X-ray flashes

Luigi Piro [1]

[1] Istituto Astrofisica Spaziale Fisica Cosmica, Roma, INAF
E-mail(LP): luigi.piro@iasf-roma.inaf.it

Abstract

After their discovery with BeppoSAX and vigorous follow up programs with HETE2 and, more recently, with SWIFT, X-ray flashes are still puzzling phenomena. They are a very numerous class of soft GRB, making up about 40% of the total population. In this talk I will review the status of observations and discuss about different scenarios proposed to explain their origin. These include the off-axis jet scenario or sub-energetic GRBs. With its soft X-ray response and wide sky capability, we expect that MAXI will provide important observations to improve our understanding on these elusive phenomena.

X-ray Flashes

Luigi Piro

INAF/IASF Roma

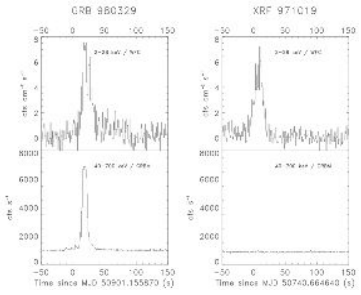
Istituto di Astrofisica Spaziale e Fisica Cosmica - Roma

Summary

- Discovery
- A new class of GRBs
- Constrain on the origin from observations
- The puzzle remains open
- MAXI perspecitves

X-ray flashes

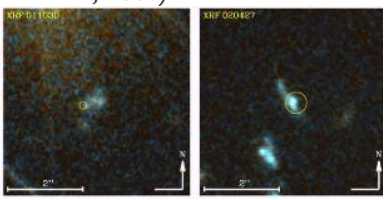
- **A New class discovered b BSAX and confirmed by HETE2: about 50% GRB with no or very faint or gamma-ray emission**
- **high redshift GRBs**
- **off-axis events**
- **Subenergetic events, mor numerous than normal GRBs**

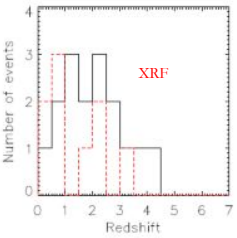


Heise et al 2001

XRF host galaxies

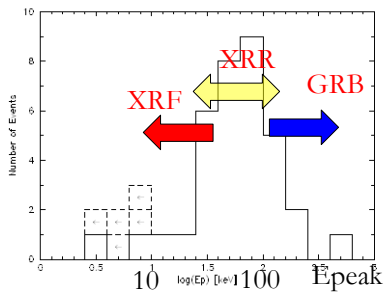
- 2 of XRF localized by BSAX and followed up by Chandra (Bloom et al 03)
- more redshift by SWIFT at z<3 (Gendre, Galli, LP, 2007)





A class of GRBs

- HETE2 (Sakamoto et al 04)

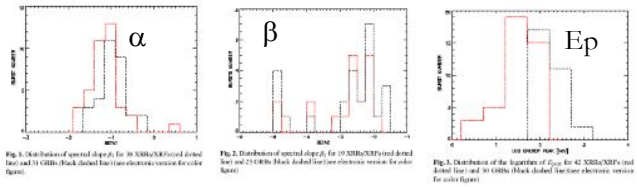


XRF vs GRB: HETE2+BSAX

- 54 XRF+XRR in a combined BeppoSAX and HETE2 (Sakamoto et al) sample (D'Alessio, LP, Rossi (A&A 2006,)
- H=S(2-30)/S(30-400 keV):
  - XRF:H>1
  - XRR: 0.32<H<1
  - GRB: H<1

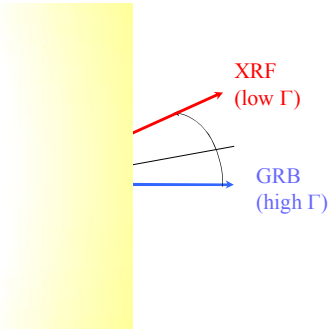
XRF vs GRB: Prompt

- Spectral indexes are consistent
- <Epeak(XRF)>=35 keV
- <Epeak(GRB)>=165 keV



Collapsar model

Sub energetic X-ray flashes

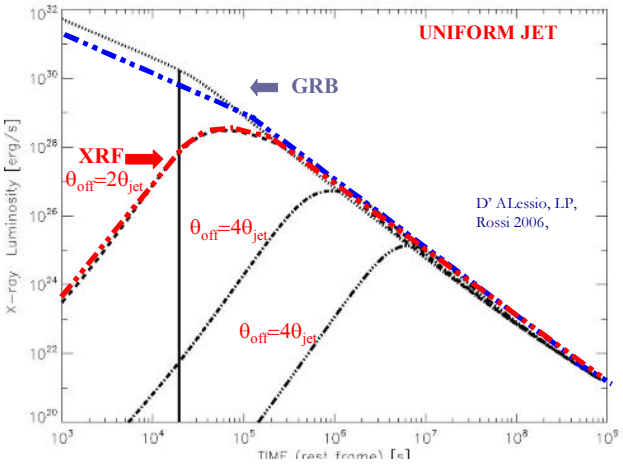


Woosley et al

Testing the unification scenario the off-axis jet

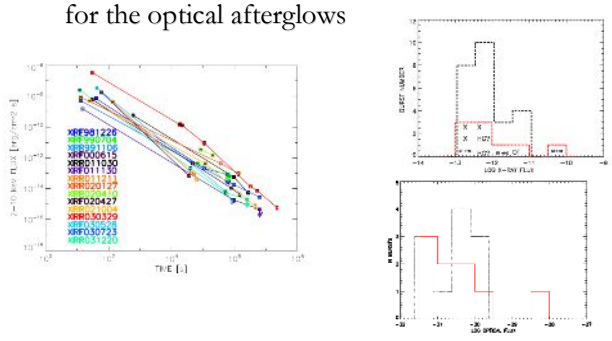
- GRB and XRF have the same intrinsic properties and z distribution
- The only difference is the viewing angle (analogous to the strong unification scenario for AGN)
- Derive average off-axis angle from the prompt (Epeak) for the two populations for homogeneous, gaussian and universal jet model, ($dE/d\Omega(\theta)$, Amati relationship)
- Derive afterglow flux at 11 hrs/(1+z) corresponding to the two average off axis angles from model and compare with observations

D'Alessio, LP, Rossi (A&A 2006,)



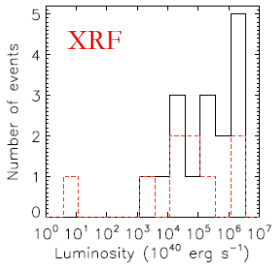
XRF vs GRB: afterglow data (I)

- Pre-SWIFT: The average X-ray flux (@ 11 hrs) in XRF is consistent with that of GRB (ratio GRB/XRF afterglow = 1.0+-0.8). Similar result for the optical afterglows



XRF vs GRB: afterglow data (II)

- SWIFT: X-ray Luminosity (z available)
- Results $<Lx_{GRB}/Lx_{XRF}$(@20ksec>=2.5+-2



Gendre,Galli & LP 07

The puzzling origin of XRF

- XRF and GRB have similar X-ray afterglow luminosity
- Off-axis jet models, in their different incarnations (uniform, gaussian, universal) have severe difficulties in explaining this result
- The subenergetic scenario appears also problematic: the X-ray luminosity is a good proxy of the kinetic energy
- the high z scenario already excluded as a whole

Prospects with MAXI

- BSAX and HETE2 samples: XRF(+XRR):77%, GRBs(Ep>100 keV): 23%
- MAXI: about 10 GRB per year, most of the should be XRR-XRF
- Crucial to get the afterglow properties and redshift: SWIFT follow up