

PULSE PROFILE STUDY OF THE ACCRETING X-RAY PULSAR A 0535+26

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Abstract

We studied the pulse profile behavior of the High Mass X-ray Binary A 0535+26 during two normal outbursts in August/September 2005. We analyzed RXTE observations that monitored A0535+26 during those outbursts. Pulse shape correlations with energy and luminosity are found. A special behavior is seen during the spike. There are changes in the pulse shape at energies around the 45 keV cyclotron line.

What do we already know about this X-ray source?

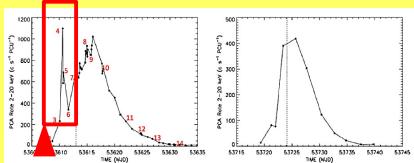
- Be/X-ray binary:**
 - $P_{orb} = 111.10 \pm 0.3$ d around O9.7 IIe star
 - Pulse period: 103-104 s
 - $i_e = 0.47 \pm 0.02$
- X-ray history Flux:**
 - Giant outbursts : ... plus weaker normal outbursts separated ~111 days
 - 1975 (the discovery)²,
 - 1980, 1989 and 1994
- Three modes of X-ray intensity:**
 - Quiescence ≤ 10 mCrab
 - "Normal outburst" of few ~100 mCrab; related to perigee passages
 - "Giant outburst" of several Crab.

11 years of quiescence...

... up to the 2005 giant outburst and 2 consecutive normal outbursts

Observations

2-20 keV RXTE PCA LIGHT CURVES FOR THE TWO NORMAL OUTBURSTS in 2005
First normal outburst Second normal outburst



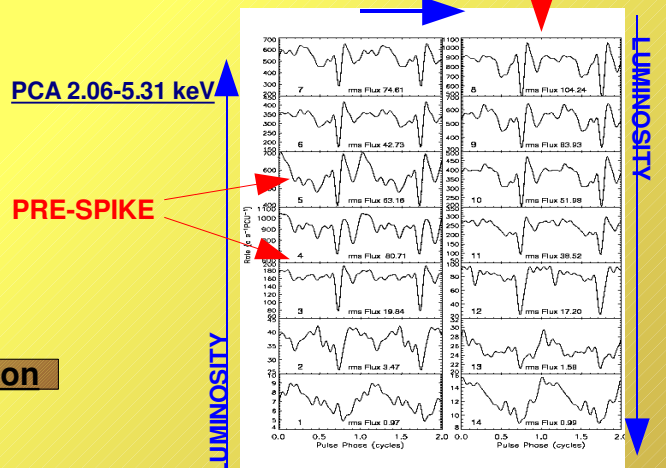
pre-outburst peak, as seen in EXO 2030+375

Finger, M., Camero-Arranz, A, Krestmar, P. et al. (2006), San Francisco HEAD meeting³

Results

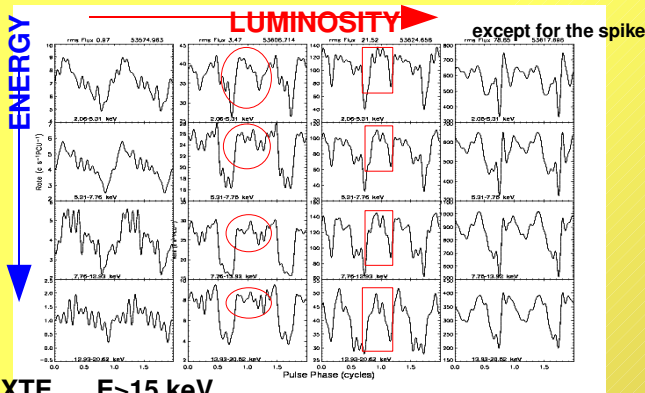
Evolution with luminosity

near MAXIMUM after the spike

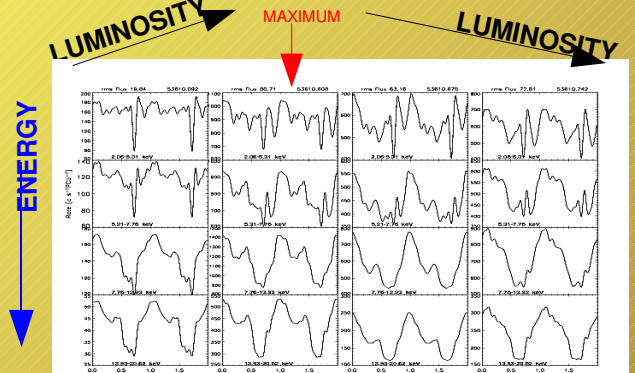


Different Luminosity States--> Different Energy Evolution

Evolution with energy



The Pre-Spike: Evolution with energy



Increasing Energy--> ~single-peak pulse shapes

Conclusions

- Pulse profile-luminosity correlations :
 - Low X-ray luminosities: pulse shapes single peaked
 - High X-ray luminosities: 2, 3 or 4 (even 5) components
- Energy dependence correlation confirmed and different patterns were found:
 - with multiple components
 - > Increasing luminosity :
 - simple high energy profiles
 - evolving from double to single peaks
- During the PRE-SPIKE:
 - Different behavior comparing with profiles at the same luminosity state.
- There are changes in the pulse shape at energies around the 45 keV cyclotron line

There are pulse shape changes at energies around the 45 keV cyclotron line

References

¹Finger, M. H., Cominsky, L. R., Wilson, R. B., Harmon, B. A., & Fishman, G. J. 1994, in AIP Conf. Proc. 308: The Evolution of X-ray Binaries, ed. S. Holt & C. S. Day, 459p
³Finger, M., Camero-Arranz, A, Krestmar, P. et al. 2006 , San Francisco HEAD meeting, Bulletin of the American Astronomical Society, Vol. 38
²Rosenberg, F. D., Eyles, C. J., Skinner, G. K., & Willmore, A. P. 1975, Nature, 256, 628K