

# GRB 初期残光の可視偏光観測

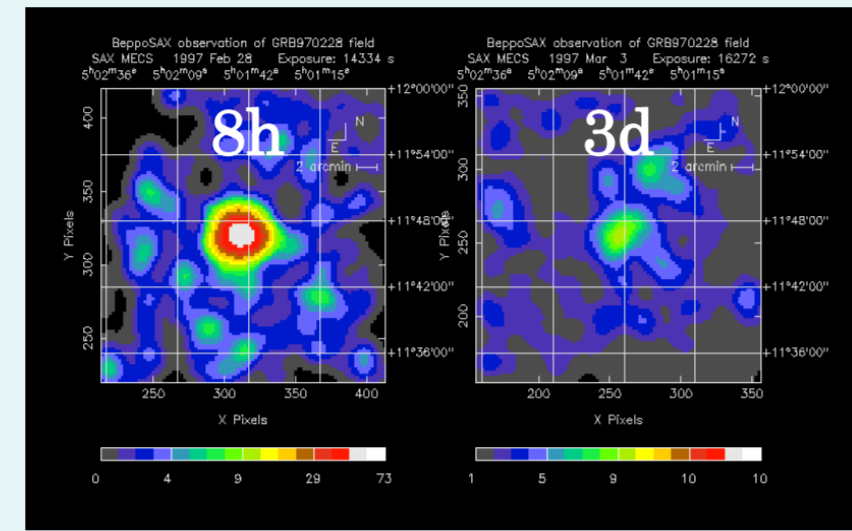
## INTRODUCTION

### What is GRB?

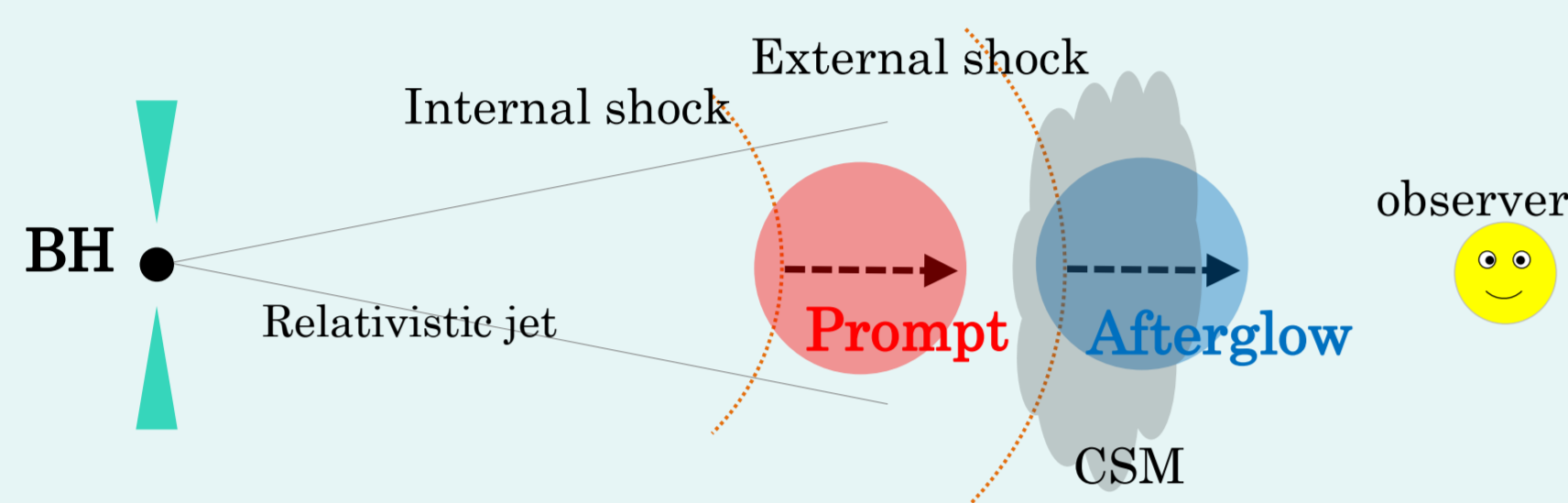
- Most energetic explosion in the universe ( $\sim 10^{52}$  erg)
- Occurring at cosmological distance
- Gamma-ray arises in the form of relativistic jet. We observe it along the axis of the jet.
- Long GRB ( $> 2s$ ) and short GRB ( $< 2s$ )
- A part of long GRBs associate with SNe Ic

### GRB Afterglow

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



### Emission mechanism



Synchrotron radiation is most likely for both prompt and afterglow

Polarimetry is a key to find out jet structure!!

## 高木 勝俊<sup>A</sup>

川端 弘治<sup>A</sup>, 當真賢二<sup>B</sup>, 伊藤亮介<sup>A</sup>, 山崎了<sup>C</sup>, 吉田道利<sup>A</sup>

A: 広島大学, B: 東北大学, C: 青山学院大学

2014年8月11-12日 岡山ユースミーティング@国立天文台

## GRB OBSERVATION



HOWPol (Hiroshima One-shot Wide-field Polarimeter)

- Polarization obs. with one exposure
- Tertiary mirror makes polarization  $\rightarrow$  correction ( $\sigma \sim 1\%$ )

### GRB auto-observation system

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

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	$\sim 10000$	
GRB 140629A	73 ~ 12000	Takaki+ in prep.

### Kanata telescope

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

## IMPORTANT MODELS

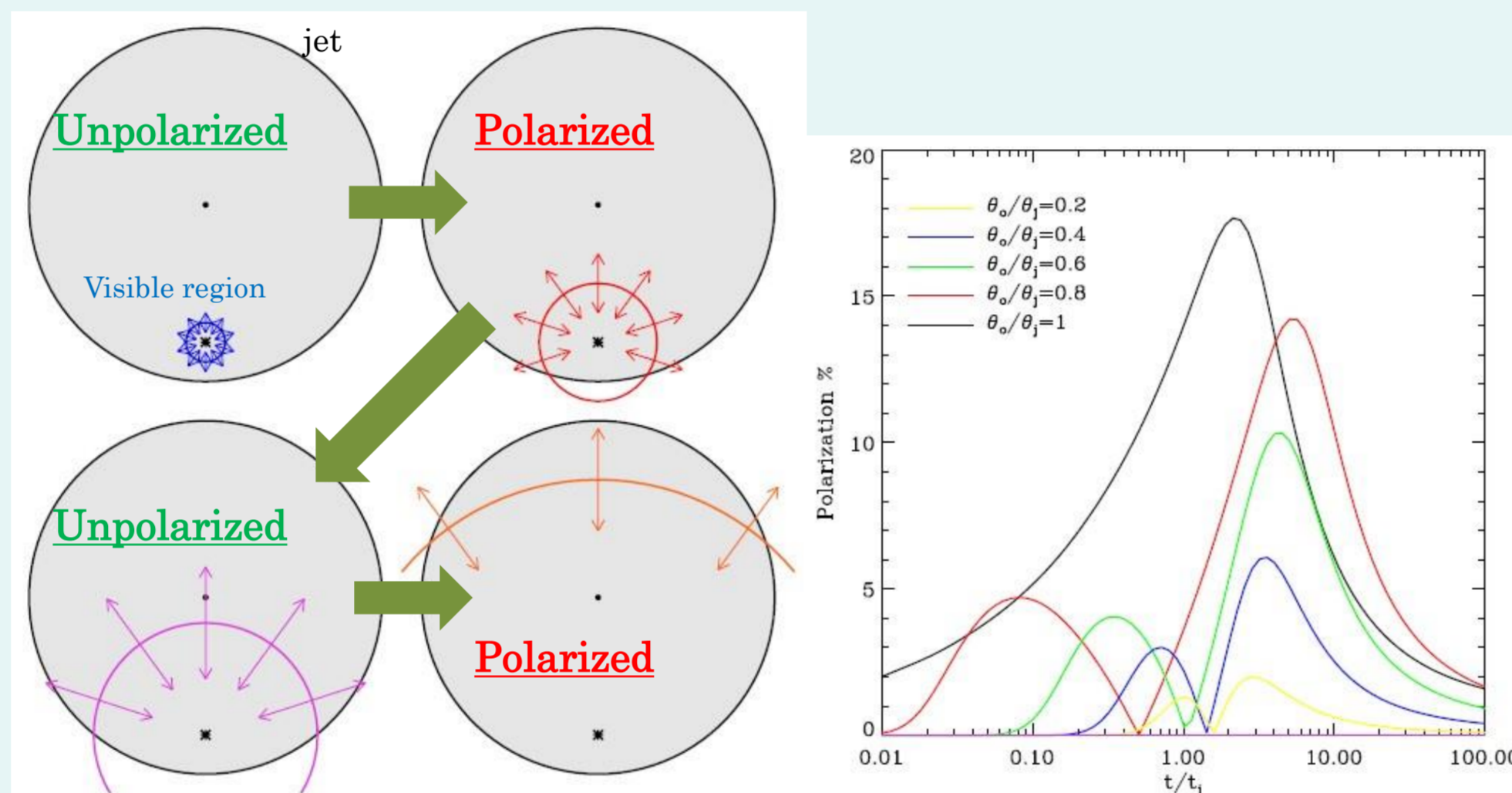
### MODEL 1

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 ( $\Gamma \rightarrow$  small).



### MODEL 2

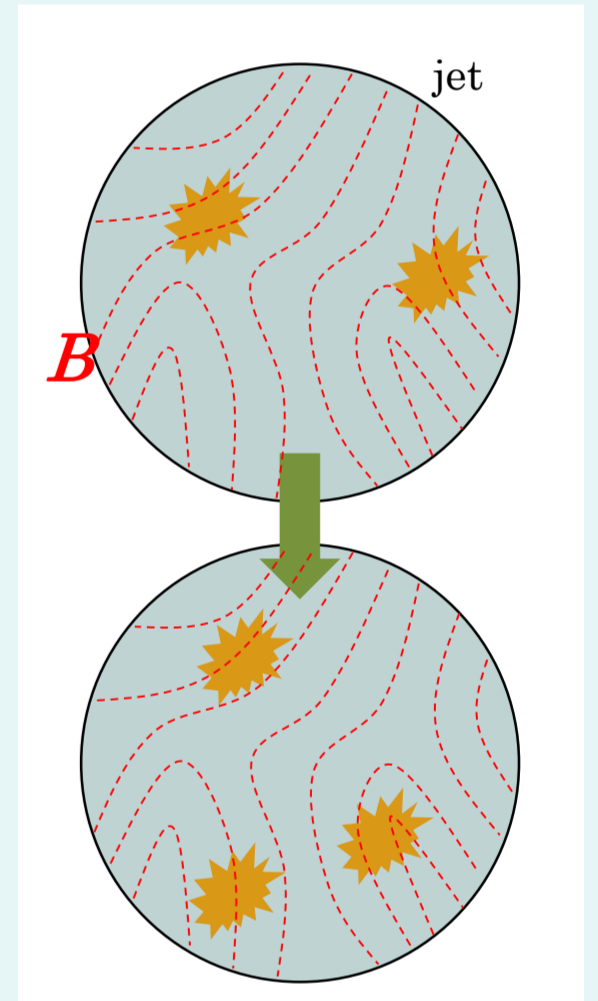
Independent patches having coherent  $B$

Many coherent patches ( $N \sim 50$ )

$$P = \frac{70\%}{\sqrt{N}} \sim 10\% \text{ Not canceled out completely}$$

Possible to produce complicated P.D.

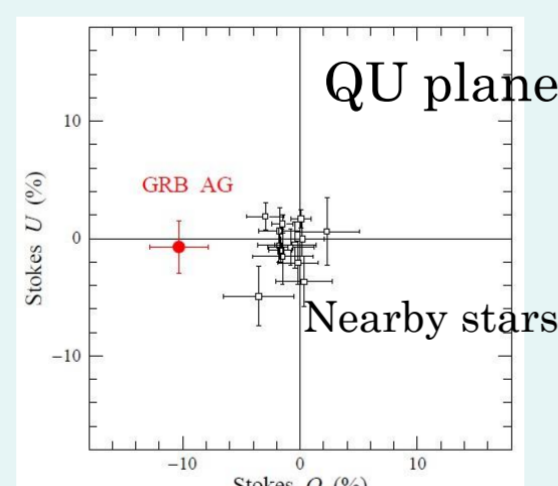
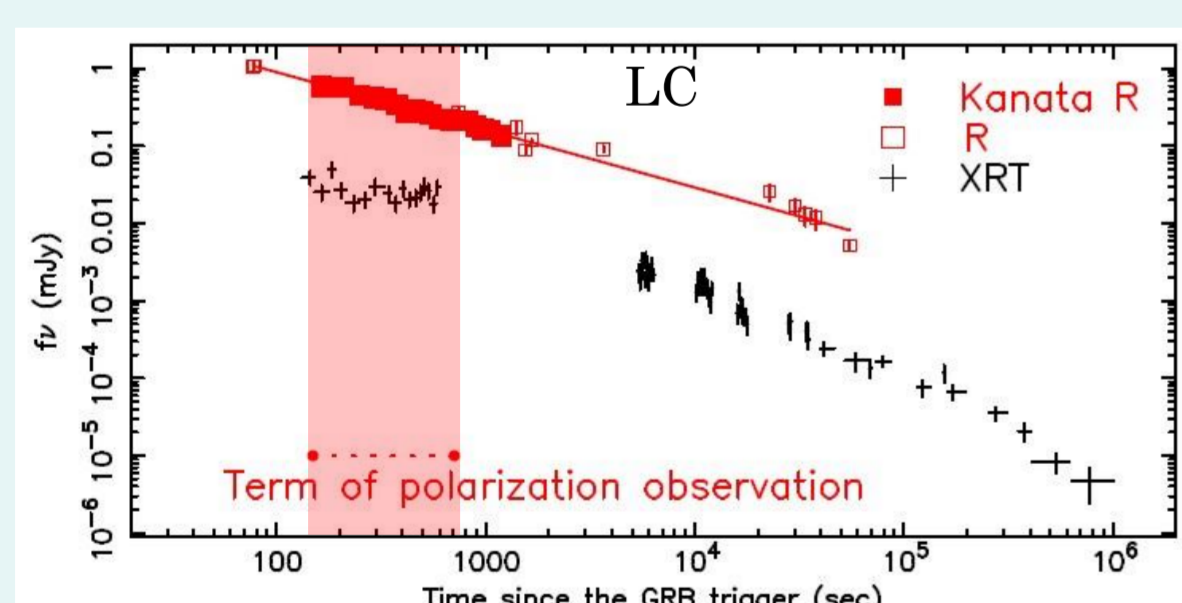
Independent from jetbreak  
 $\rightarrow$  high P.D. at early epoch?



## RESULTS & DISCUSSION

### GRB 091208B

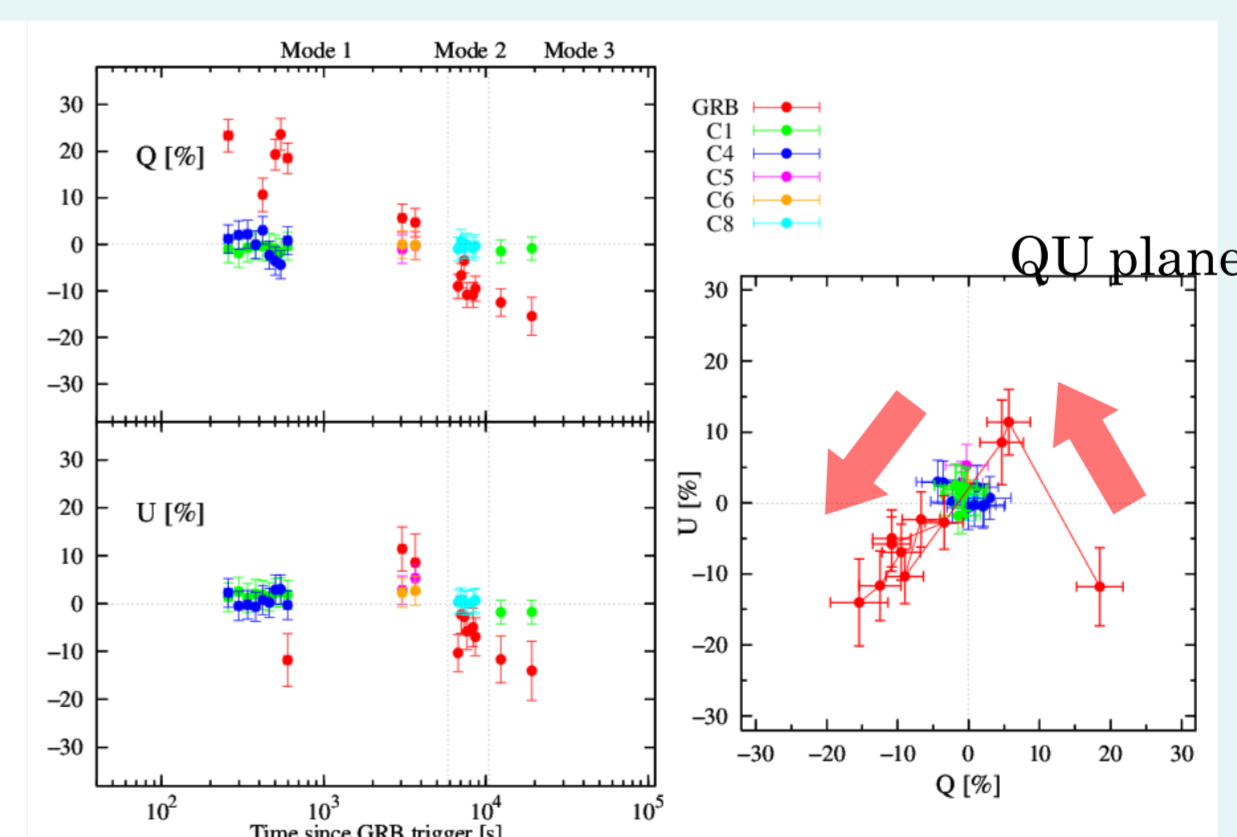
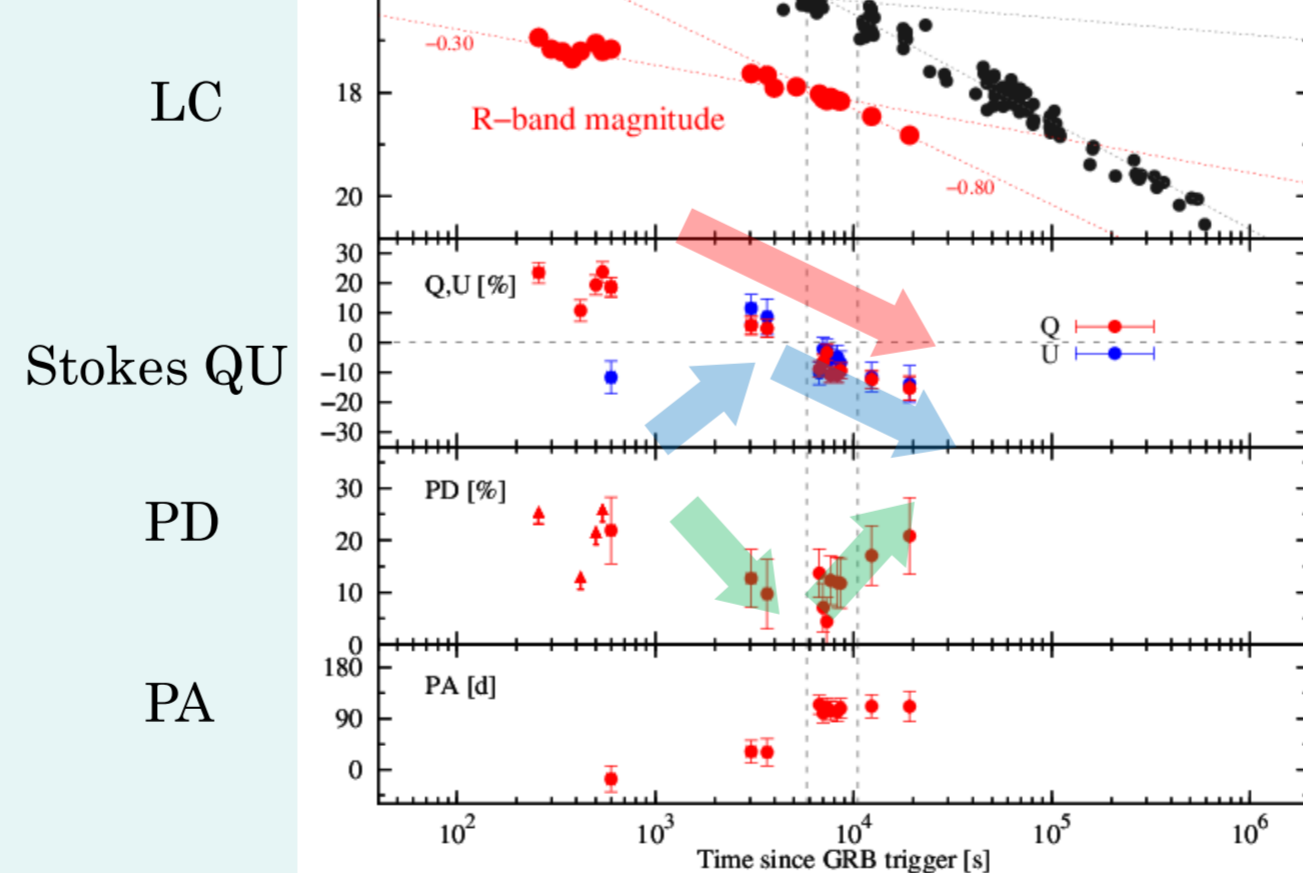
PD  $\sim 10\%$  at hundreds of second



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

### GRB 111228A

LC



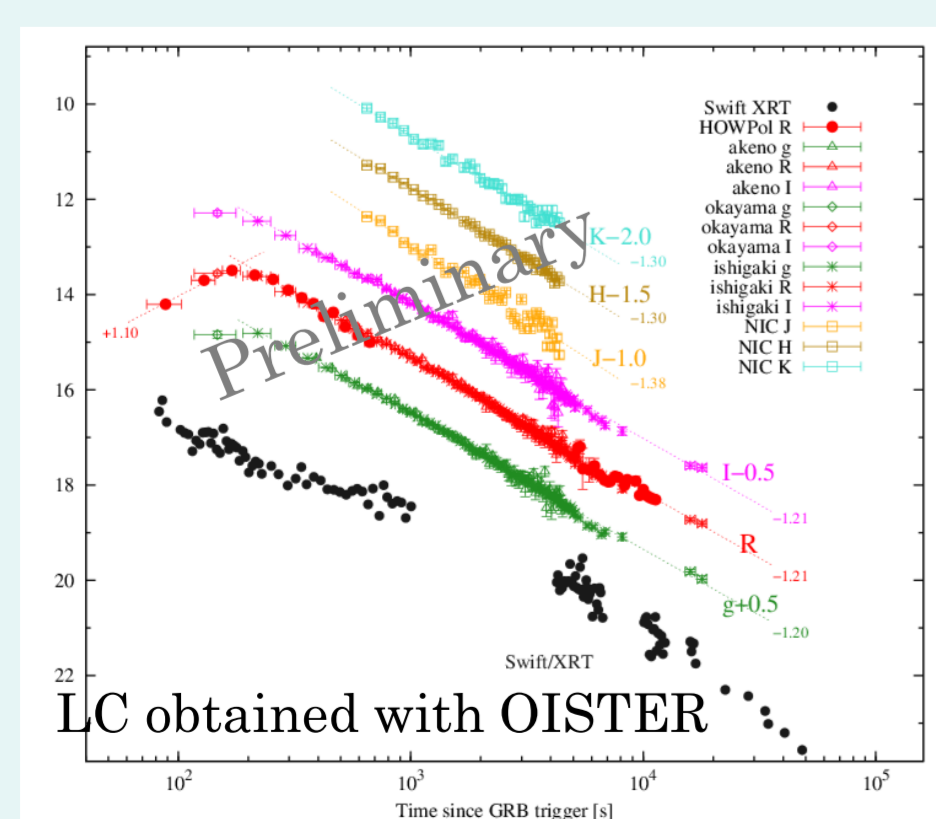
PD  $> 20\%$  at very early phase once become zero at  $\sim 6000s$  then, become larger

PA rotated 90 degree before and after zero-PD

This timing is synchronized to LC break (jetbreak?)

Can be explain with model 1 (Takaki+ in prep.)

### GRB 140629A

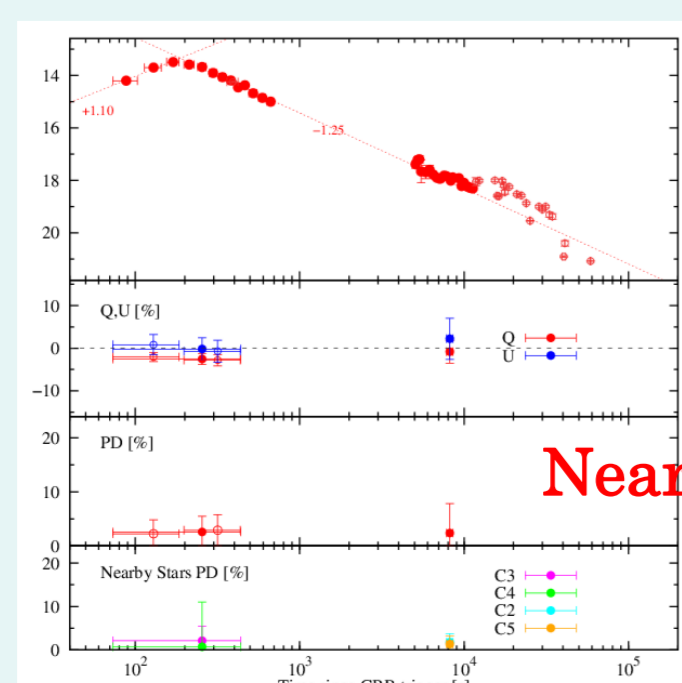


LC with HOWPol

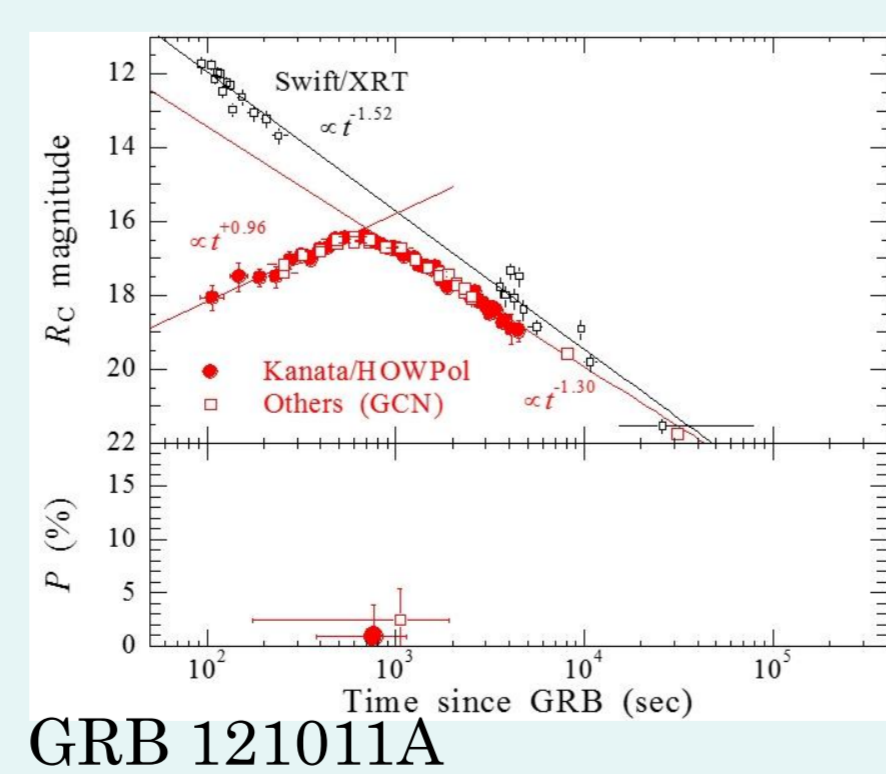
Stokes QU

PD

PA



### OTHER GRBs

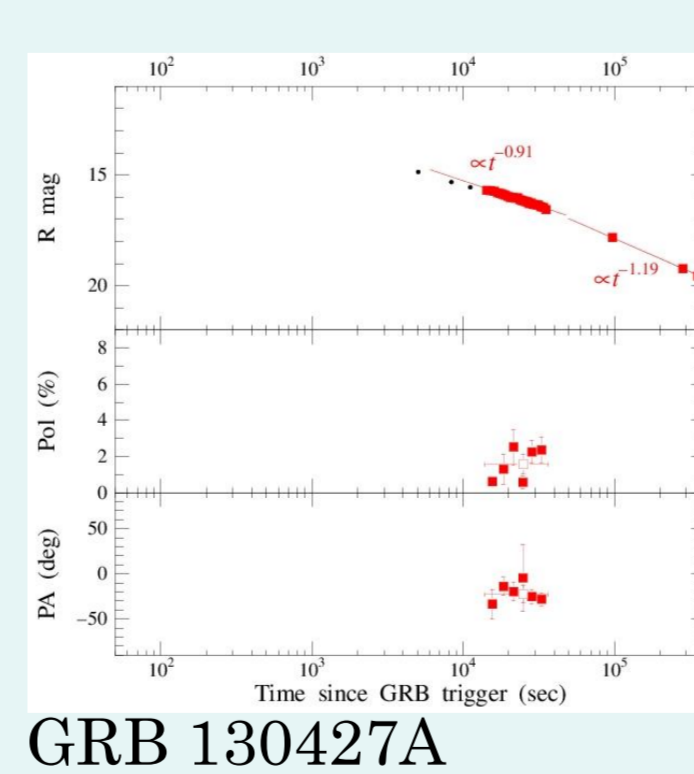


GRB 121011A

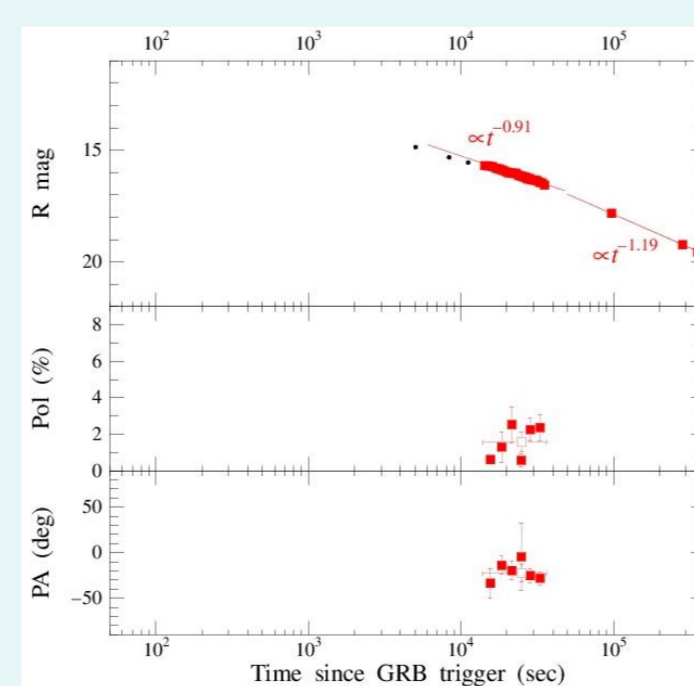
GRB 121011A small PD at hundreds of second standard afterglow

GRB 130427A & 130505A small PD  $\sim 3h$  after the burst

PD tend to be very small at late phase?

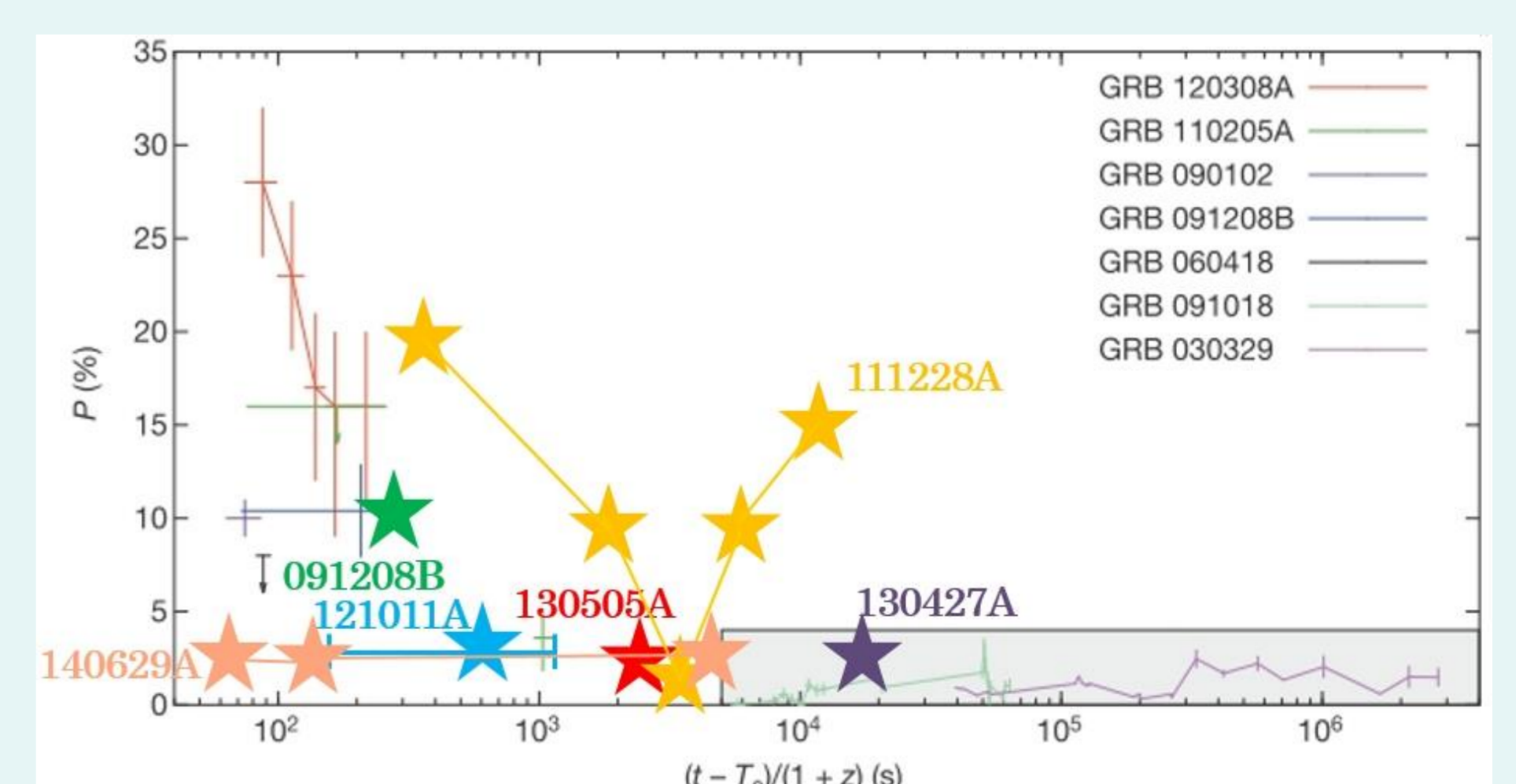


GRB 130427A



GRB 130505A

## SUMMARY



- PD large (early)  $\rightarrow$  small (late)?
- GRB 111228A is different behavior from the rest.
- More samples, and aim prompt polarimetry.