GRB初期残光の可視偏光観測

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2014年8月11-12日 岡山ユーザーズミーティング@国立天文台

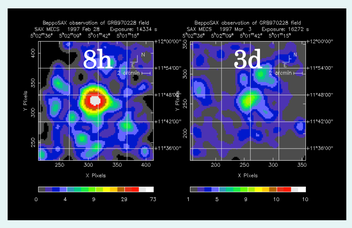
INTRODUCTION

What is GRB?

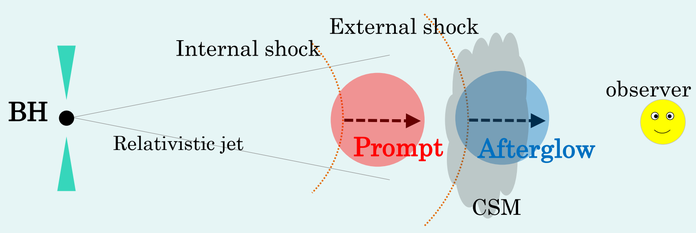
- ❒ **Most energetic explosion** in the universe (~ 10^{52} erg)
- ❒ Occurring at **cosmological distance**
- ❒ Gamma-ray arises in the form of **relativistic jet**.
  We observe it along the axis of the jet.
- ❒ Long GRB (> 2s) and short GRB (< 2s)
- ❒ A part of long GRBs associate with SNe Ic

GRB Afterglow

- ❒ A considerable fraction of GRBs show afterglows, in **X-ray, optical, NIR, and radio** wavelength.
- ❒ GRBs are relativistic events.
  " jetbreak " ~1d after the burst.



Emission mechanism



Synchrotron radiation is most likely for both prompt and afterglow

Polarimetry is a key to find out jet structure!!

GRB OBSERVATION

HOWPol (Hiroshima One-shot Wide-field Polarimeter)

- ❒ Polarization obs. **with one exposure**
- ❒ Tertiary mirror makes polarization → correction (σ ~ 1%)

GRB auto-observation system

Start to GRB polarimetry soon getting Swift/BAT trigger
Ever successed polarimetry with 6 GRBs

Kanata telescope

- ❒ Located Higashi-Hiroshima
- ❒ Effective aperture 1.5 m
- ❒ Fair weather ratio ~50%
- ❒ Moving speed
  Azimuth axis 5 degree / s
  Altitude axis 2 degree / s
  Extremely fast as 1m-class

ID	Obs. Time [s]	Publication
GRB 091208B	149 ～ 1286	Uehara +12, ApJL
GRB 111228A	163 ～ 19000	Takaki+ in prep.
GRB 121011A	92 ～ 5241	
GRB 130427A	10000 ~ 30000	
GRB 130505A	~10000	
GRB 140629A	73 ～ 12000	Takaki+ in prep.

INPORTANT MODELS

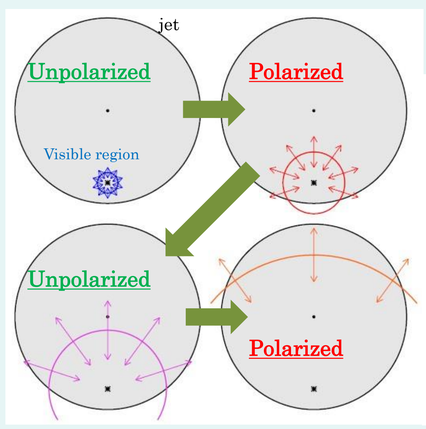
MODEL 1

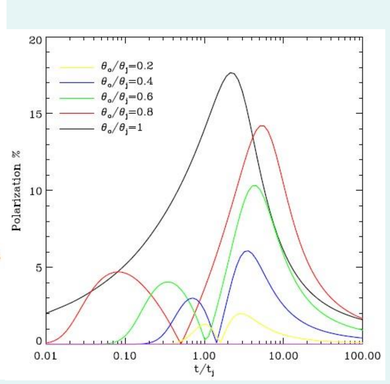
Random B + off-axis jet beaming

Can explain PD temporal evolution

At first : **Unpolarized**
Second : **Polarized**
Next : **Unpolarized** at the moment
Last : **Polarized**

PD becoming zero may be synchronized to jetbreak (Γ→small).





MODEL 2

Independent patches having coherent B

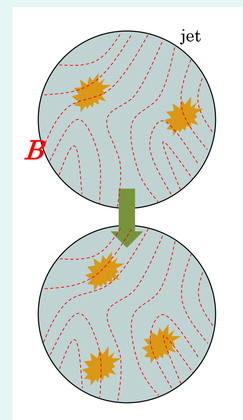
Many coherent patches (N~50)

$$P = \frac{70\%}{\sqrt{N}} \sim 10\%$$

Not canceled out completly

Possible to produce complicated P.D.

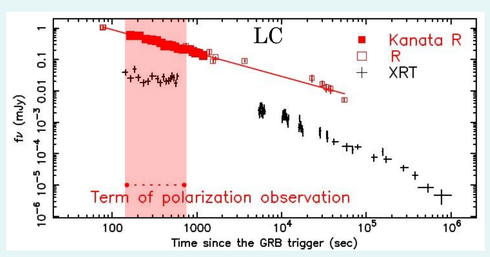
Independent from jetbreak
→ high P.D. at early epoch ?

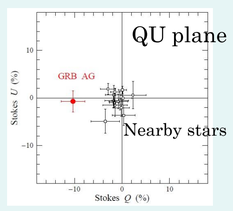


RESULTS & DISCUSSION

GRB 091208B

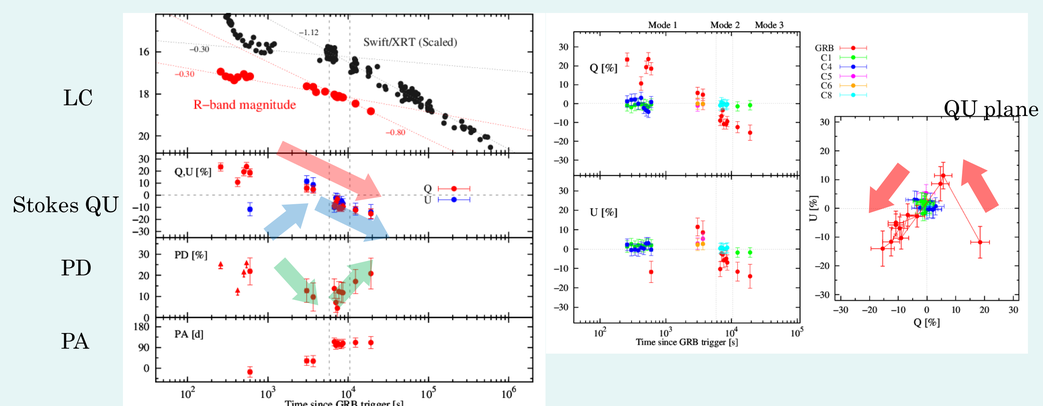
PD ~ 10% at hundreds of second





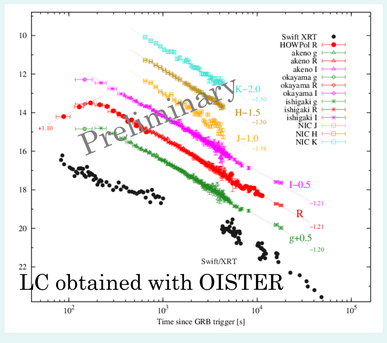
Difficult to explain with model 1.
(Uehara+ 2012)

GRB 111228A

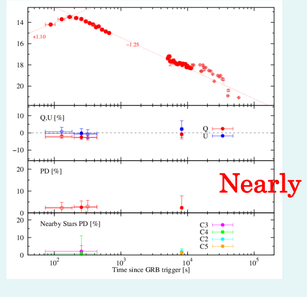


- ❒ **PD > 20%** at very early phase once **become zero** at ~6000s then, **become larger**
- ❒ **PA rotated 90 d** before and after zero-PD
- ❒ This timing is synchronized to LC break (jetbreak?)
- ❒ Can be explain with model 1 (Takaki+ in prep.)

GRB 140629A

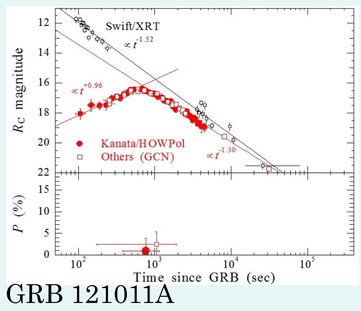


LC obtained with OISTER

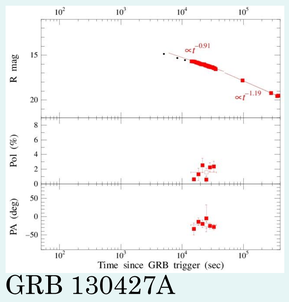


Nearly zero-PD

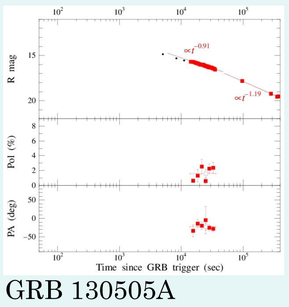
OTHER GRBs



GRB 121011A



GRB 130427A



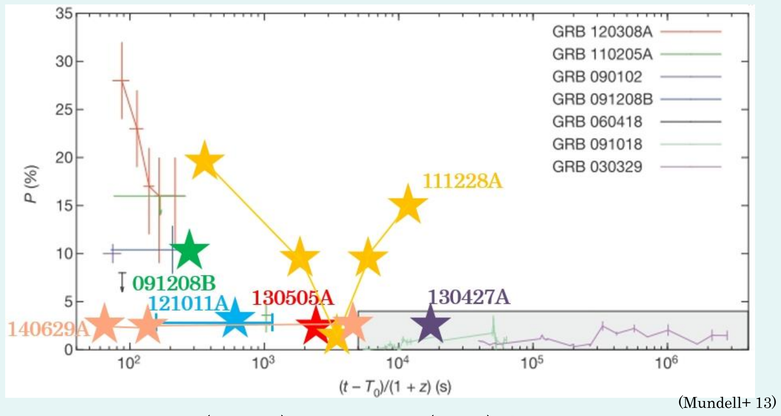
GRB 130505A

❒ GRB 121011A
small PD at hundreds of second
standard afterglow

❒ GRB 130427A & 130505A
small PD ~3 h after the burst

PD tend to be very small at late phase?

SUMMARY



(Mundell+ 13)

- ❒ PD large (eraly) → small (late) ?
- ❒ GRB 111228A is different behavior from the rest.
- ❒ More samples, and aim prompt polarimetry.