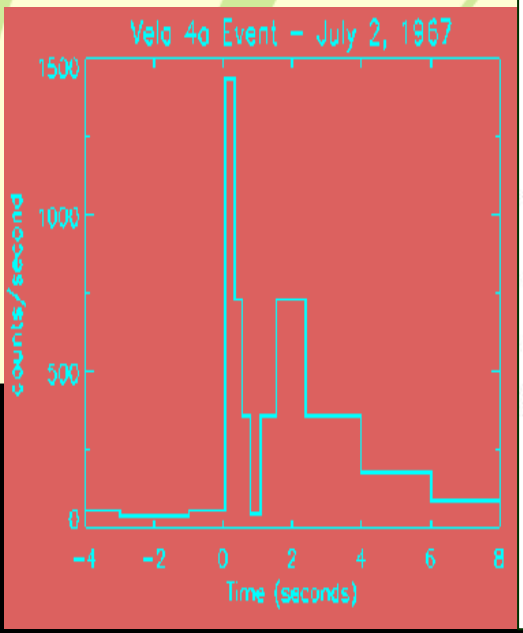
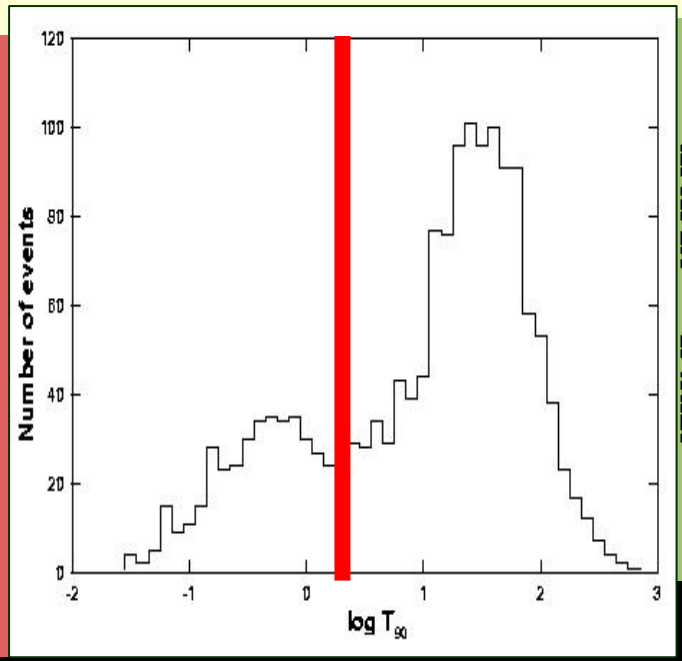
萃英学术论坛 2009. 12.21

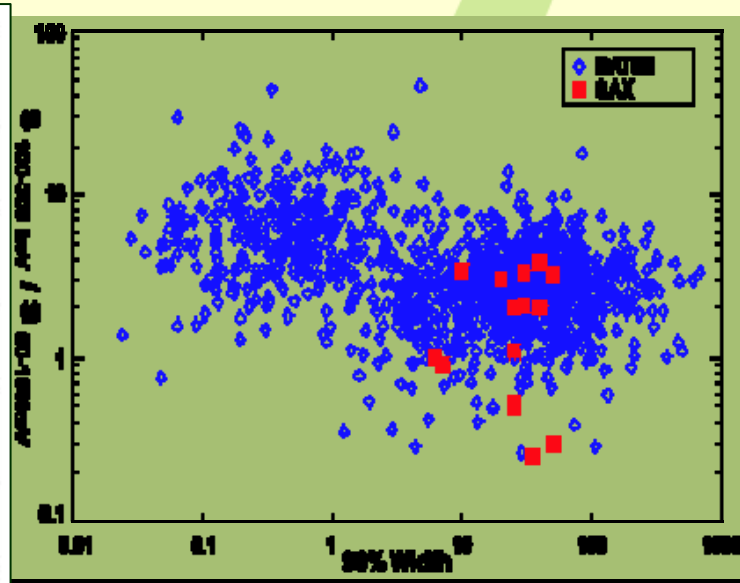

Martin Pugh / Barcroft Media

GRB

- 10^{53} ergs
- 0.01-1000s



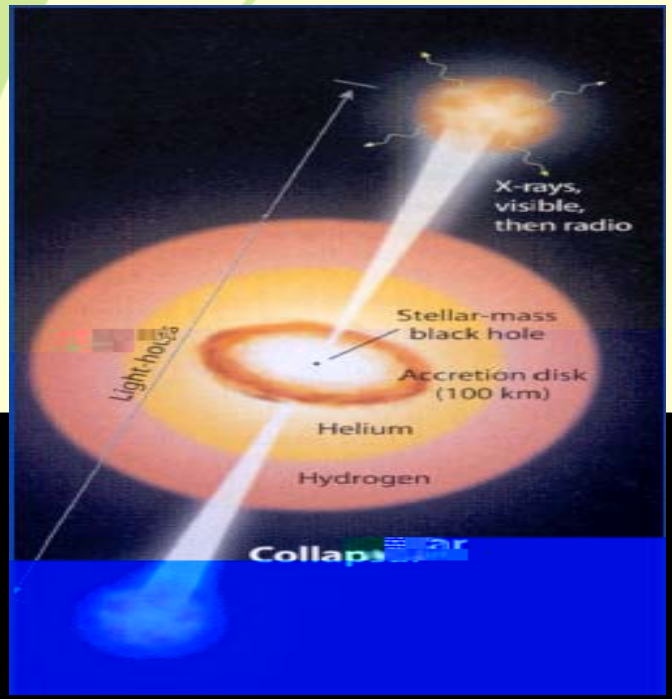


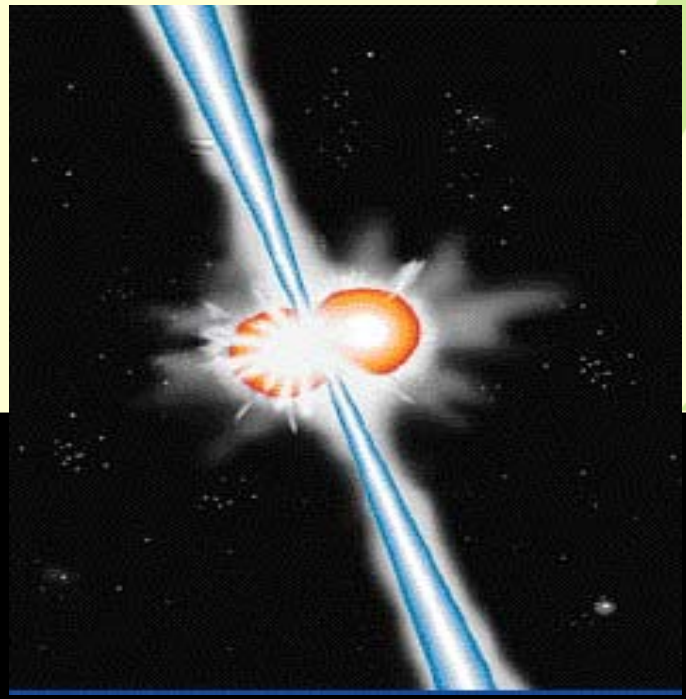


Kouveliotou, C., et al. 1993

-
  : collapsars
  : Mergers
- :

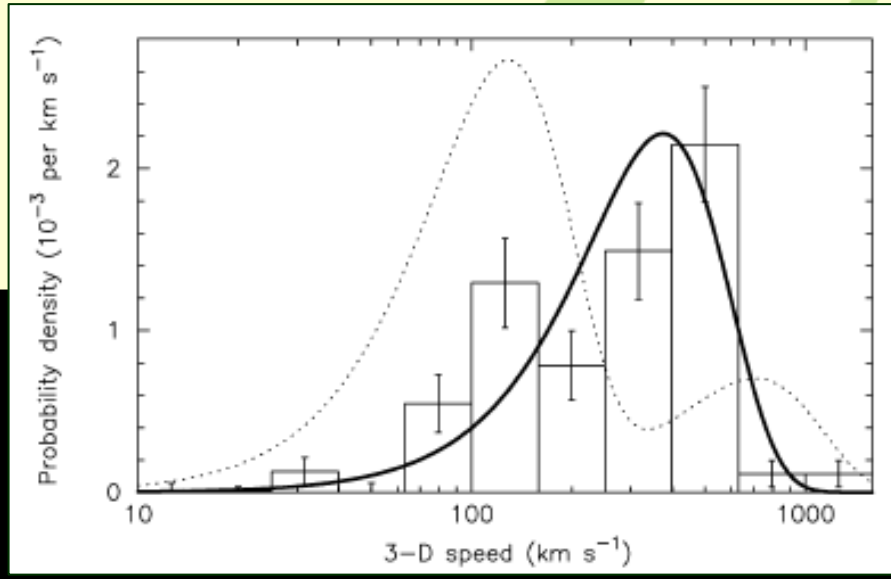
SN





GRB

-
  - “ Any small asymmetry during the explosion can result in a substantial 'kick' velocity to the NS” (Lyne & Lorimer 1994)
  - Kick from the relativistic jet of compact jet (Dar & Plaga 1999)
-
  - Bimodel (Arzoumanian et al. 2003)
  - One component (Hobbs et al. 2005)



$P \sim 10^{50} / c \sim 10^{30}$ g cm/s

$\upsilon \sim P/1M_{sun} \sim 10^{7}$cm/s $= 100$km/s

- 137 pulsar kick velocity ($V = \mu_{tot} D$)
- 66 GRBs with known redshifts and fluence

GRB

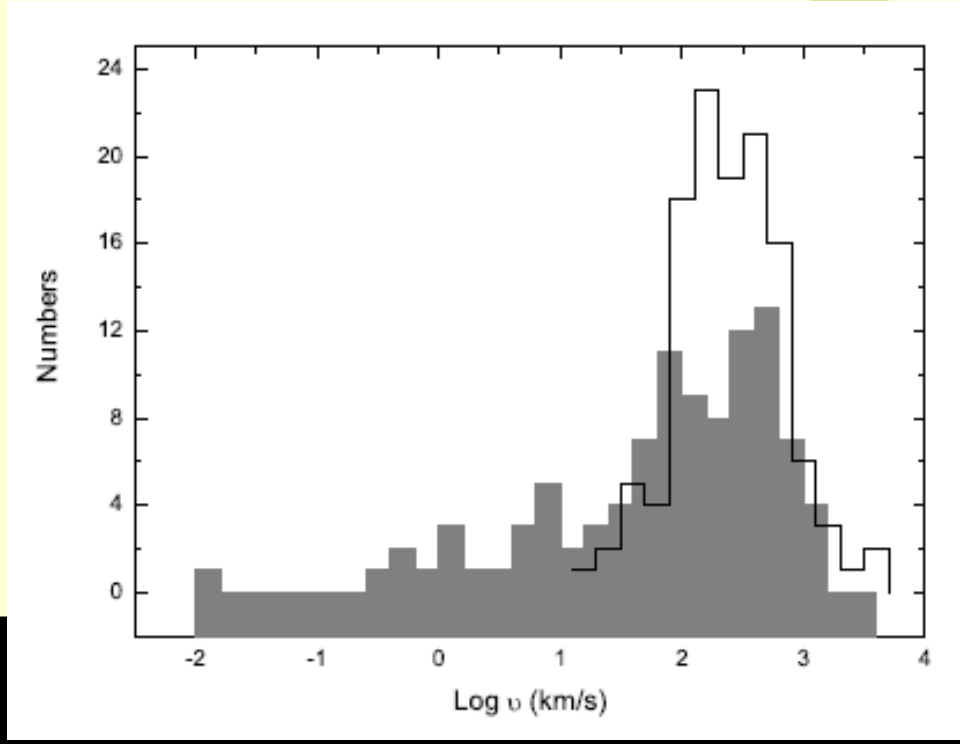
- $E_{iso} = E_{\gamma}(1-\cos\theta)$,
  $\theta_{max}=25$ degrees (GGL04)
- The calculation of total energy :

$$E_{iso} = \frac{4\pi D_L^2 k S_\gamma}{1+z}$$

- The 2D velocity in celestial sphere
  $V_{2D} = V_{3D}\sin\varphi$
  φ : randomly select in celestial sphere

- GRBs (66) with known redshifts and fluences
- PSR (137)

P_{ks}=0.36 with p=0.14



-
- GRB

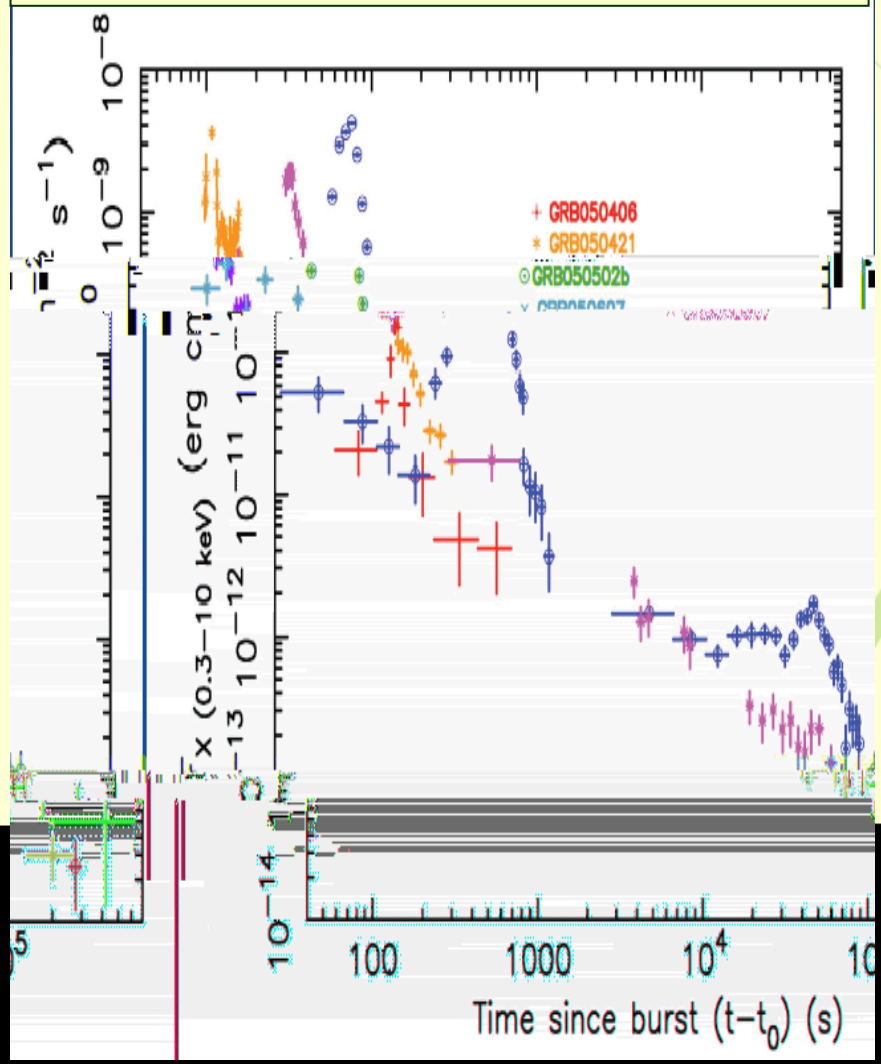
P_{KS}

Sample	$MSP14$	$NP107$	$Young44$	$old73$
$GRB66$	0.33 (0.43)	0.38 (0.15)	0.13 (0.89)	0.24 (0.69)

(Hansen & Phinney 1997), GRB

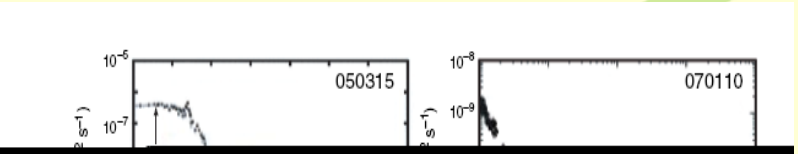
Swi

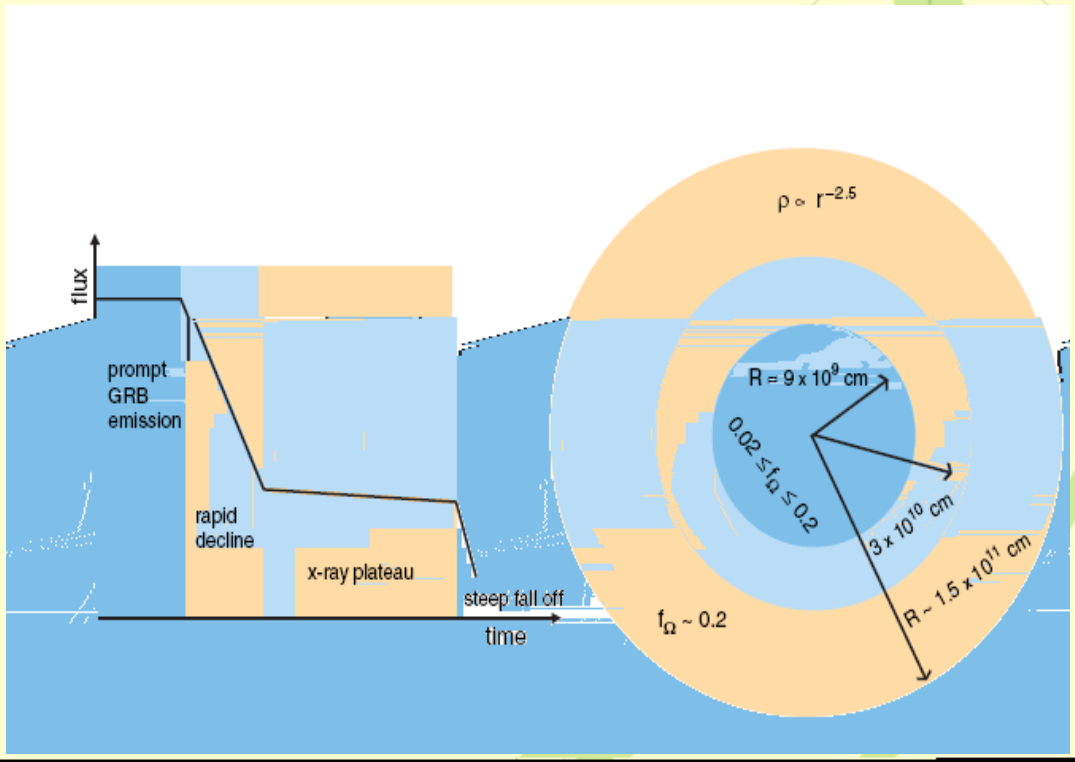
X-ray Flares



Barthelmy et al. 2005, nature

Nosek et al. 2006



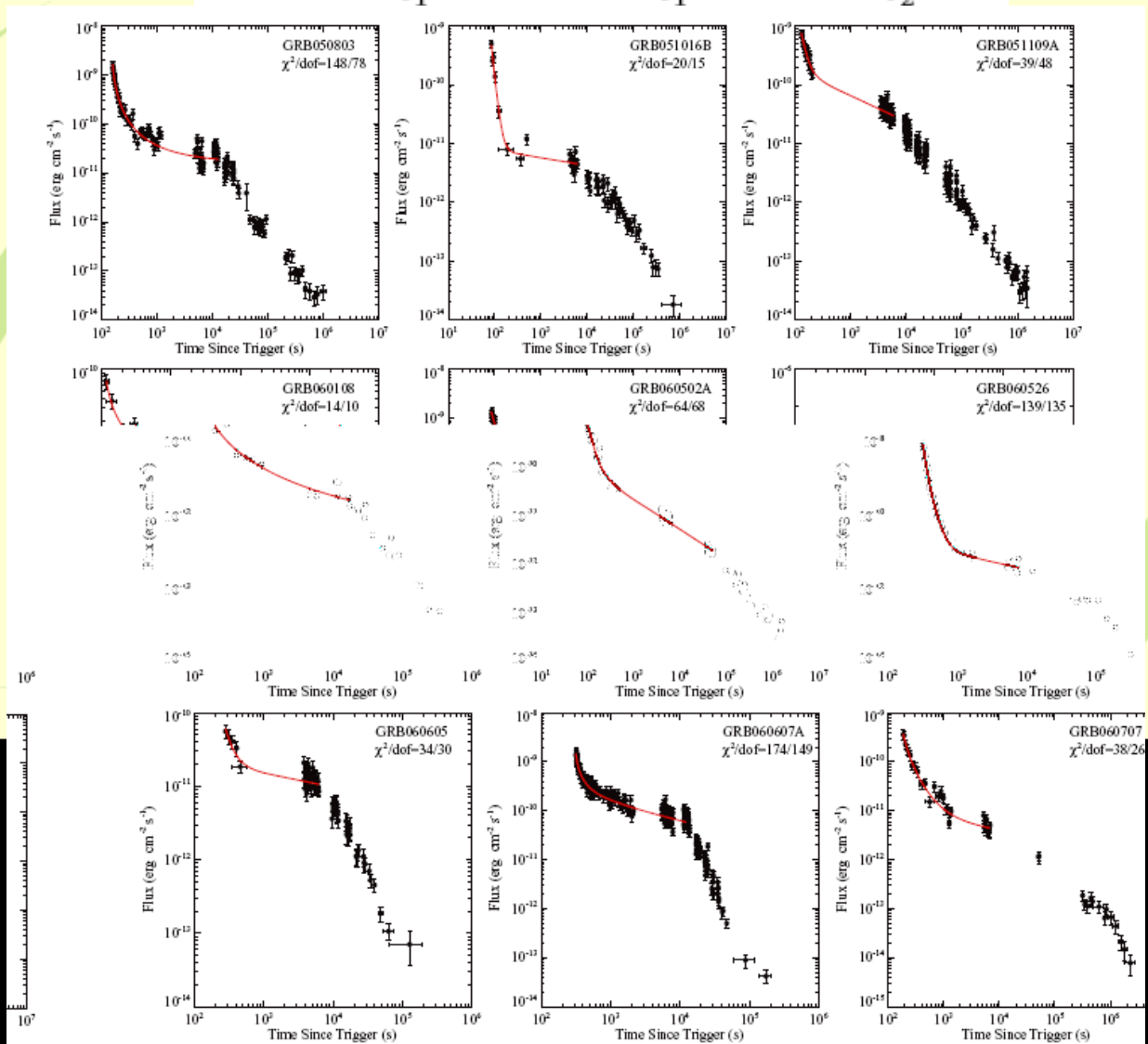


Liang et al. 2007

Kumar, P., Narayan, R. & Johnson, J Sci, 2008, 321, 376
MNRAS, 2008, 388, 1729

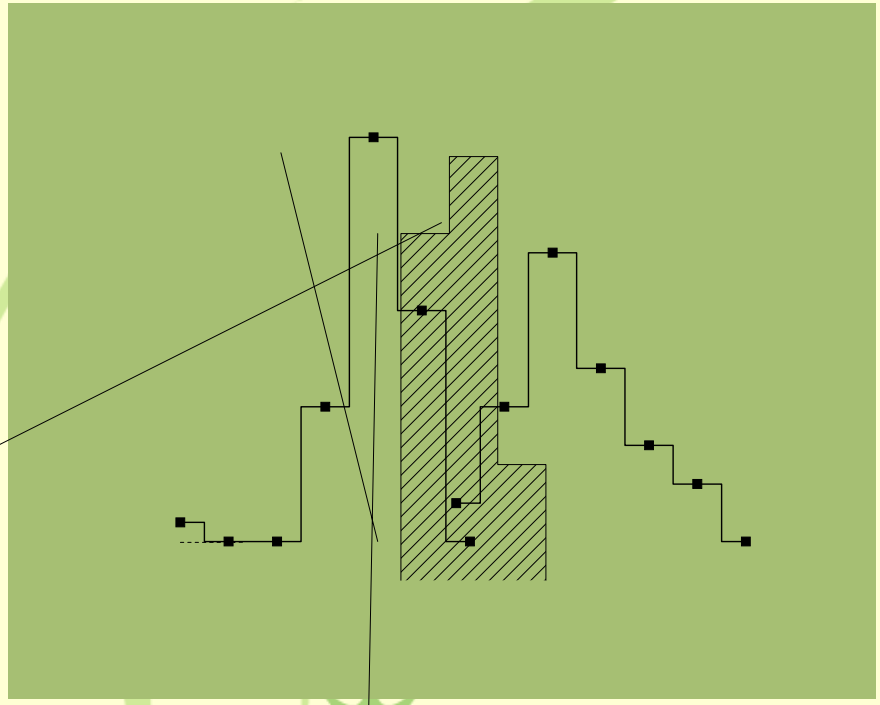
- X-ray data → (core, envelope, M* R*)
- : z, with steep decay and shallow decay
-
-

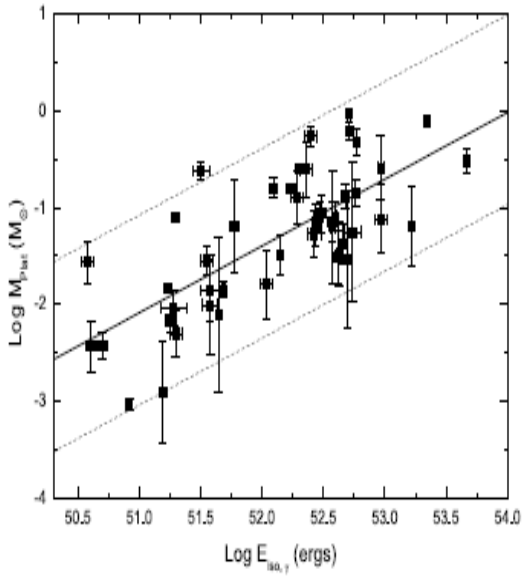
$$F = F_0[(\frac{t-t_1}{t_1})^{-\alpha_1} + (\frac{t_2-t_1}{t_1})^{-\alpha_1} \times (\frac{t}{t_2})^{-\alpha_2}]$$

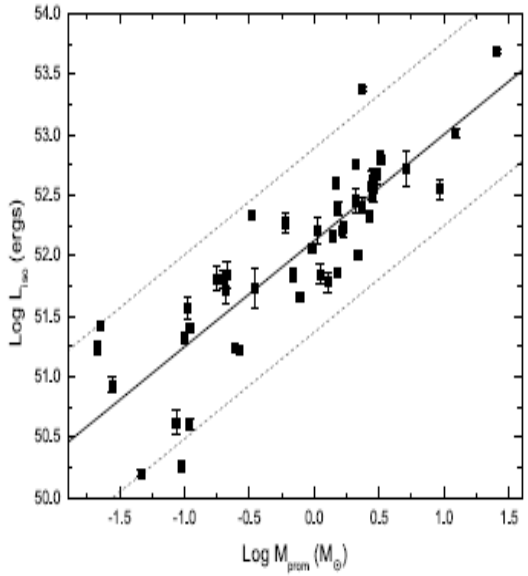


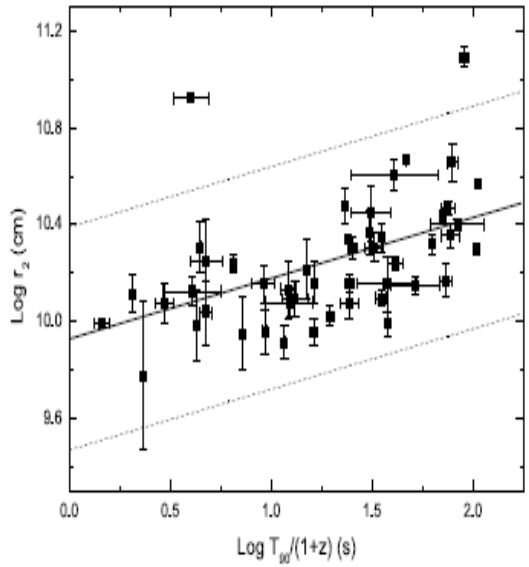
GRB	S_x[a] (10^{-7} erg cm $^{-2}$)	Γ_x[b]	t_1[c] (s)	t_2[d] (s)	t_3 (ks)	α_2[e]	$E_{\rm iso,X}$ (10^{50} erg)	$L_{\rm X,t_2}$ (10^{47} erg s^{-1})	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.70	[illegible]	[illegible]	[illegible]	[illegible]
	5.96 ± 0.51	1.88	104 ± 5	263 ± 11	13.71	0.36	2.6 ± 0.2	0.8	050803
	0.13 ± 0.11	3.90	120 ± 50	684 ± 82	8.00	1.01	2.9 ± 2.4	1.4	050908
	2.18 ± 1.10	2.82	50 ± 5	157 ± 12	6.64	0.14	4.9 ± 2.5	0.6	051016B
	3.46 ± 0.75	2.33	62 ± 23	173 ± 33	7.30	0.42	42.9 ± 9.3	109.3	051109A
	0.53 ± 0.17	1.91	40 ± 30	186 ± 31	22.08	0.39	5.1 ± 1.6	5.4	060108
	4.86 ± 0.69	1.93	298 ± 8	452 ± 11	7.00	0.80	141.0 ± 20.0	721.2	060210
	1.38 ± 0.66	2.04	81 ± 2	309 ± 4	1.00	~0	7.6 ± 3.6	51.6	060418
	5.09 ± 1.19	2.43	12 ± 6	190 ± 13	72.57	0.59	28.6 ± 6.7	16.9	060502A
	0.28 ± 0.27	1.42	310 ± 2	~3205	170.00	~0	11.4 ± 10.9	0.7	060510B
	0.12 ± 0.20	1.97	117 ± 15	248 ± 16	0.73	~0	5.2 ± 8.6	114.7	060522
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	0.82 ± 0.52	1.60	59 ± 74	455 ± 42	7.00	~0	22.8 ± 14.5	29.3	060605
	8.45 ± 0.17	1.79	214 ± 12	384 ± 10	12.34	0.44	166.0 ± 3.3	408.0	060607A
	0.55 ± 0.26	2.00	56 ± 22	505 ± 76	10.00	0.39	12.8 ± 6.0	12.5	060707
	0.96 ± 1.06	2.51	20 ± 2	231 ± 19	6.66	0.39	11.5 ± 12.7	16.8	060708
	1.48 ± 0.46	2.02	145 ± 4	311 ± 15	3.70	0.02	23.5 ± 7.3	33.1	060714
	19.58 ± 0.83	2.71	120 ± 2	425 ± 8	72.97	0.27	14.3 ± 0.6	1.0	060729
	6.93 ± 0.87	1.84	81 ± 13	967 ± 74	17.45	0.15	12.5 ± 1.6	1.4	060814
	0.96 ± 0.29	2.44	85 ± 26	222 ± 21	13.66	0.33	25.2 ± 7.6	20.7	060906
	19.89 ± 6.14	1.62	103 ± 2	176 ± 3	2.43	0.25	85.4 ± 26.4	60.5	061121
	3.59 ± 0.23	2.11	61 ± 3	522 ± 19	20.40	0.17	44.7 ± 2.9	17.2	070110
	2.53 ± 0.94	2.29	110 ± 2	542 ± 8	15.00	~0	14.0 ± 5.2	4.6	070306
	0.79 ± 1.45	1.40	86 ± 12	809 ± 47	2.00	~0	1.4 ± 2.6	3.2	070318
	1.80 ± 1.38	1.48	289 ± 9	450 ± 28	7.50	0.62	46.2 ± 35.4	192.2	070721B
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	9.1	080310	1.19 ± 0.53	1.45	504 ± 1	~1313	20.00	0.33	15.7 ± 7.0
	2.2	080430	0.82 ± 0.23	2.42	0 ± 5	165 ± 12	8.80	0.52	1.2 ± 0.3
	954.8	080607	2.85 ± 0.81	1.81	100 ± 2	238 ± 7	1.50	1.03	54.7 ± 15.5
	8.4	080707	0.24 ± 0.13	2.10	34 ± 8	192 ± 28	7.60	0.16	0.9 ± 0.5
	104.4	080905B	3.50 ± 2.34	1.49	62 ± 5	179 ± 7	6.50	~0	44.4 ± 29.7
[illegible]	[illegible]	081008	0.96 ± 0.31	3.00	~35	168 ± 5	40.00	0.69	0.5 ± 0.2
	35.0	081008	1.59 ± 0.52	1.91	232 ± 3	484 ± 15	20.00	0.73	14.5 ± 4.7

GRB	r_c[a] (10^9 cm)	r_t[a] (10^{10} cm)	r_e[a] (10^{11} cm)	$f_{\Omega,c}$[b]	$f_{\Omega,e,low}$[c] (10^{-3})	δ[d]	M_c[e] $M_\odot$	M_e[f] $0.1\ M_\odot$
050416A	9.14	0.98	0.72	[0.21 0.02]	7.85	2.56	0.02	0.04 ± 0.02
050803	2.15 ± 1.57	2.26 ± 0.27	3.16	[0.34 0.02]	3.75	2.04	0.09 ± 0.01	0.14 ± 0.01
050908	6.34 ± 3.53	2.03 ± 0.49	1.05	[0.19 0.03]	6.52	3.02	0.61 ± 0.06	0.16 ± 0.13
051016B	6.05 ± 1.30	1.30 ± 0.23	7.34	[0.29 0.03]	2.46	1.71	0.02 ± 0.01	0.27 ± 0.14
051109A	4.86 ± 2.50	0.97 ± 0.32	1.17	[0.33 0.03]	6.16	2.13	0.18 ± 0.03	2.38 ± 0.51
060108	3.87 ± 3.23	1.08 ± 0.33	2.62	[0.34 0.03]	4.12	2.09	0.20 ± 0.02	0.28 ± 0.09
060210	10.74 ± 0.93	1.42 ± 0.12	0.88	[0.30 0.02]	7.10	2.70	12.29 ± 0.66	7.81 ± 1.11
060418	7.00 ± 0.50	1.73 ± 0.10	0.38	[0.33 0.03]	10.83	1.50	2.53 ± 0.08	0.17 ± 0.30
2.39	0.69 ± 0.03	1.59 ± 0.37	060502A	2.01 ± 1.29	1.25 ± 0.21	6.56	[0.24 0.05]	2.60
1.50	9.27 ± 0.40	0.63 ± 0.60	060510B	9.76 ± 0.32	4.64	6.54	[0.38 0.02]	2.61
1.50	2.77 ± 0.27	0.29 ± 0.47	060522	4.98 ± 1.28	0.82 ± 0.13	0.17	[0.33 0.03]	16.2
1.50	1.47 ± 0.19	0.53 ± 0.30	060526	11.04 ± 0.30	2.71 ± 0.18	1.24	[0.35 0.02]	5.99
1.50	1.07 ± 0.14	1.26 ± 0.80	060605	3.70 ± 4.30	1.45 ± 0.30	0.90	[0.36 0.03]	7.05
2.15	2.84 ± 0.11	9.23 ± 0.19	060607A	9.76 ± 1.46	1.44 ± 0.13	1.46	[0.34 0.02]	5.53
2.09	2.08 ± 0.20	0.71 ± 0.33	060707	3.76 ± 2.02	1.64 ± 0.46	1.20	[0.31 0.03]	6.09
2.09	0.33 ± 0.03	0.64 ± 0.71	060708	2.33 ± 0.57	1.18 ± 0.23	1.11	[0.24 0.04]	6.32
1.53	2.65 ± 0.18	1.31 ± 0.41	060714	8.01 ± 0.76	1.33 ± 0.18	0.69	[0.33 0.02]	8.00
1.91	0.11 ± 0.01	0.79 ± 0.03	060729	12.71 ± 0.91	2.95 ± 0.20	9.12	[0.29 0.02]	2.21
1.72	1.50 ± 0.02	0.69 ± 0.09	060814	8.68 ± 2.55	4.53 ± 0.82	3.12	[0.32 0.02]	3.78
1.99	3.22 ± 0.20	1.40 ± 0.42	060906	4.80 ± 2.21	0.91 ± 0.19	1.42	[0.31 0.03]	5.59
1.88	3.27 ± 0.05	4.75 ± 1.47	061121	8.77 ± 0.61	1.25 ± 0.09	3.34	[0.33 0.02]	3.65
1.75	1.11 ± 0.07	2.48 ± 0.16	070110	4.82 ± 0.58	2.02 ± 0.22	2.32	[0.30 0.03]	4.38
1.50	1.65 ± 0.09	0.78 ± 0.29	070306	8.67 ± 0.54	2.51 ± 0.15	2.30	[0.31 0.02]	4.40
1.50	0.25 ± 0.01	0.08 ± 0.01	070318	9.03 ± 2.41	4.03 ± 0.61	0.74	[0.39 0.02]	7.77
2.43	5.13 ± 0.28	2.57 ± 1.96	070721B	10.95 ± 1.08	1.47 ± 0.23	0.96	[0.37 0.02]	6.80
2.06	3.05 ± 0.47	0.56 ± 0.09	071021	6.61 ± 0.42	1.43 ± 0.37	1.55	[0.33 0.03]	5.35
2.00	1.68 ± 0.15	0.87 ± 0.39	080310	19.39 ± 0.39	3.67	2.26	[0.37 0.02]	4.44
2.28	0.10 ± 0.01	0.07 ± 0.02	080430	0.25 ± 1.45	1.43 ± 0.25	2.03	[0.11 0.03]	4.68
3.05	25.60	3.04 ± 0.86	080607	5.92 ± 0.38	1.05 ± 0.10	0.36	[0.34 0.03]	11.12
1.74	0.11 ± 0.01	0.05 ± 0.03	080707	4.27 ± 1.60	1.36 ± 0.37	1.58	[0.32 0.03]	5.31
1.50	1.27 ± 0.44	2.47 ± 1.65	080905B	4.84 ± 0.96	0.98 ± 0.11	0.78	[0.37 0.03]	7.55





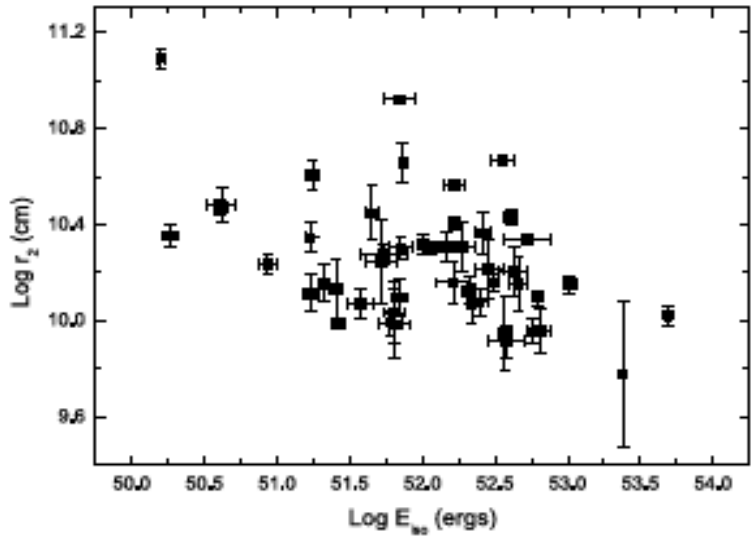


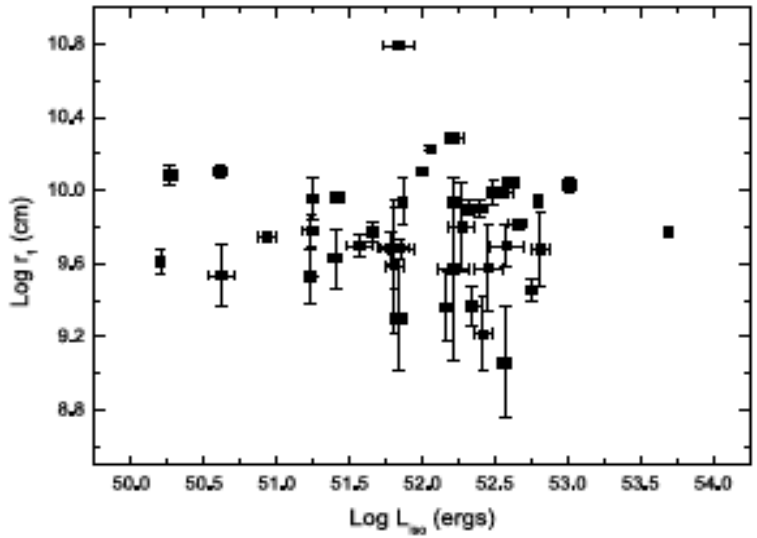


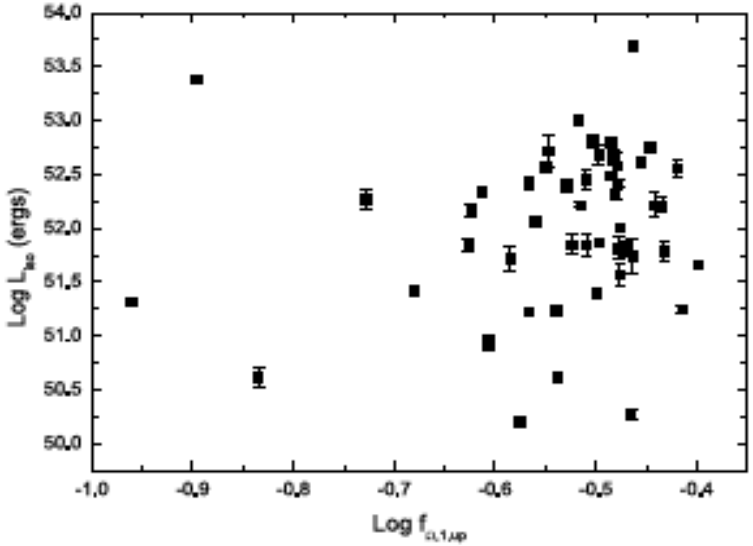
$$\log M_{plat} = -(37.25 \pm 5.01) + (0.69 \pm 0.10) \log E_{\mathrm{iso},\gamma} \qquad R = 0.73 \quad p < 1e-4 \text{ for } N = 48$$

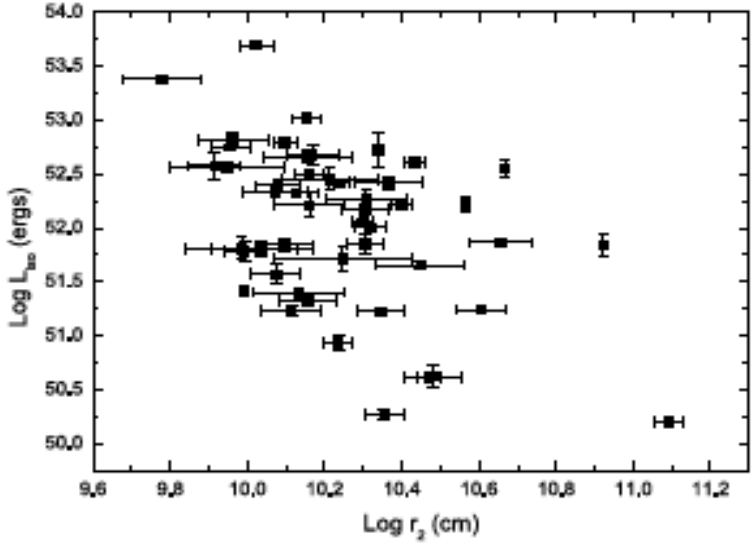
$$\log L_{\mathrm{iso}} = (52.13 \pm 0.05) + (0.88 \pm 0.07) \log M_{prom} \text{ with } R = 0.86 \text{ in } p < 1e-4 \text{ for } N = 48$$

$$\log r_2 = (9.93 \pm 0.09) + (0.25 \pm 0.07) \log T(90)/(1+z) \text{ with } R = 0.49 \text{ and } p = 3.96e-4$$


Log r_2 (cm)
Log E_{iso} (ergs)


Log r_1 (cm)
Log L_{iso} (ergs)


Log L_{iso} (ergs)
Log $f_{\alpha,1,pp}$

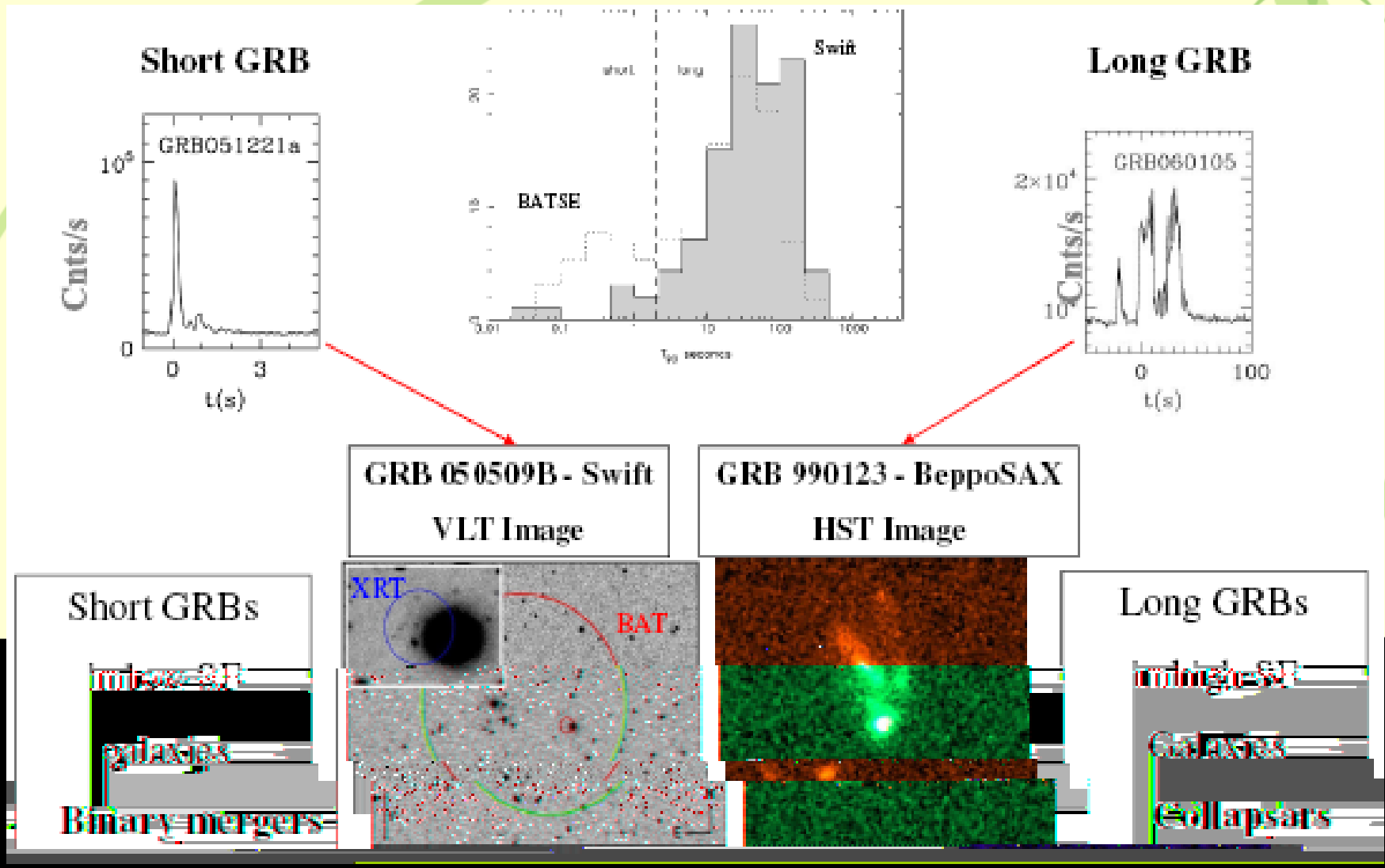

Log L_{iso} (ergs)
Log r_2 (cm)

1. lognormal

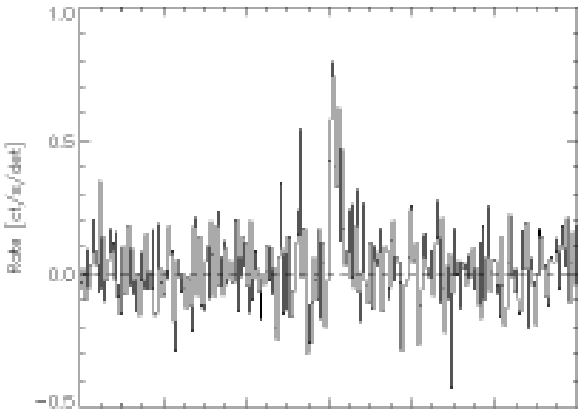
2. E_{iso}

L_{iso}

GRB


Short GRB
GRB051221a
Cnts/s
t(s)
BATSE
Swift
short
long
Long GRB
GRB060105
Cnts/s
t(s)
GRB 050509B - Swift
VLT Image
GRB 990123 - BeppoSAX
HST Image
Short GRBs
Long GRBs
XRT
BAT
Binary mergers
Collapsars

GRB050509B (Gehrels et al. 2005)



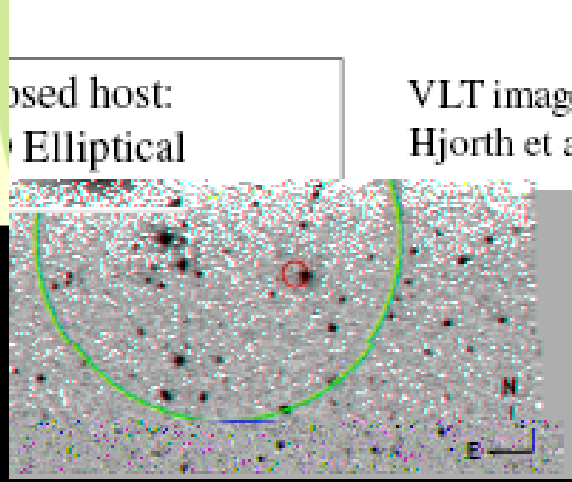
BAT
- 30 ms duration
- spectrum is medium hard
- very weak, 2×10^{-8} erg/cm^2

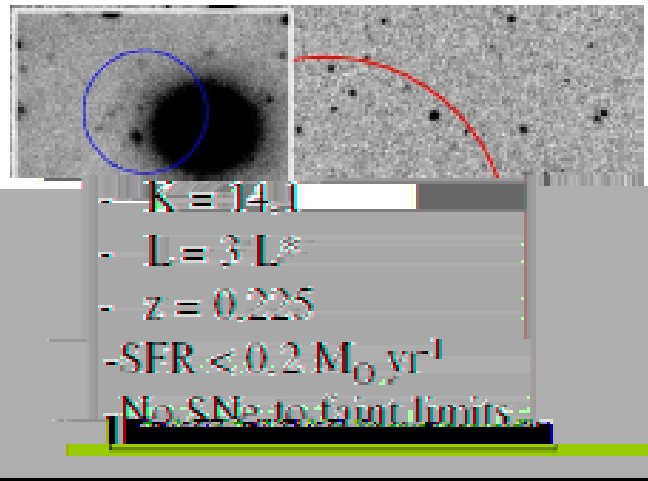
Spacecraft slew in 52 sec

XRT
- faint source, fading

osed host:
Elliptical

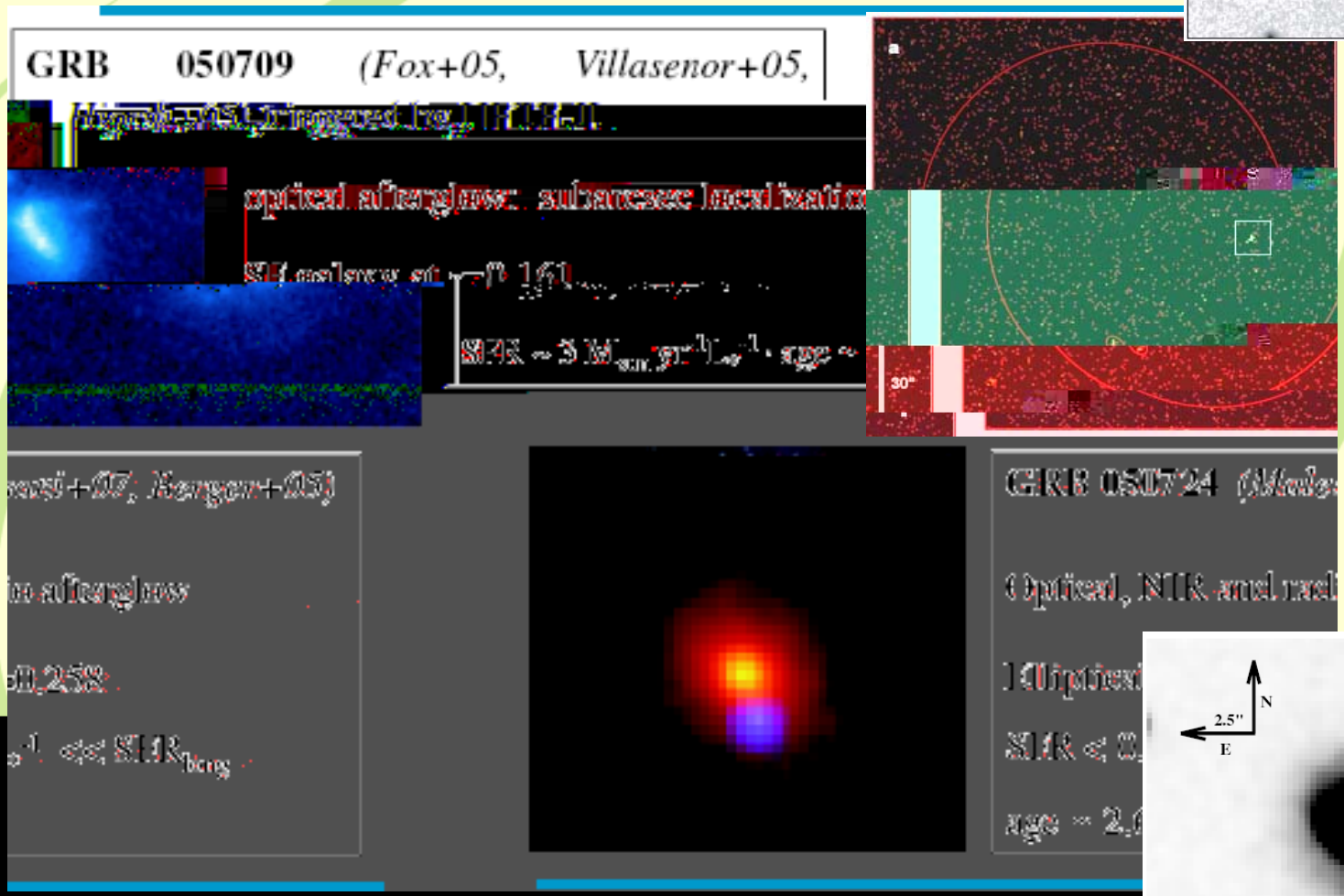
VLT image
Hjorth et al.





- K = 14.1
- L = 3 L*
- z = 0.225
- SFR < 0.2 $M_\odot$ yr^{-1}
- No SNe to faint limits

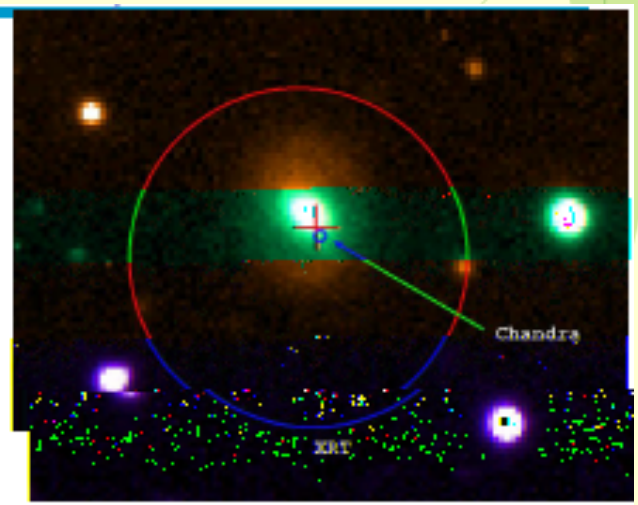
Prop
- cD

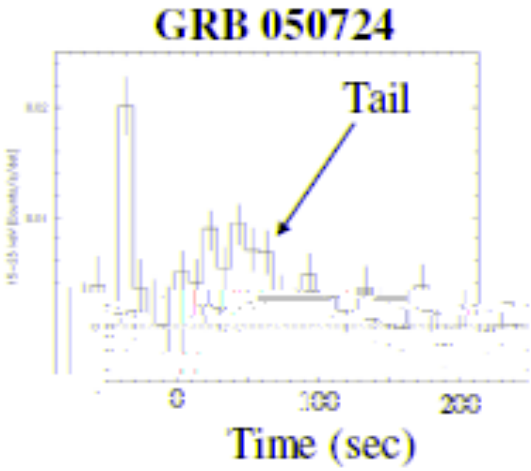

GRB 050709 (Fox+05, Villasenor+05,
optical afterglow: subarcsec localizatio
a
30"
GRB 050724 (Malesani+07, Berger+05)
optical, NIR and radi
2.5"
N
E

GRB 050724
Barthelmy et al. (2005)

BAT
- 250 ms hard spike + softer long tail
- 6×10^{-7} erg/cm^2 fluence

Afterglow
- bright fading x-ray afterglow with flares
- detected by Chandra days after GRB
- optical & IR detections…
- radio VLA detection at 12 hours





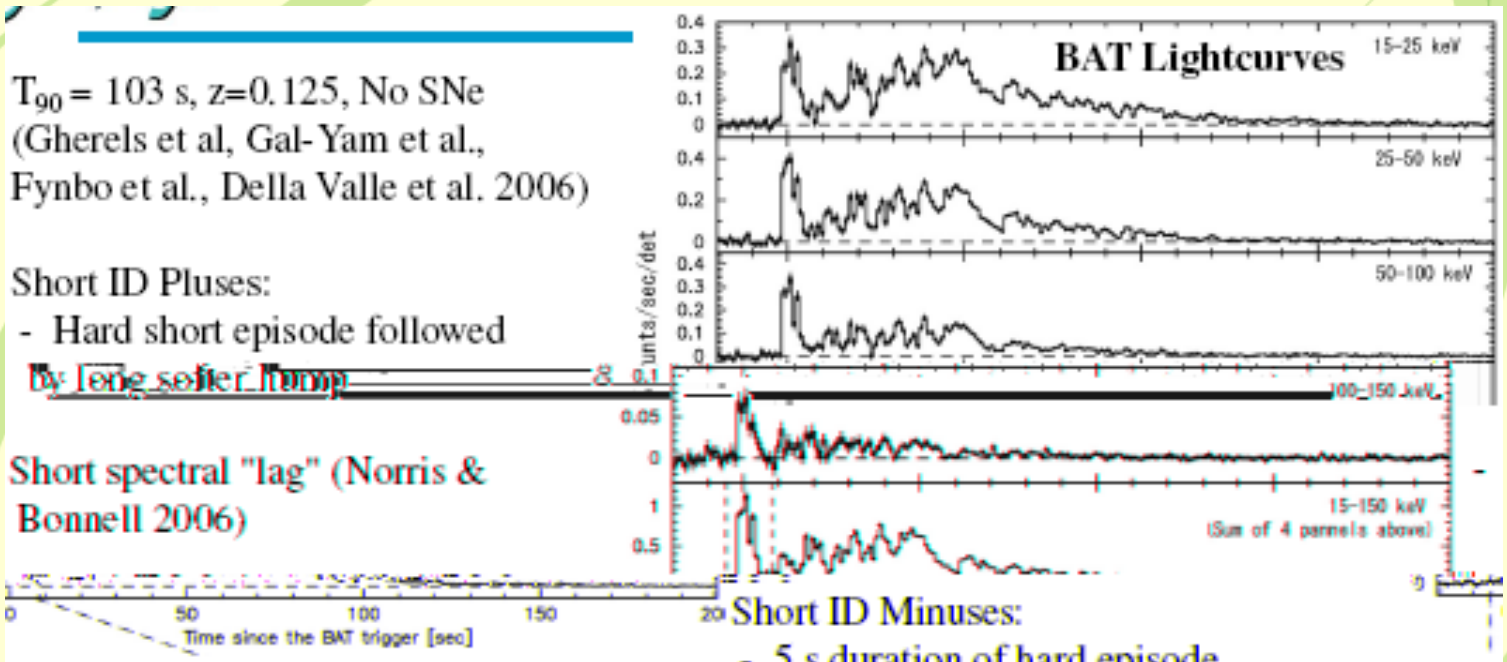
Host:
- Elliptical
- K = 15.3
- L ~ 1.7 L*
- z = 0.258
- SFR < 0.02 $M_\odot$ yr^{-1}

GRB 060614

T_{90} = 103 s, z=0.125, No SNe
(Gherels et al, Gal-Yam et al.,
Fynbo et al., Della Valle et al. 2006)

Short ID Pluses:
- Hard short episode followed by long softer hump

Short spectral "lag" (Norris & Bonnell 2006)



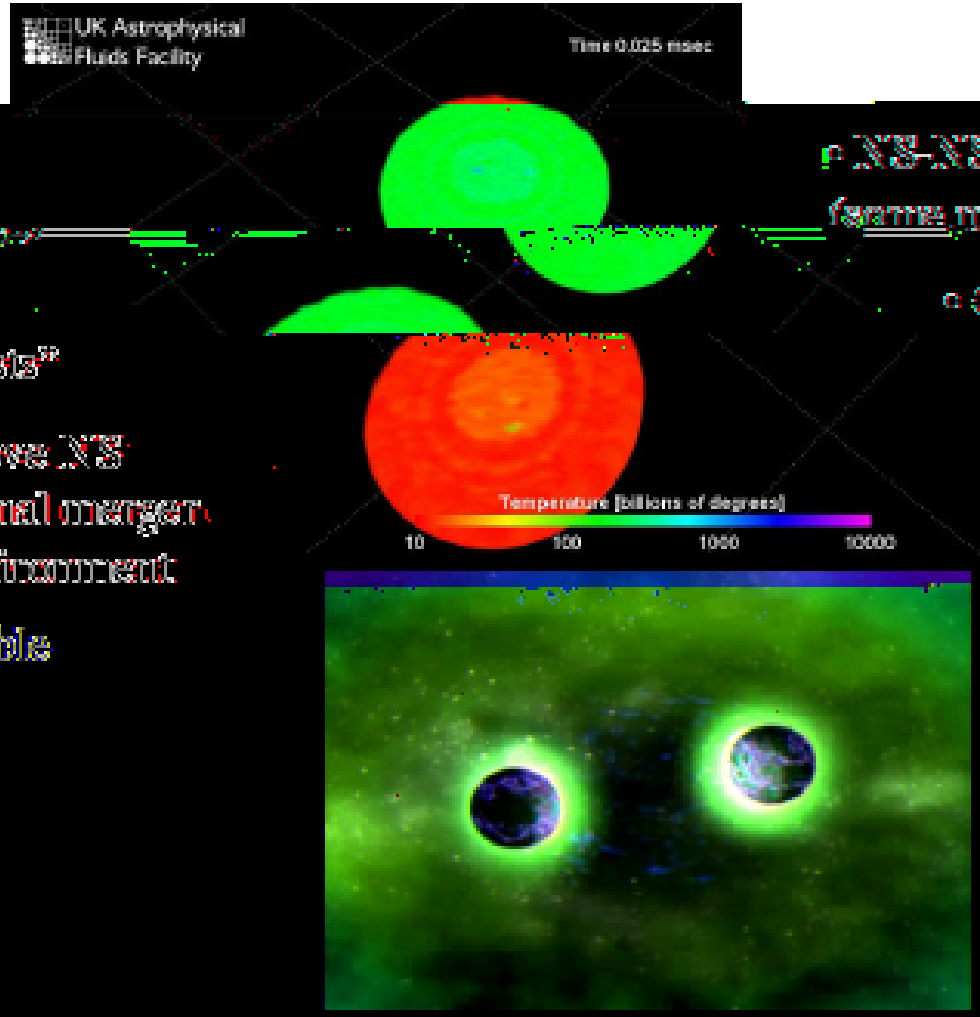
Short ID Minuses:
- 5 s duration of hard episode

GRB 060614
Tiny galaxy
SFR ~0.014 $M_\odot$ yr^{-1}

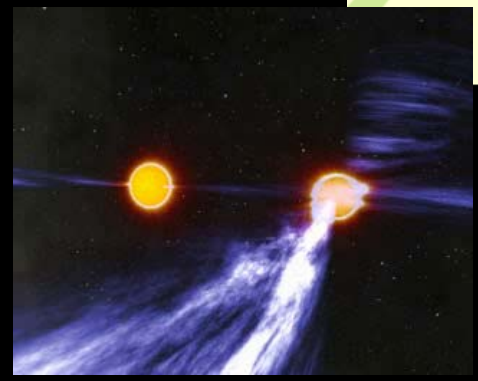
(S-SFR~3)

- Brighter & more variable hump emission than others

Could GRB060614 be a member of a new class – the long shorts?



- NS-NS merger is fast (msec) > BH
- Can occur in any type of galaxy
- Dynamical "kick" can m
- > very weak X-rays poss

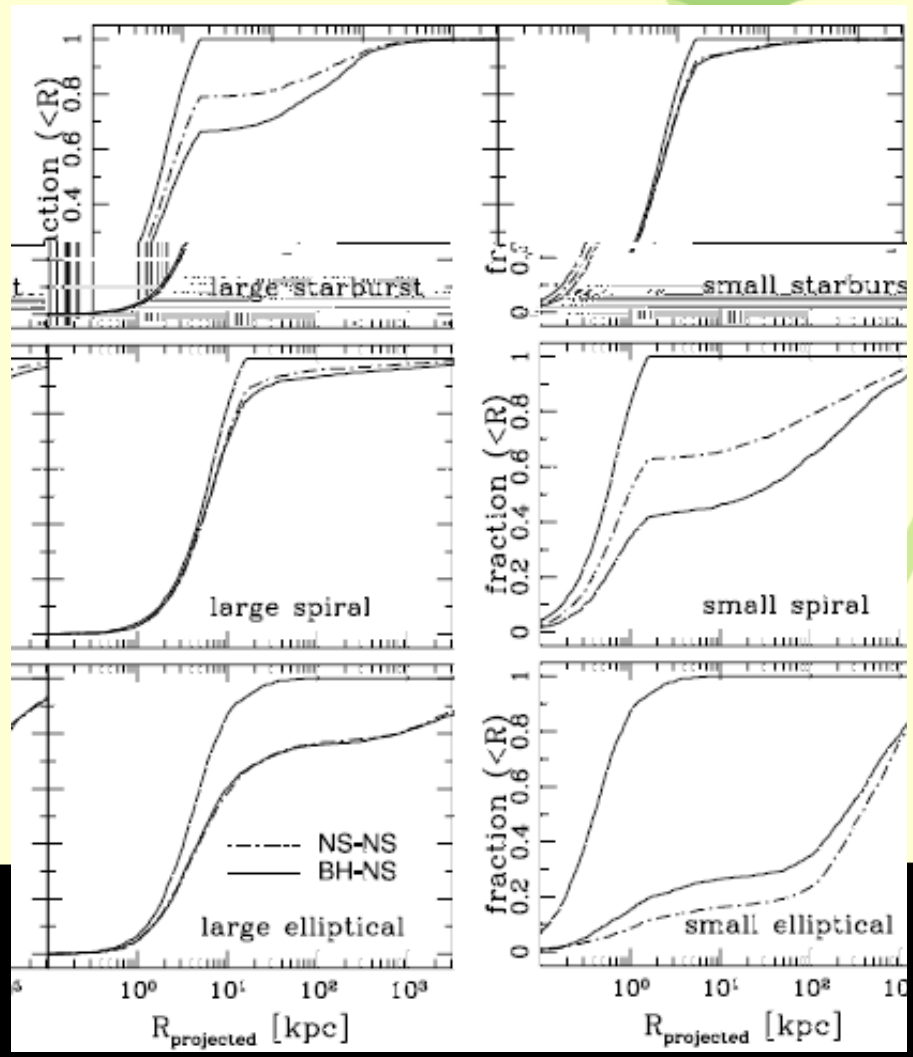


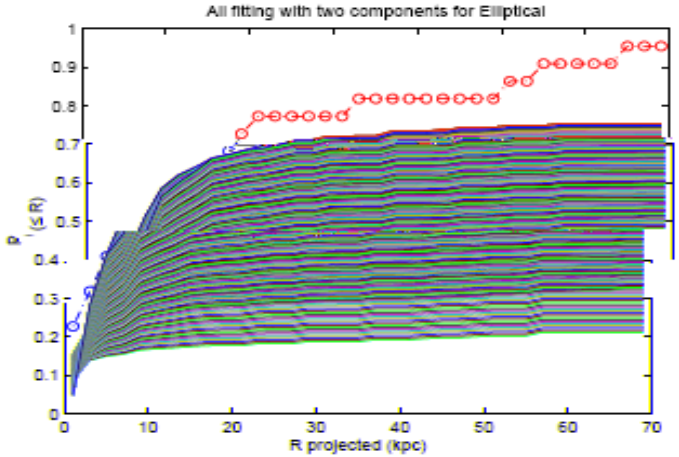
GRB	T_{90} (s)	redshift	$R_{\rm projected}$ (kpc)	$R_{\rm projected}/R_{\rm e}$	Type.....	
(1)	(2)	(3)	(4)	(5)	(6)	
050509B	0.04	0.225	54.25 ± 12.05	2.59 ± 0.58	E	
050709*	0.07	0.161	3.7 ± 0.03	2.04 ± 0.02	S	
050724*	3	0.258	2.69 ± 0.07	1.28 ± 0.05	E	
051210	1.27	<1.4	30.3 ± 19.5	5.66 ± 3.65	0	
051221A	1.4	0.546	2.05 ± 0.19	0.88 ± 0.08	S	
051227*	110	...	0.7 ± 0	...	0	
060121	1.97	>1.7	0.96 ± 0.37	0.18 ± 0.07	Faint	
060313	0.7	<1.1	2.57 ± 0.53	1.66 ± 0.32	Faint	
60502B	0.09	0.287	70 ± 16	6.66 ± 1.52	E	06
60505	4	0.089	7.45 ± 0.53	...	S	06
60614*	103	0.125	1.1 ± 0	...	LSF	06
60801	0.5	1.131	19.7 ± 19.8	...	0	06
61006*	0.42	0.438	1.37 ± 0.27	0.41 ± 0.09	LSF	06
61201	0.8	0.111	33.9 ± 0.4	...	SF	06
61210*	0.19	0.41	10.7 ± 9.7	...	SF	06
61217	0.21	0.827	55 ± 28	...	SF	06
70429B	0.5	0.9023	16.99	...	Faint	07
70714B*	3	0.9225	11.64	...	S	07
70724A	0.4	0.457	4.8 ± 0.1	...	SF	07
70809	1.3	0.2187	20	...	S	07
71227	1.8	0.381	15 ± 2.2	...	S	07
90426	1.2	2.609	0.8	...	SF	09
90510	0.3	0.903	5.5	...	Field	09

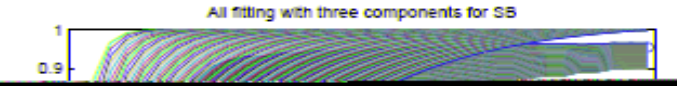
- Belczyski et al. (2006):
  NS-NS, NS-BH merger location in three types of HG, cumulative probability distribution from PS method

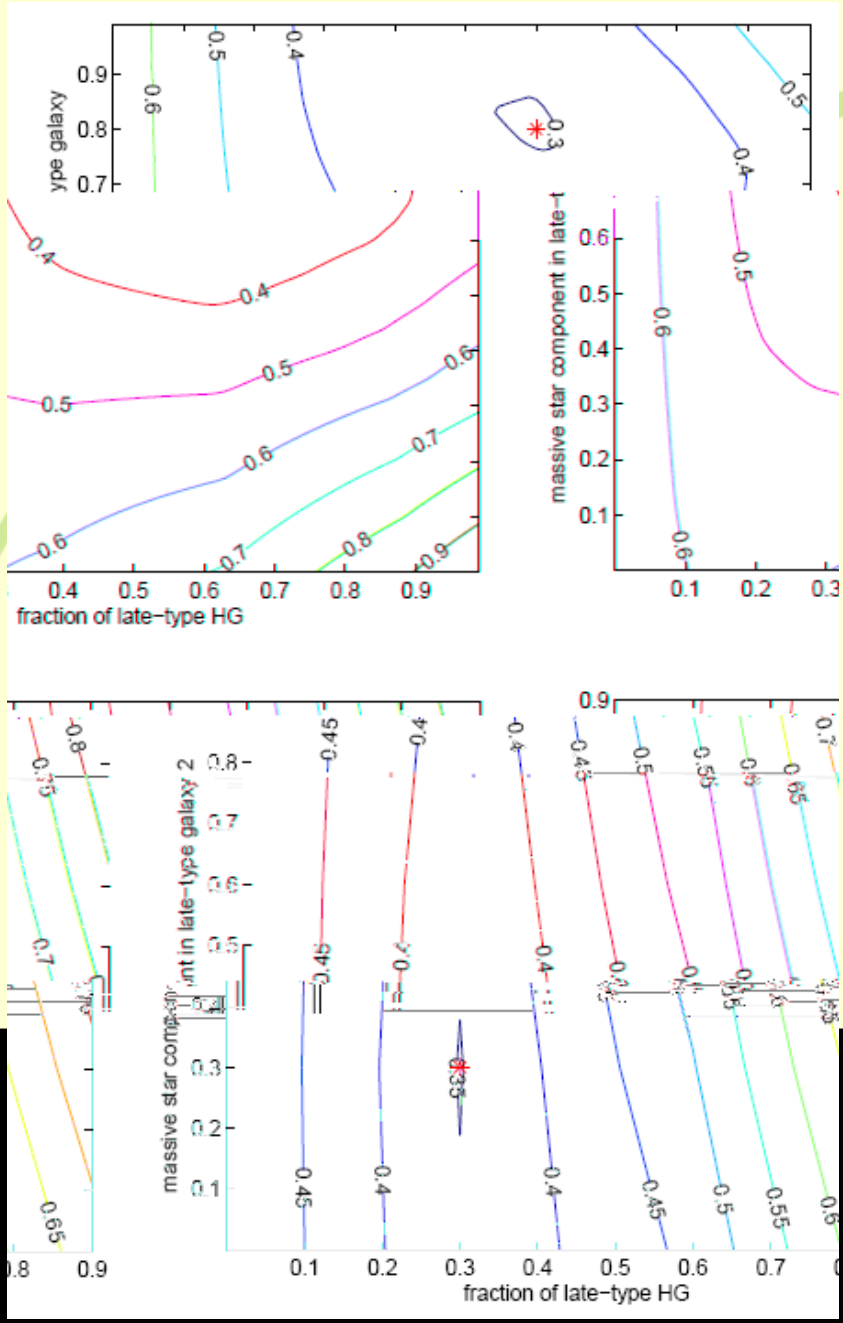
- Bloom et al. (2002): Massive star model from the observations of star distribution in galaxy

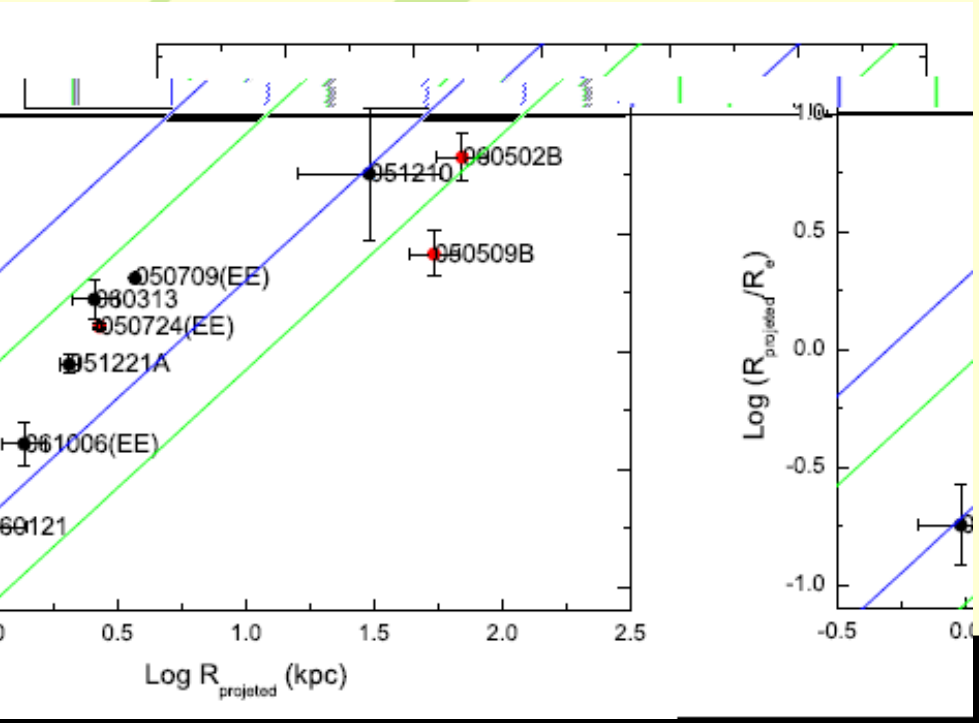
$$N(r)dr \propto rexp(-1.67r)dr$$




All fitting with two components for Elliptical
R projected (kpc)


All fitting with three components for SB


ype galaxy
massive star component in late−t
fraction of late−type HG
massive star component in late−type galaxy 2
fraction of late−type HG



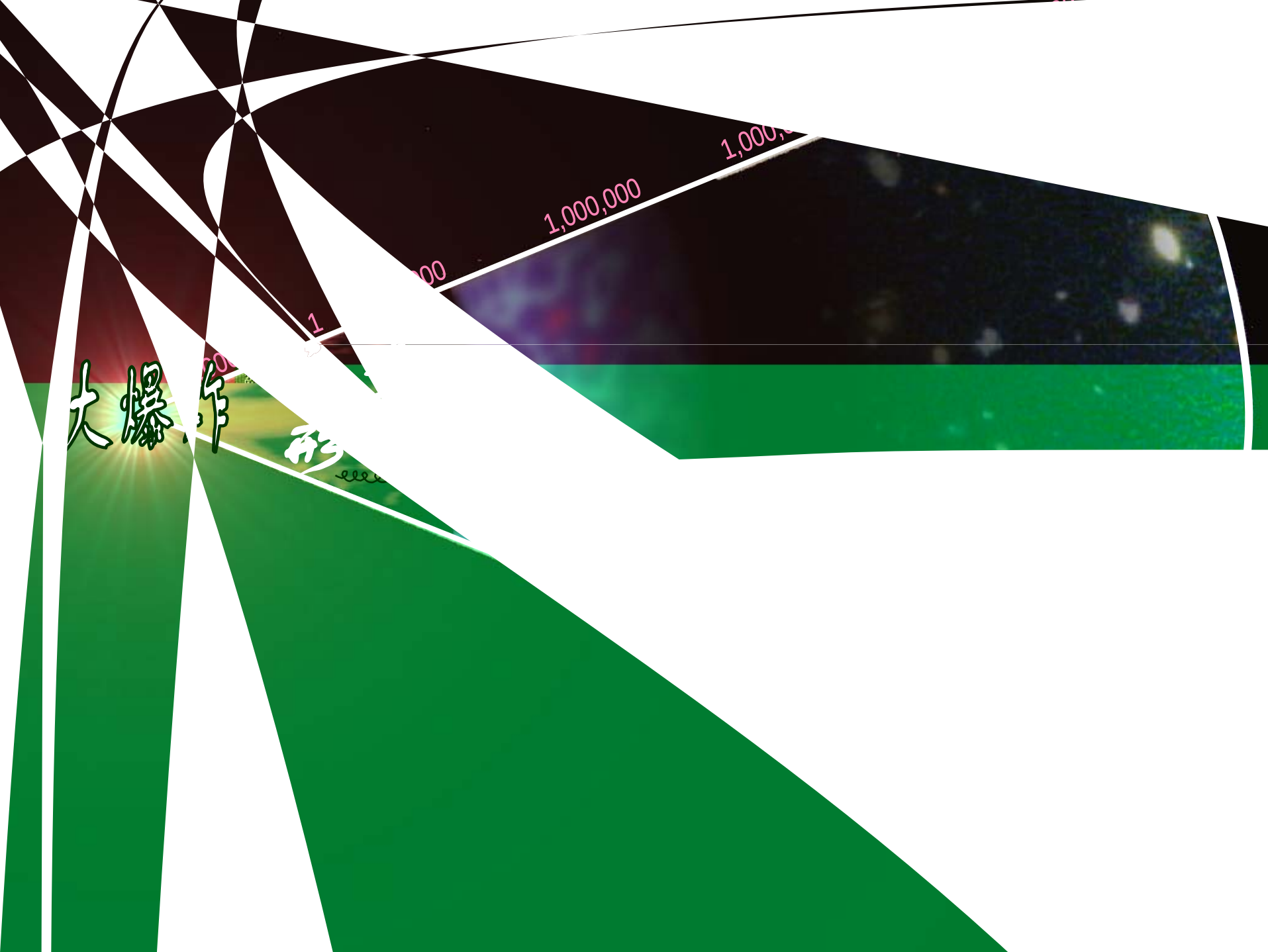
- 0.99
- $R \approx$
- $p < 0.0001$

(1)

(2)

(3)R_{off}—R_{off}/Re

- GRB
- GRB
- Swift GRB
- GRB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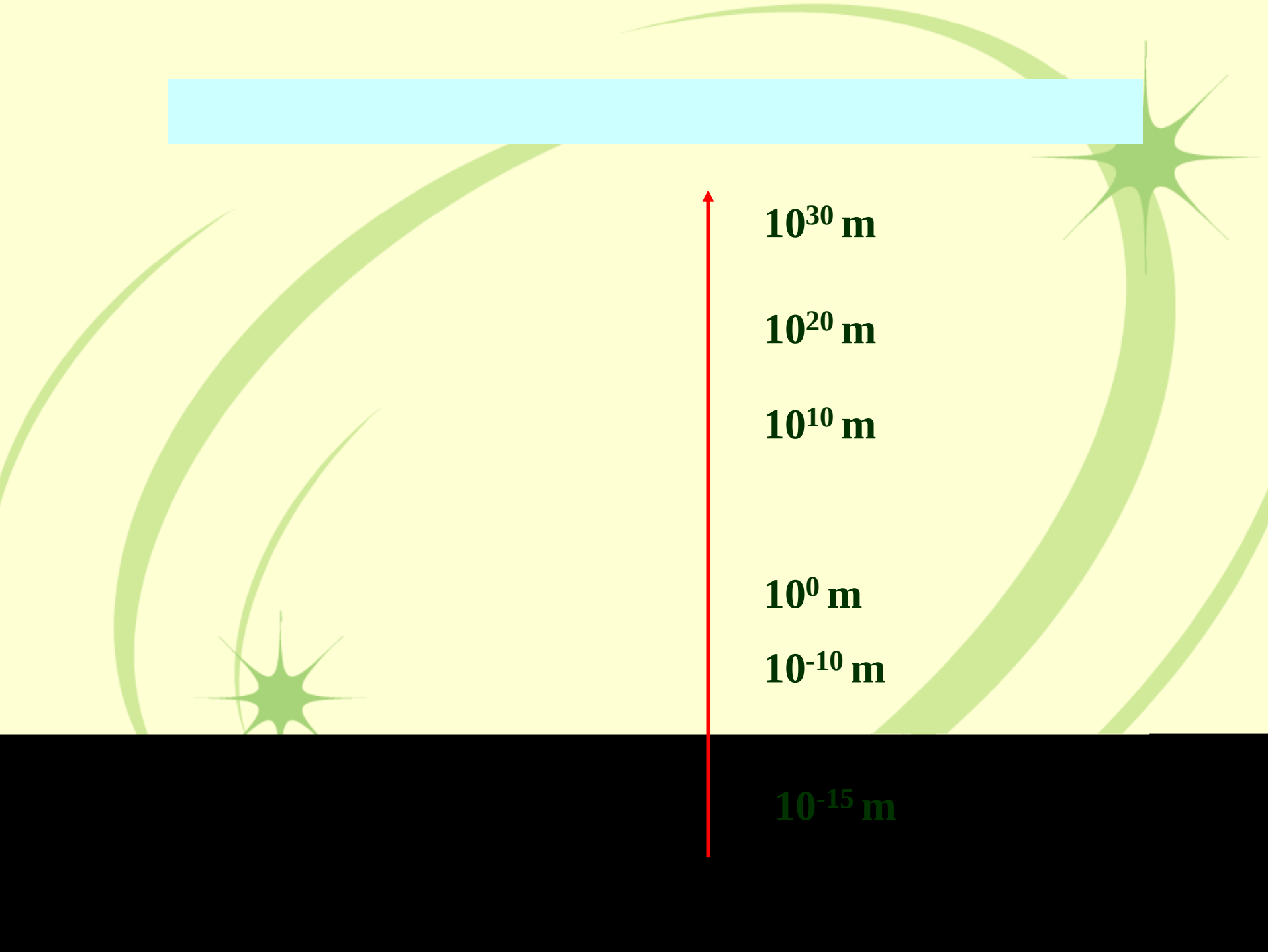
大爆炸


10^{30} m
10^{20} m
10^{10} m
10^{0} m
10^{-10} m
10^{-15} m

谢谢！