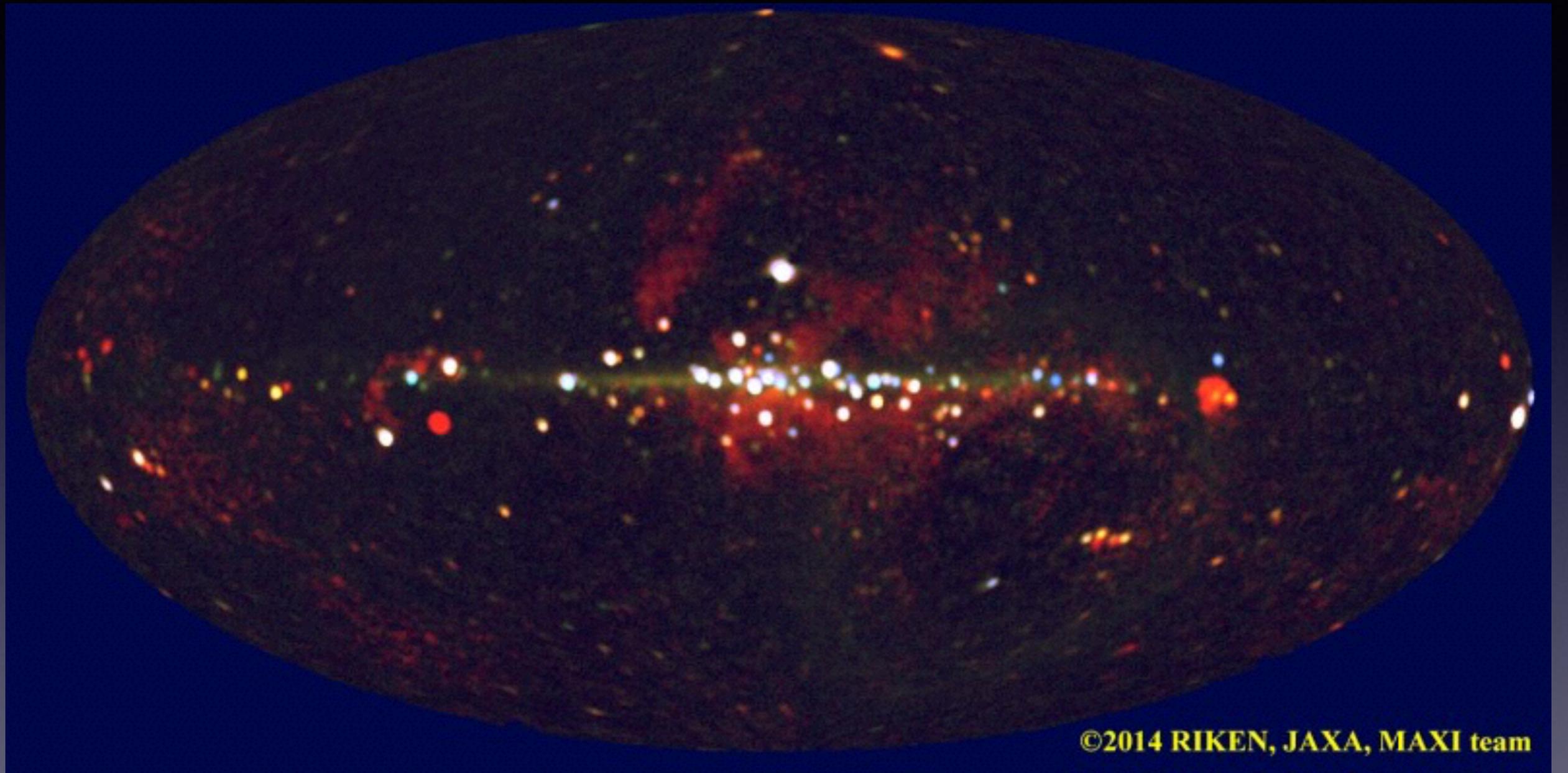


On the orbital period of MAXI J1305-704

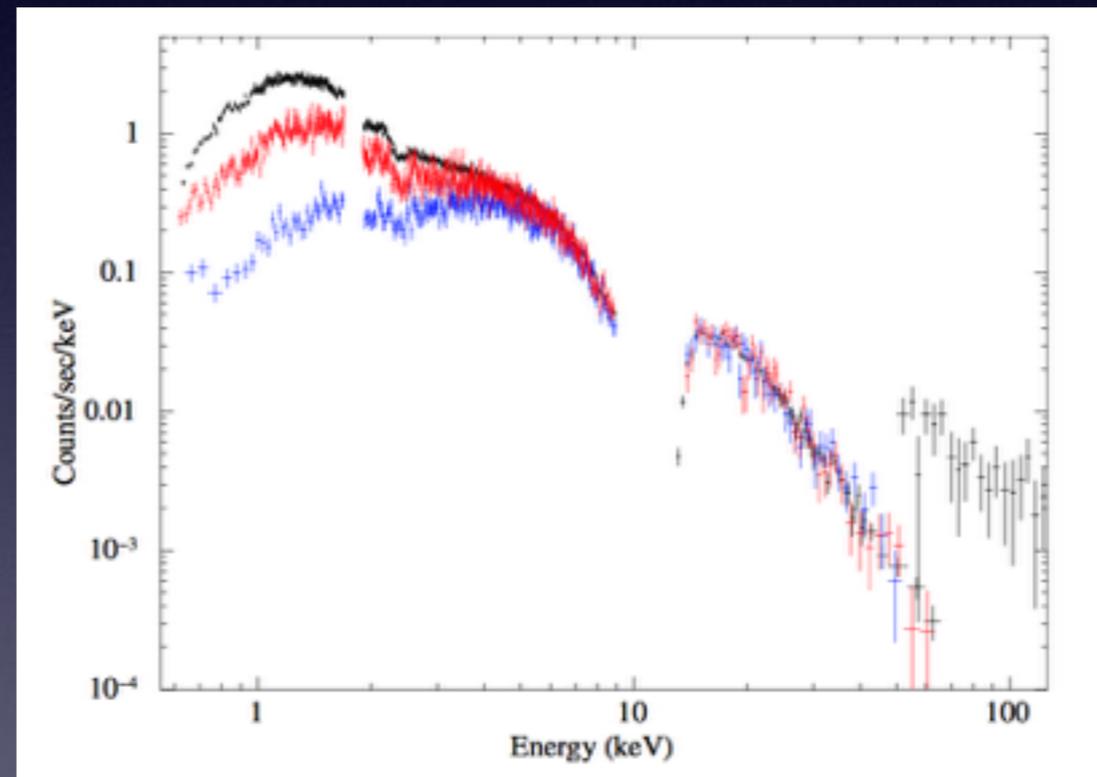
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aarran@ualberta.ca





MAXI J1305-704

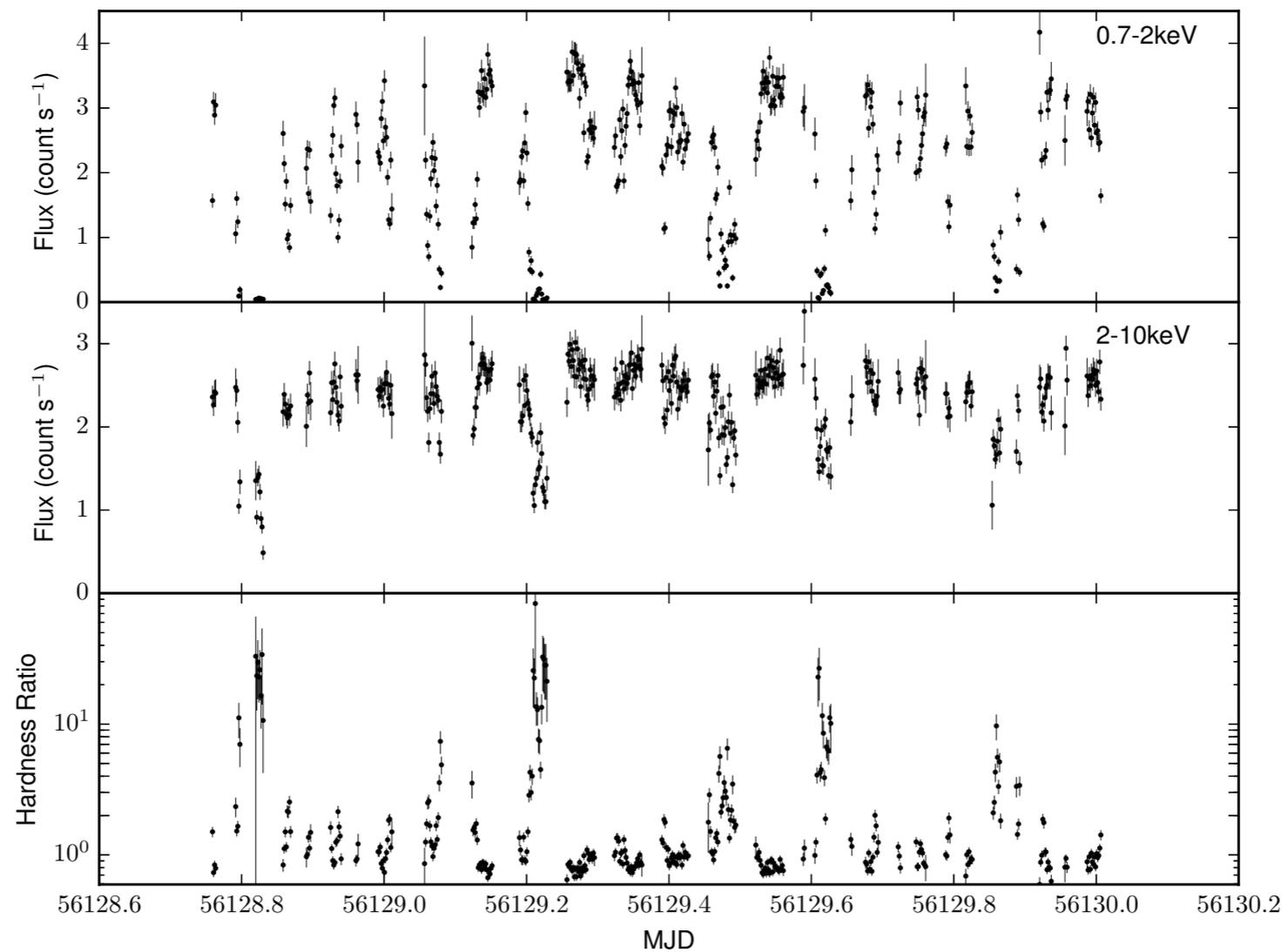
- Discovered by MAXI in 2012 (ATel #4024)
- (Likely) BH transient - no X-ray bursts, typical BHXRB spectrum
- Strong absorption dips present in *Suzaku* and *Swift* light curves - high inclination source (Shidatsu+2013)
- Disk wind observed by *Chandra* (Miller+2014)



Shidatsu+2013

Orbital Period

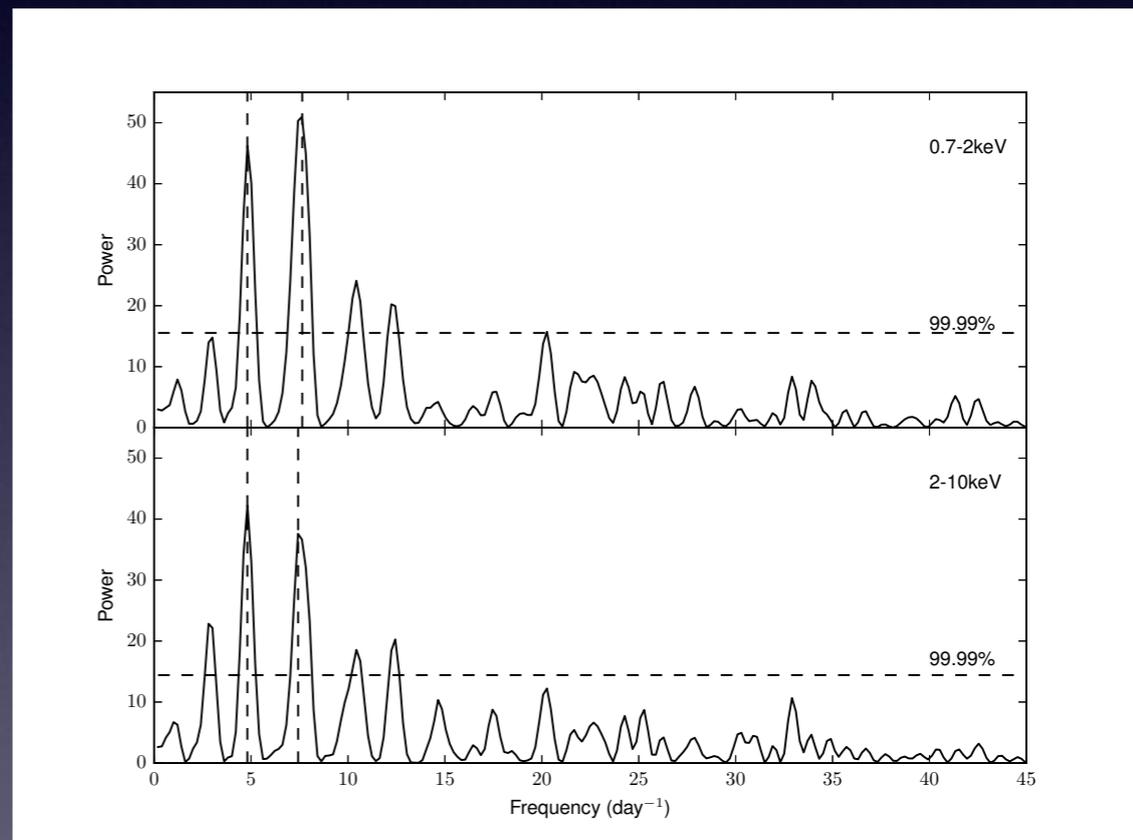
- Shidatsu(+13) determined orbital period to be 9.74h (from measuring time between dips)
- Other estimates have been 1.5h and 2.7h from Swift observations (ATel #4044)
- Clearly difficult to estimate $P(\text{orb})$ - with no quiescent optical coverage
- I went back to the Suzaku data and applied timing analysis techniques

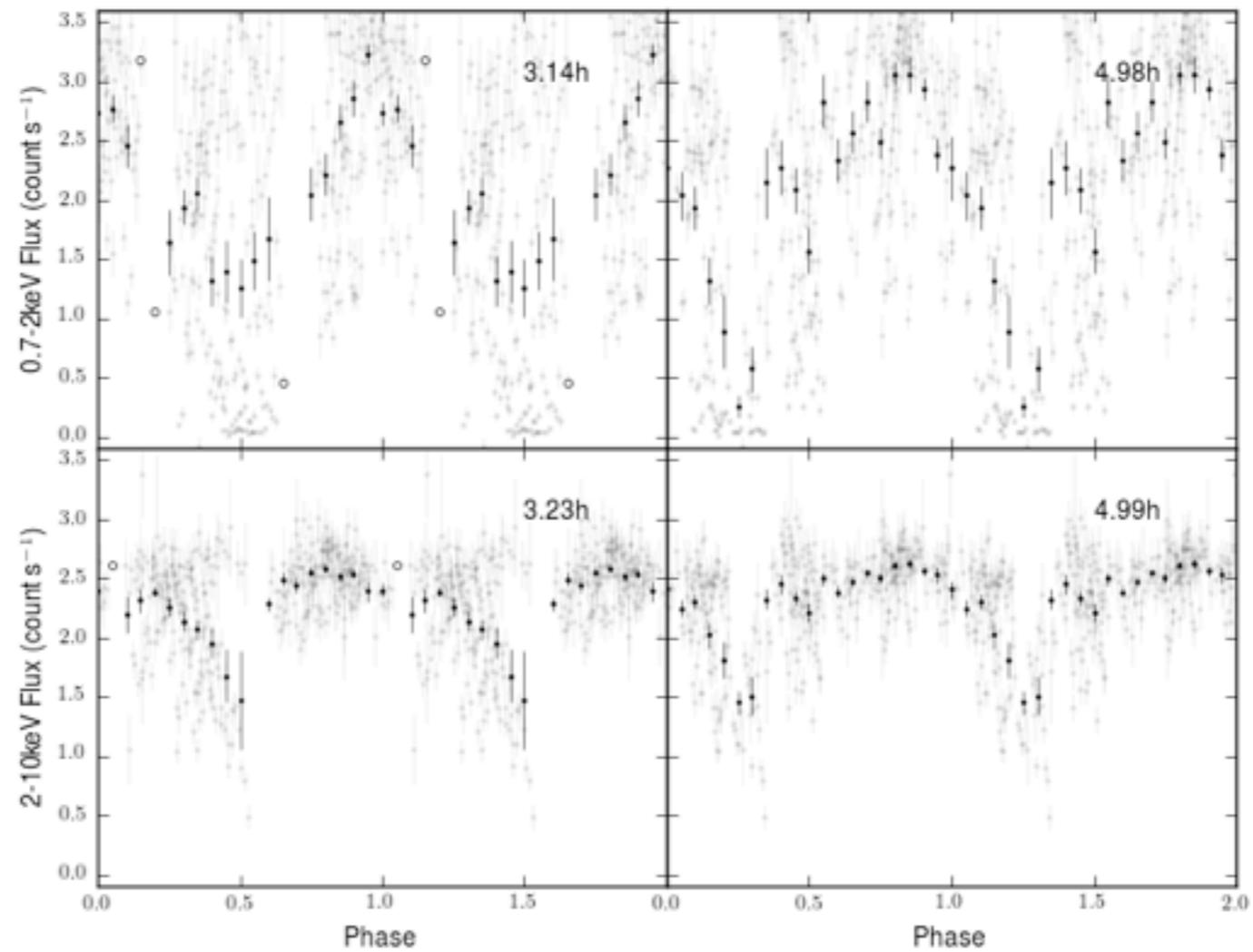


Suzaku light curve (40ks on-source time)
Absorption dips immediately clear

Timing analysis

- Lomb Scargle periodogram revealed no evidence of a 9.7hr periodicity
- Several candidate periods, two strongest peaks are ~ 3 h and ~ 5 h
- Similar results found from Phase Dispersion Minimization analysis
- Need to look at folds to get a handle on candidate periodicities





Only the 5hr period accurately reproduces the structure of the absorption dips

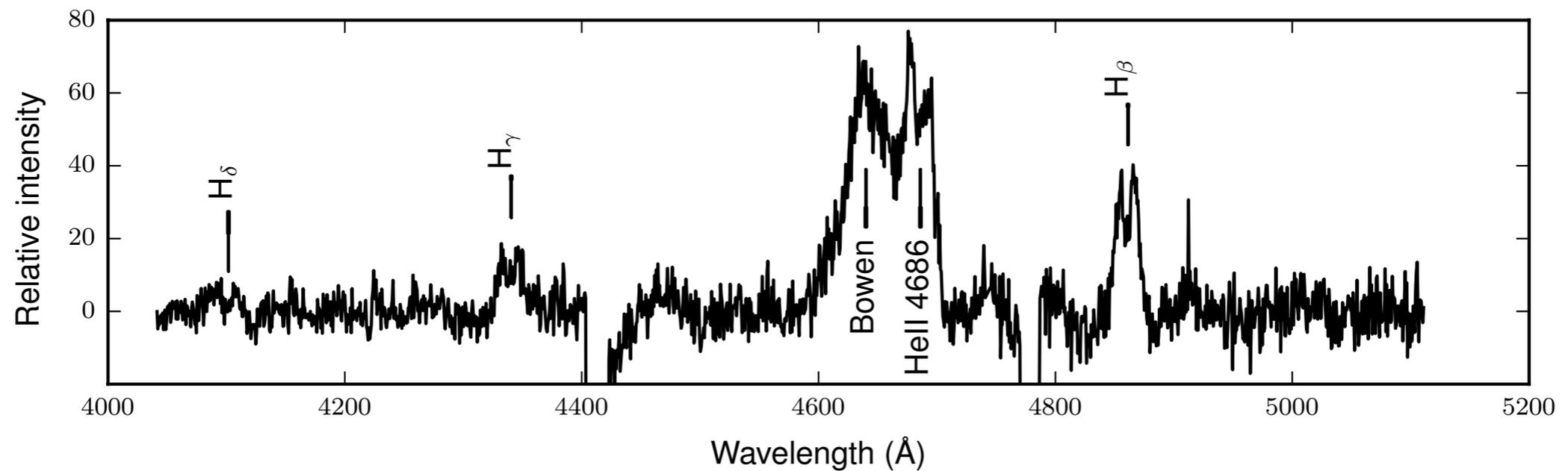
Periodicities

- $\sim 3.2\text{h}$ periodicity does not reproduce dips at all
- Could be attributed to $2 \times P(\text{orb})$ of Suzaku?
- 9.74h period does not appear in timing analysis.
- From a combination of folds and timing analysis, 5h seems most likely periodicity

What does this tell us about the donor?

- $P=9.74\text{h}$ would require non-MS star: $R < R_{\odot}$, $M < M_{\odot}$, $\rho < \rho_{\odot}$ (Shidatsu+13)
- With $P=4.98\text{h}$, using Eggleton formula and sensible mass ratio range, donor \rightarrow
 $R=0.55-0.7R_{\odot}$, $\log(\rho/\rho_{\odot}) = 0.51$
- Completely consistent with low-mass donors K5-M1 (but we need quiescent spectroscopy to be sure!)

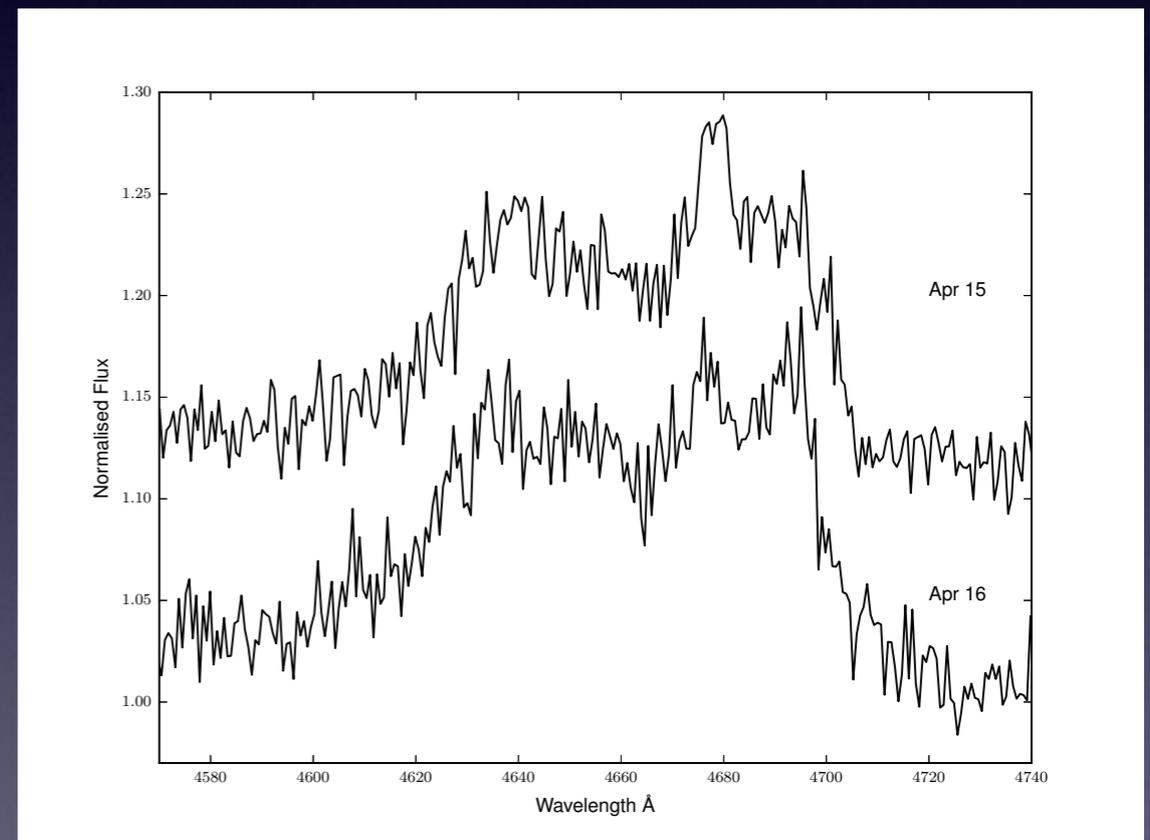
Optical Spectroscopy



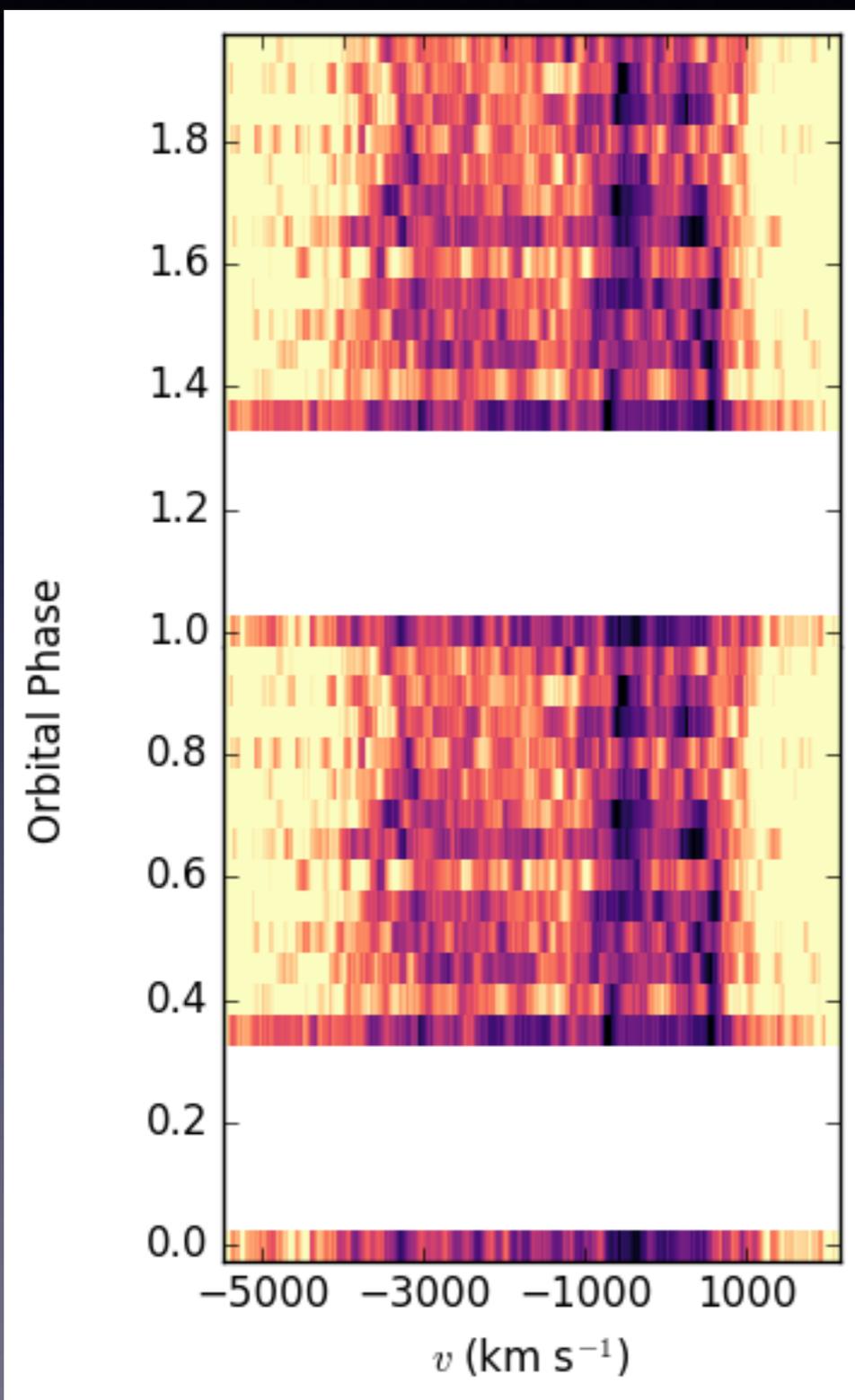
SALT RSS spectrum in outburst (April 2012)
Features typical of LMXBs

Optical Spectroscopy

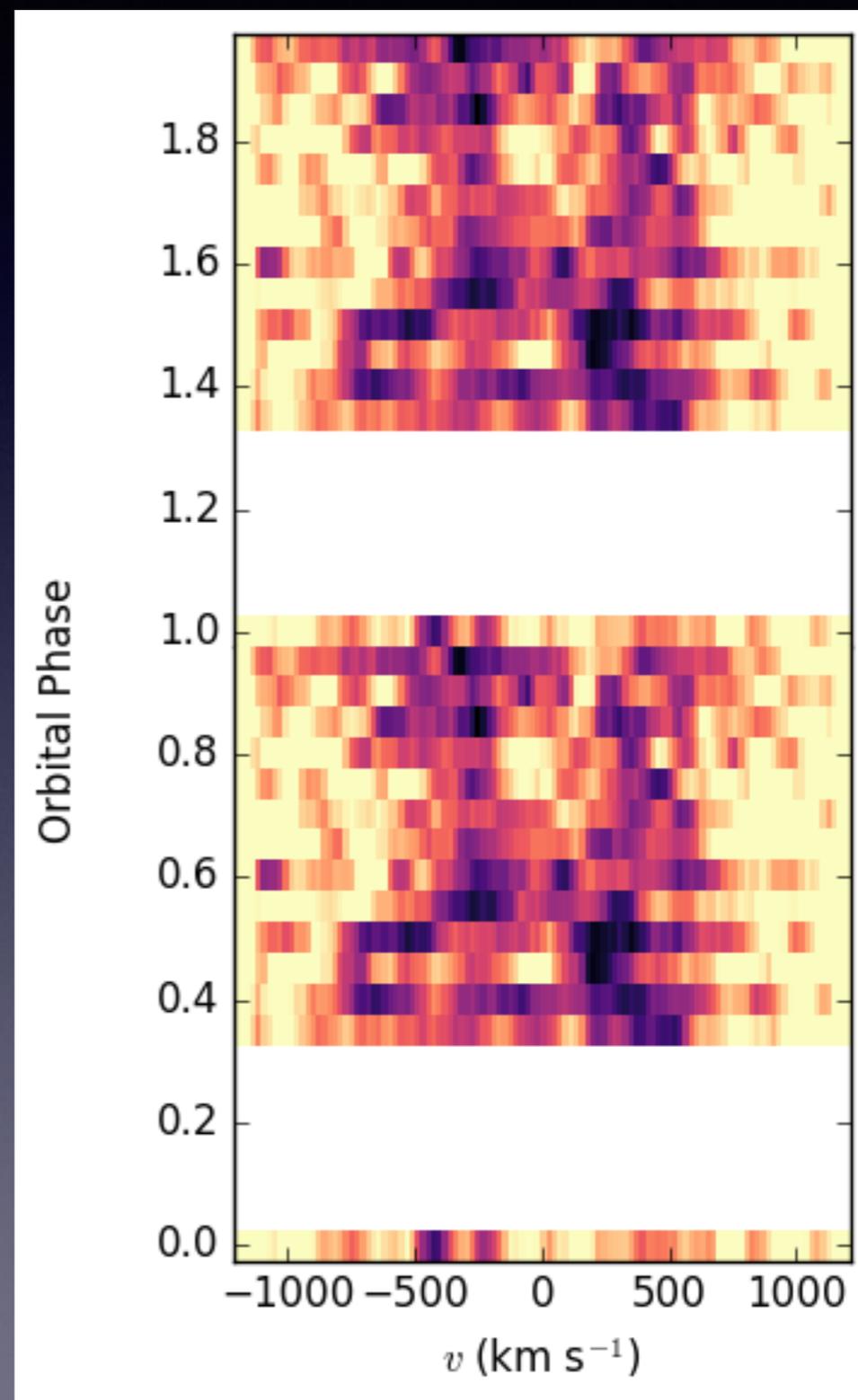
- Strong He II $\lambda 4686$, Balmer double peaked emission lines and Bowen blend
- He II peaks show night-to-night variations
- Can use Bowen spectroscopy to measure mass of the compact object (Steeghs & Casares 2002)
- However, no sharp Bowen features in spectra



HeII/Bowen



H β



Mass estimates from optical spectrum

- Can use peak separation of Balmer lines to estimate K_2 - velocity semi-amplitude of donor - leading to mass function of the system
- Using $H\beta$ $\rightarrow K_2 > 313 \text{ km/s} \rightarrow f(M) > 0.66M_{\odot}$
- Not actually very useful...Need (as always) quiescent spectroscopy. Hurry up and build E-ELT!
- Can also perform Doppler Tomography to reveal accretion disc structure - analysis ongoing

Conclusions

- MAXI J1305-704 previously determined to have $P(\text{orb}) = 9.74\text{h}$
- Using timing analysis techniques, we now suggest that $P(\text{orb}) = 4.98\text{h}$
- Optical spectrum reveals night-to-night variability of emission features. Unfortunately, no sharp features for Bowen spectroscopy \rightarrow no legitimate mass estimate yet!
- Need quiescent observations to get a true handle on system parameters, but these require bigger telescopes