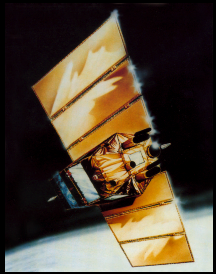
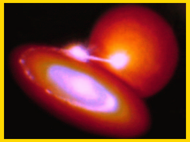


A bursting GX3+1: 6 years of BeppoSAX observations (a preliminary report)

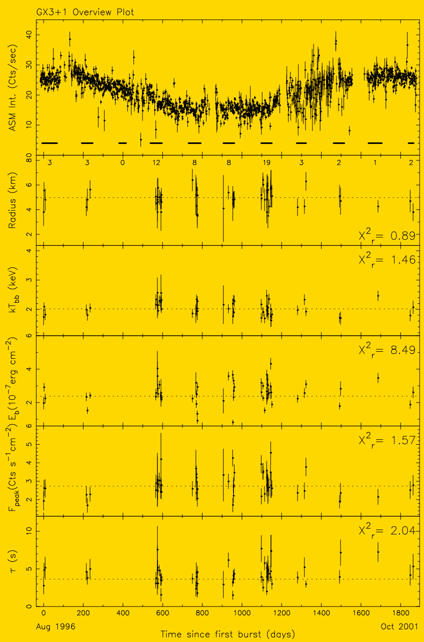
Peter den Hartog, Jean in ’t Zand, Erik Kuulkers
Astronomical Institute Utrecht, Princetonplein 5, 3508 TA Utrecht
SRON, National Institute for Space Research, Sorbonnelaan 2, 3584 CA Utrecht

P.R.denHartog@astro.uu.nl



GX3+1

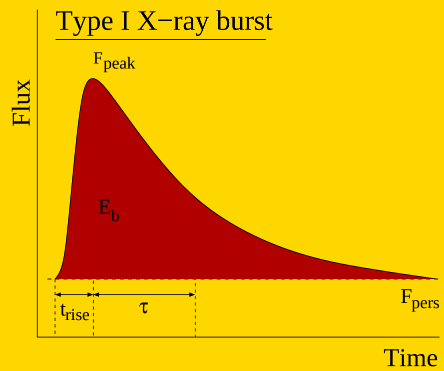
- Low Mass X−ray Binary
- Neutron Star & low−mass companion (<2M☉) with Roche lobe overflow
- 6.5 Msec net observation time
- Unique dataset with 61 Type I X−ray bursts
- Smooth variation in persistent flux



- Over the past six years the Wide Field (X-ray) Cameras (WFCs) on BeppoSAX have provided more than 75 days of net observation time of the Galactic center region. These observations resulted in unique datasets, for example on GX3+1.
- Our goal is to investigate the relations between type IX-ray burst properties and the mass-accretion rate.
- The All Sky Monitor (ASM) on RXTE monitors GX3+1 daily in 2-12 keV. Measurements reveal a smooth variation in intensity. The source started out in a high state in 1996 and smoothly decreased to a low state where the intensity was half of its original value. After being in the low state for two years the intensity increased again to its initial value. This intensity is probably a good indicator of the mass-accretion rate because the spectrum of the radiation doesn’t change much over the different states.
- The WFCs detected 61 bursts. The observed burst rate is significantly higher, i.e. a factor of 10, in the low state. This is in agreement with the theory of stable nuclear burning in the lower layers of the neutron star when the mass-accretion rate is high. Remarkably, the transition between the high and low burst rate is very discrete.
- We carried out time-resolved spectrometry of the bursts. The data were fitted with a black body spectrum, because the upper layer of the neutron star’s atmosphere radiates as a cooling black body. Then we derive the radius of the emitting area for an assumed source distance of 5 kpc, the temperature (kT), the fluence, the peak flux and the decay times. These parameters show some interesting details when plotted against time.
- The radius of the emitting area is consistent with being constant. This indicates that this radius is the radius of the neutron star and not a variable part of its surface. The variations in the peak fluxes can not be explained by statistical noise. It seems that there is a bigger dynamic range in this property when the source is in the low state. The chance that this is due to a small sampling effect is a few percent. We do see some variation in the decay times, but it is clear that all bursts are short, i.e. less than 10 seconds. This shows that all the bursts are fueled by pure helium.

Conclusions:

- Our observations enabled the first−time accurate measurement of the burst frequency versus accretion rate relation for small frequencies.
- The suggested discrete nature of the burst rate transition has never been seen in any burster.
- All bursts are short. Theory says that all are then fueled by pure helium. This implies that helium is produced by stable nuclear burning of accreted hydrogen in the low as well as in the high state, but at different rates.
- No strong vatiation is observed in the emission surface area, suggesting that the whole neutron star surface burns in every burst.
- The only parameters truly seen to vary with accretion rate are burst frequency and burst peak flux.



- Fast rise, exponential decay
- Rise time (t_{rise}): ~ sec
- Decay time (τ): 10−1000 sec
- Peak flux (F_{peak})= Max flux−Persistent flux (F_{pers})
- Fluence (E_b)= ∫(Flux− F_{pers}) dt
- Recurrence time (t_{rec}) is the time between two bursts