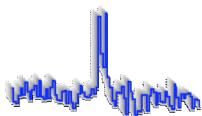


X-ray Flashes and Gamma-ray Bursts

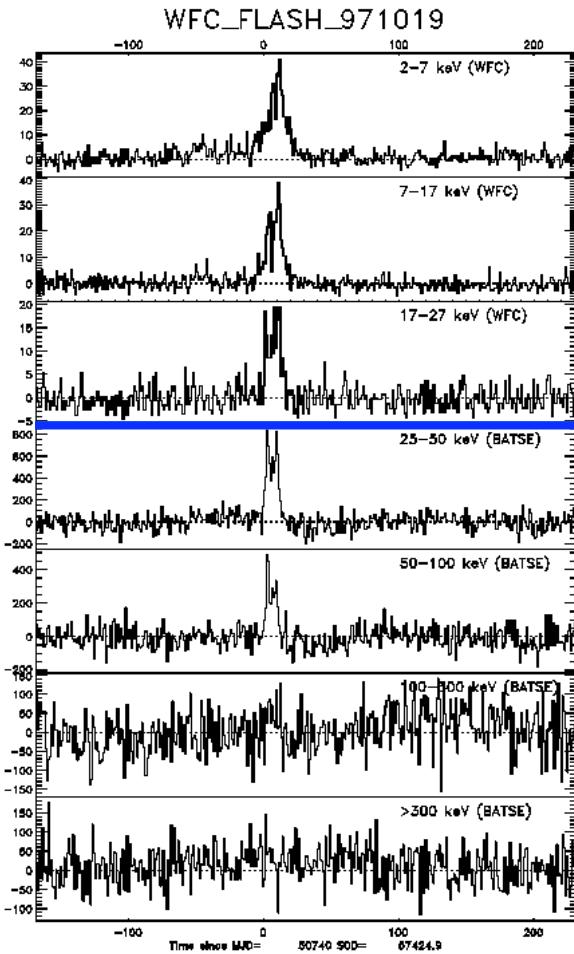
**R. M. Kippen (LANL), P. M. Woods (USRA/NSSTC),
J. Heise (SRON), J. J. M. in 't Zand (SRON),
R. D. Preece (UAH/NSSTC), and M. S. Briggs (UAH/NSSTC)**

- ★ Short transients detected in WFC (2–25 keV) with little/no signal in GRBM (40–700 keV) and no BATSE (>20 keV) trigger
- ★ 17 events detected in 3.8 years of observations (cf. 36 GRBs)

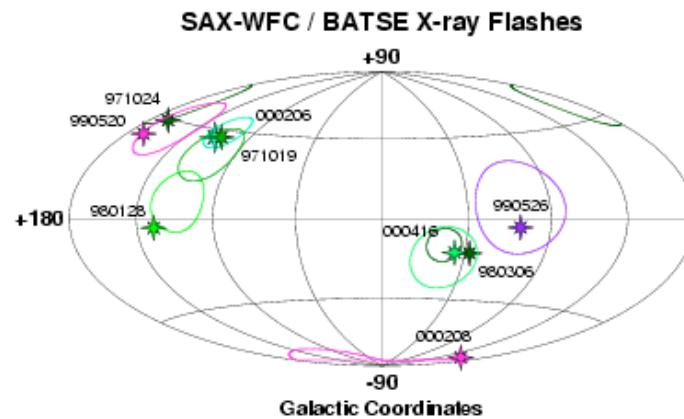
- ☞ Use BATSE continuous data (>20 keV) to search for (*untriggered*) γ -ray emission
- ☞ Characterize γ -ray properties and wide-band spectra
- ☞ Compare to the observed properties of GRBs



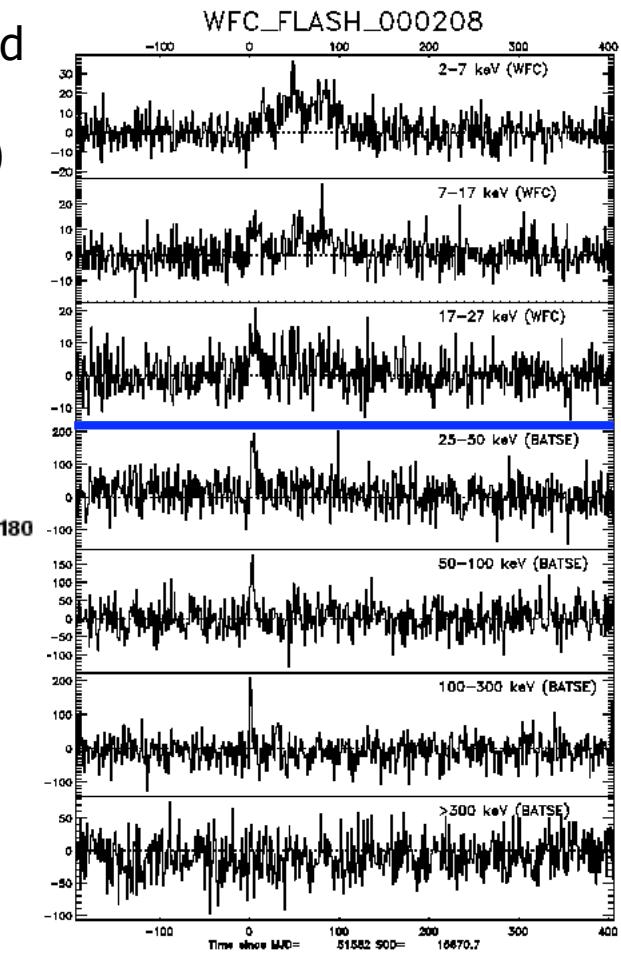
Search for γ -ray Emission

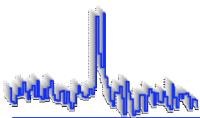


- ★ 10 unocculted events observed with BATSE
- ★ 9 events detected (<300 keV) by combining detectors



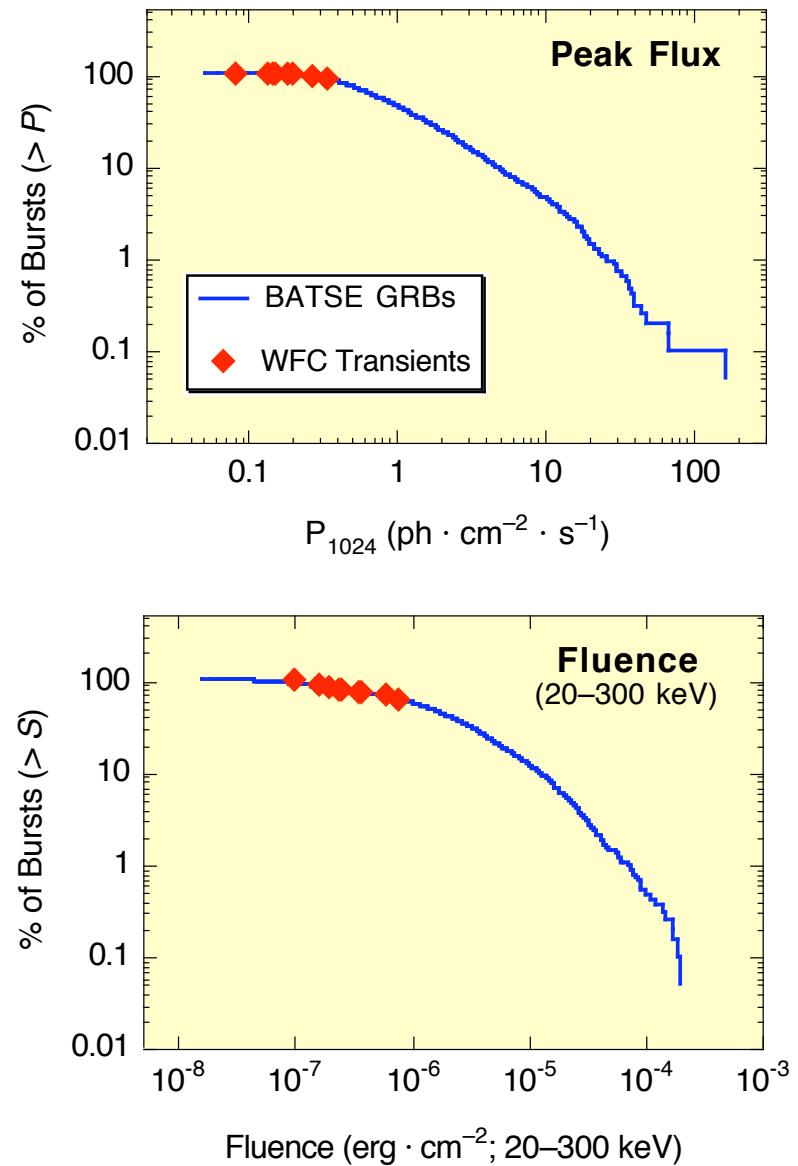
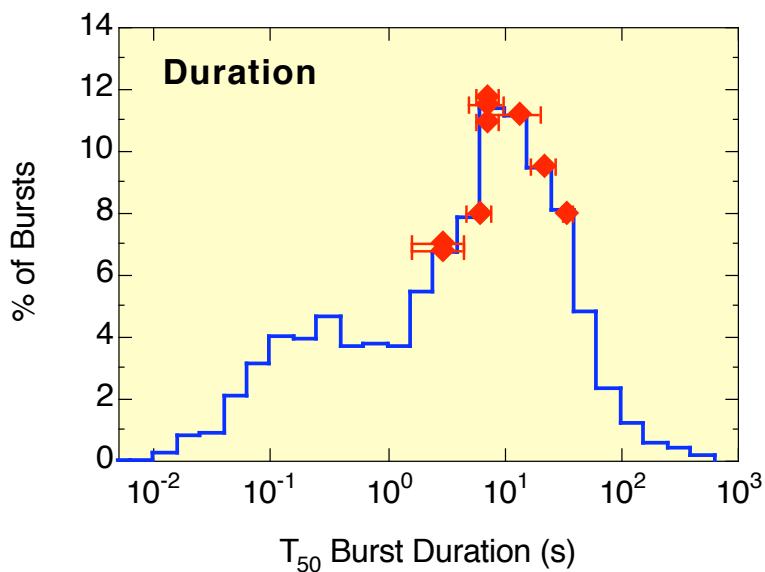
- ☞ ~Isotropic sky Dist.
- ☞ Qualitatively similar to weak GRBs

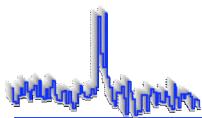




Standard Burst Parameters

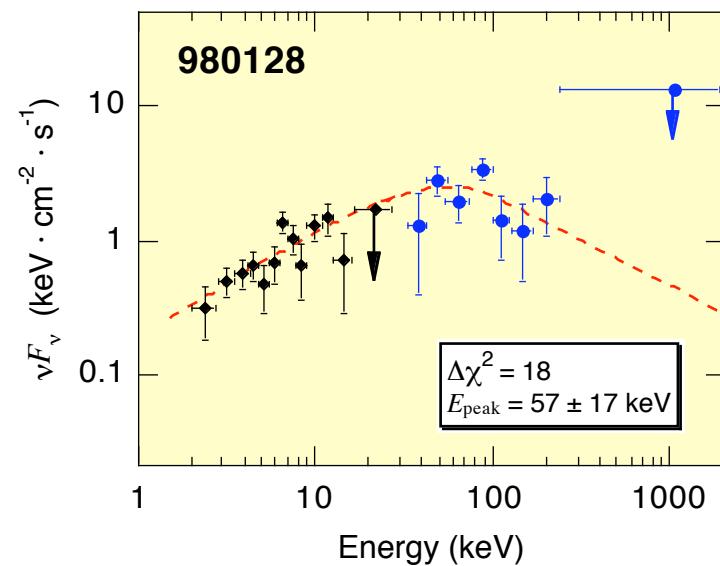
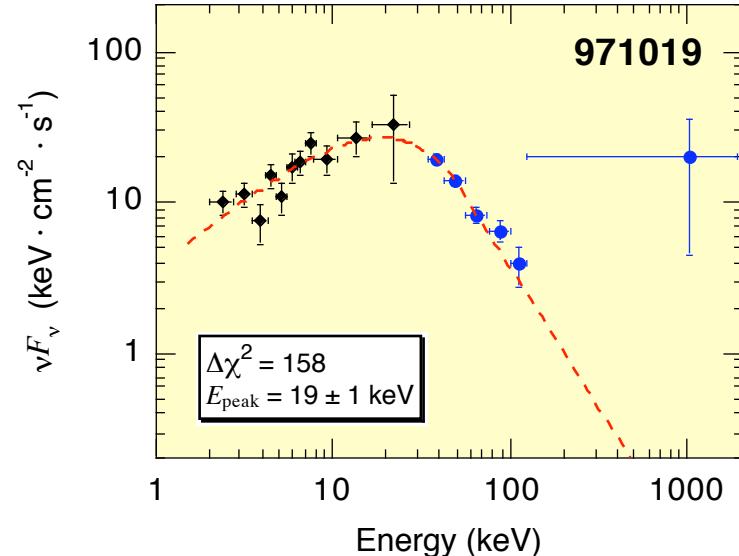
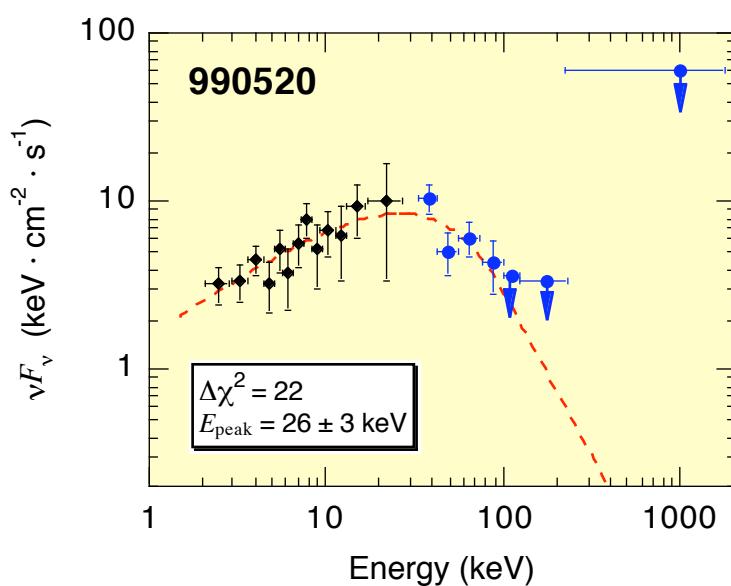
- ★ Apply Std. BATSE burst analysis to flashes
- ★ Compare to BATSE GRB catalog (1973 bursts w/flux, flu, dur)
- ☞ Flashes consistent with weak, long-duration GRBs
- ☞ How do detailed spectra compare?

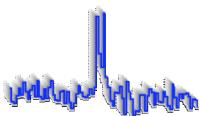




WFC/BATSE Joint Spectral Analysis

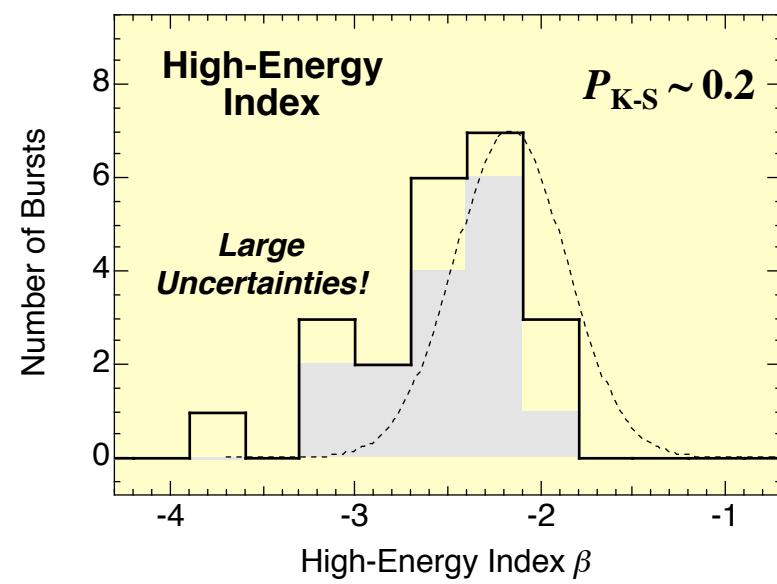
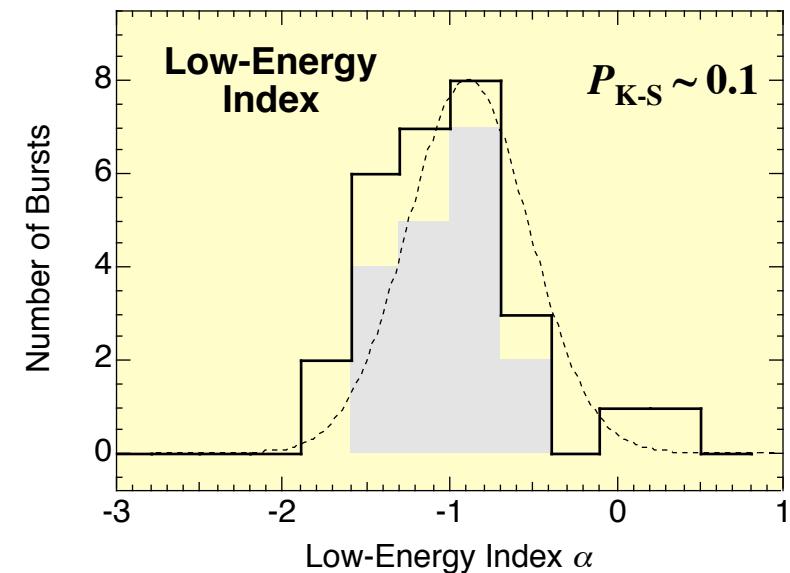
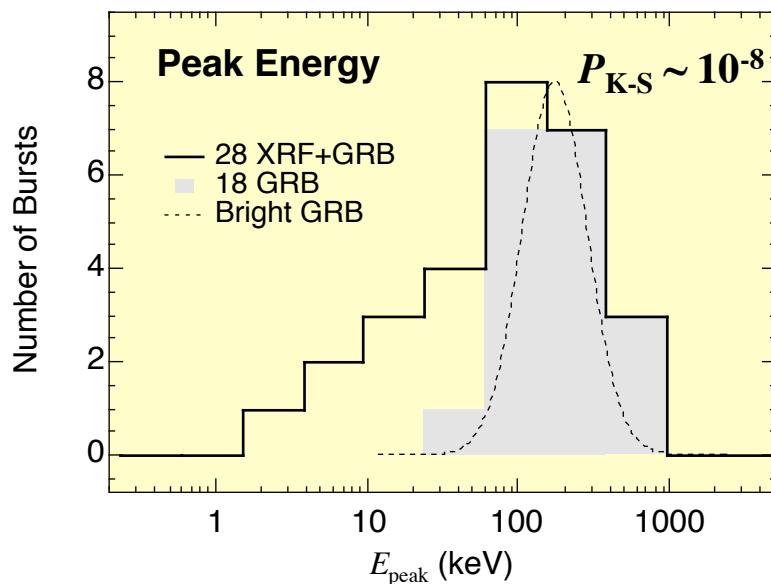
- ★ Time averaged flash spectra
- ★ Good agreement between WFC & BATSE around 20 keV
- ☞ 8 events have significant curvature (compared to single power law fit)
- ☞ E_{peak} and α are well constrained
- ☞ Band/Comp models generally consistent

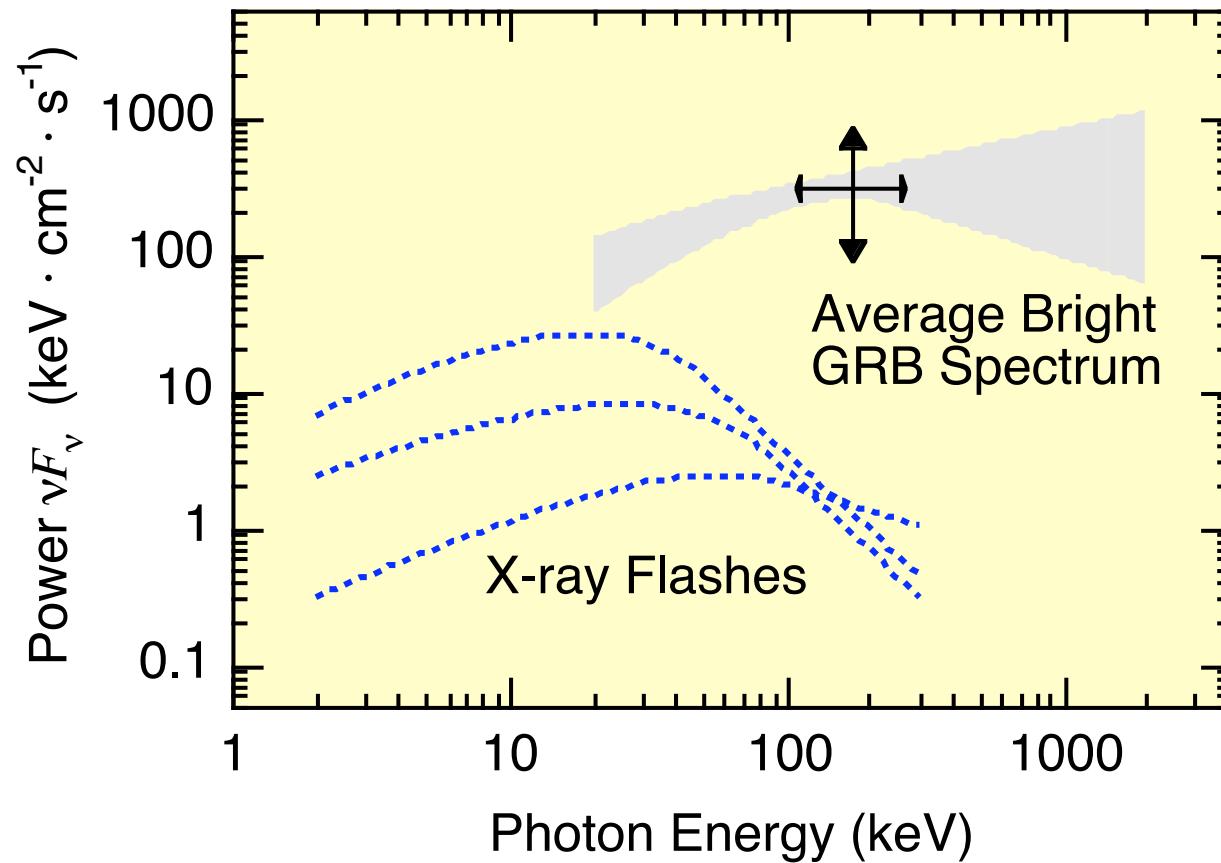


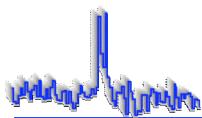


Flashes vs. Bright GRBs

- ★ Compare to Preece *et al.* results for 156 bright GRB (BATSE-only)
- ★ Also compare 18 WFC-selected GRBs (BATSE-only spectra)
 - ☞ WFC-selected GRBs consistent with bright GRBs
 - ☞ Flashes have consistent α & β
 - ☞ E_{peak} significantly different (lower)

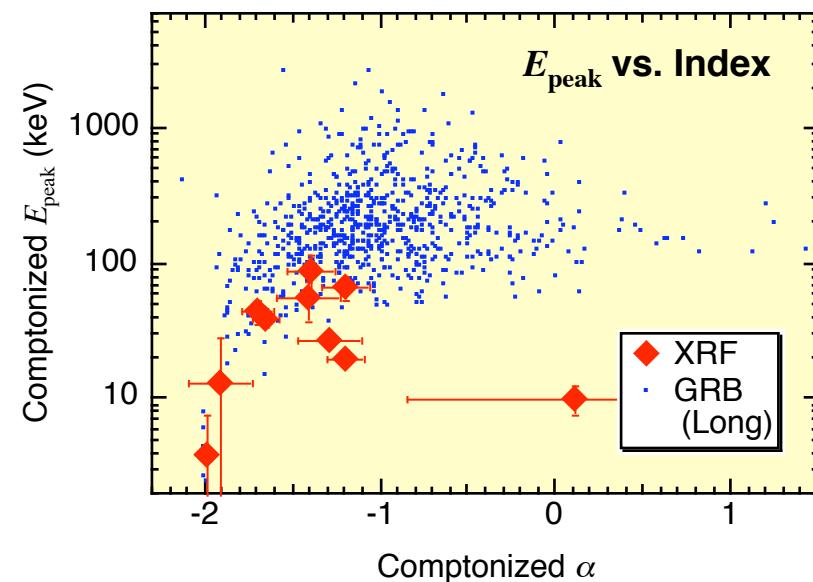
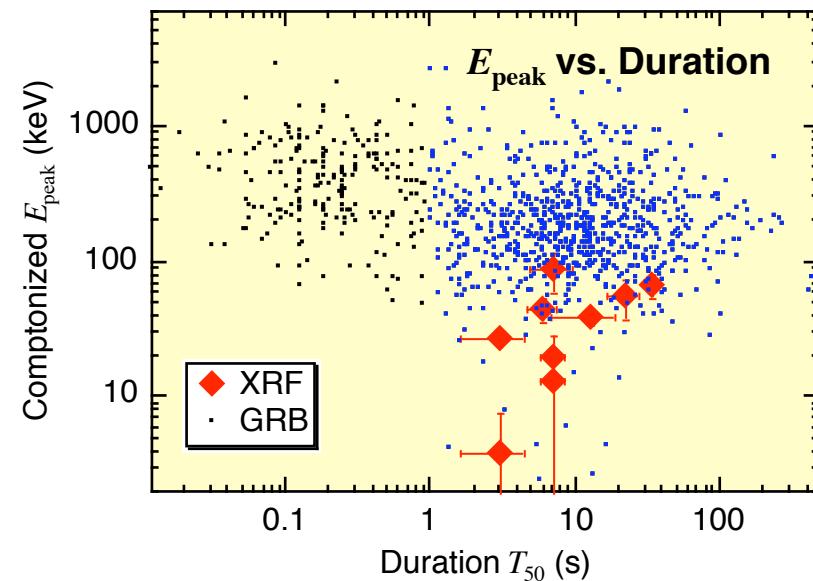
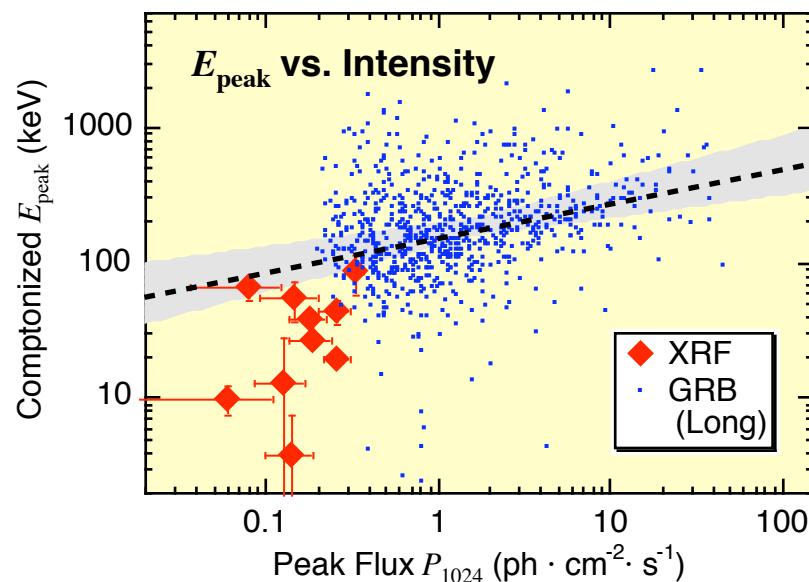


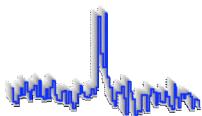




Flashes vs. Dim GRBs

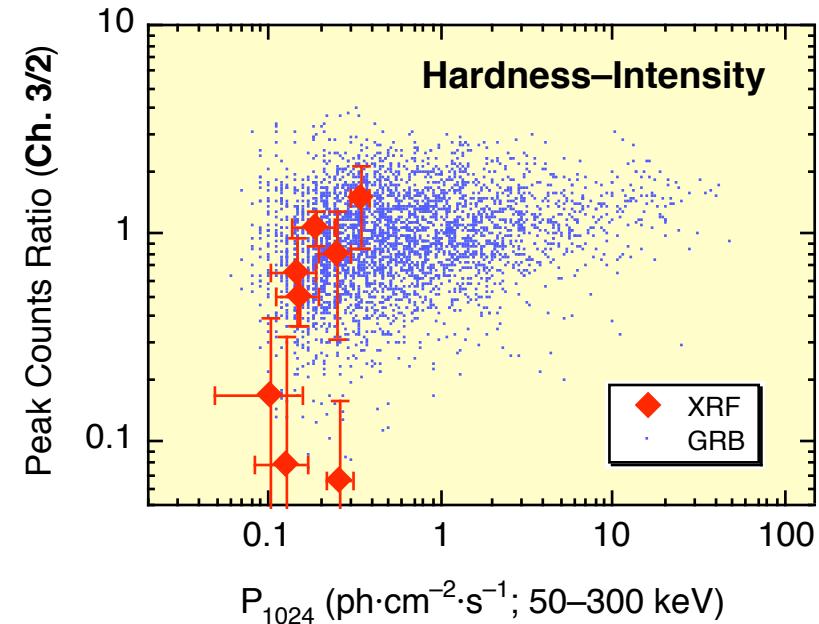
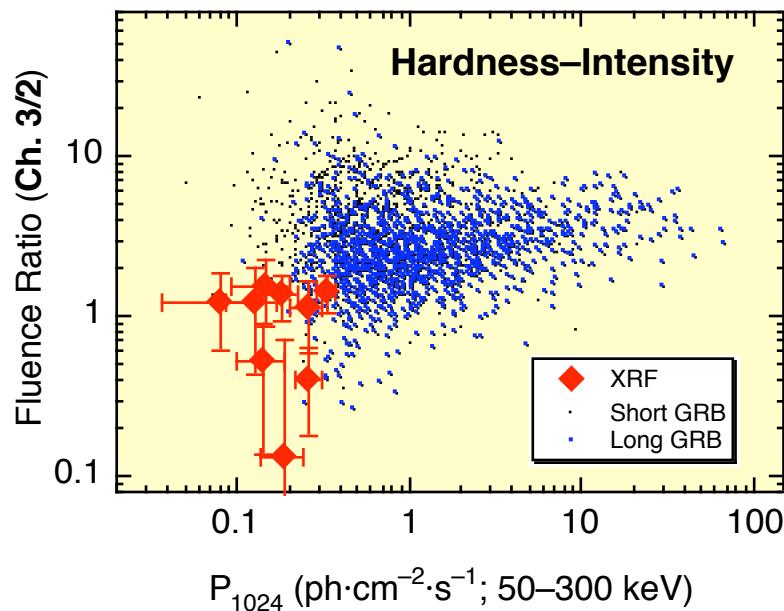
- ★ Compare “Comptonized” joint fit results to Mallozzi *et al.* [2000] BATSE GRB spectral catalog (1023 bursts)
 - ☞ α consistent with long GRBs
 - ☞ E_{peak} roughly follows hardness intensity trend of long GRBs





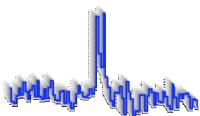
Flashes vs. *Dimmest* GRBs

- ★ Compare to BATSE 5B catalog
Briggs *et al.* [2002] (2704 triggers)
- ★ Compare to Stern *et al.* [2000]
catalog (3923 off-line triggers)



- ★ Characterize spectra with broad-band hardness ratios
- ☞ Flashes similar in hardness to bursts of same intensity

- ☞ ~400 bursts per year (full-sky) with similar hardness, duration, and intensity = 40% of all long bursts
- ☞ Consistent with WFC detection rate of FXTs = 32% of all SAX bursts



Conclusions

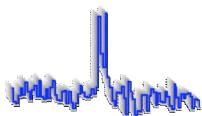
- ☞ X-ray flashes similar to GRBs except that they emit most power in X-rays
- ☞ Joint WFC+BATSE spectral fits reveal that flashes have significantly curved spectra — similar to GRBs
- ☞ Spectra of X-ray flashes are roughly consistent with the long GRB E_{peak} vs. intensity trend
- ☞ Could represent a large extension of the full GRB population

Caveats:

- ★ Small sample size
- ★ Subject to selection and analysis biases

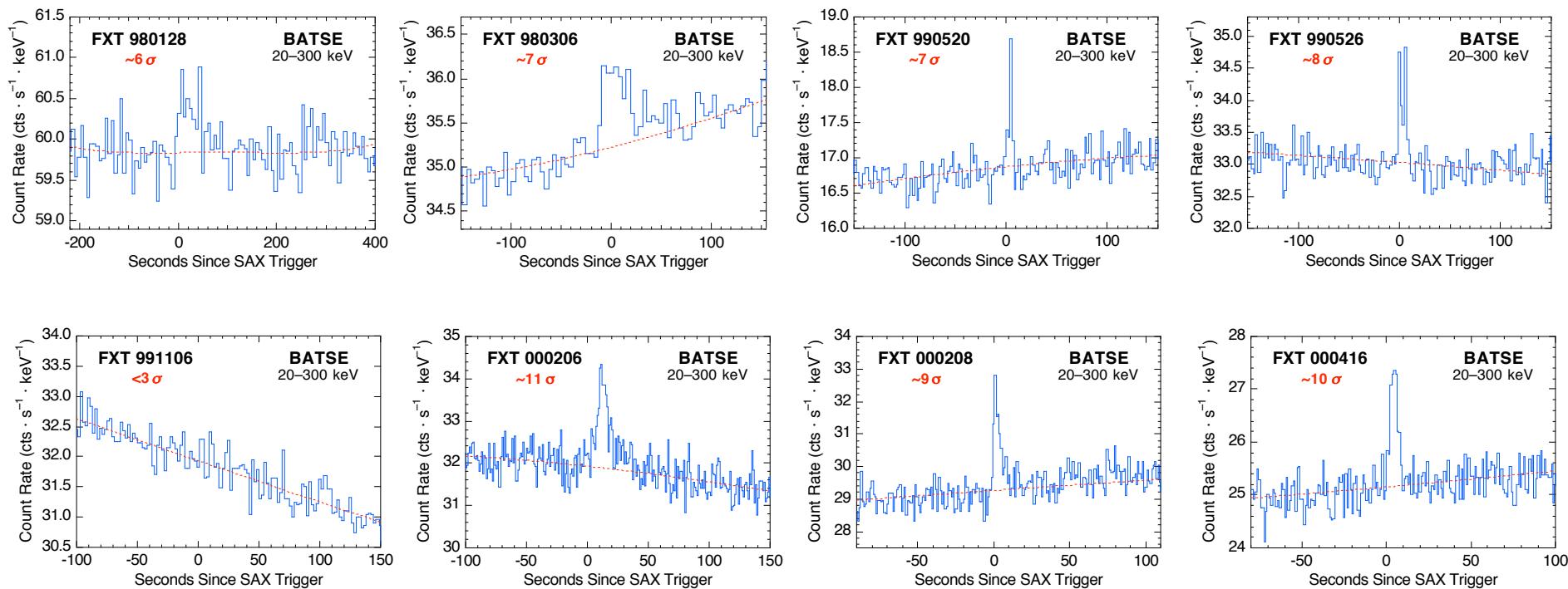
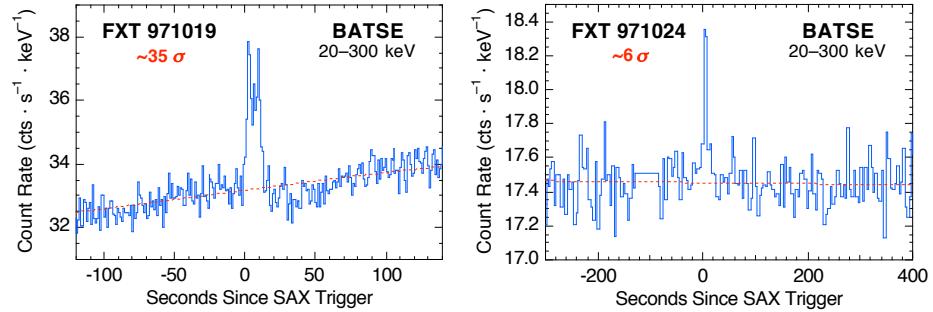
Future:

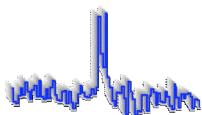
- ★ Afterglow counterparts (so far elusive) will conclusively show how flashes are related to GRB
- ★ BeppoSAX & HETE continue to routinely observe flashes, but lack sensitive γ -ray data
- ★ Swift (5–150 keV) should provide a large sample for wide-band spectral comparisons



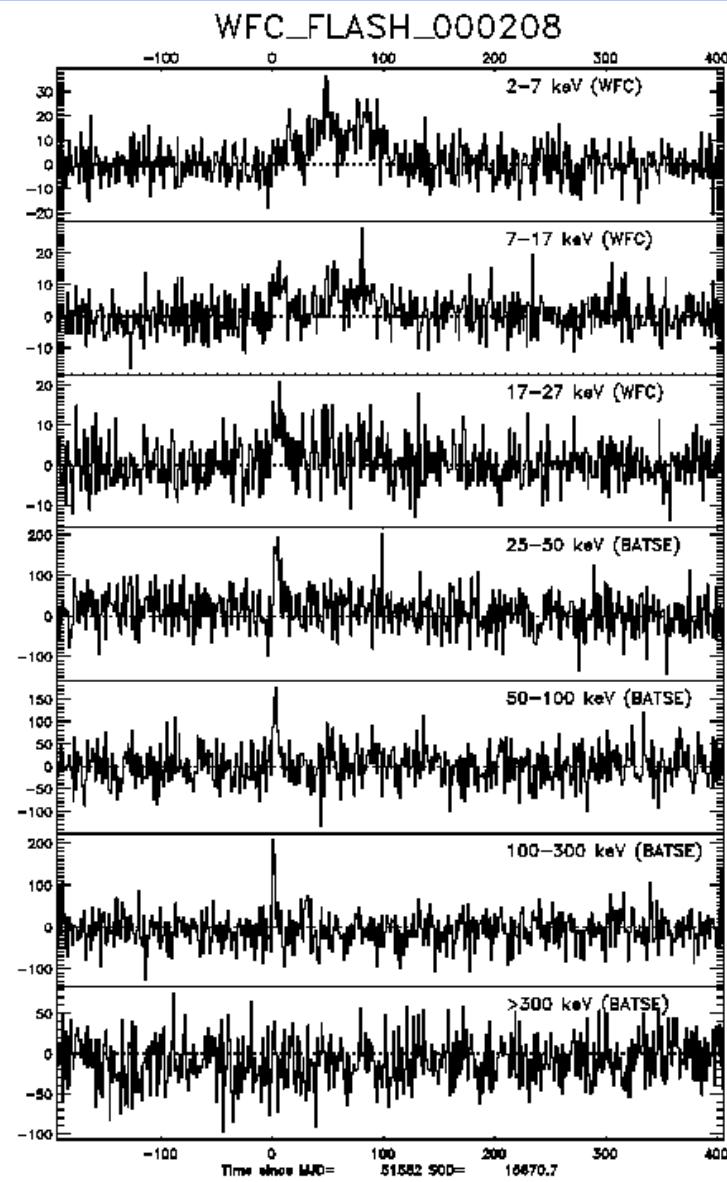
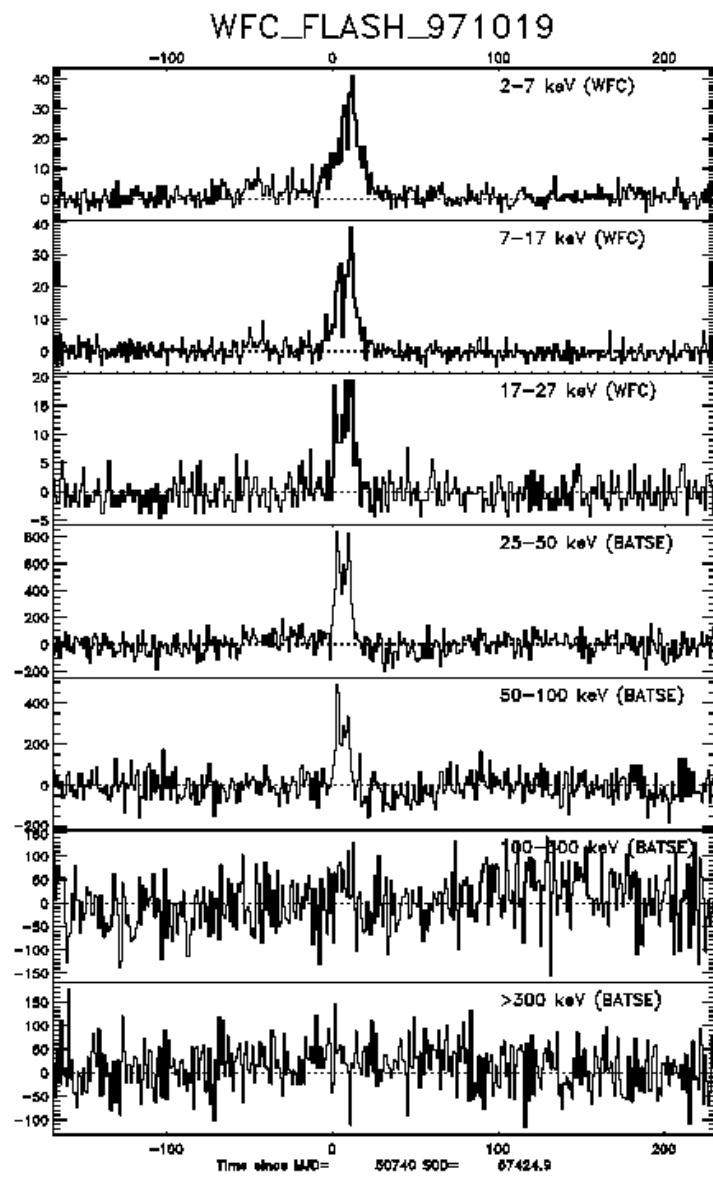
BATSE Search Results (20–300 keV)

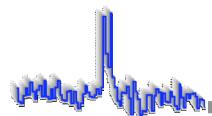
- ★ 10 unocculted events with BATSE continuous data
- ★ 9 detections (> 5 sigma in select, summed detectors)
- ★ No detections above 300 keV





Spectral Evolution





Spectral Evolution

