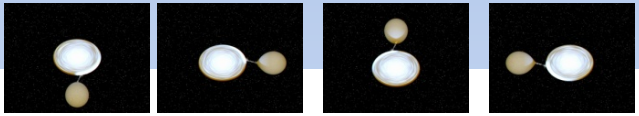
Swift J1749.4-2807
VLT-NACO campaign #2



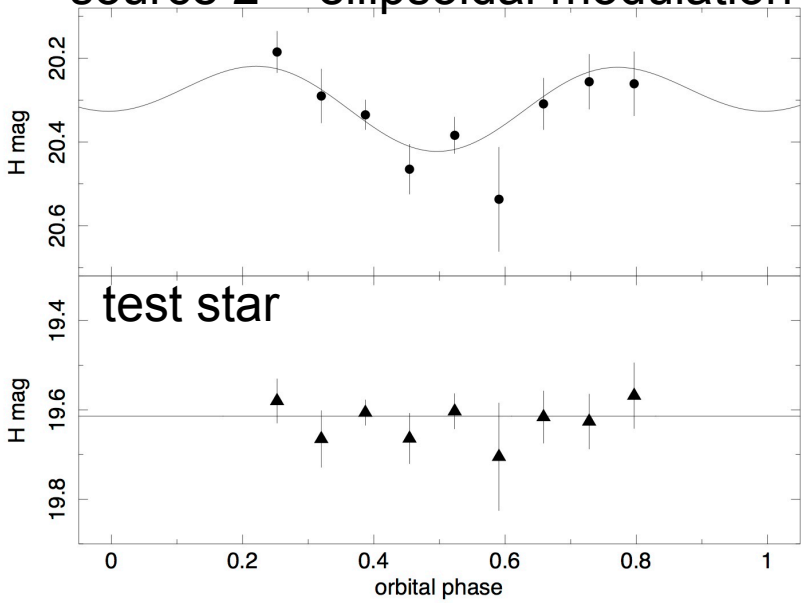


Swift J1749.4-2807
VLT-NACO campaign #2





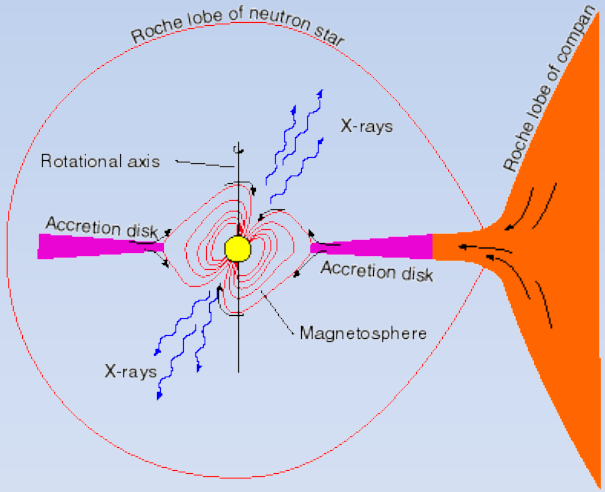
source 2 ellipsoidal modulation



H = 20.3, K = 19.3 (Jonker+ 2013)
E(B-V) = 5.4
M(H) = 3.4 mag
M(K) = 3.2 mag
Consistent with late main sequence G8-K0 star
Expected K0V-M0V companion

L(NIR) ~ 1e33 erg/s
L_X ~ 1e33 erg/s
Possibly some extra irradiation at play

Dynamical studies of AMXPs



$$f_X(M) \equiv \frac{4\pi^2 (a_X \sin i)^3}{G P_{orb}{}^2} = \frac{M_c \sin^3 i}{(1+q)^2}$$

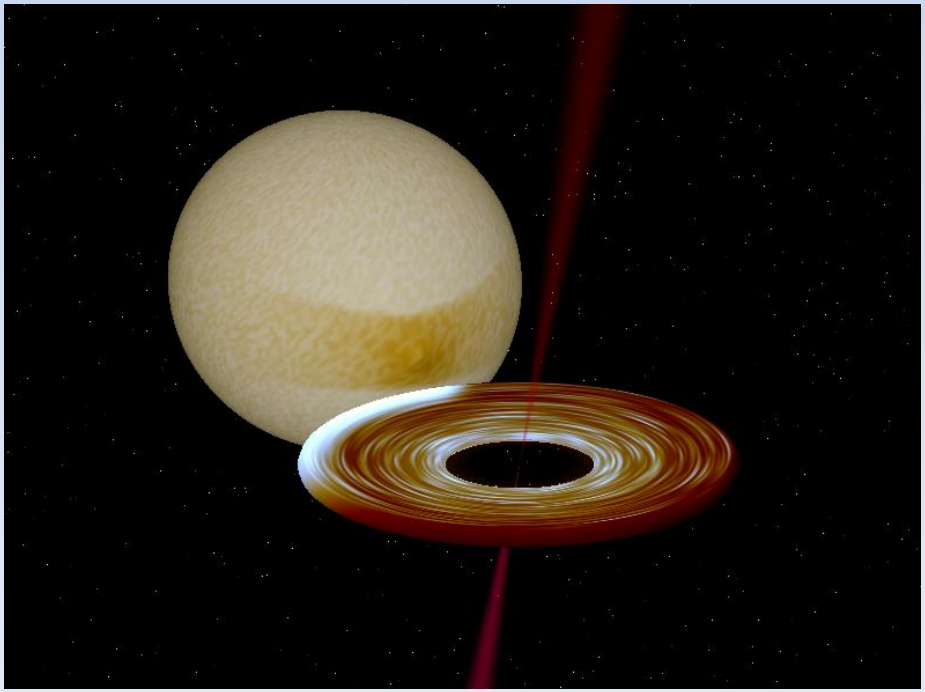
$$f_c(M) \equiv \frac{P_{orb} K_c{}^3}{2\pi G} = \frac{M_X \sin^3 i}{(1+1/q)^2}$$

$q \equiv M_C / M_X = K_X / K_C$

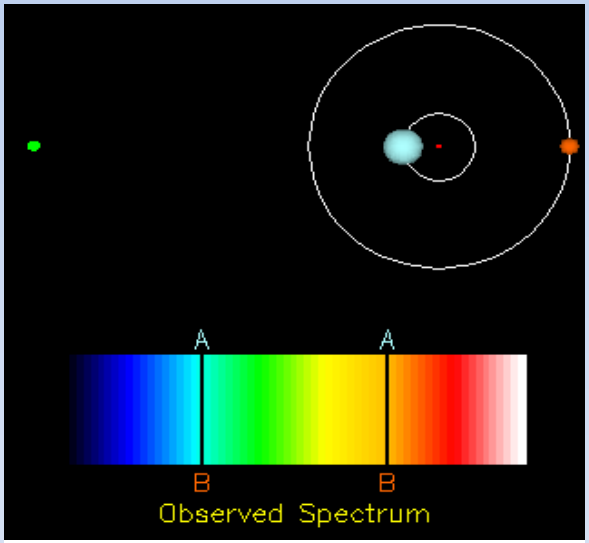
- precise determination of system parameters (K_X, P_{orb}, $a_X \sin i$, P_{spin})
- mass functions
- ideal systems for dynamical studies aimed at precise mass determination

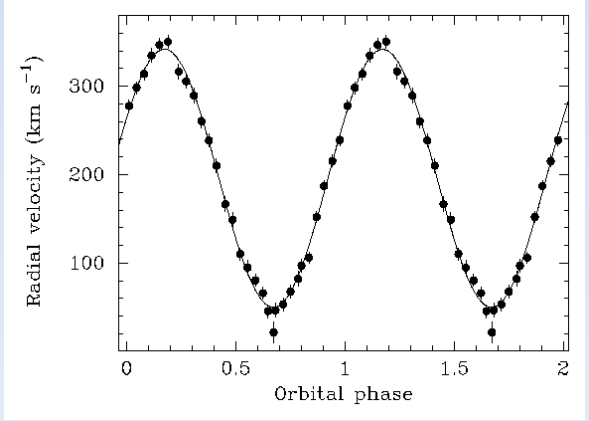
Dynamical studies of AMXPs during quiescence

- Unique opportunity to detect the companion
- Radial velocity curve of the companion (K_C)



BinSim R. Hynes

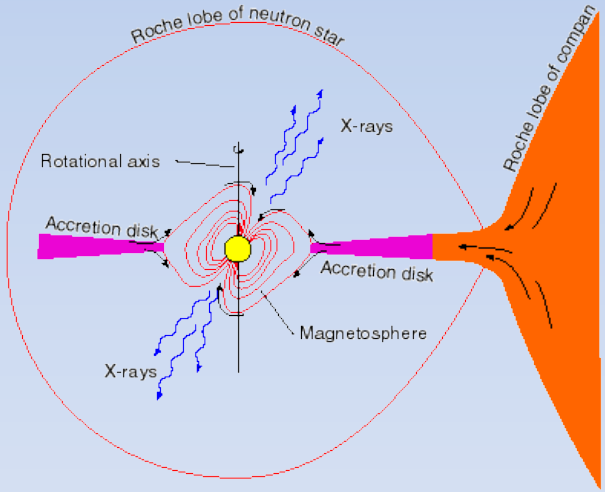




AMXPs

Source name	Spin	Orbital period	Optical counterpart
SAX J1808.4-3658	401 Hz /2.49 ms	2.01 hrs	Y (o,q)
XTE J1751-305	435 Hz /2.30 ms	0.70 hrs	N
XTE J0929-314	185 Hz /5.41 ms	0.73 hrs	Y (o, q)
XTE J1807-294	191 Hz /5.24 ms	0.67 hrs	N
XTE J1814-338	314 Hz /3.18 ms	4.30 hrs	Y (o, q)
IGR J00291-5934	599 Hz /1.67 ms	2.46 hrs	Y (o, q)
HETE J1900.1-2455	377 Hz/2.65 ms	1.39 hrs	Y (o)
SWIFT J1756.9-2508	182 Hz/5.49 ms	0.90 hrs	N
Aql X-1	550 Hz/1.82 ms	18.95 hrs	Y (o, q)
SAX J1748.9-2021	442 Hz/2.26 ms	8.77 hrs	N
NGC 6440 X-2	206 Hz/4.85 ms	0.96 hrs	N
IGR J17511-3057	245 Hz/4.08 ms	3.47 hrs	N
Swift J1749.4-2807	518 Hz/1.93 ms	8.82 hrs	Y (q)
IGR J17498-2921	401 Hz/2.49 ms	3.84 hrs	N

Dynamical studies of AMXPs



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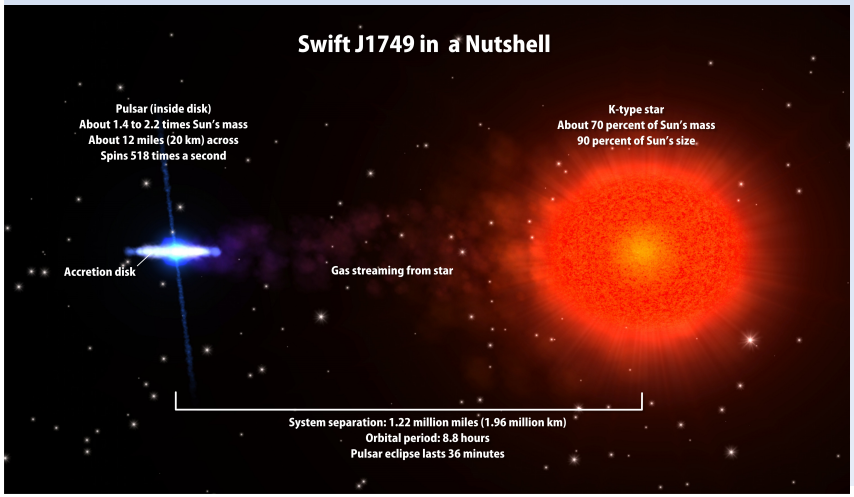
$q \equiv M_C / M_X = K_X / K_C$



System inclination: a problem[3]

But not for Swift J1749.4-2807!

i = 74-78 deg

(Markwardt & Strohmayer 2010; Altamirano et al. 2011)

Conclusions

- A variable candidate NIR counterpart for Swift J1749.4
- H ~ 20: suitable for NIR spectroscopy
- Promising target for dynamical study (NS mass)
- Need for AO NIR spectrograph