Marco Nardini

In collaboration with The GROND group

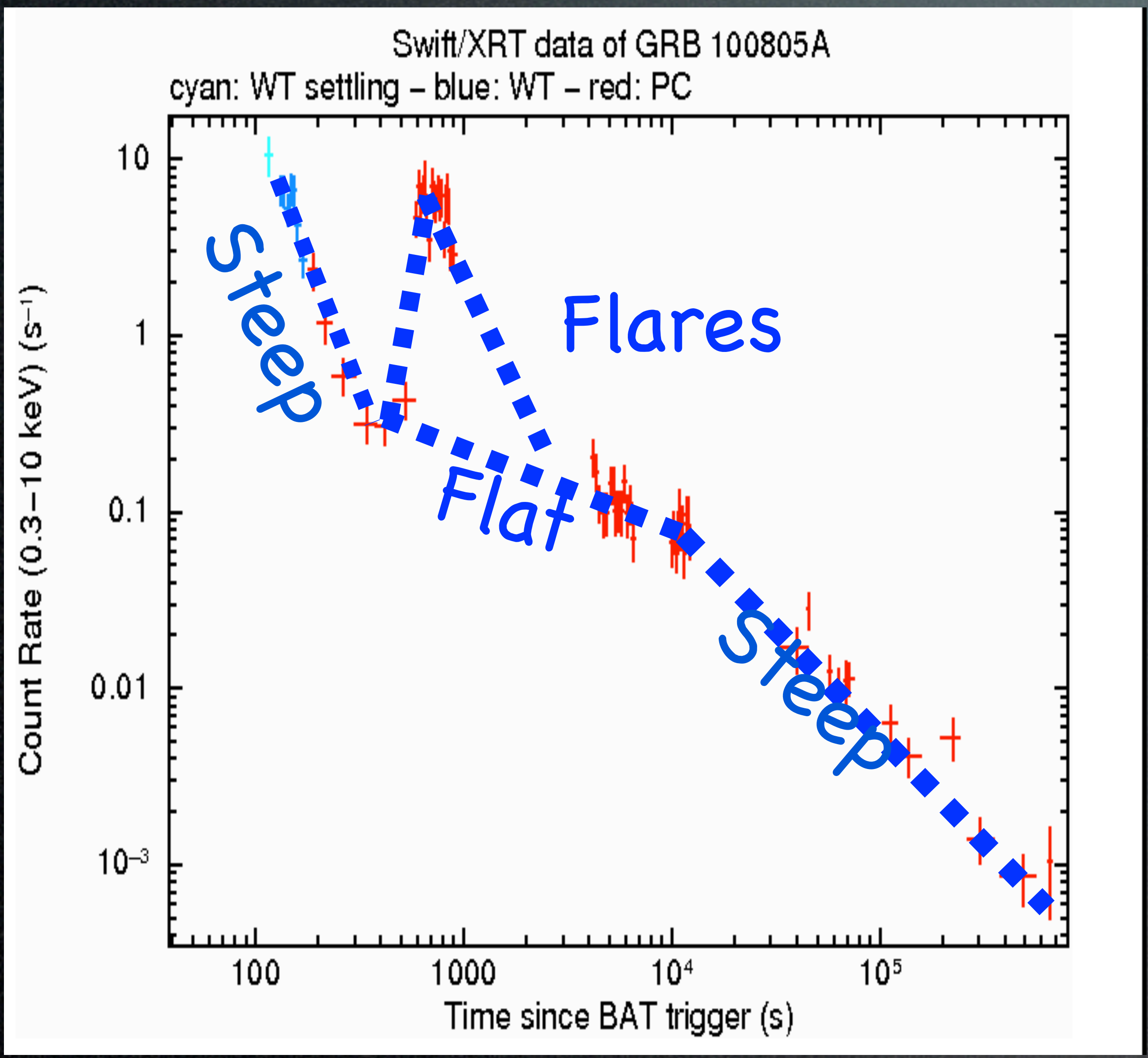
Unveiling long lasting central engine activity with Optical-NIR afterglows

Gamma-Ray Burst 2012 Conference
München
2012 May 10th

GRB AFTERGLOWS

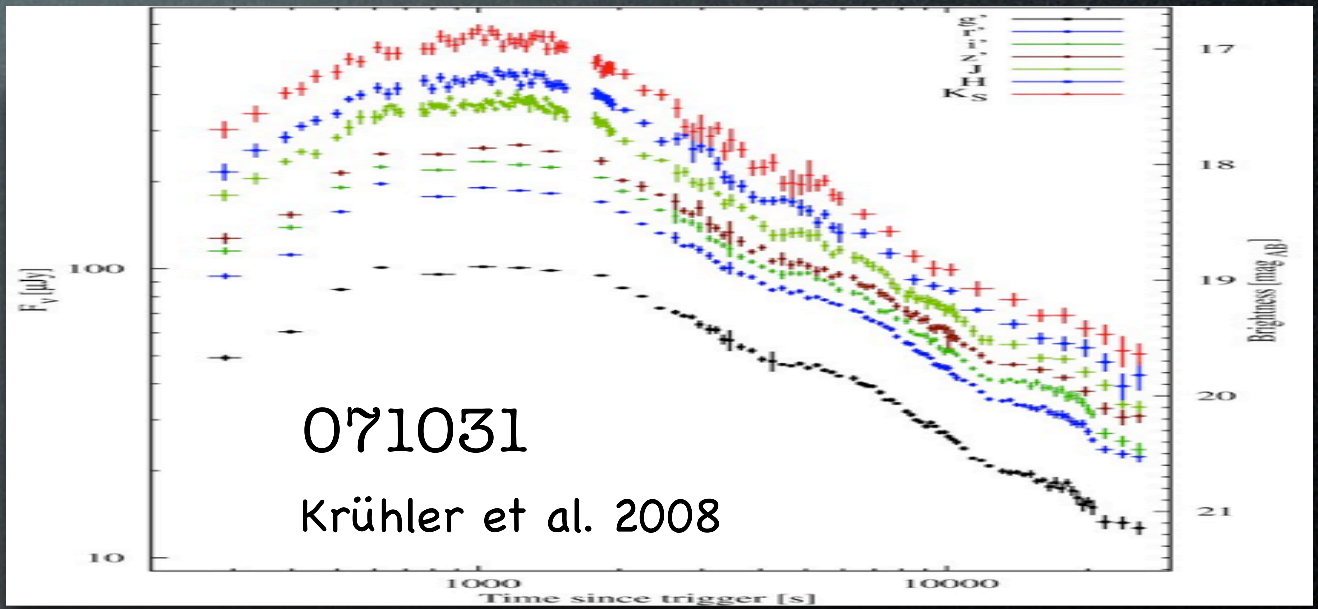
State of the art in the SWIFT era

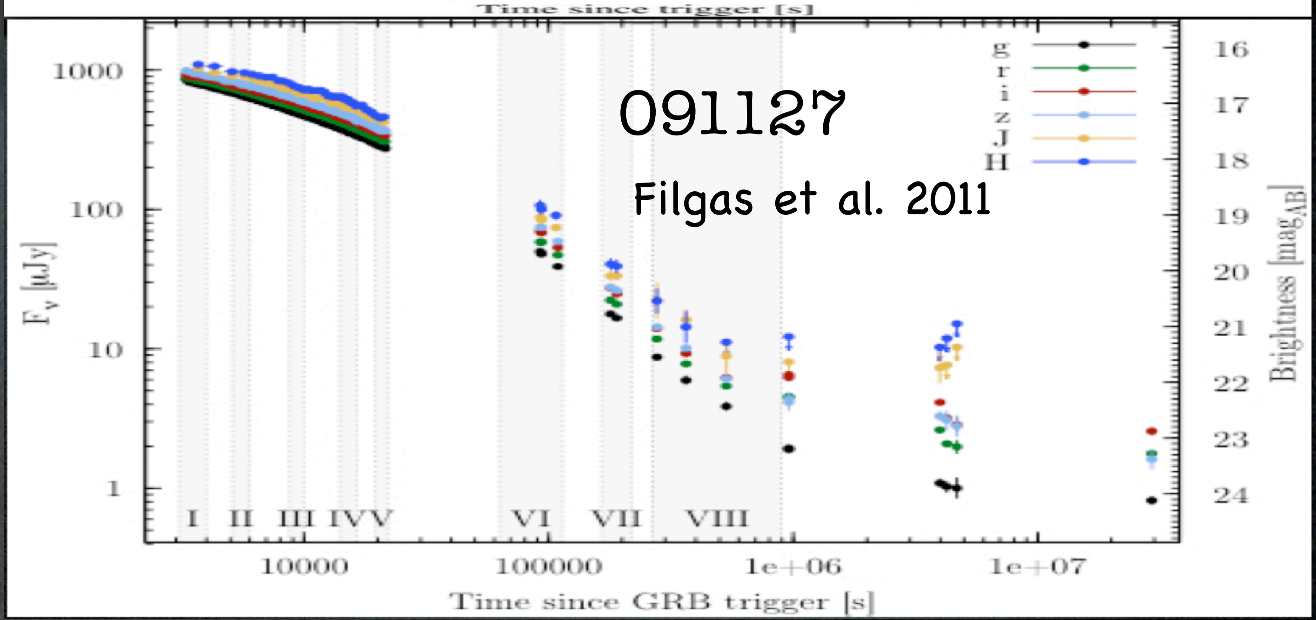
X-rays



Canonical X-ray light curve
Nousek et al. 2006

Optical -NIR





Complex light curves

GRB 081029 A CASE STUDY

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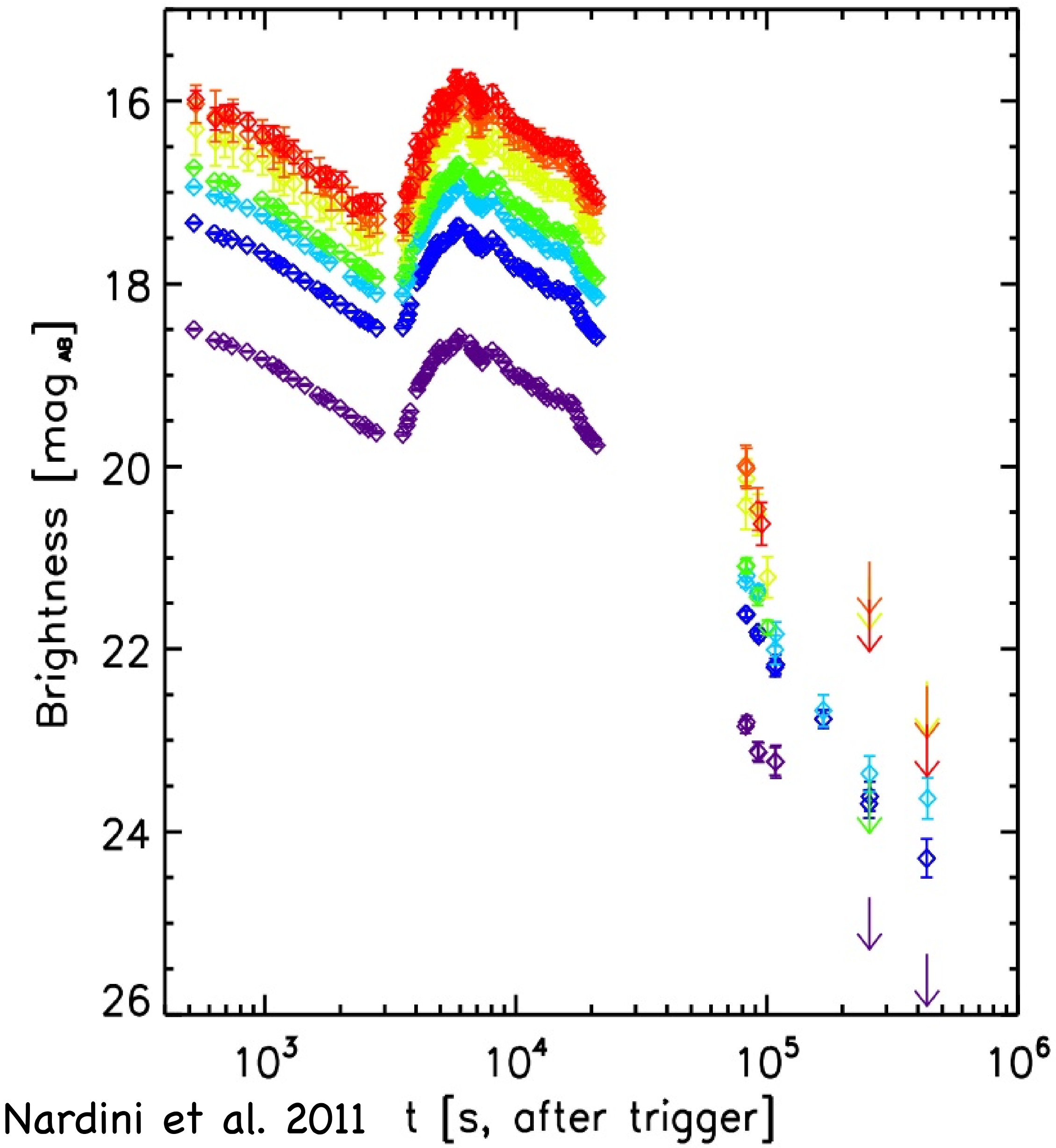

Nardini et al. 2011

WHAT DO WE SEE?

- The bright optical-NIR afterglow is detected in all 7 GROND filters up to a few days after the trigger

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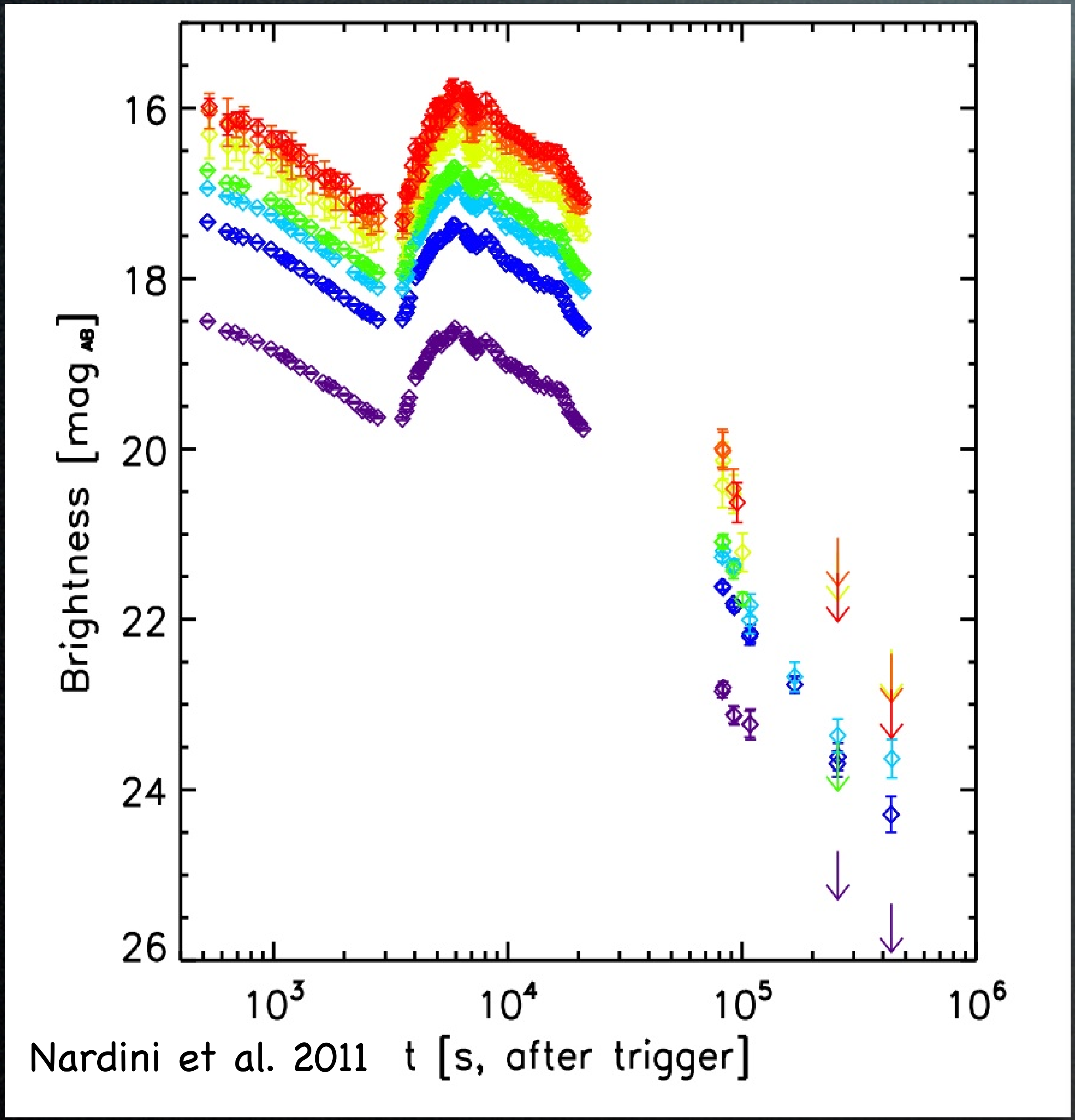

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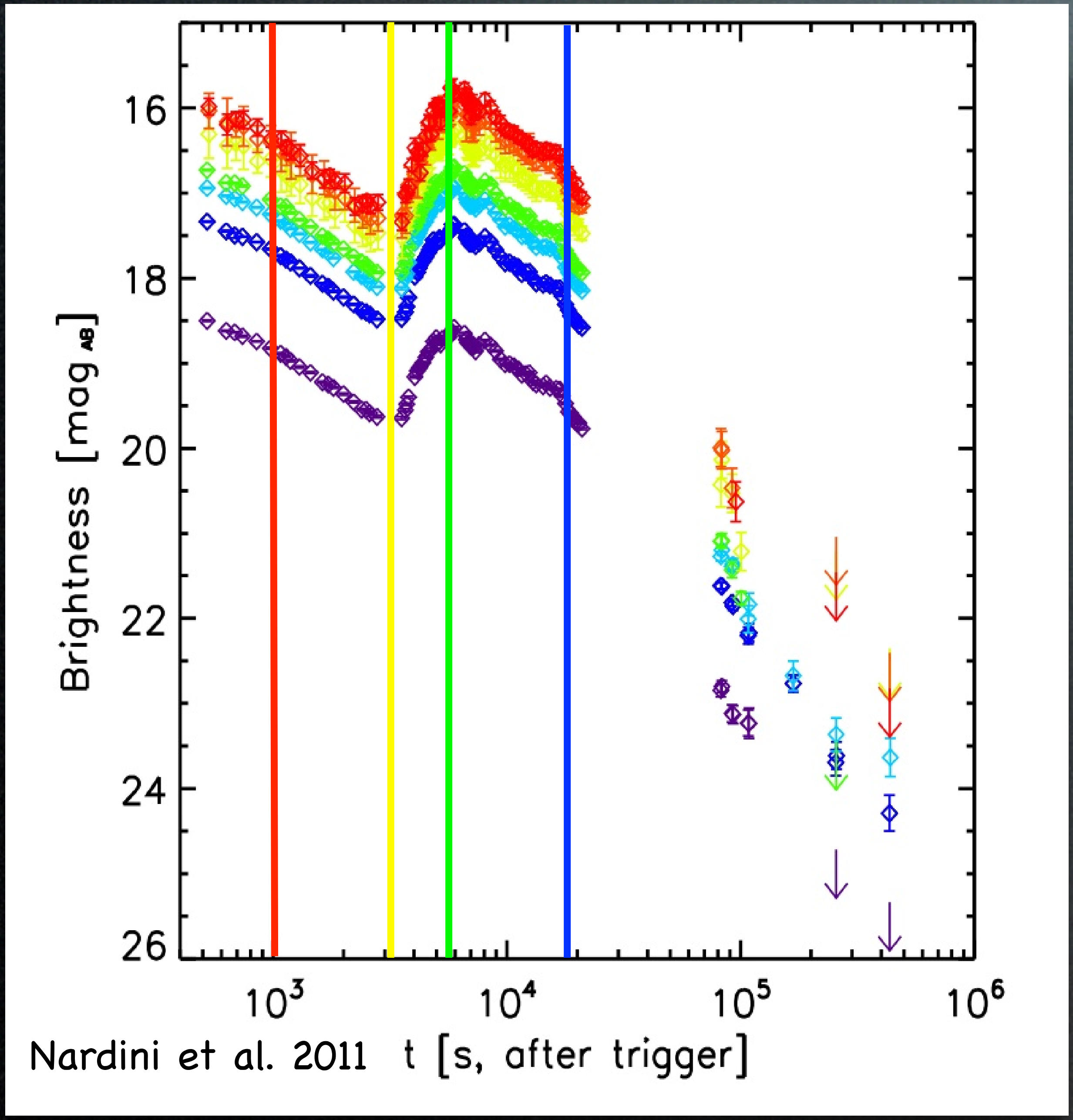

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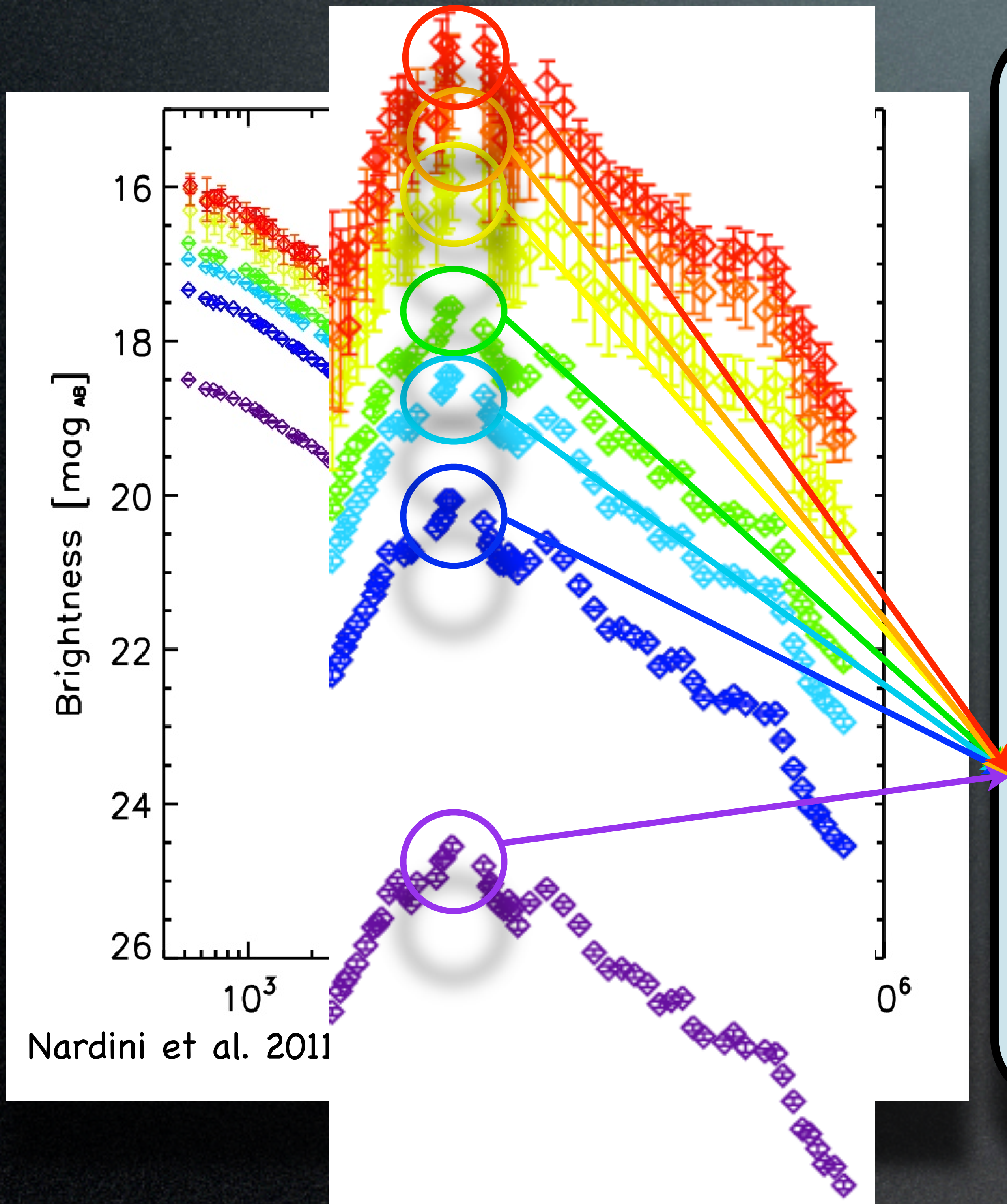

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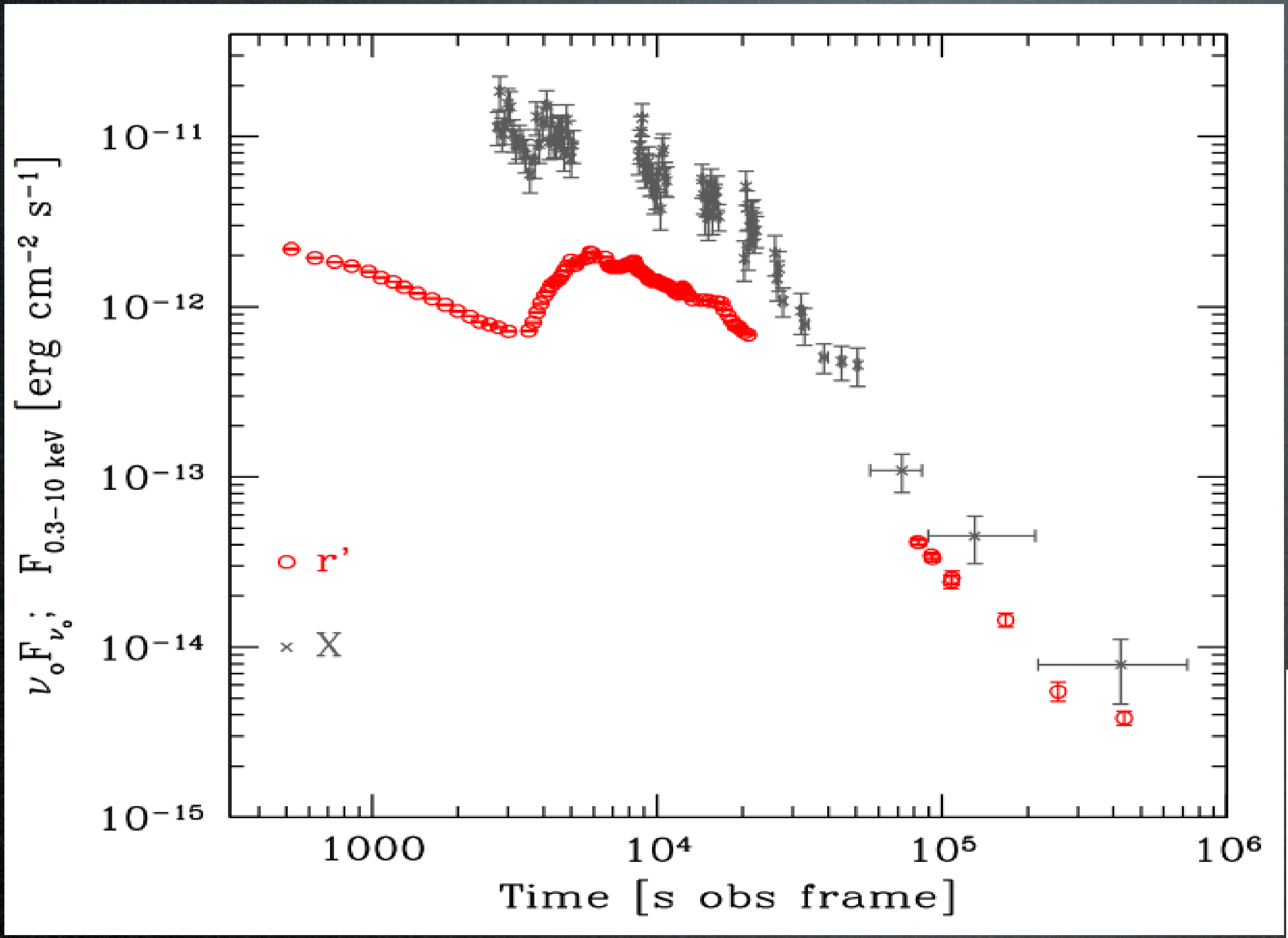
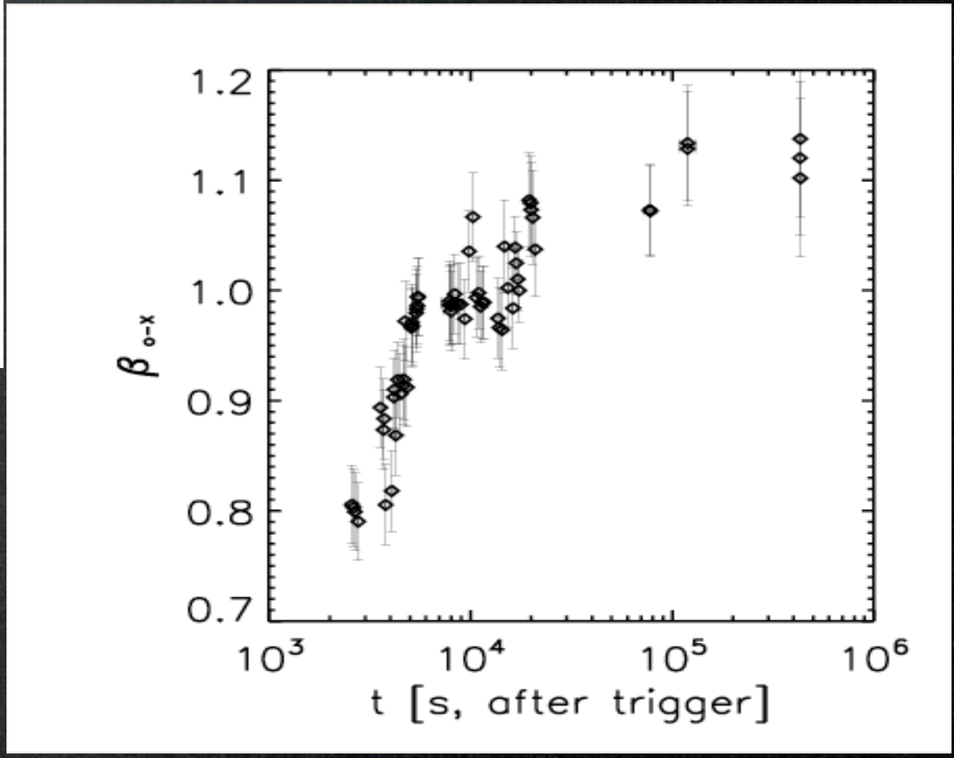
- Temporal breaks are achromatic in all optical and NIR bands

- Achromatic wiggles during the optical-NIR bump

GROND vs X-rays LIGHT-CURVEs





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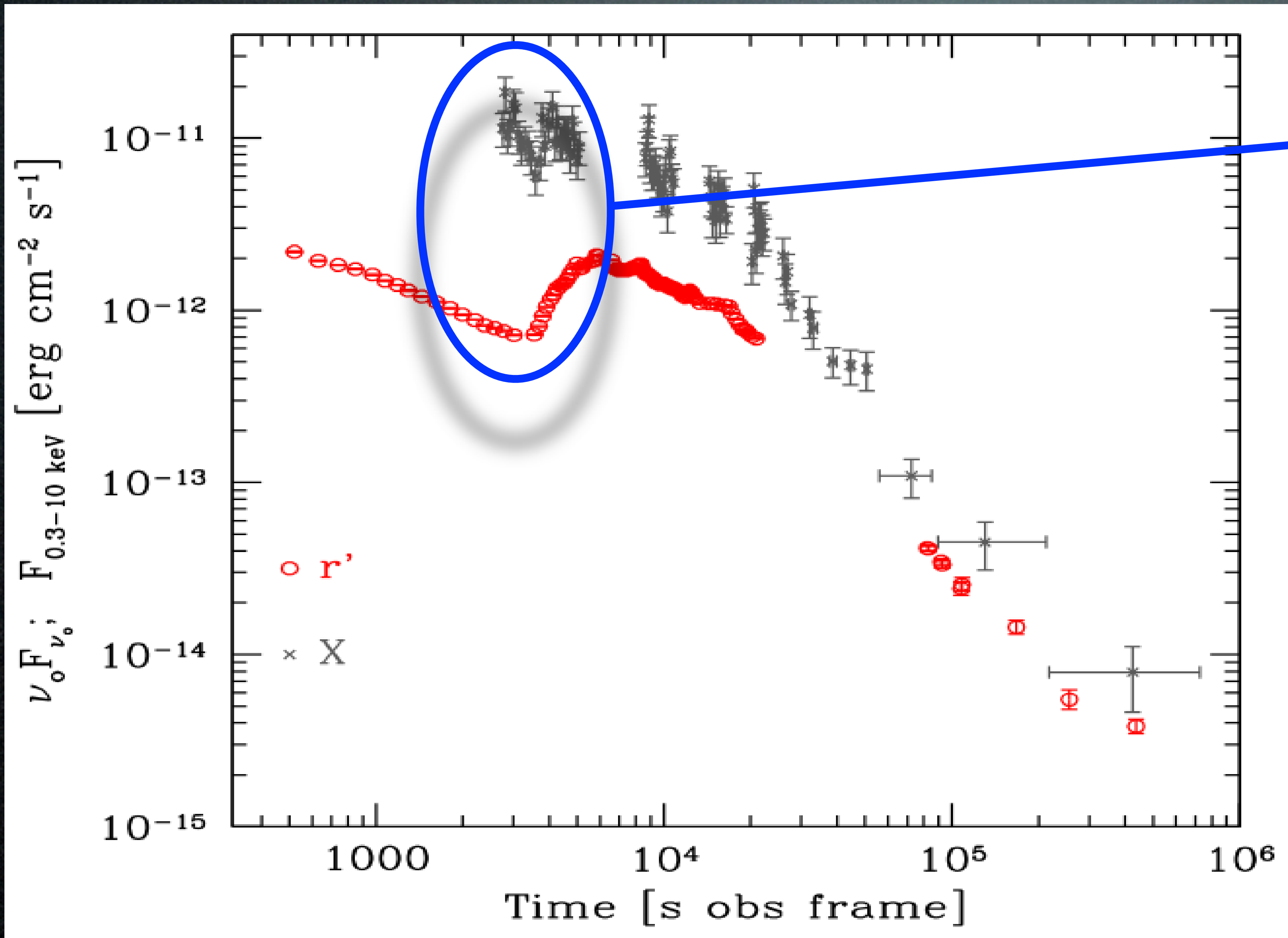
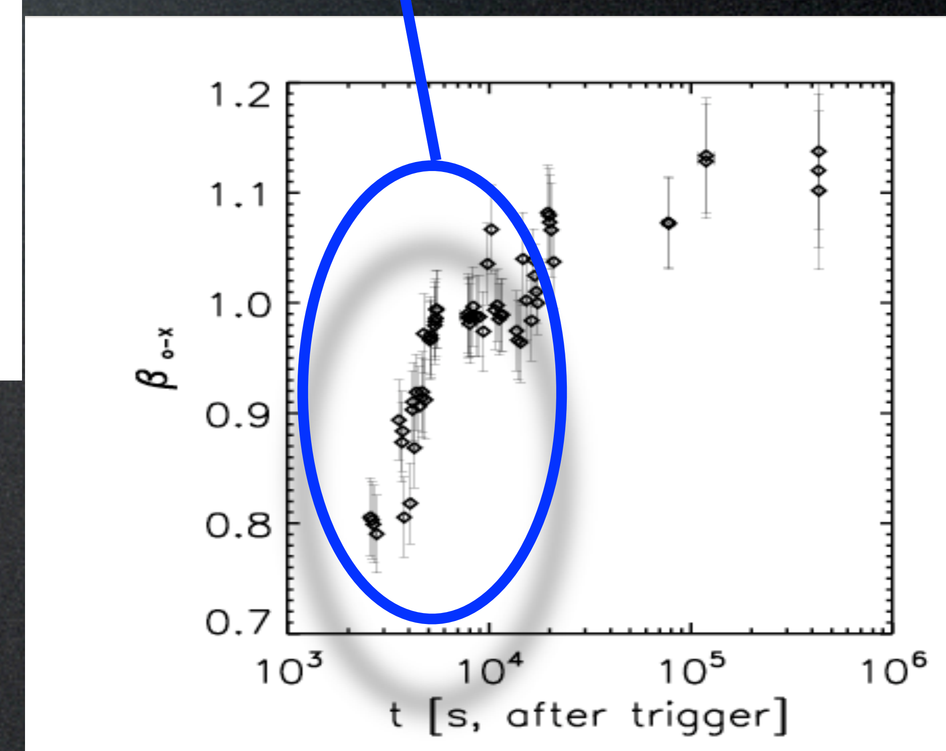


No contemporaneous X-ray bump



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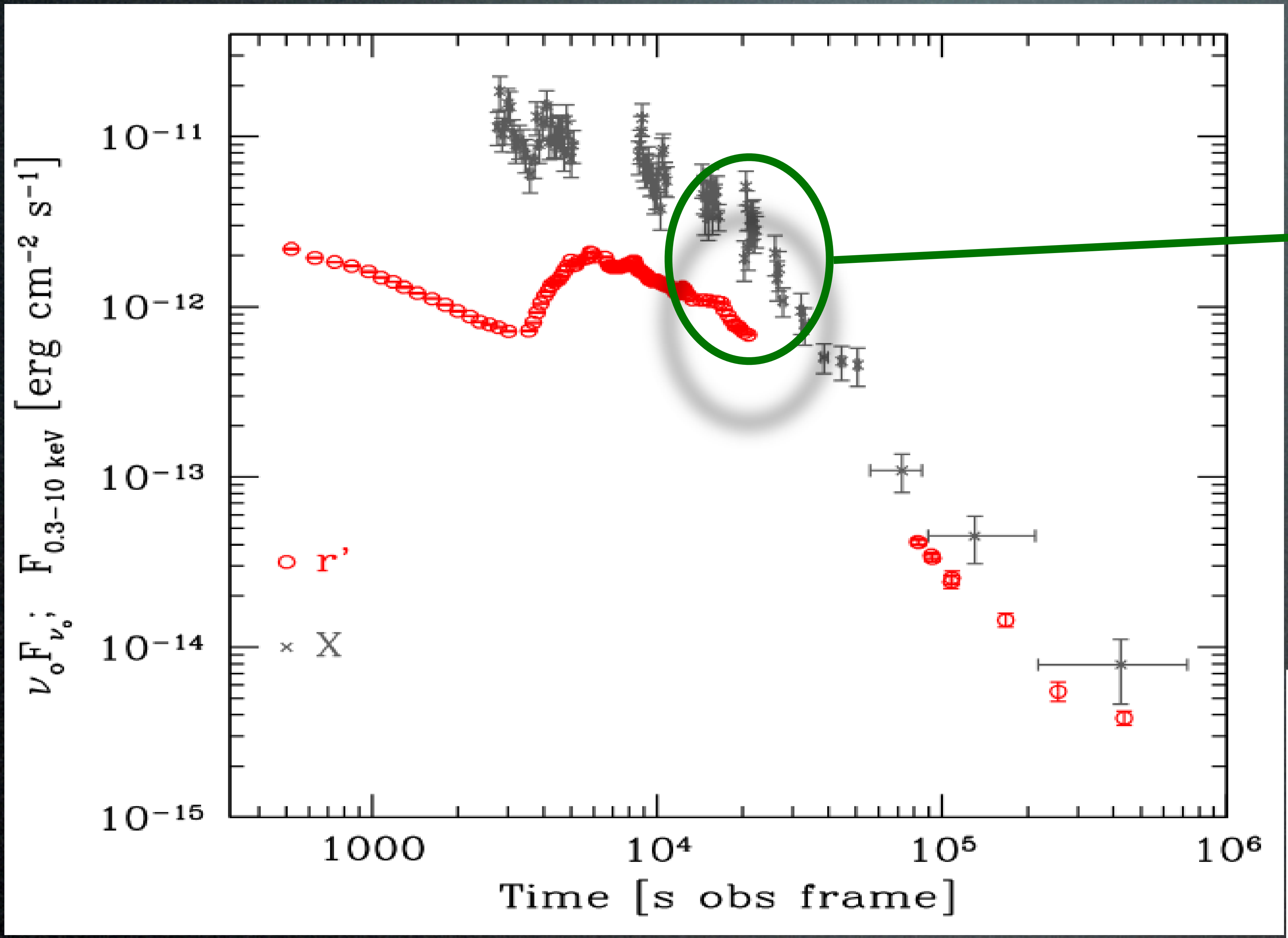

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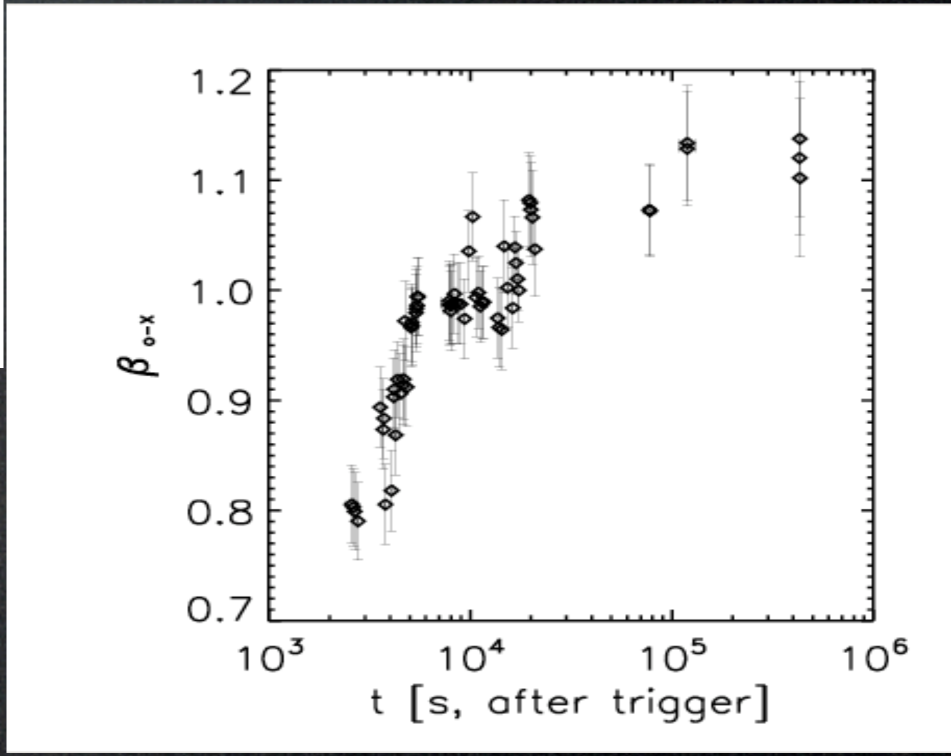
Achromatic break at 20 ks



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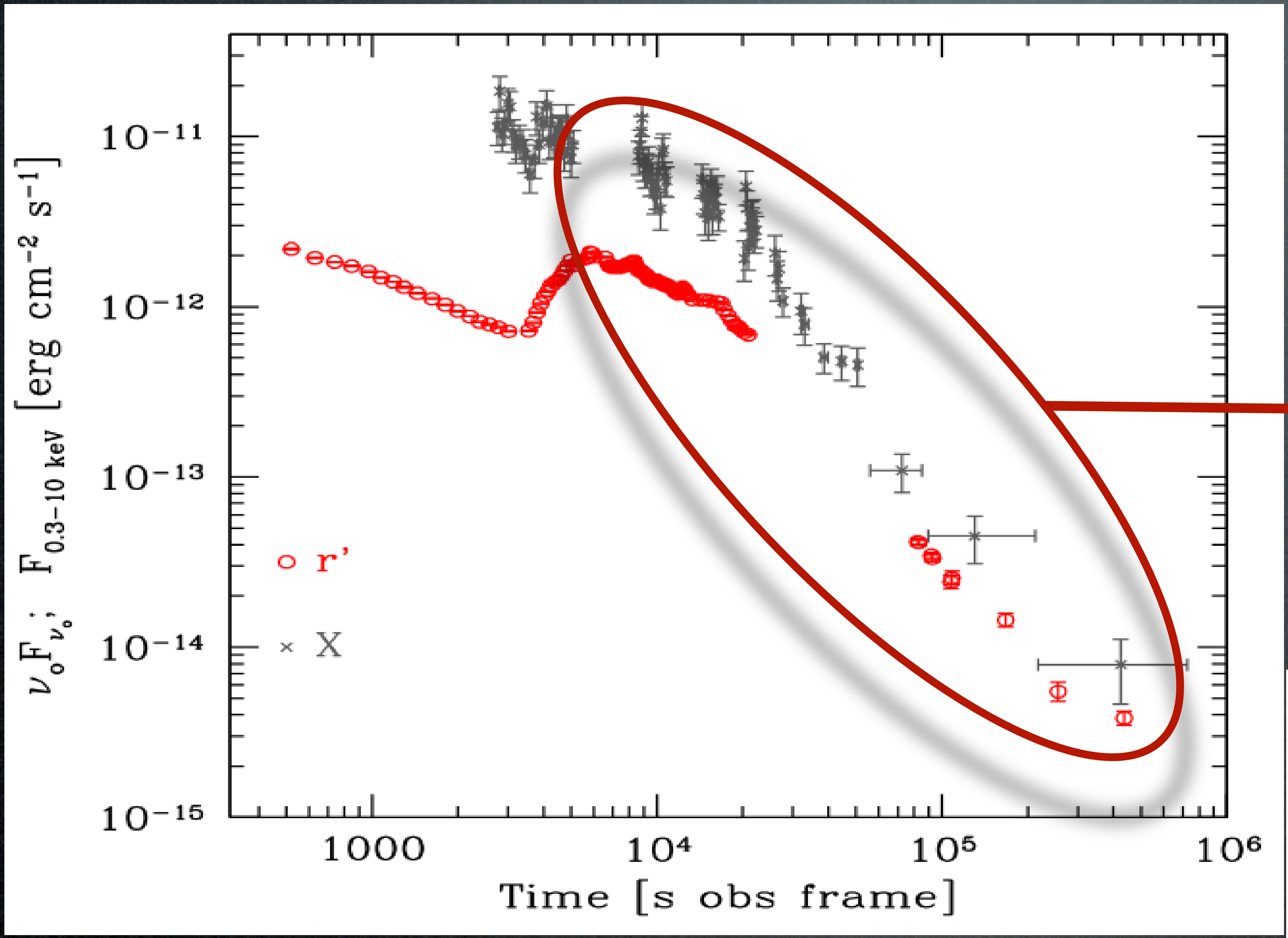

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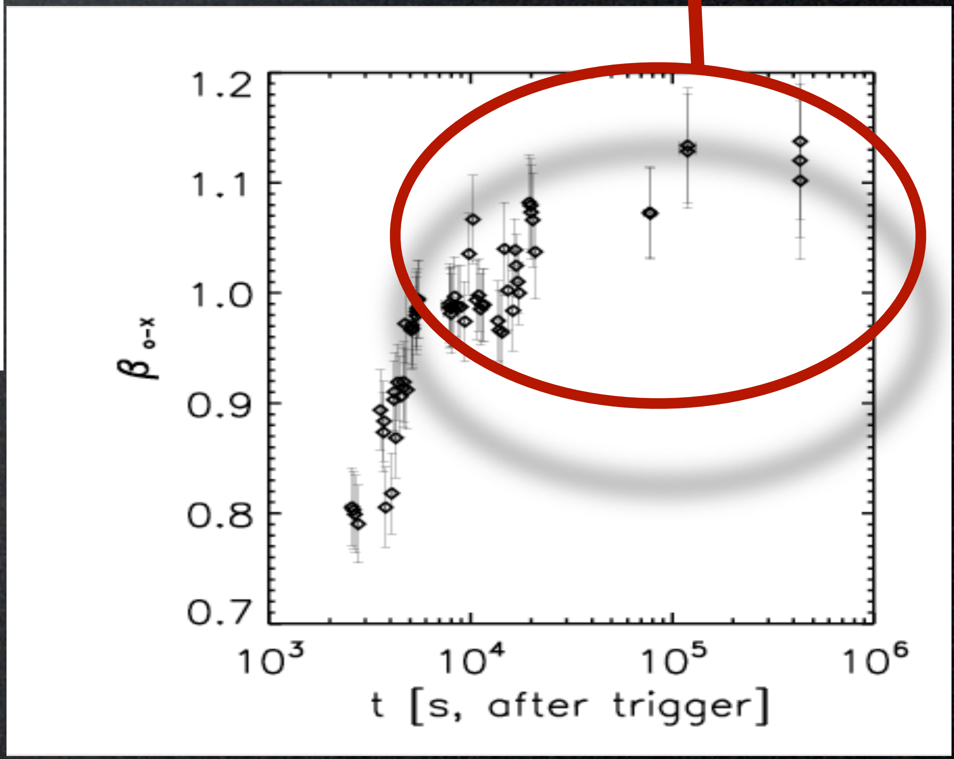
Achromatic GROND and X-ray ligt-curves



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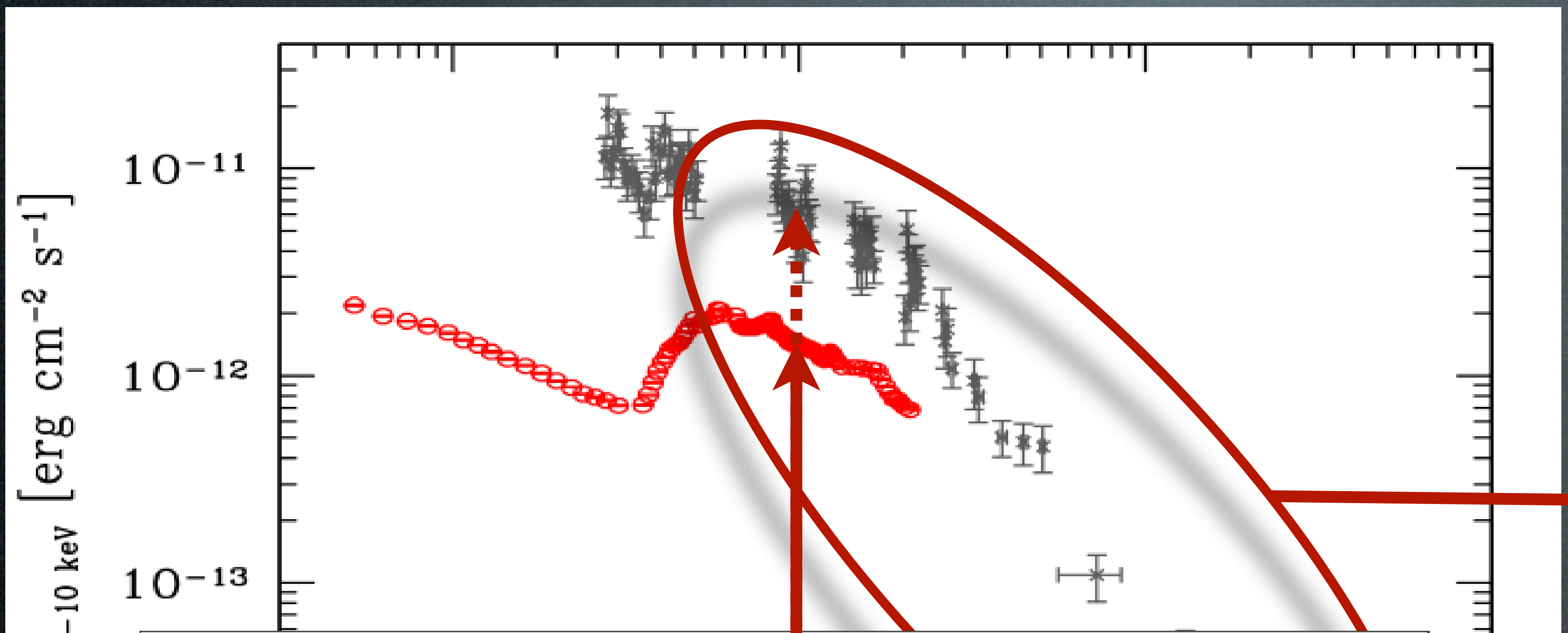

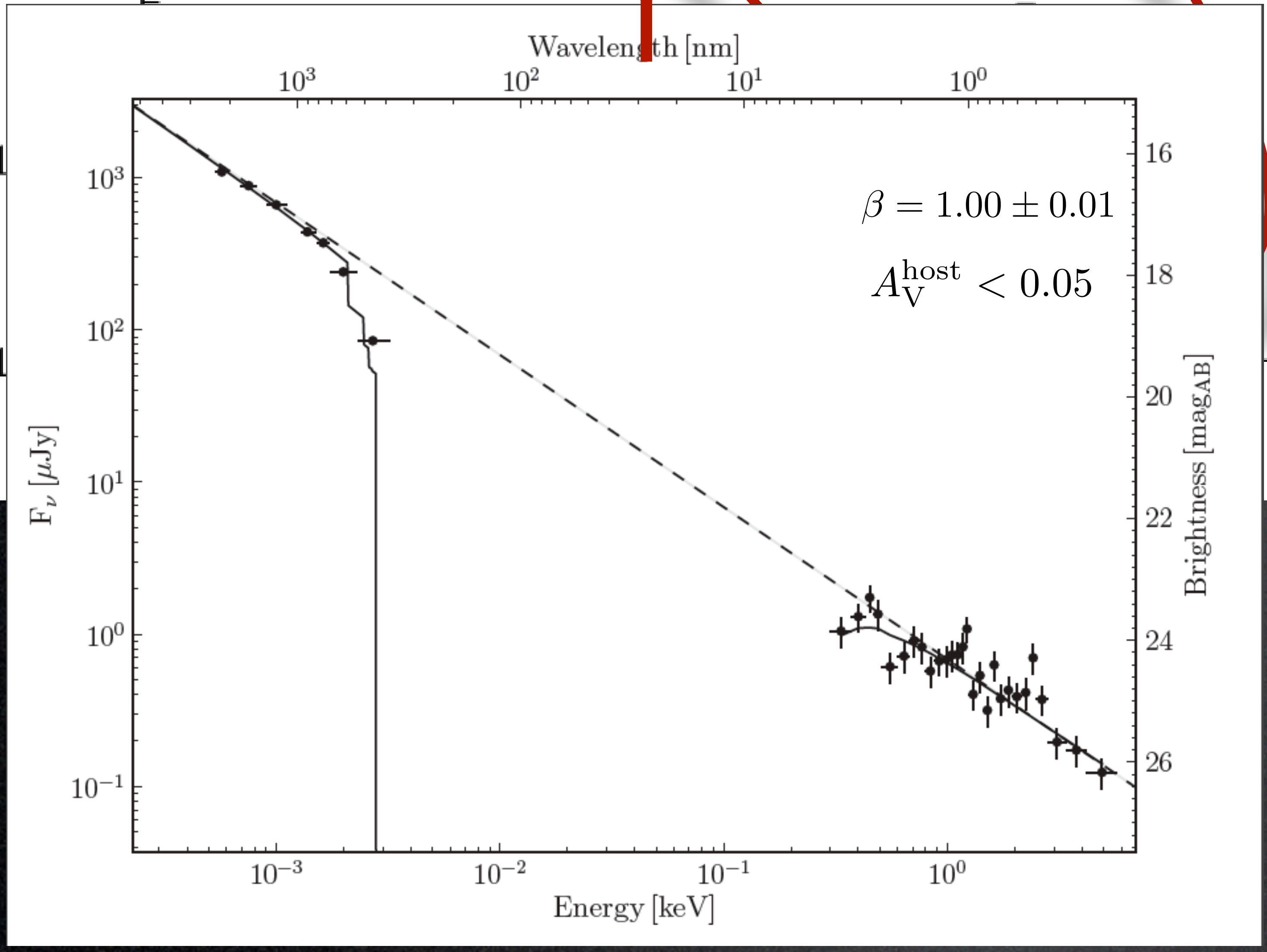

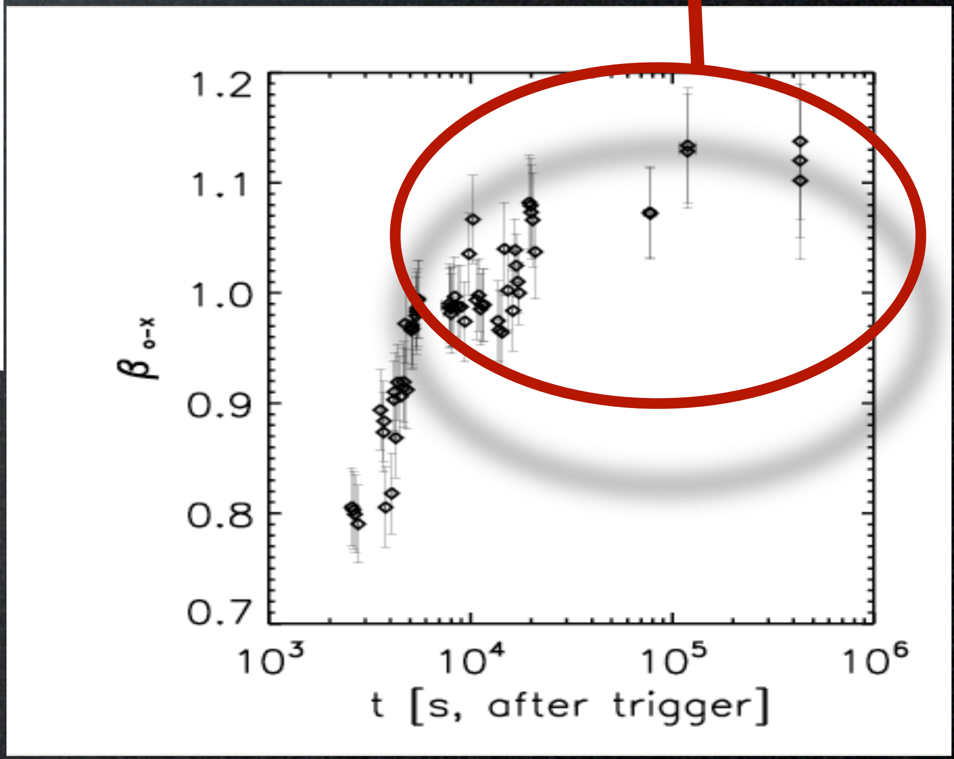

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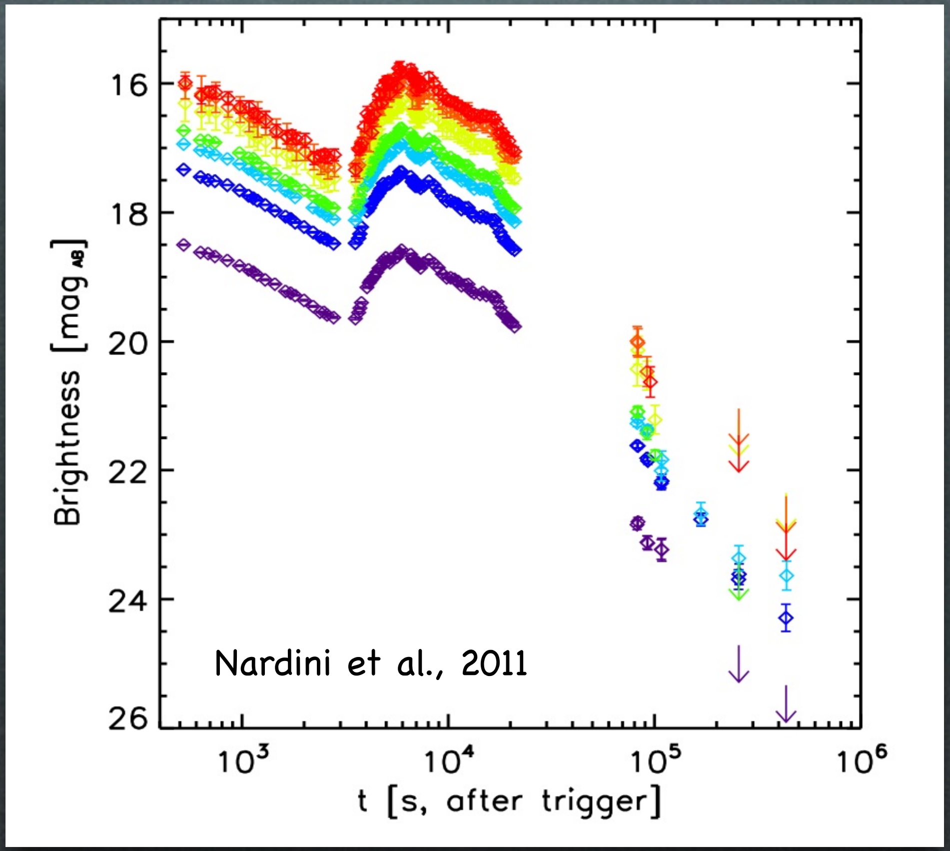
Achromatic GROND and X-ray ligt-curves

IS THE BUMP OF GRB 081029 UNIQUE?



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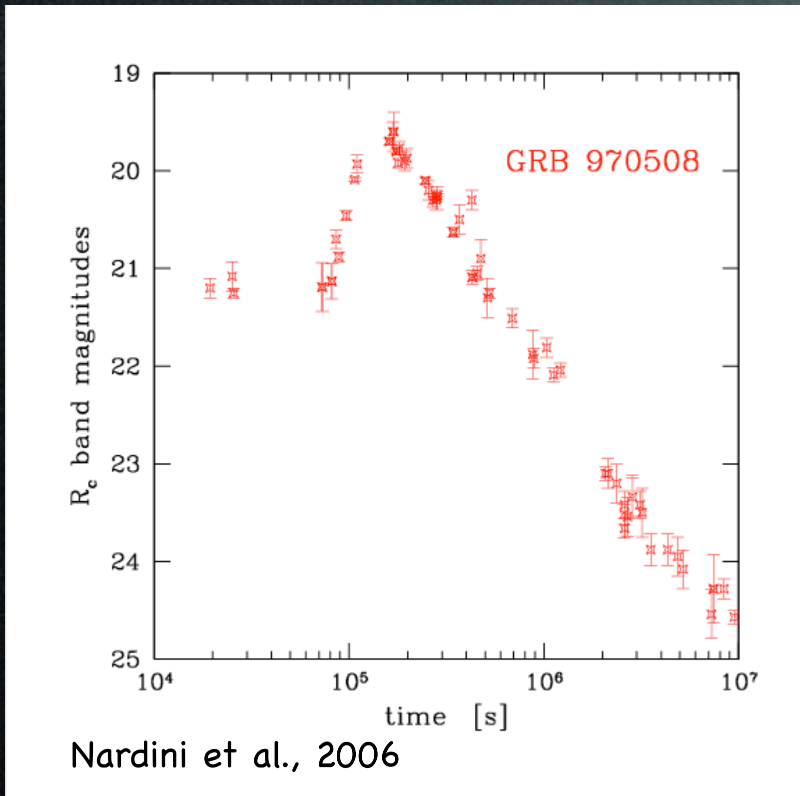
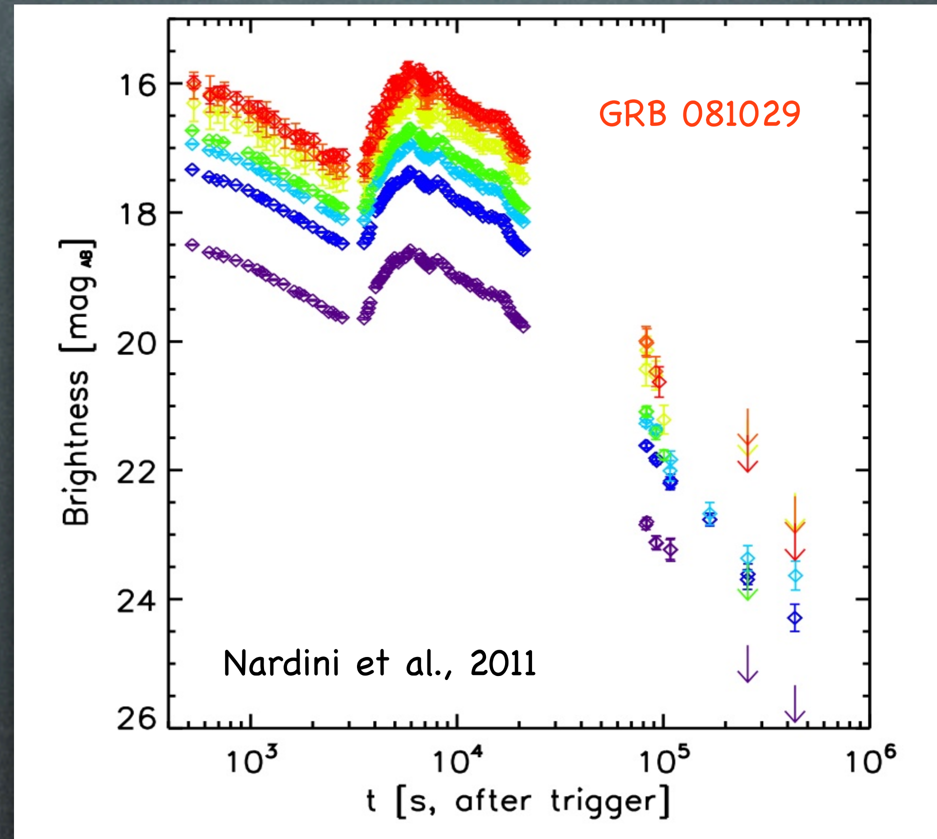
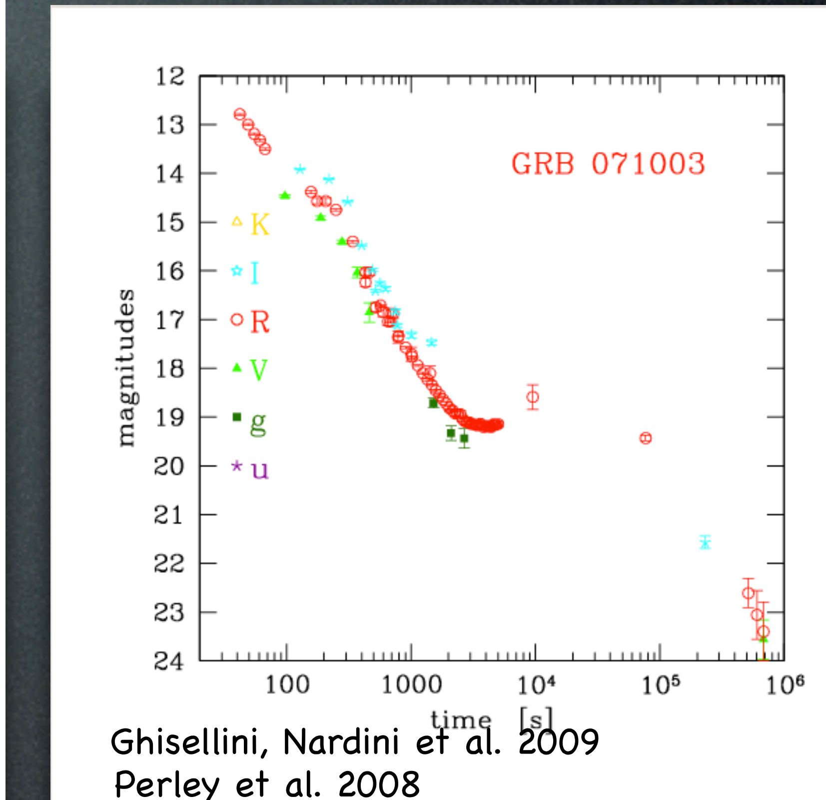
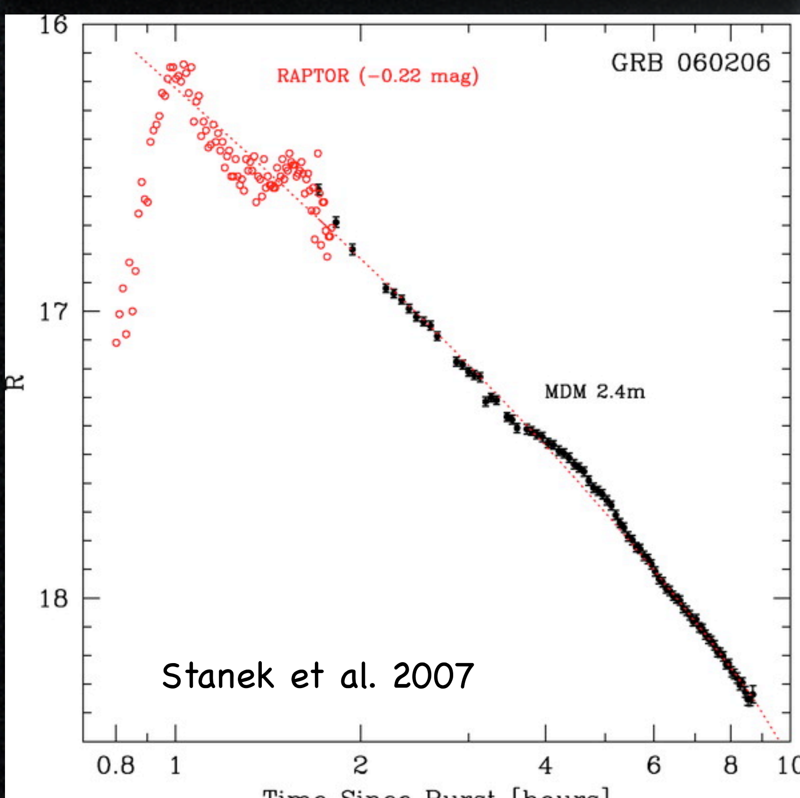
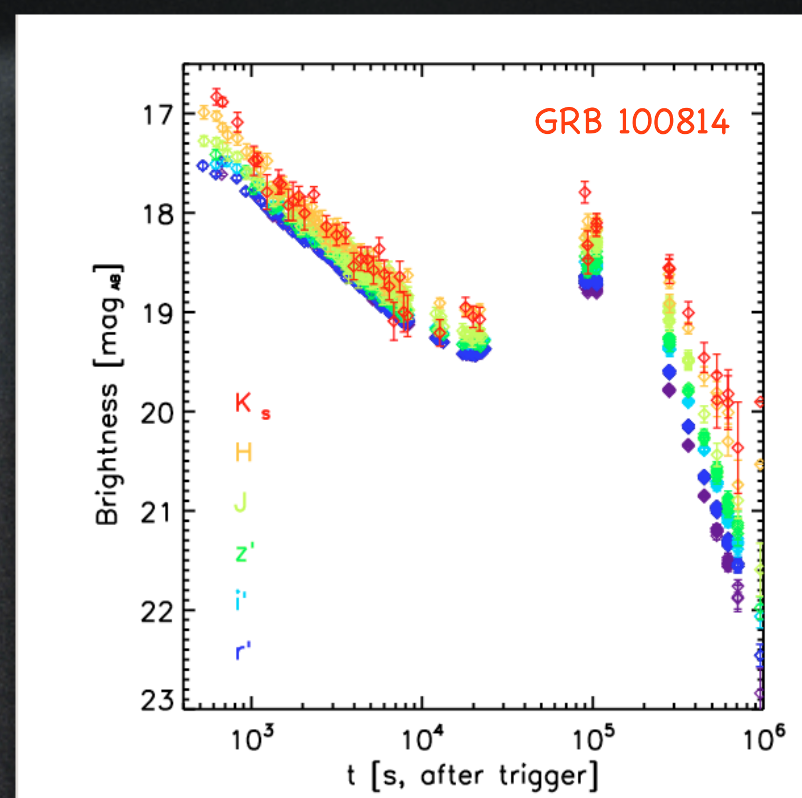
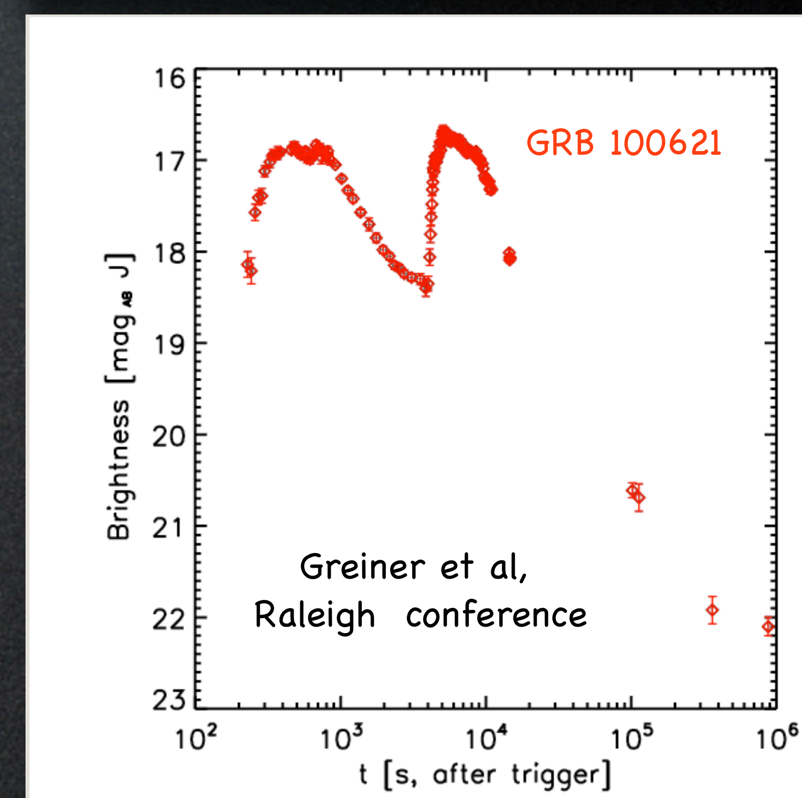




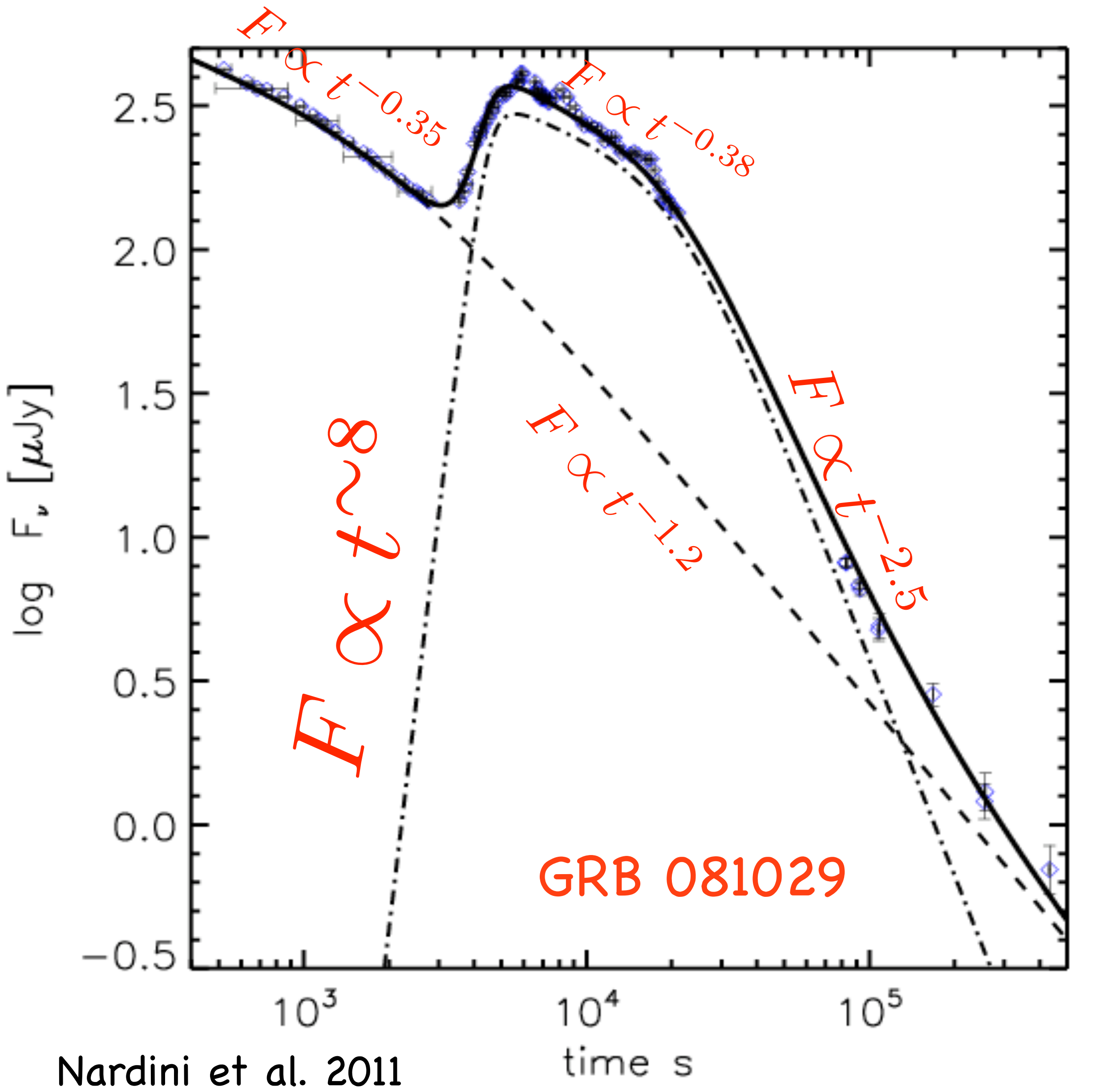








LIGHT-CURVE FITTING



Nardini et al. 2011

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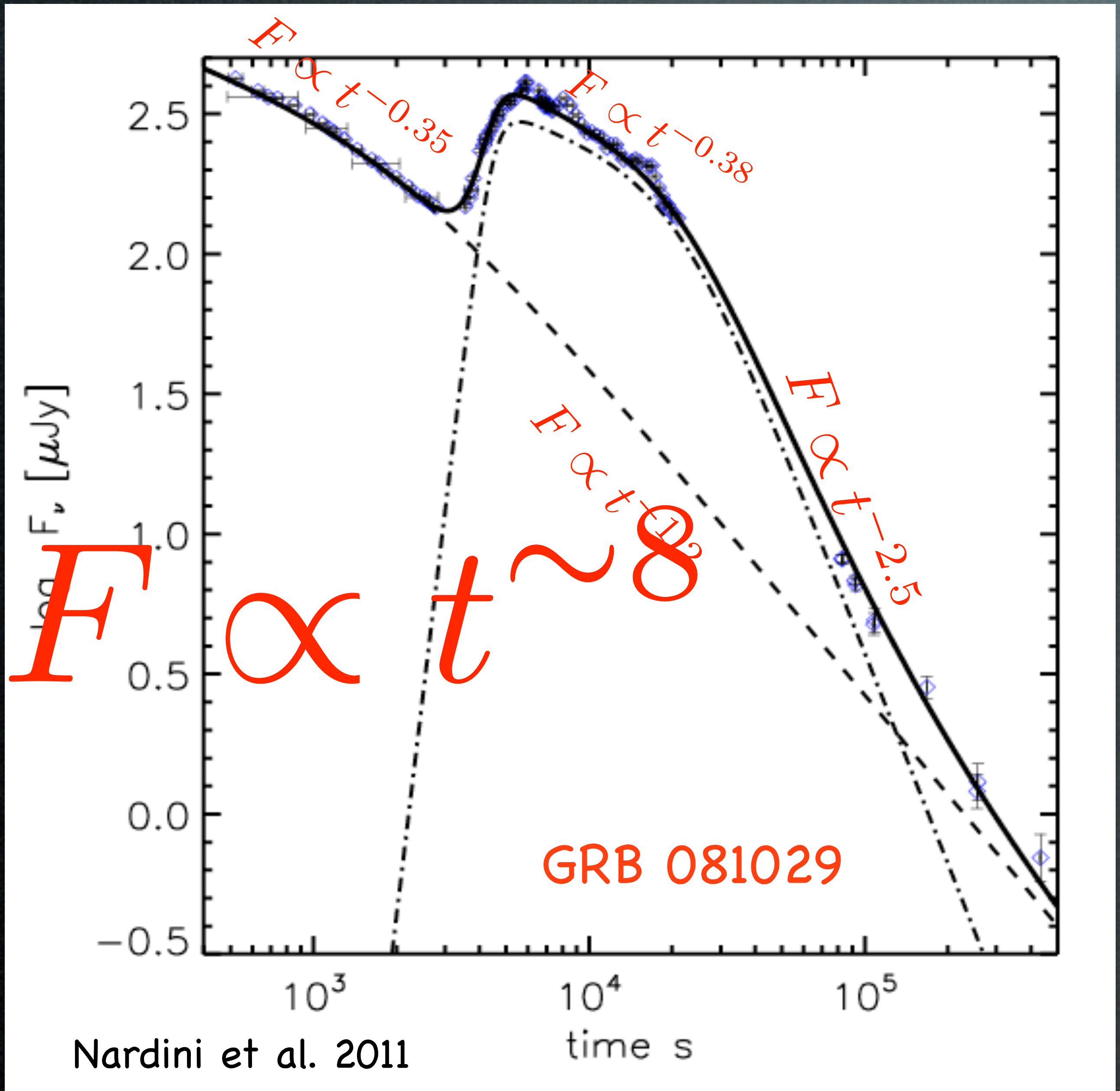

Some events show extremely fast second component rise

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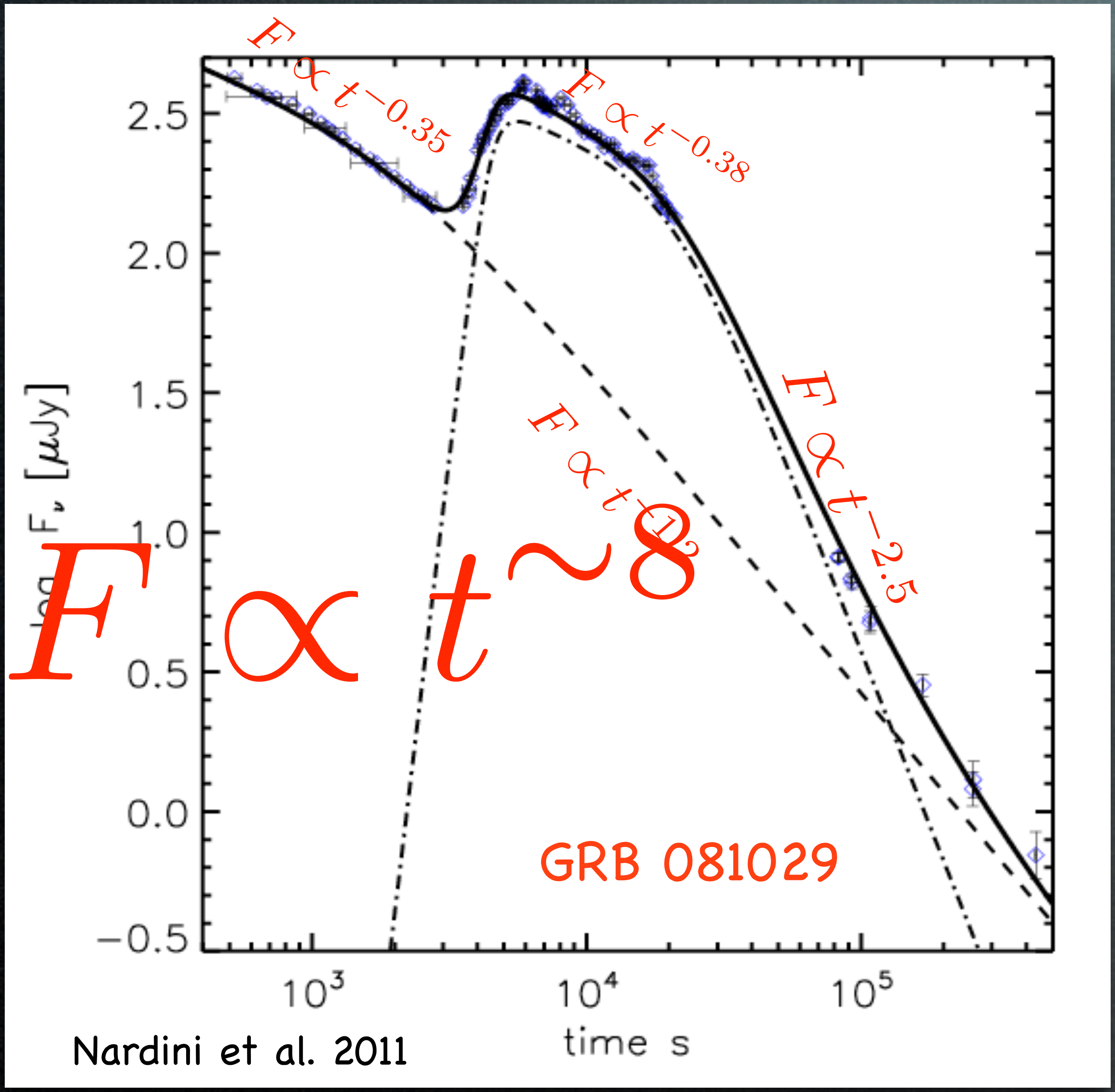

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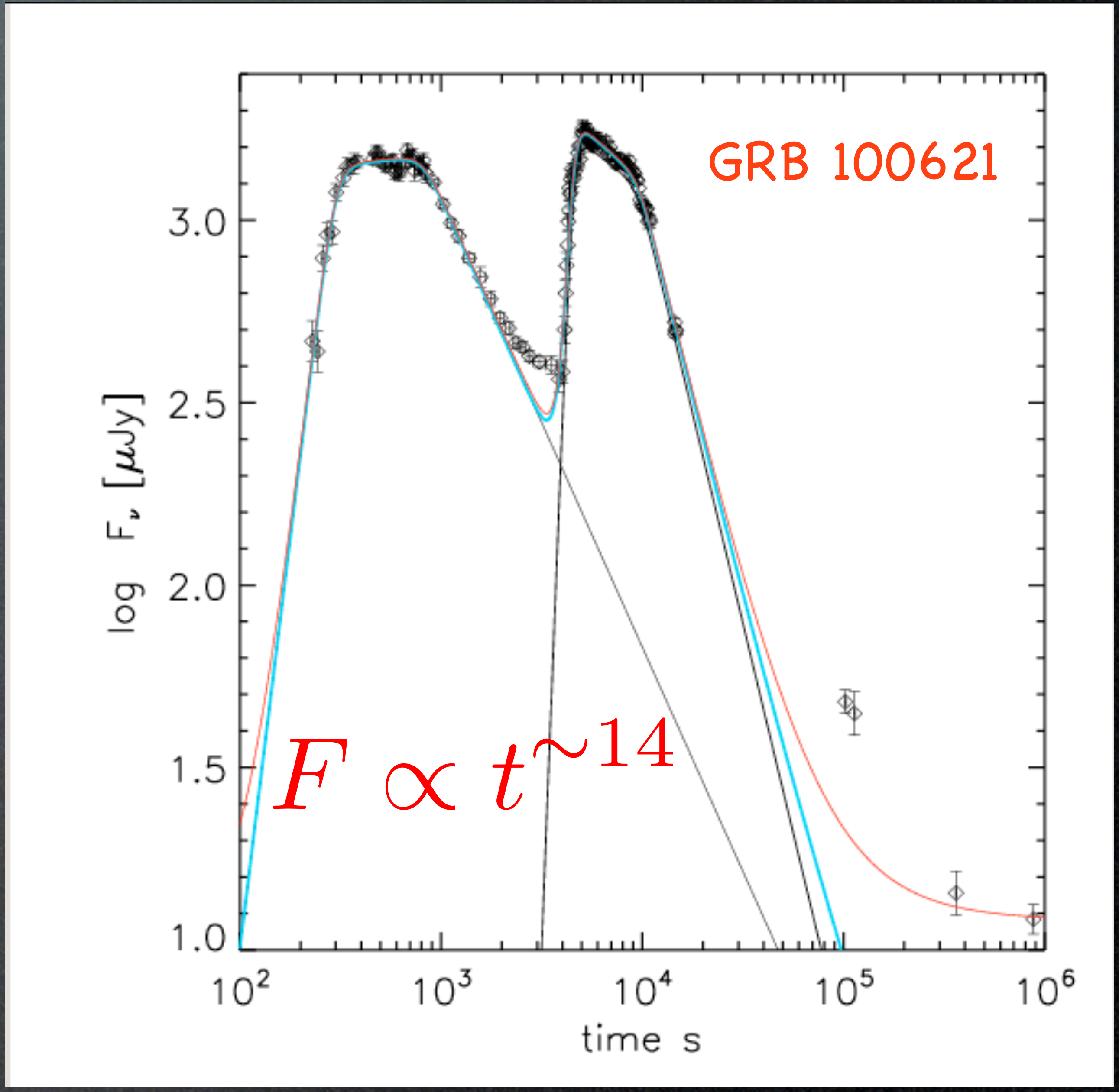
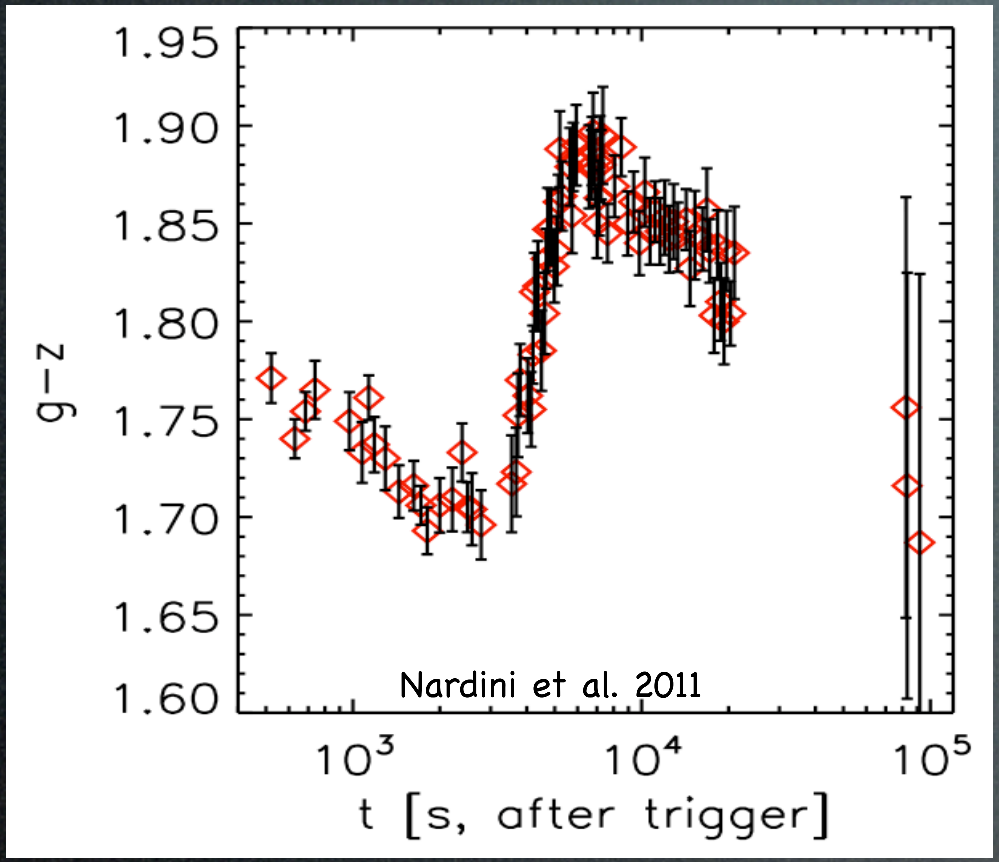
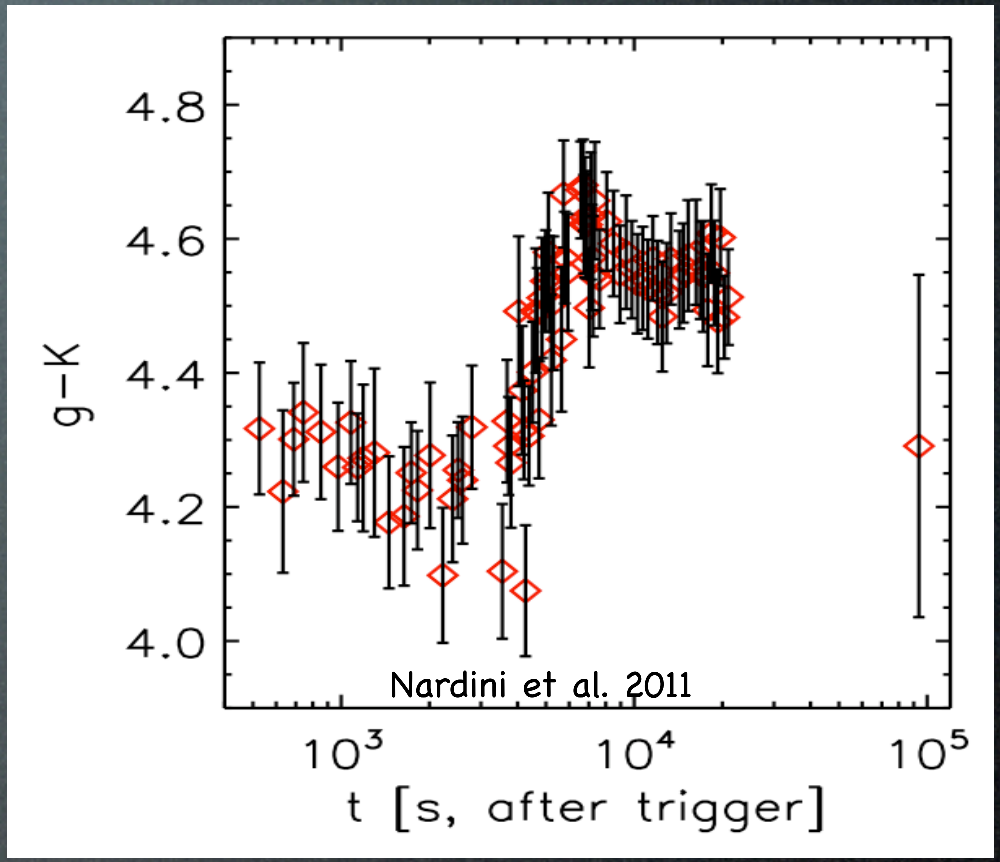
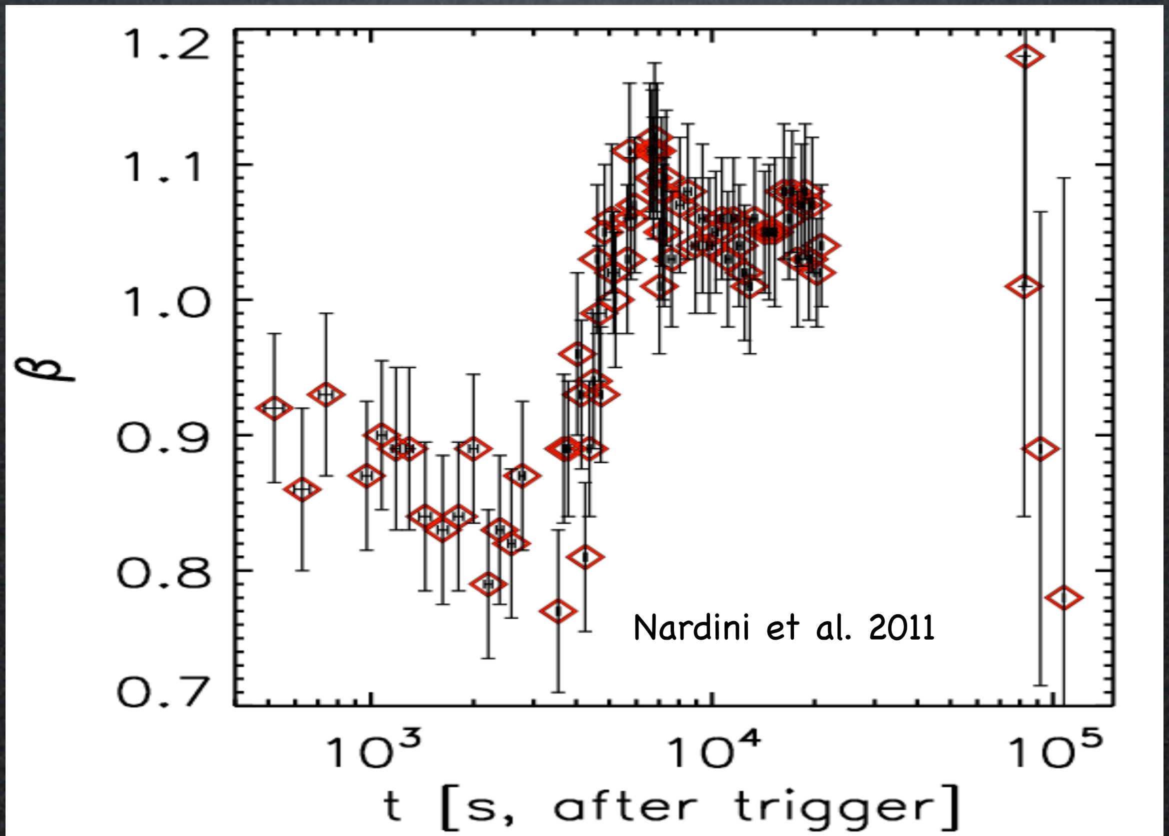


GRB 081029 OPTICAL-NIR COLOUR EVOLUTION

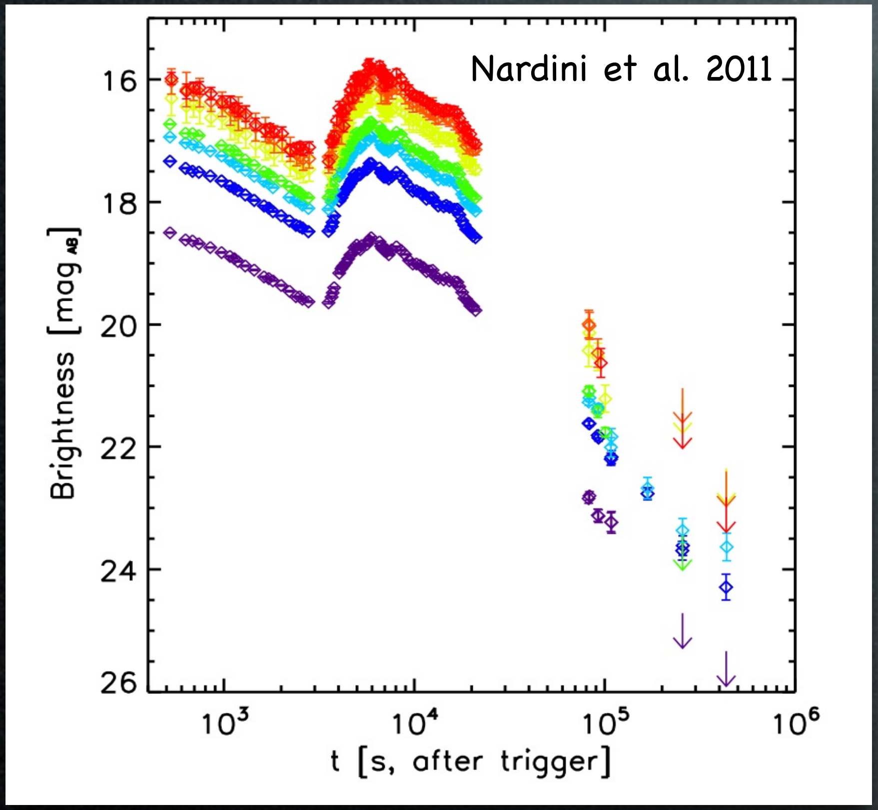


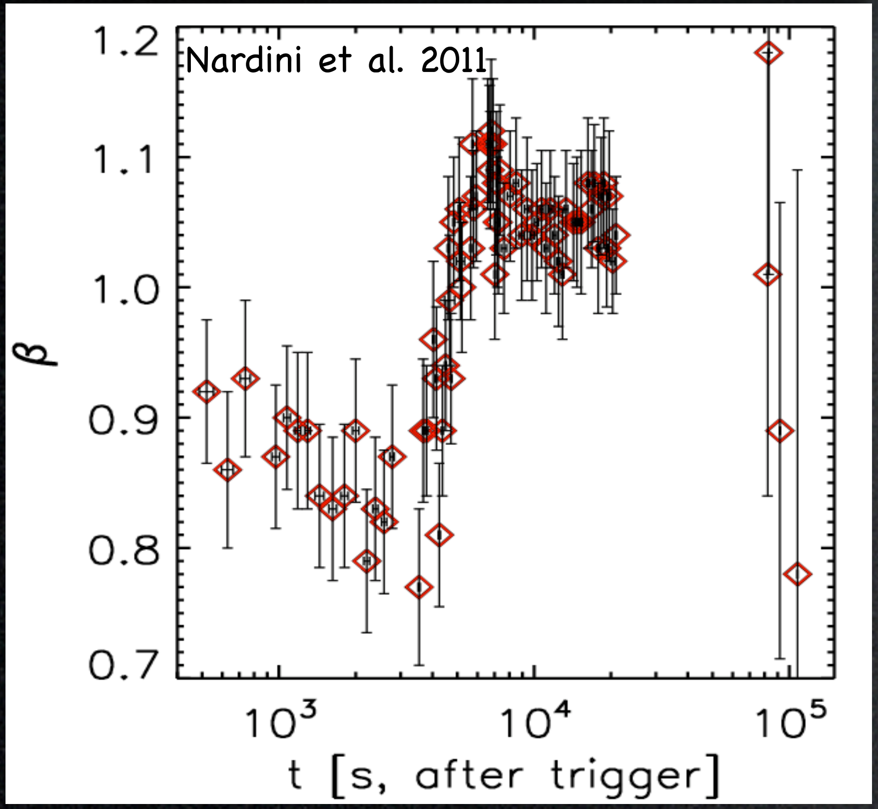




OPTICAL-NIR COLOUR EVOLUTION

A common behaviour?





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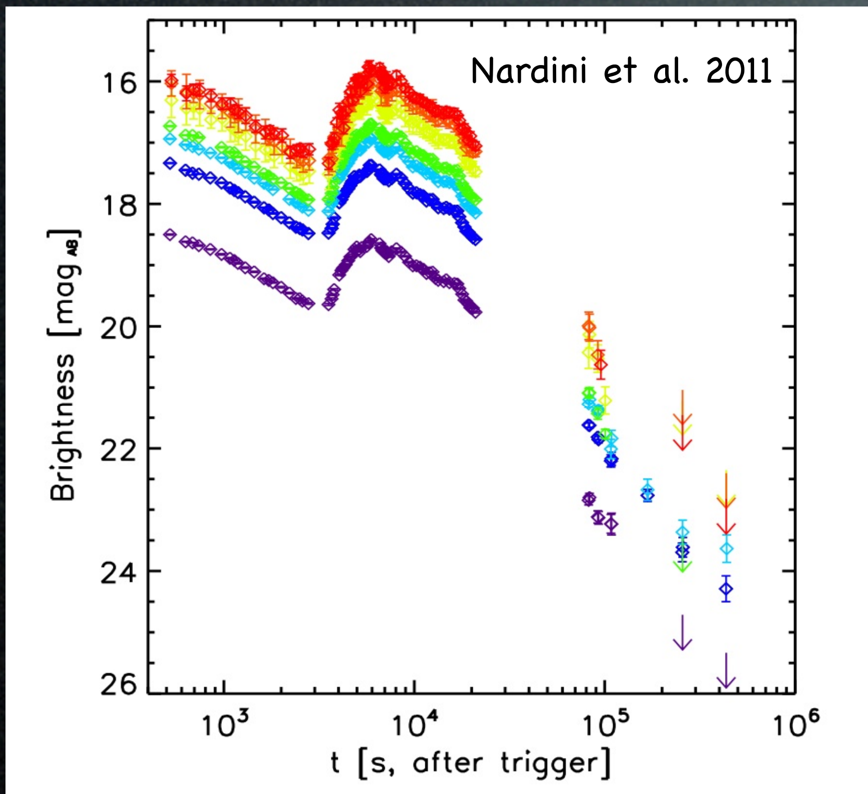

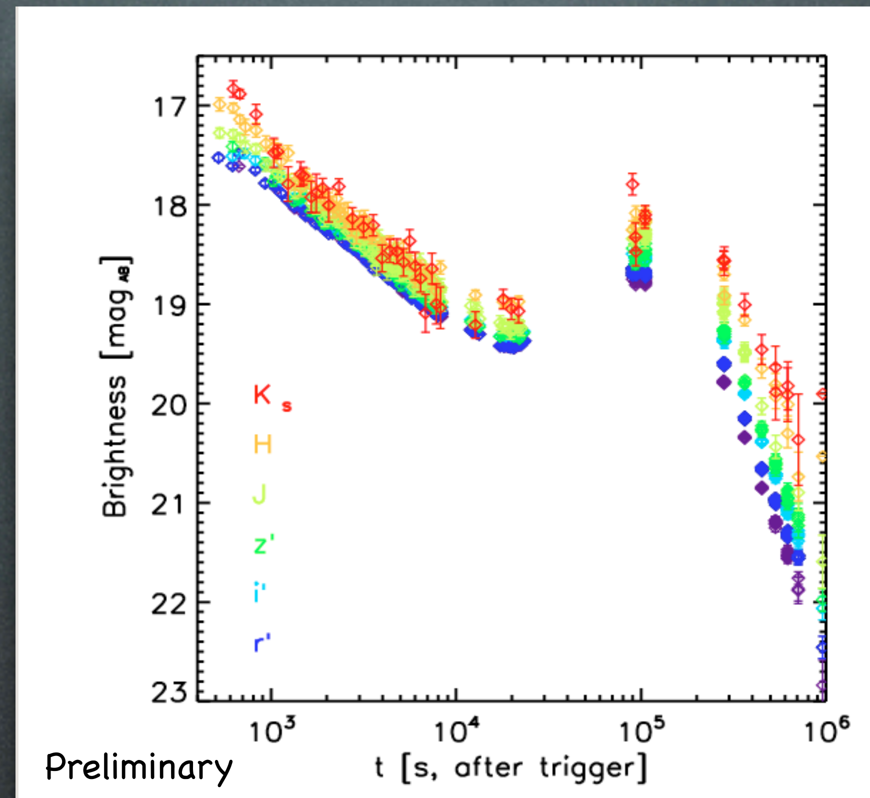

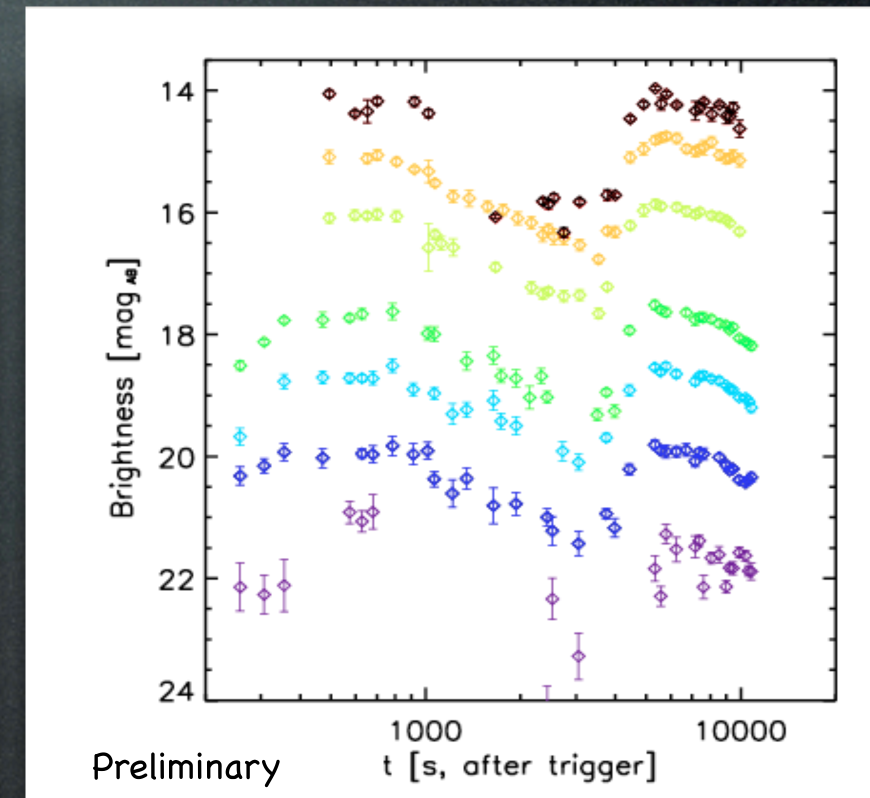

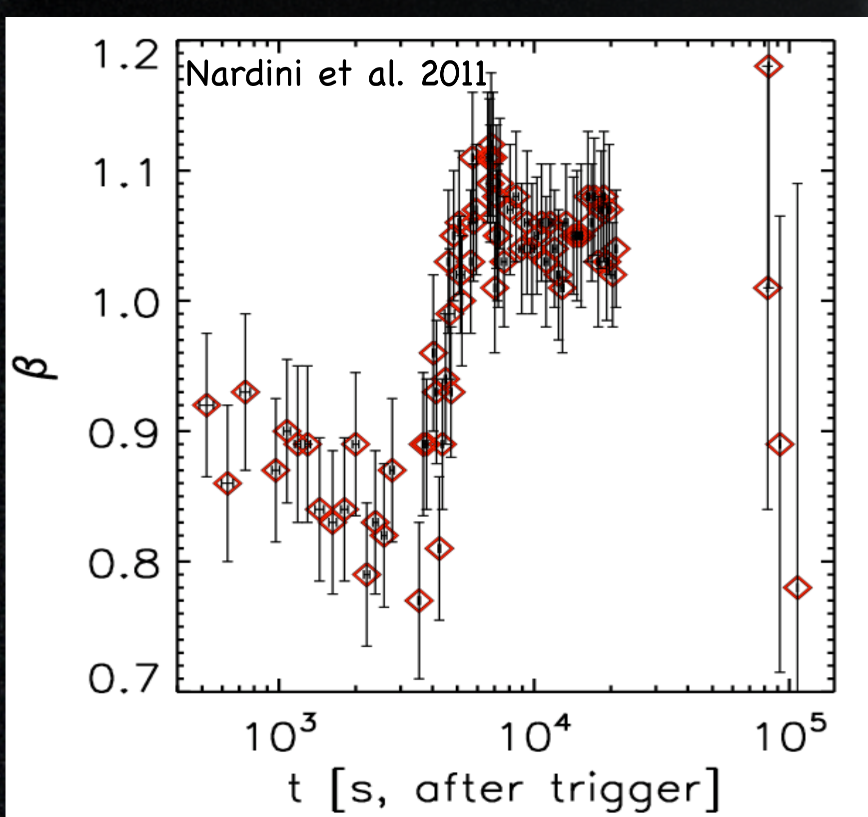

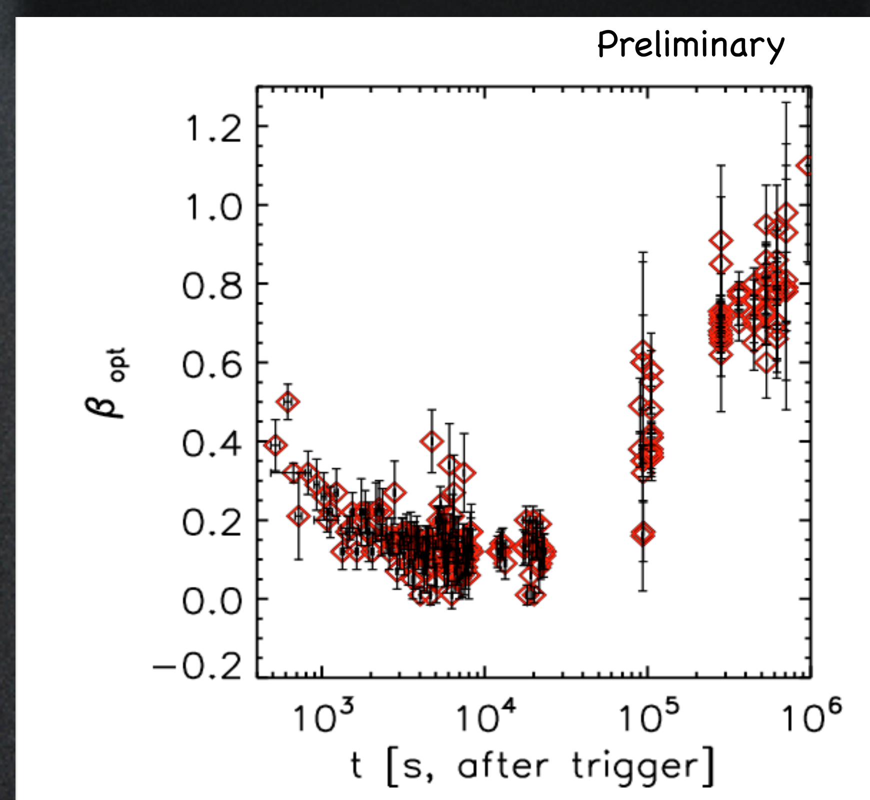

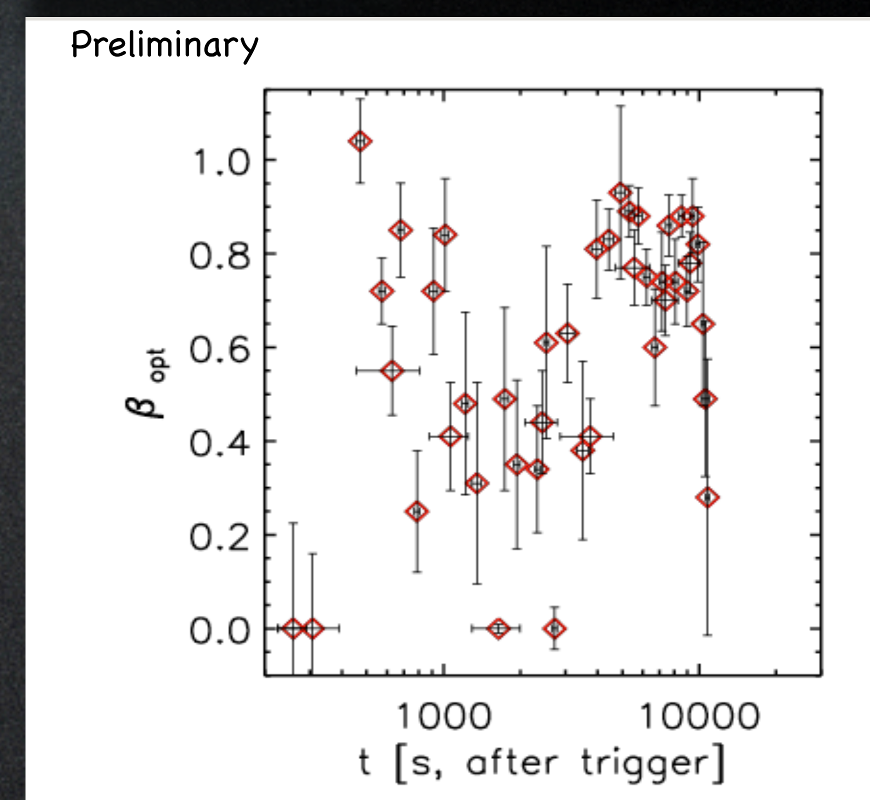

WHAT CAN PRODUCE SUCH A BUMP?

Any among the most commonly invoked scenarios?

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INHOMOGENEOUS EXTERNAL MEDIUM

(Dai & Wu 2003, Lazzati et al. 2002...)

PRO

- Physical justification
- Bump not visible in the X-rays

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- Sharpness of the bump (Nakar & Granot 2007, van Erten et al. 2009)

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MULTIPLE JET MODEL

Racusin 2008,De Pasquale 2009,Filgas 2010...

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- Achromatic post break evolution

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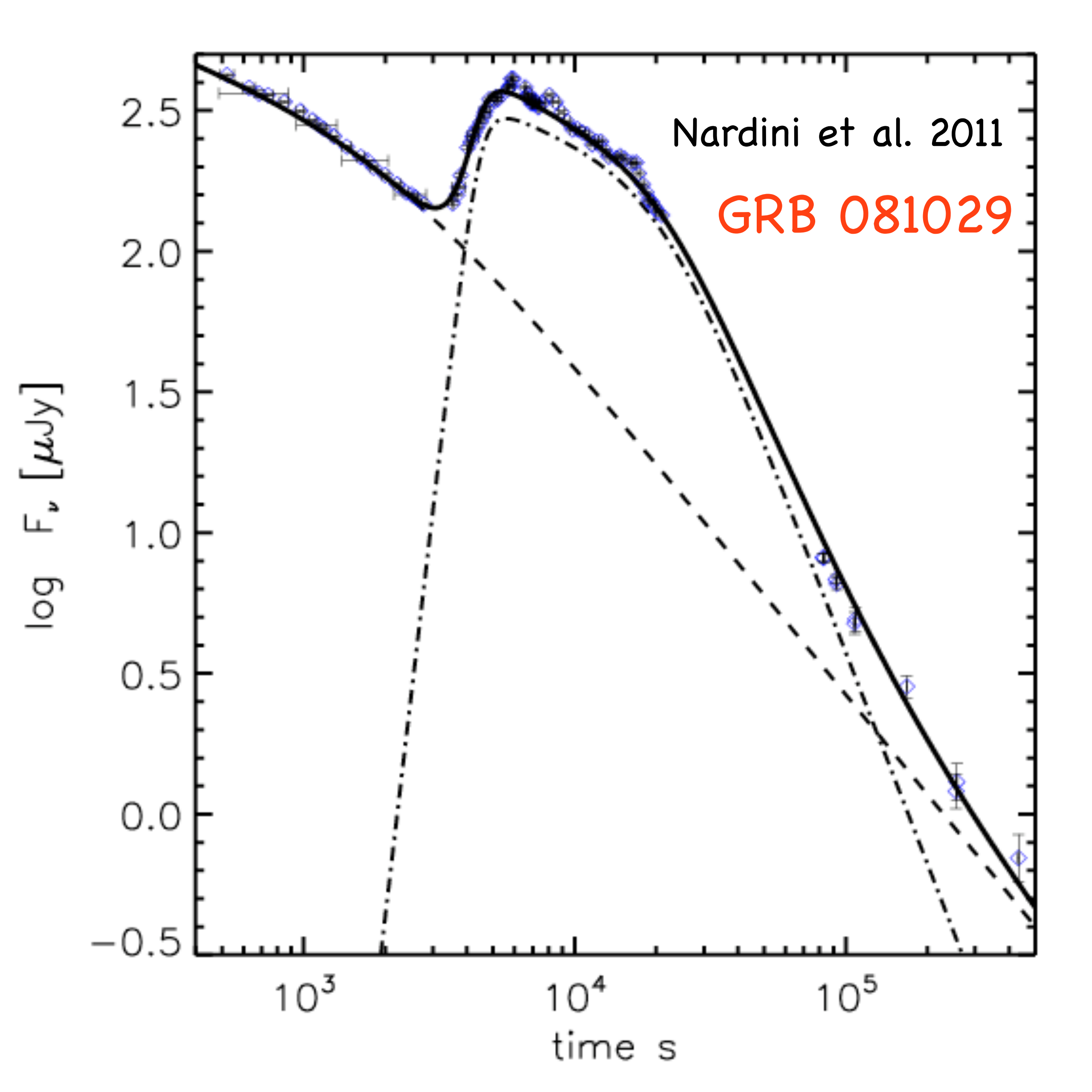

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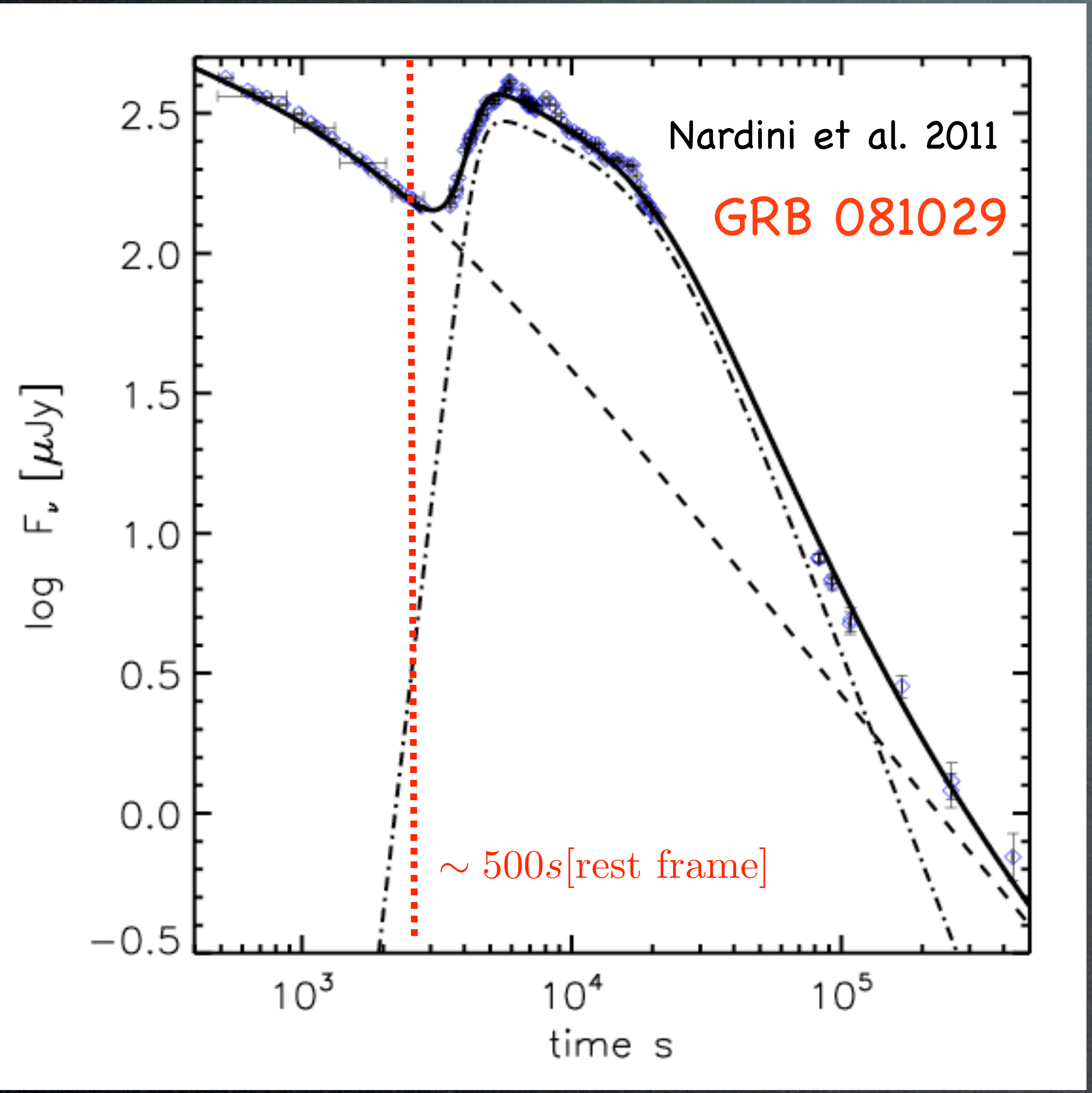

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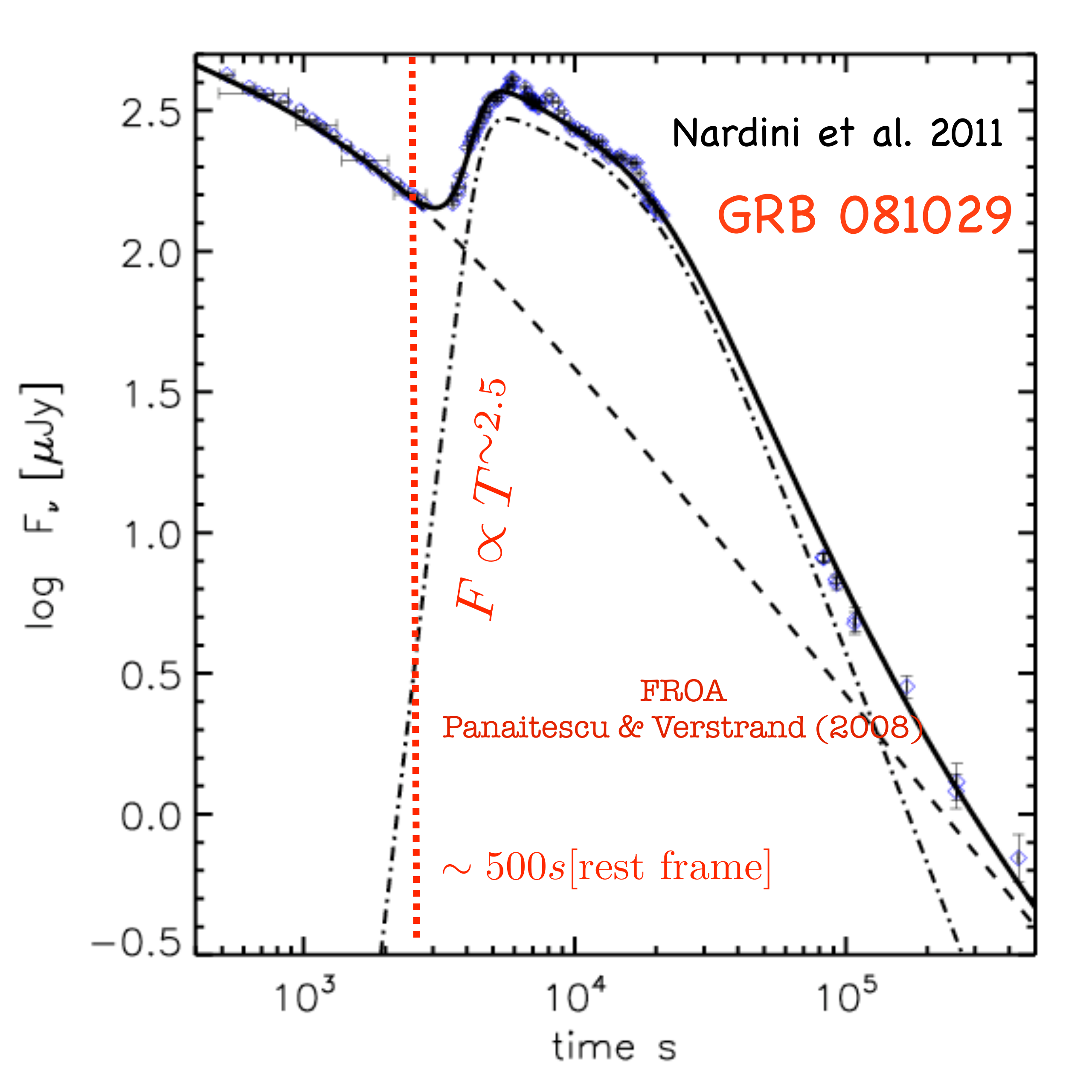

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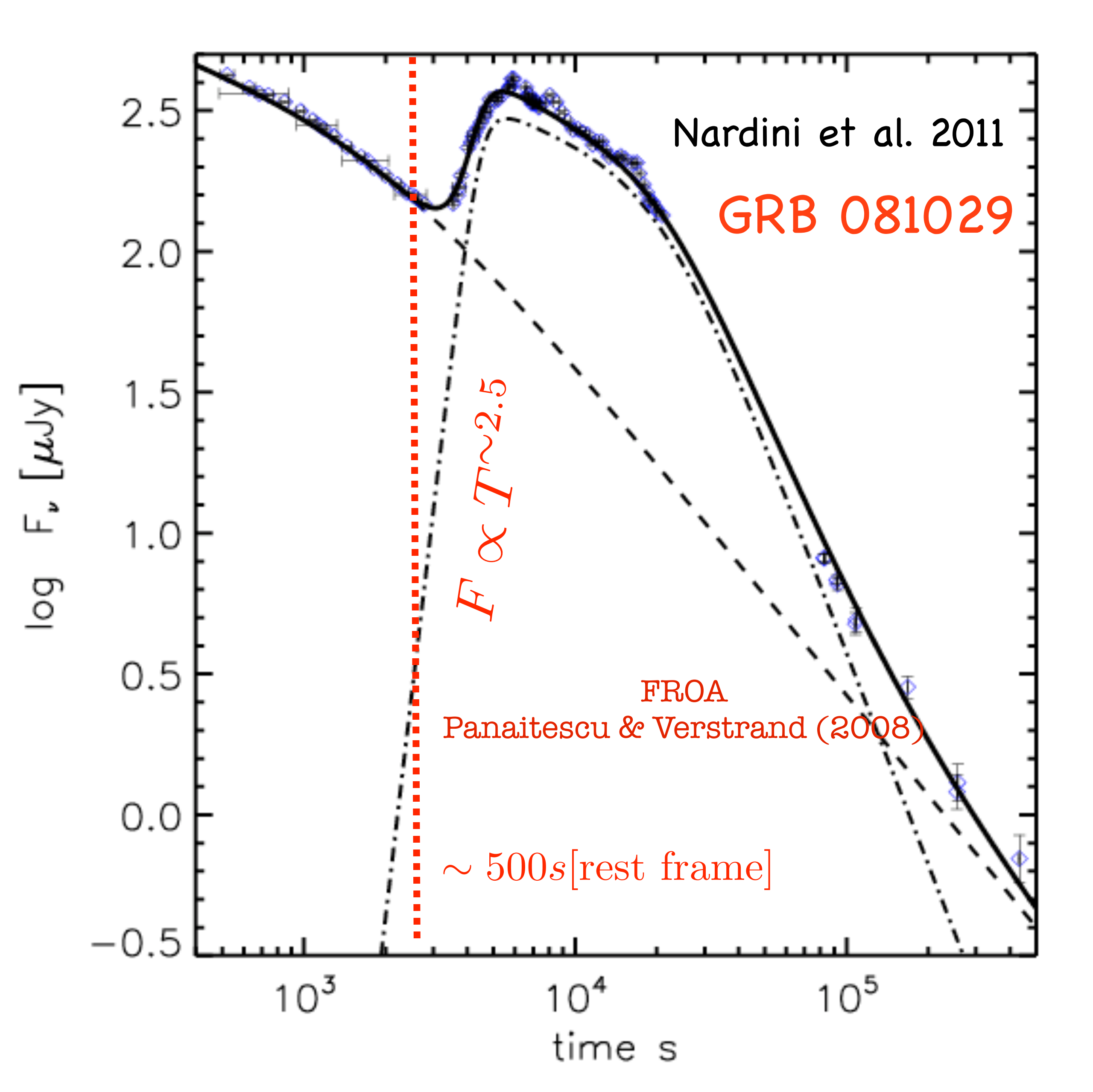

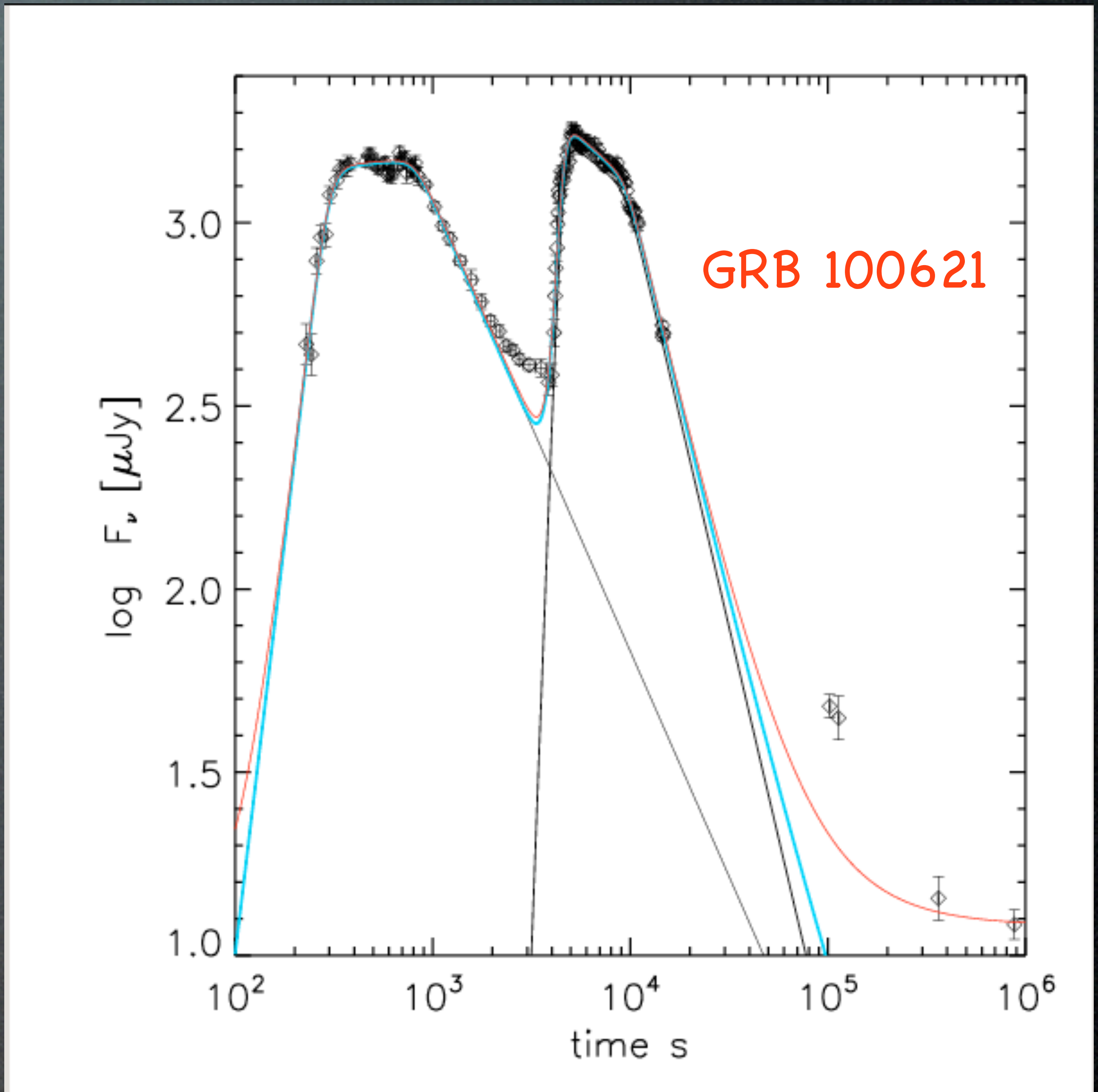

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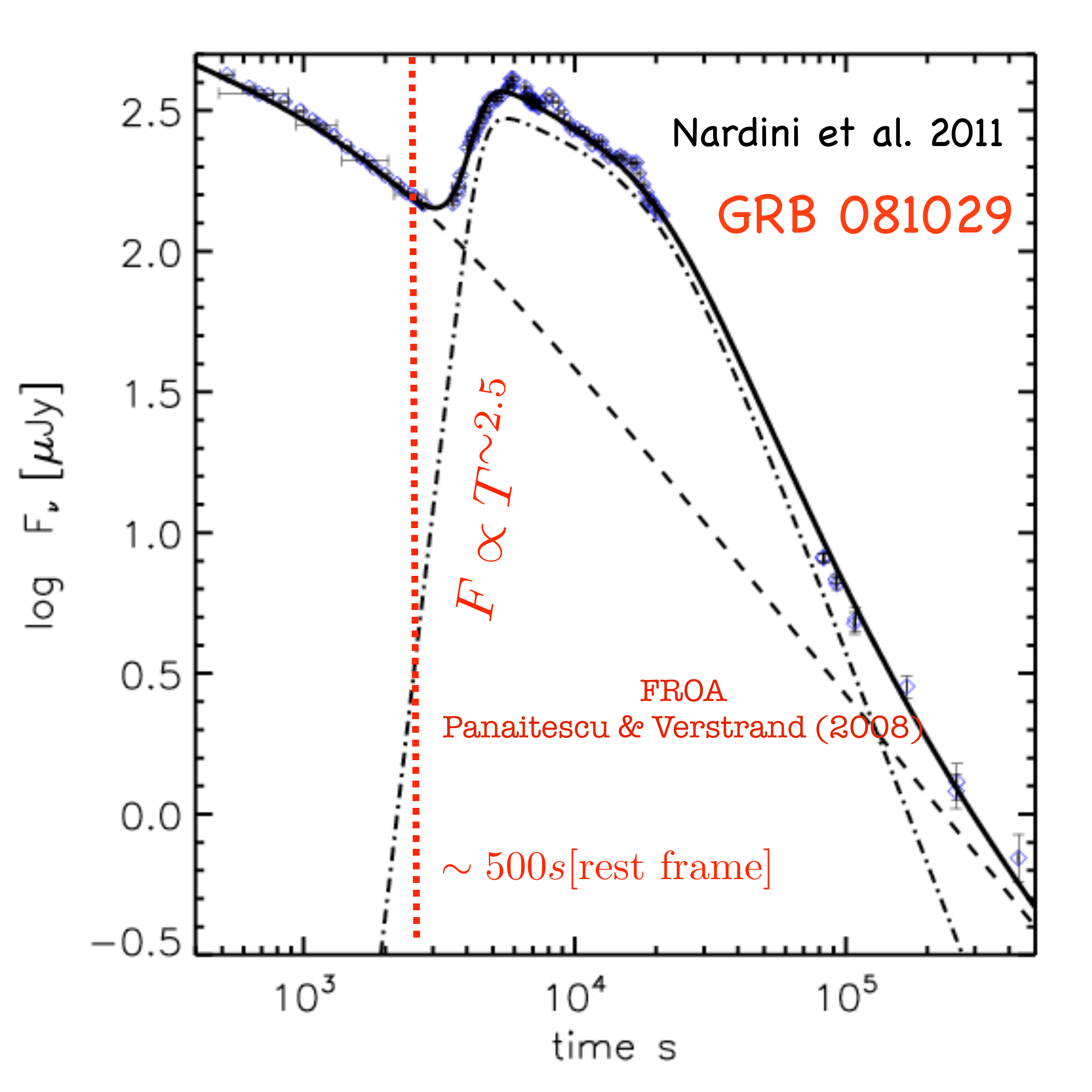

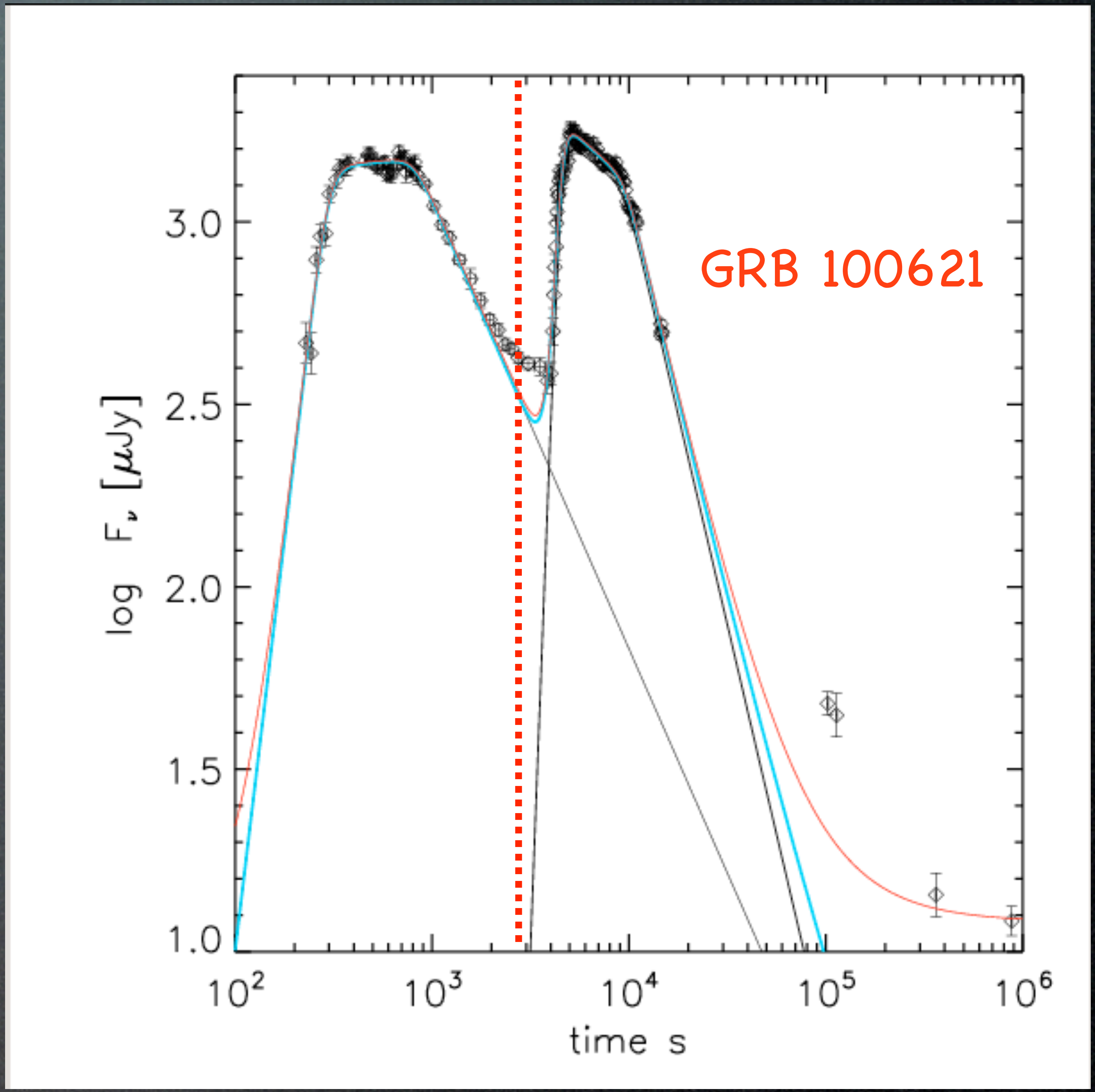

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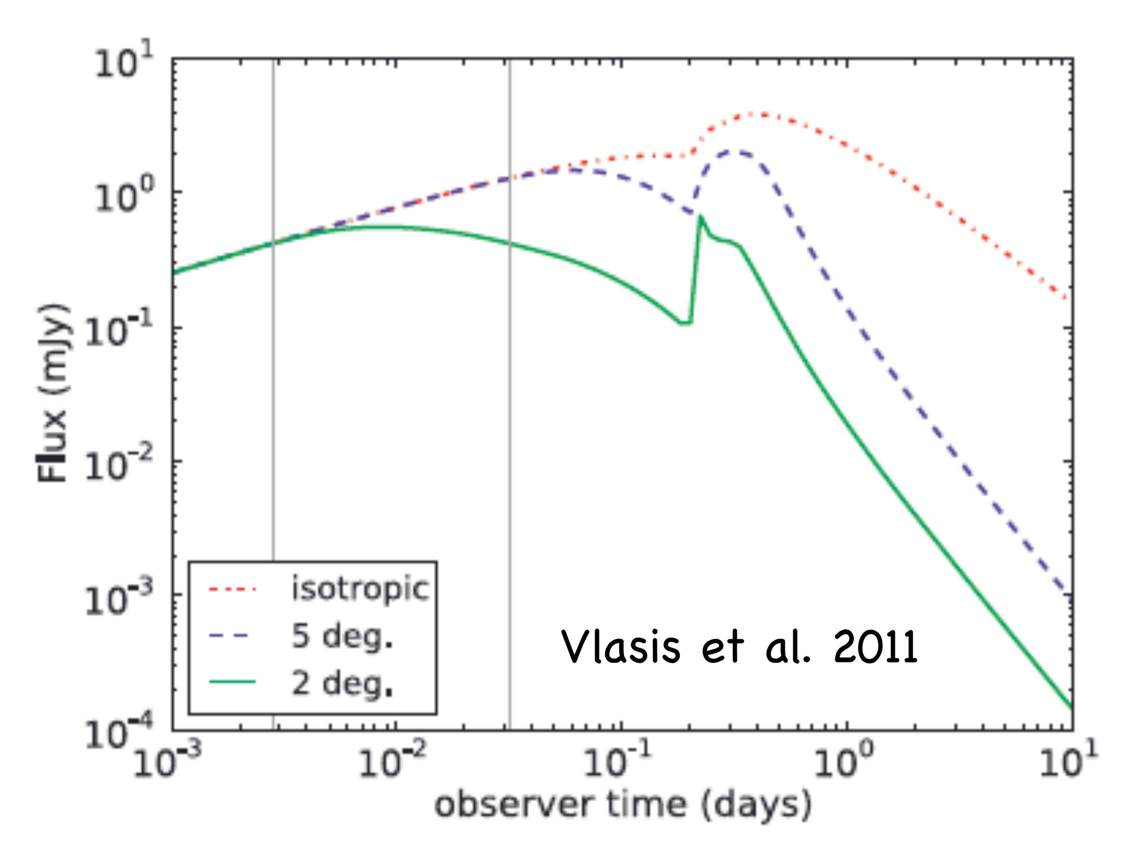

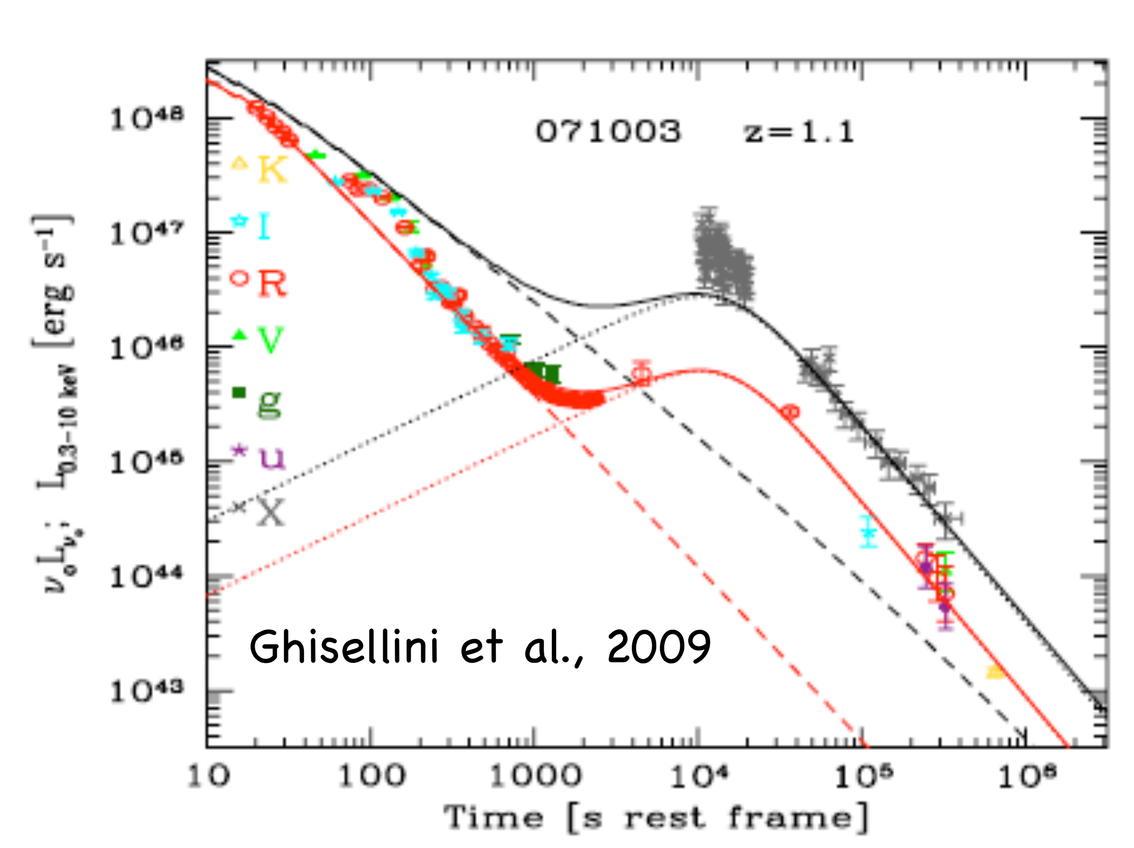

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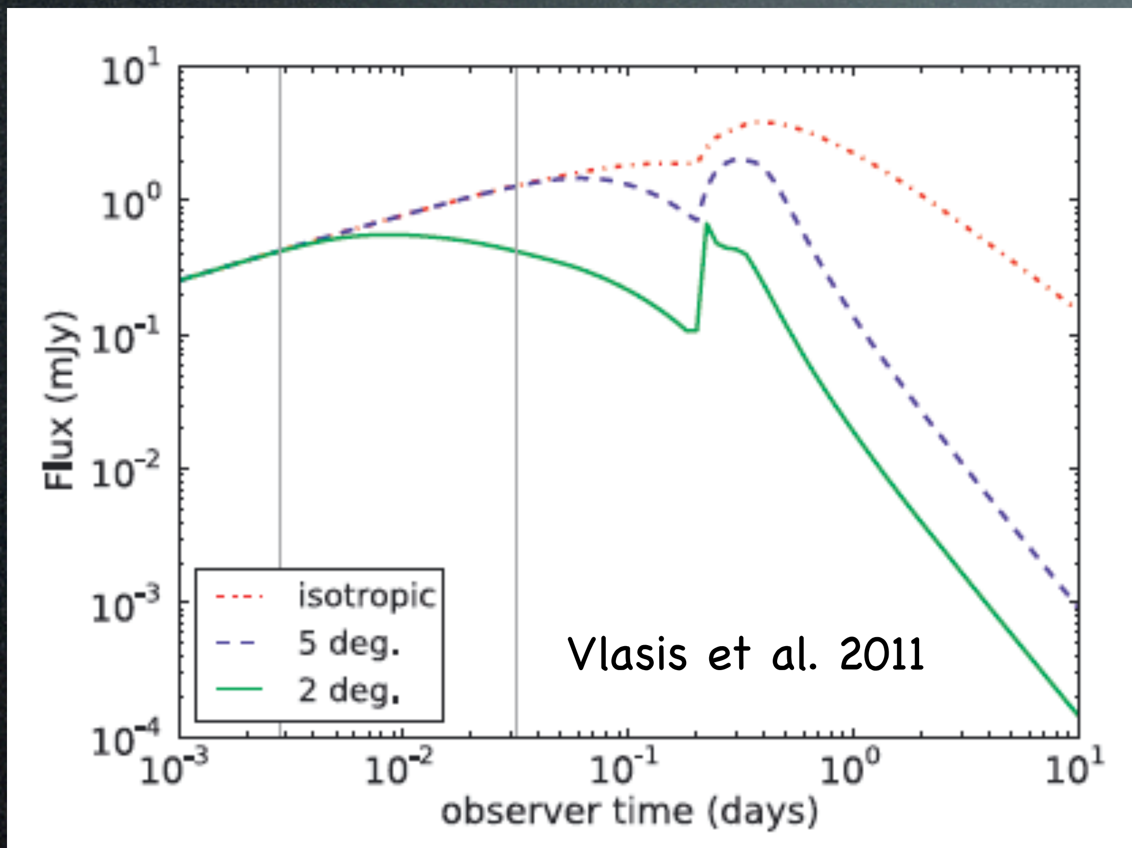
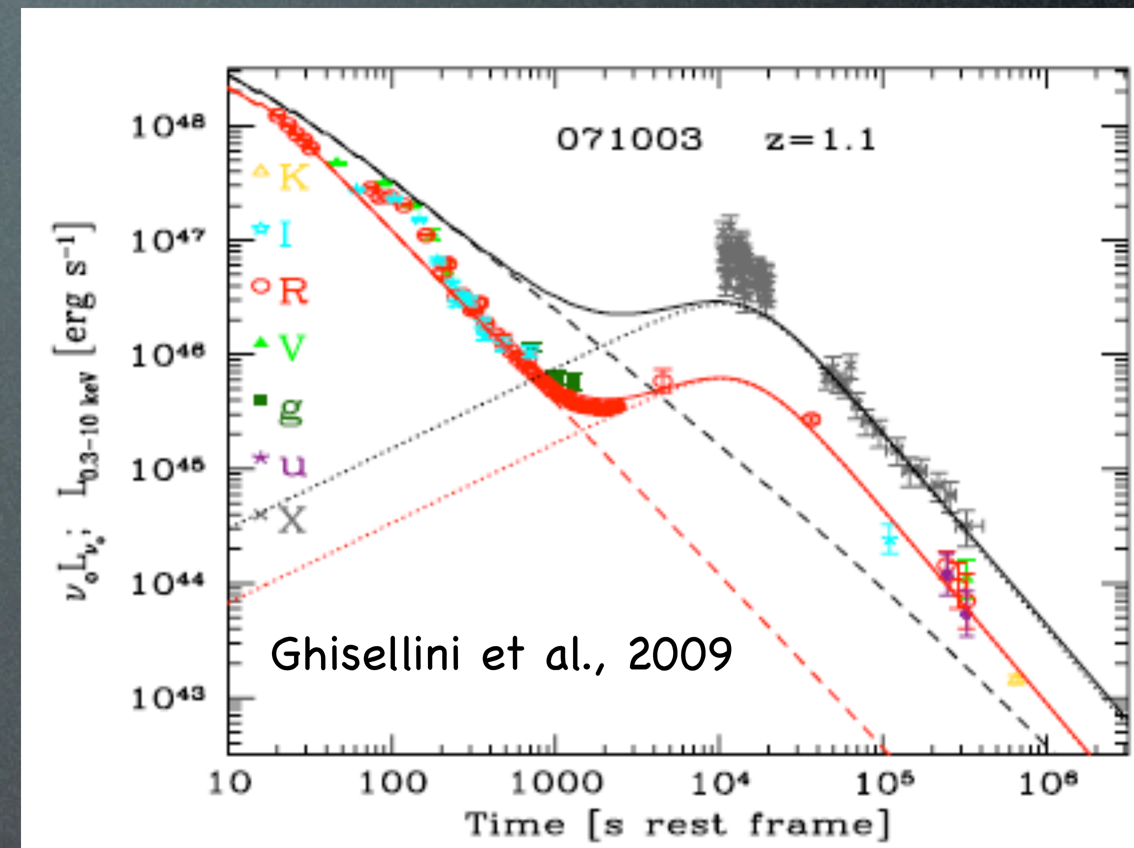




Two shells collision

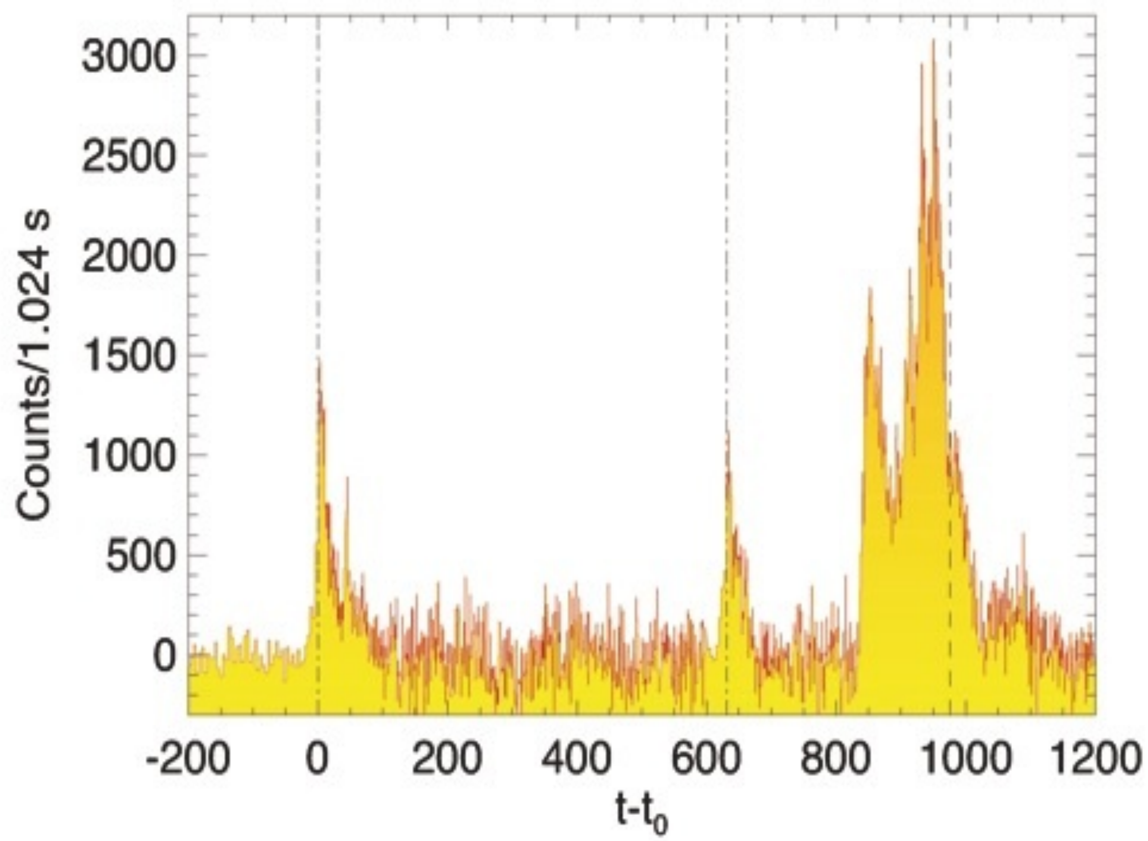
Rising late prompt component

Long lasting activity/reactivation of the central engine

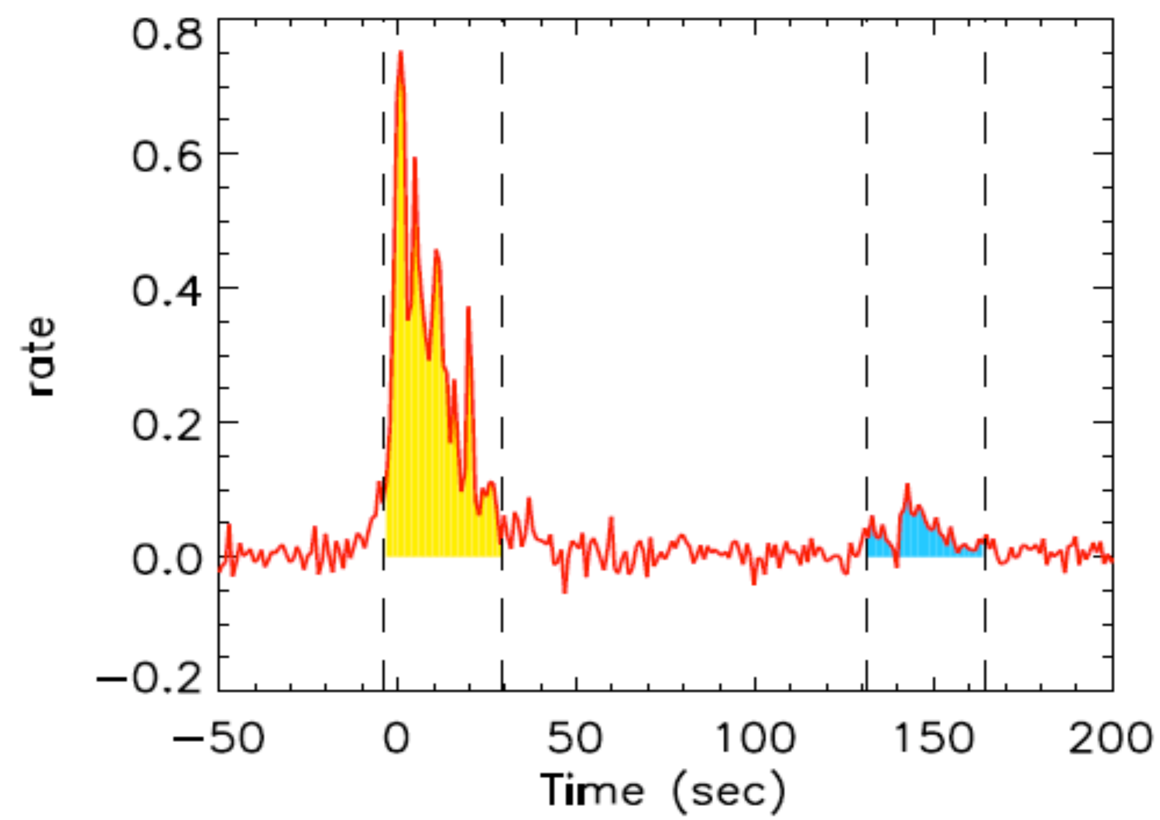
ANY EVIDENCE FROM OTHER BANDS?

Delayed pre and post cursors

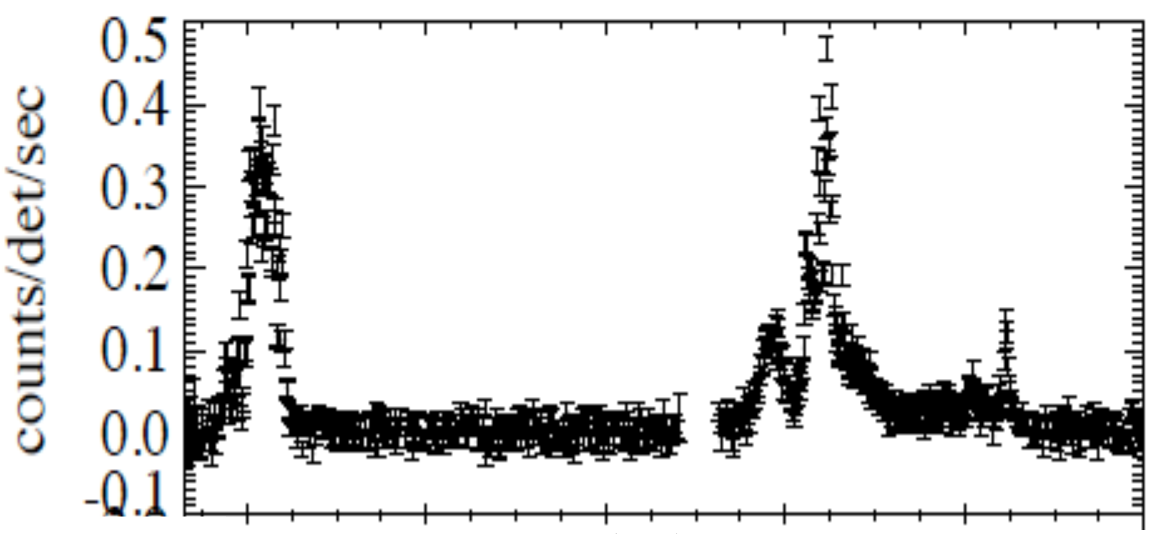
GRB 091024



GRB 071003

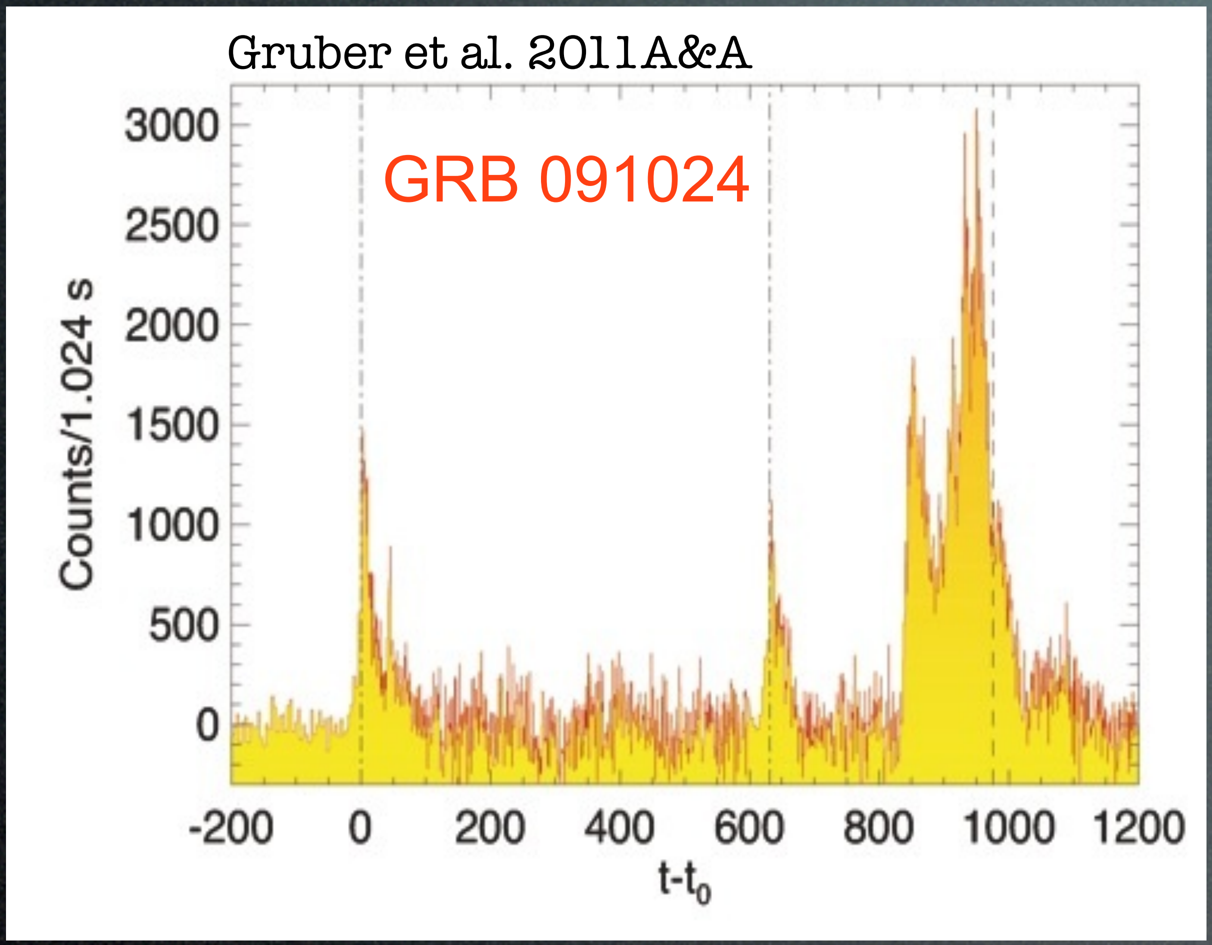


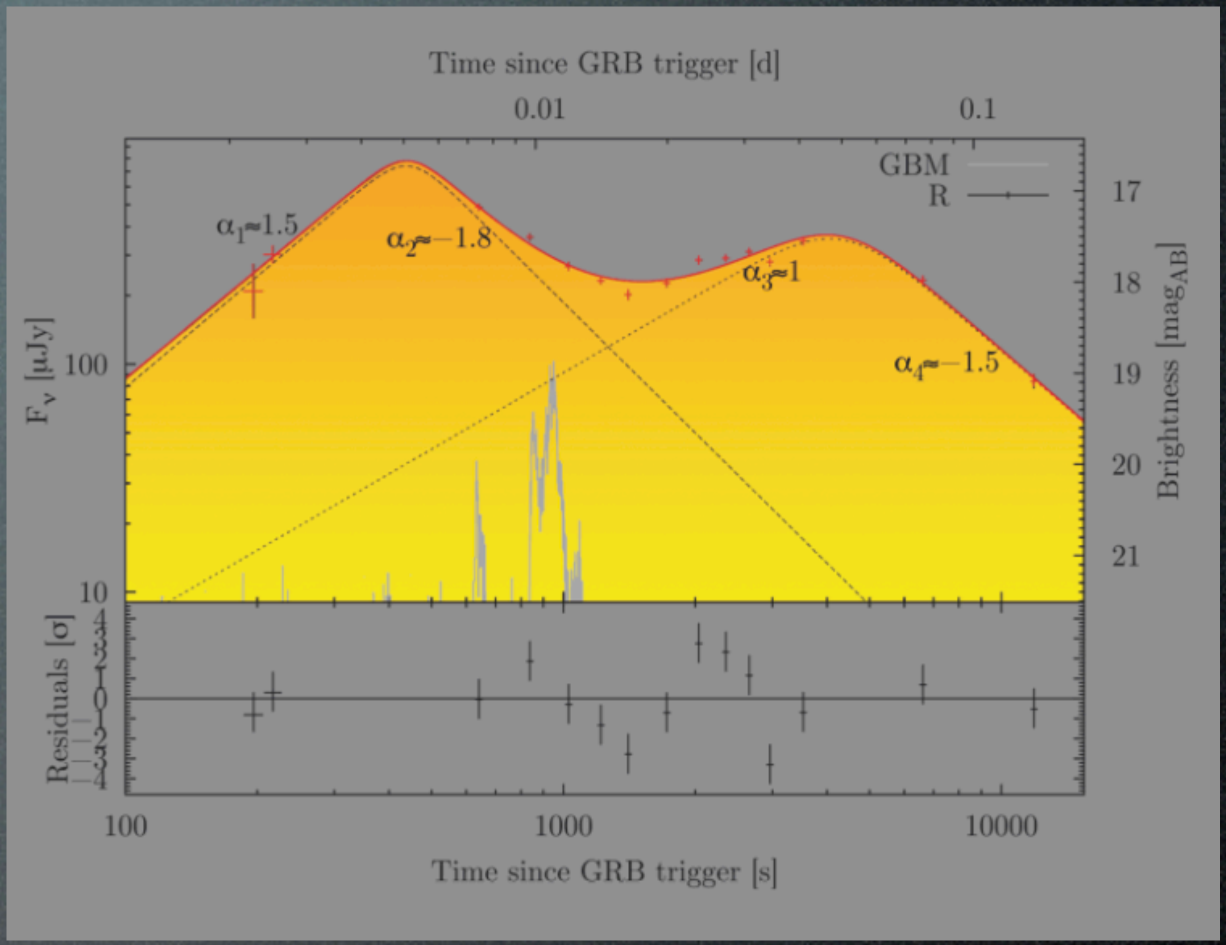
GRB 111709B

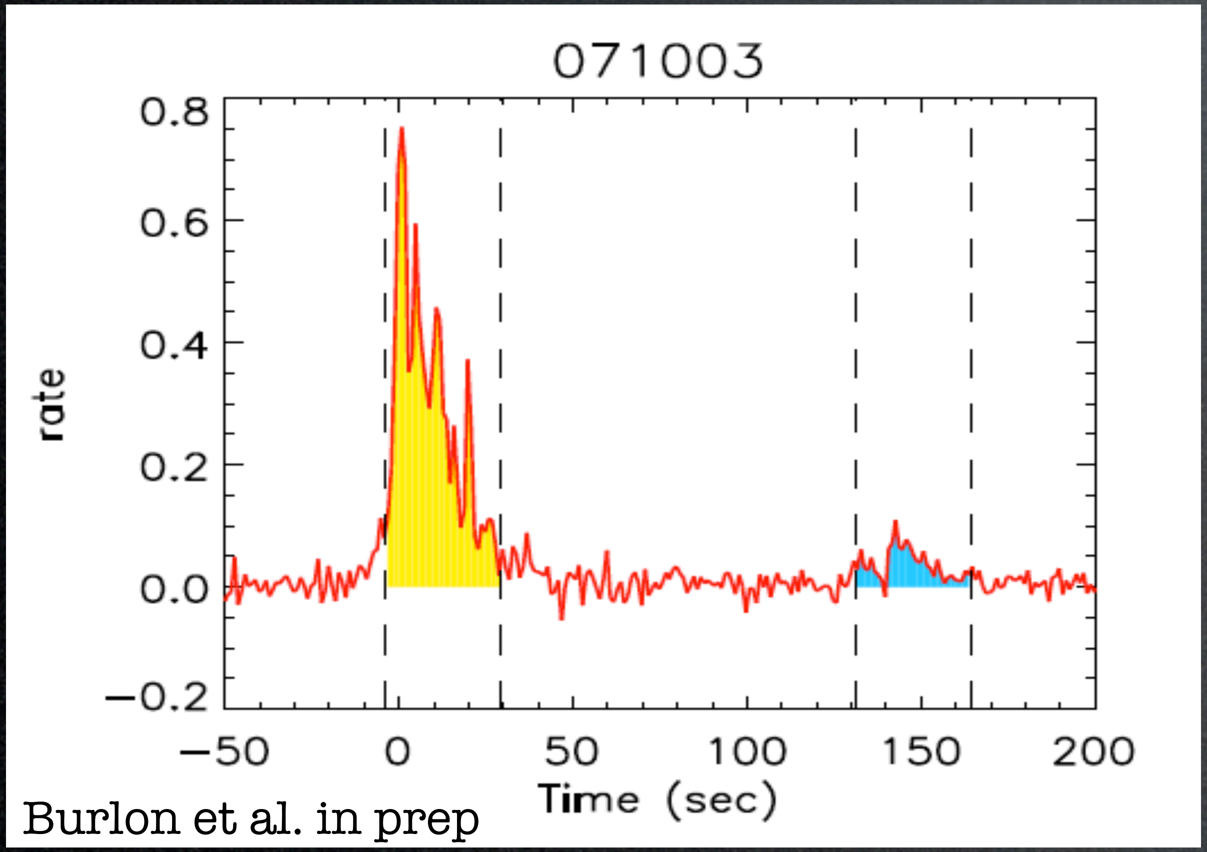


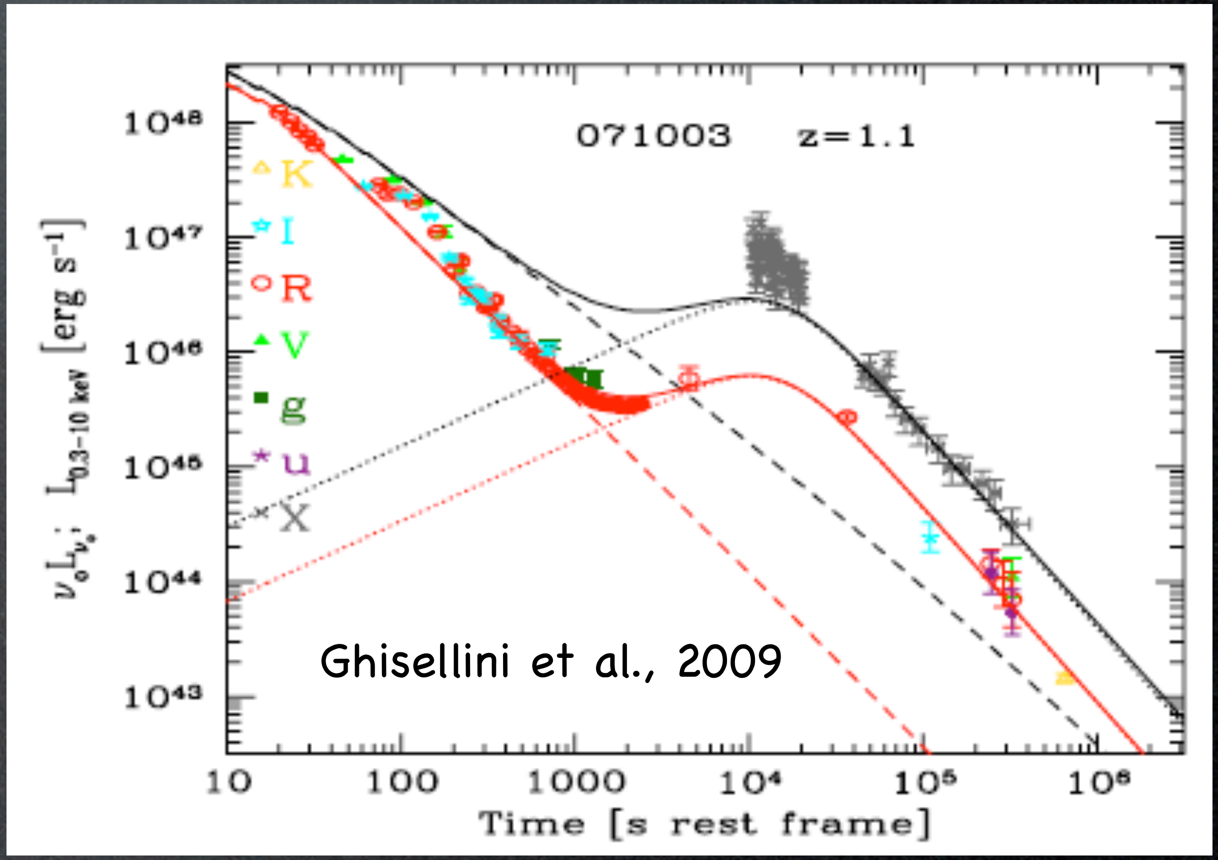
Zhang et al. 2012

Pre/Post-cursors and rebrightenings









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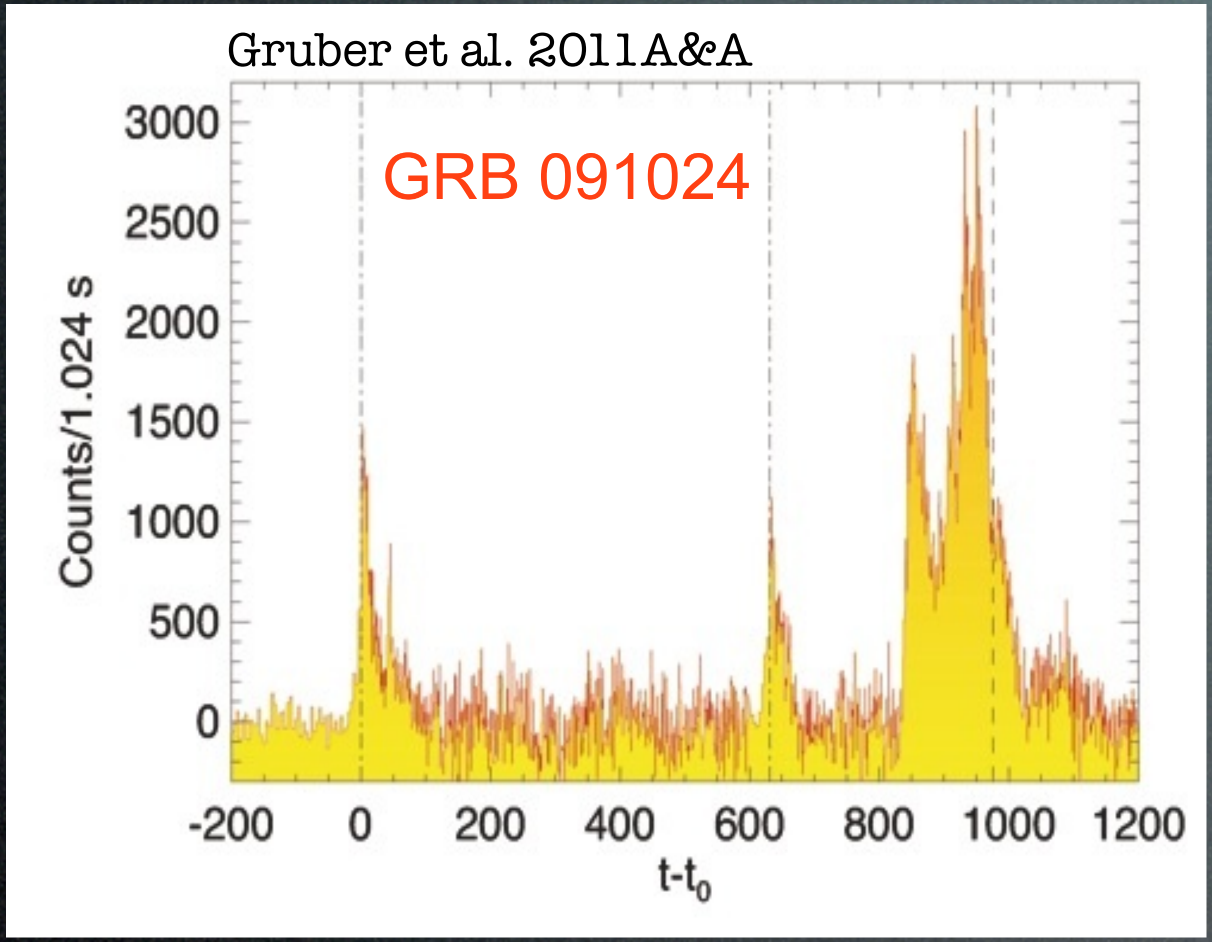
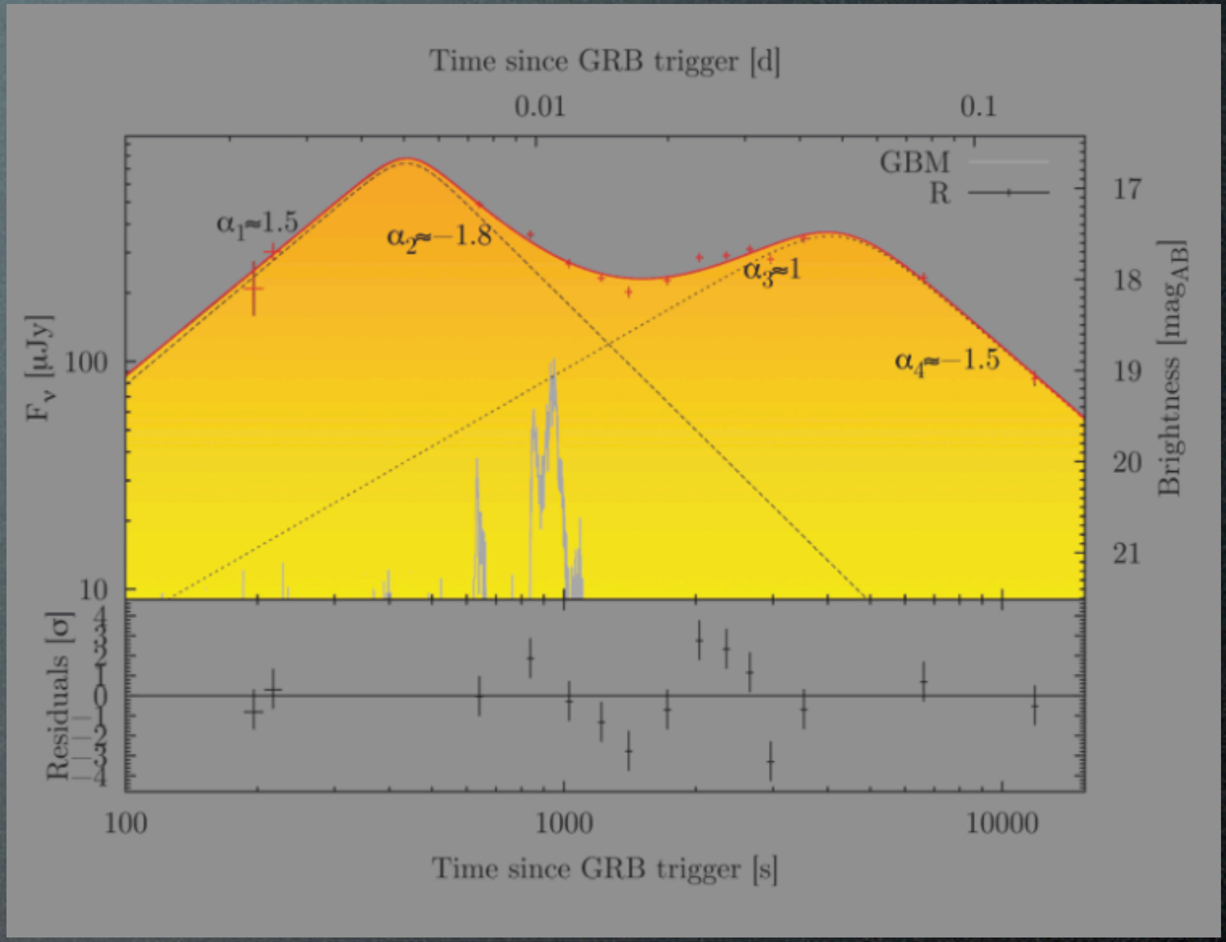
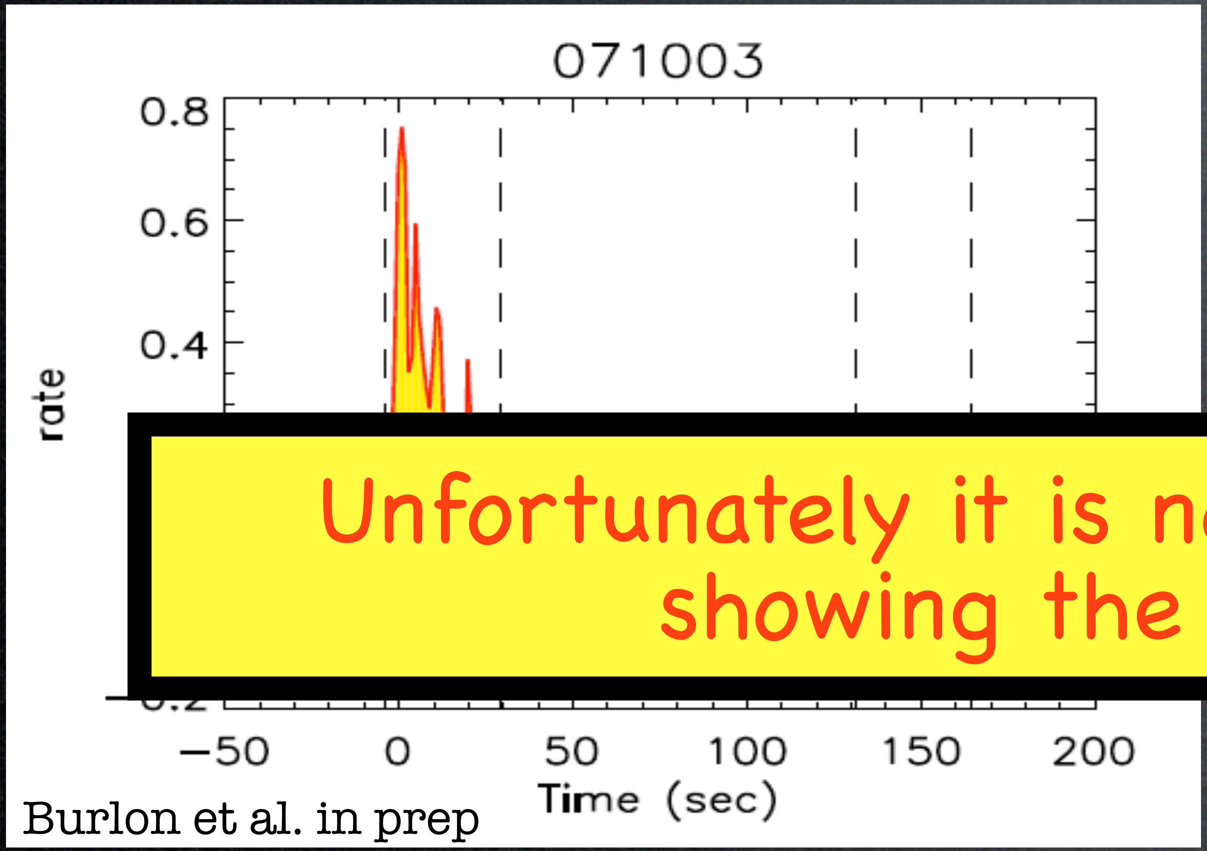
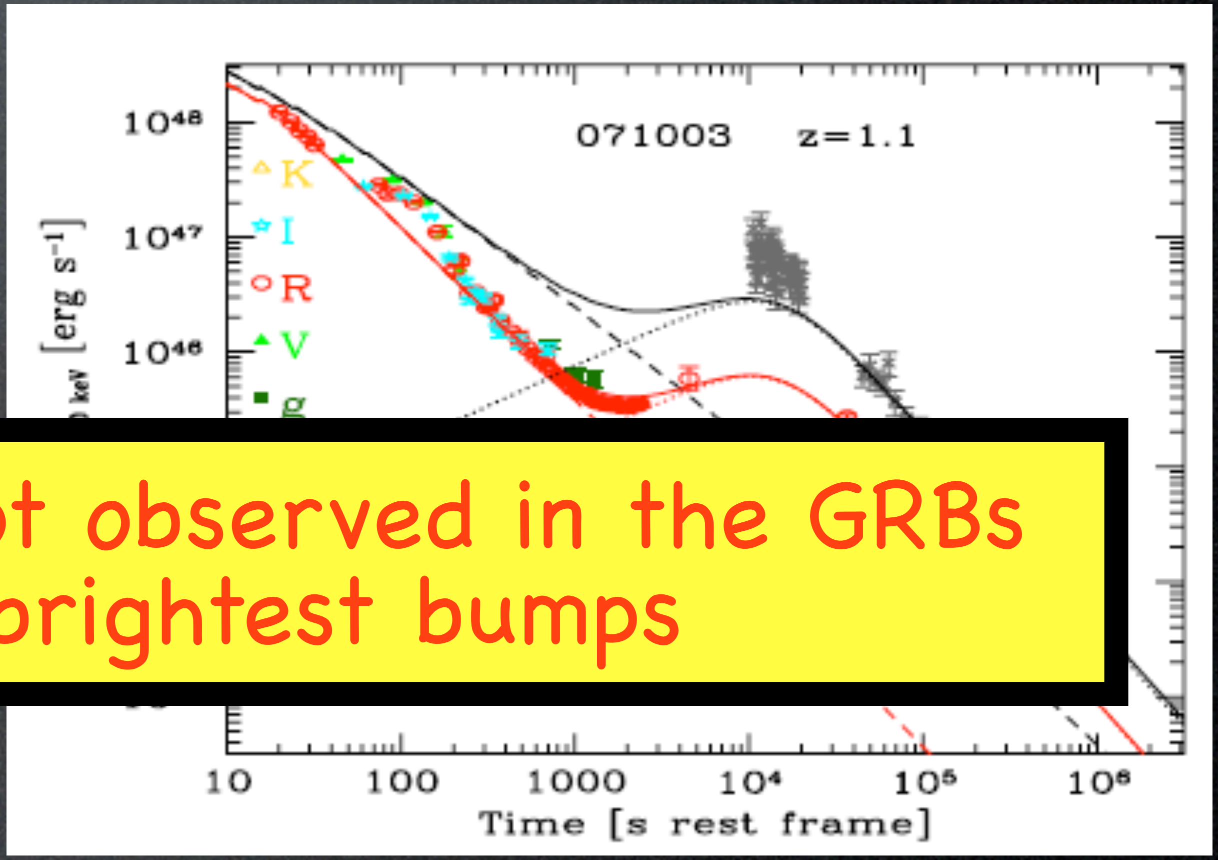


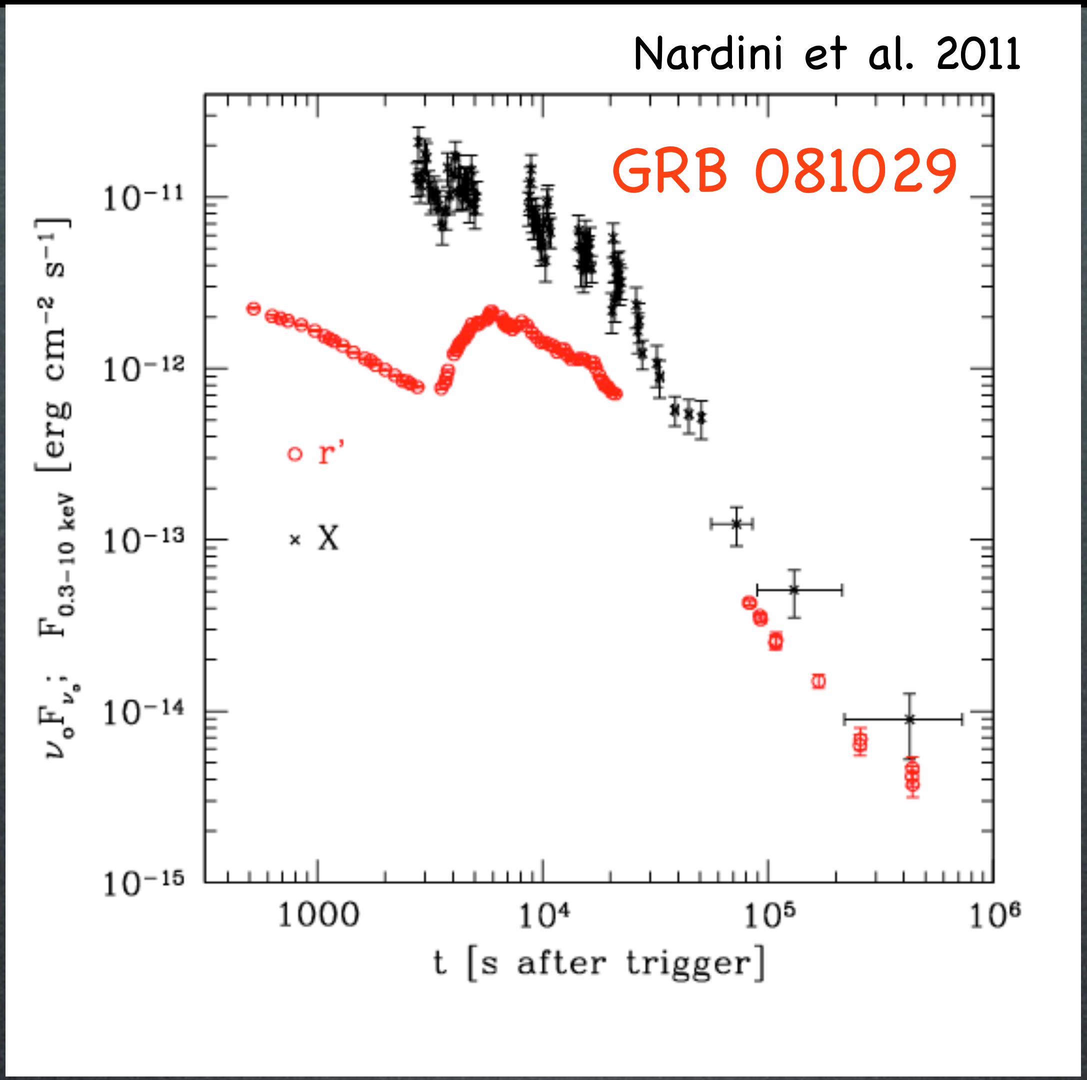






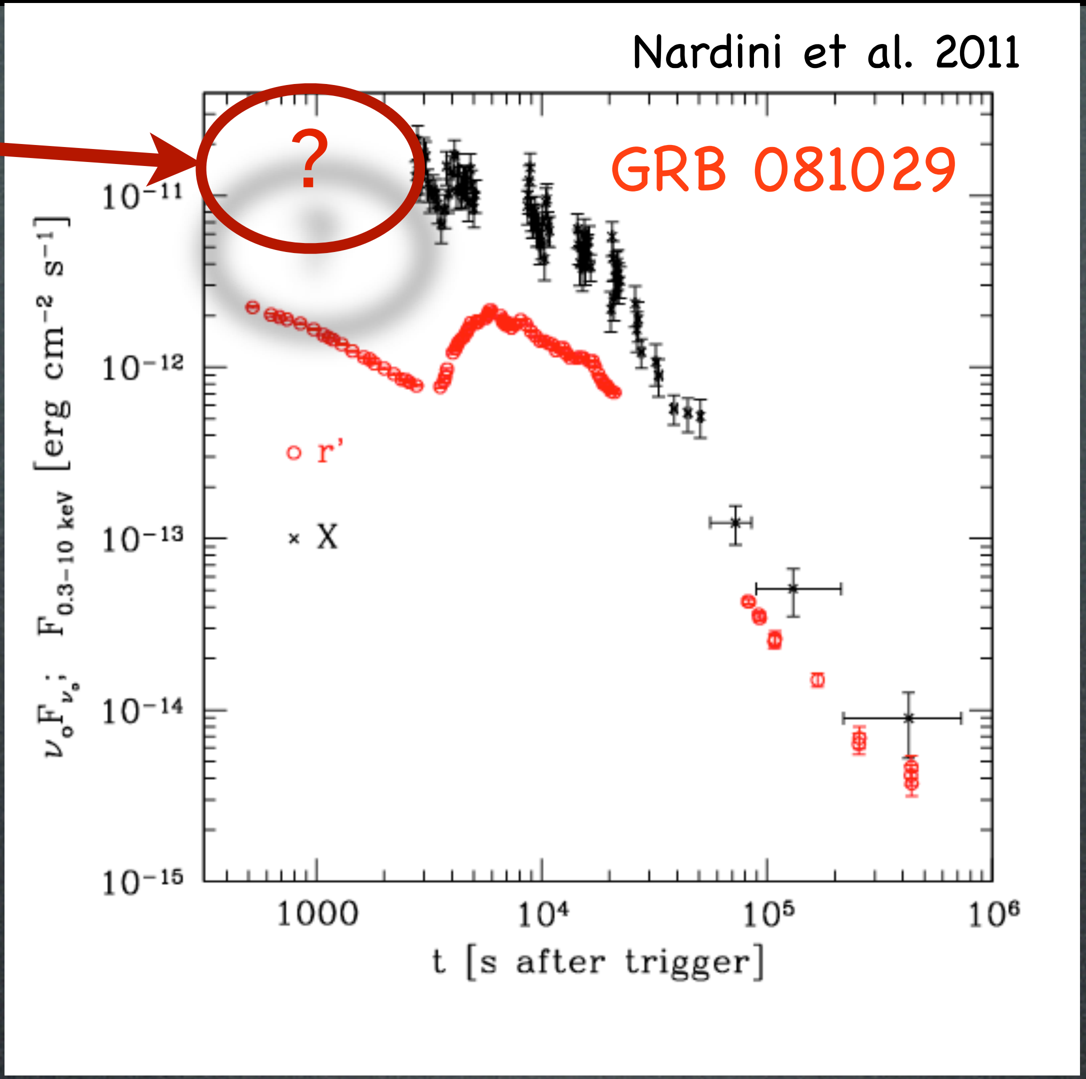
Unfortunately it is not observed in the GRBs showing the brightest bumps

What can we infer from the X-rays?

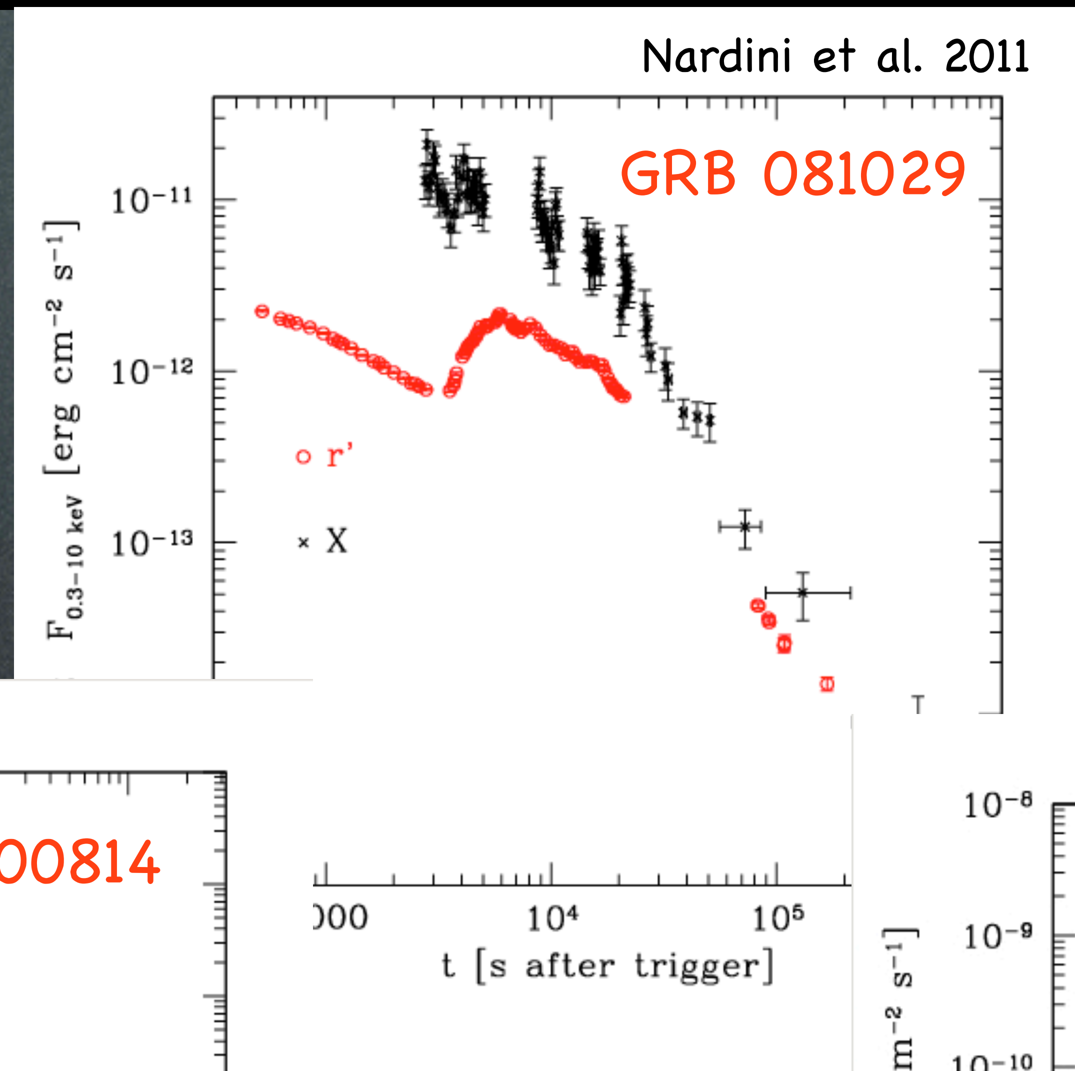


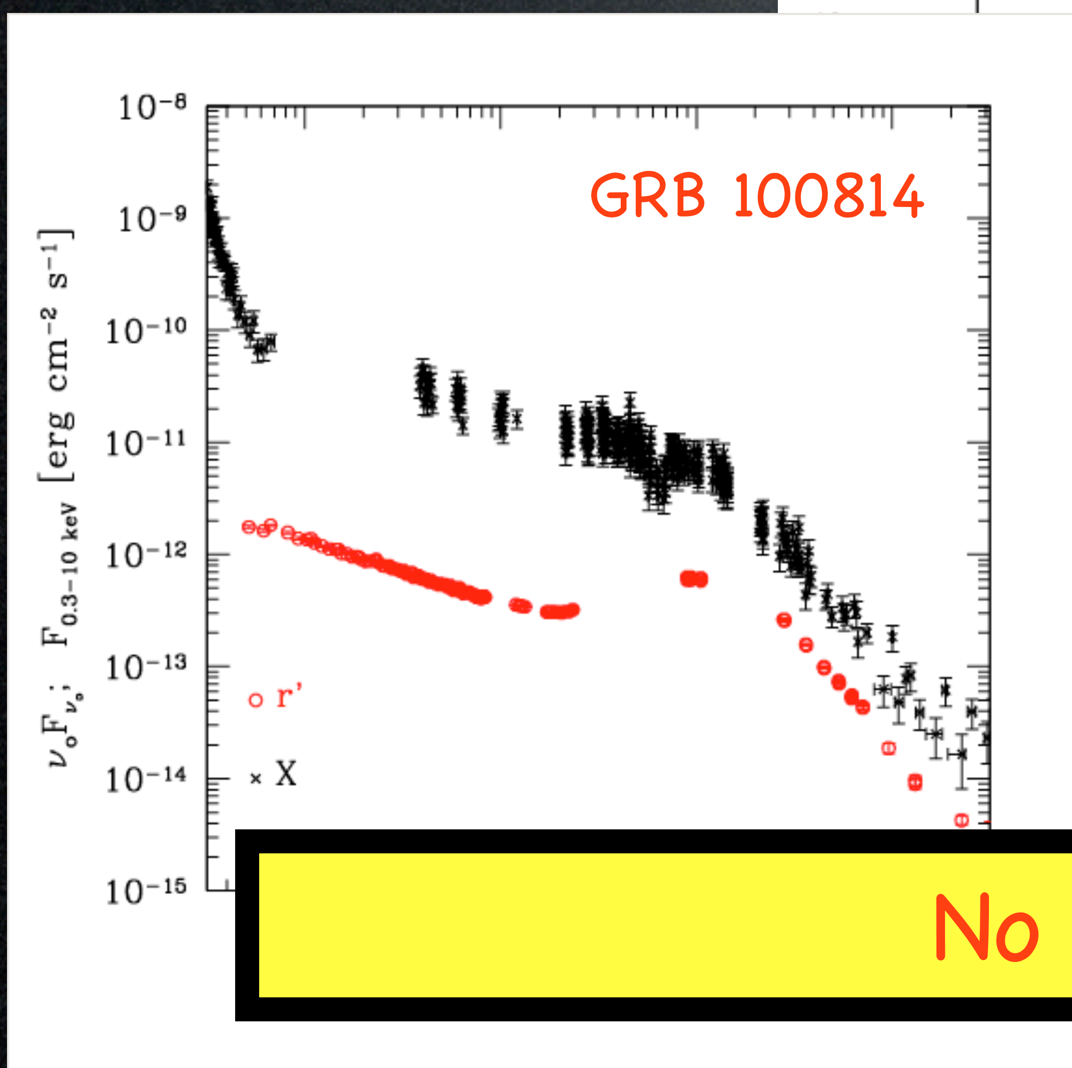
What can we infer from the X-rays?

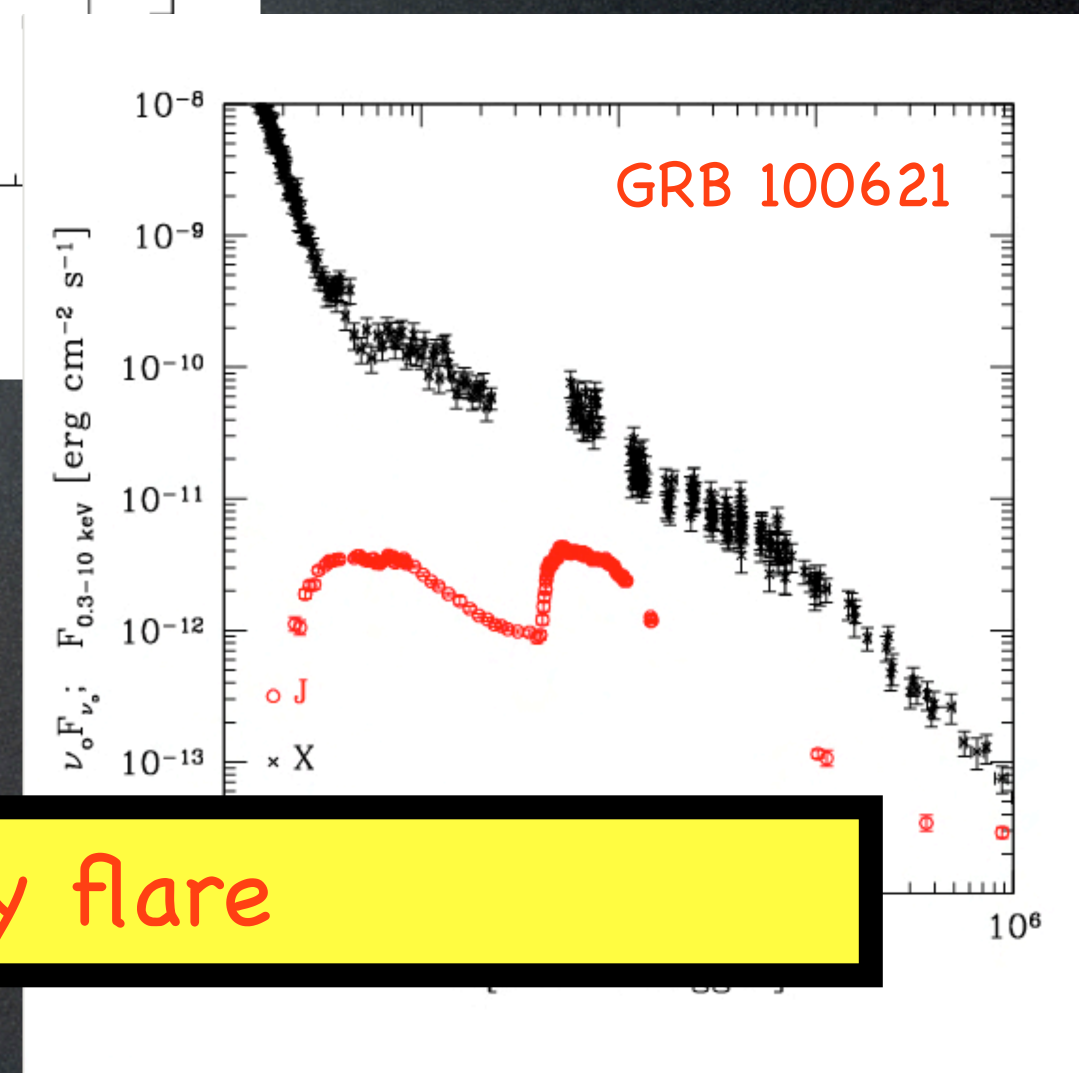
Did something happen here



What can we infer from the X-rays?

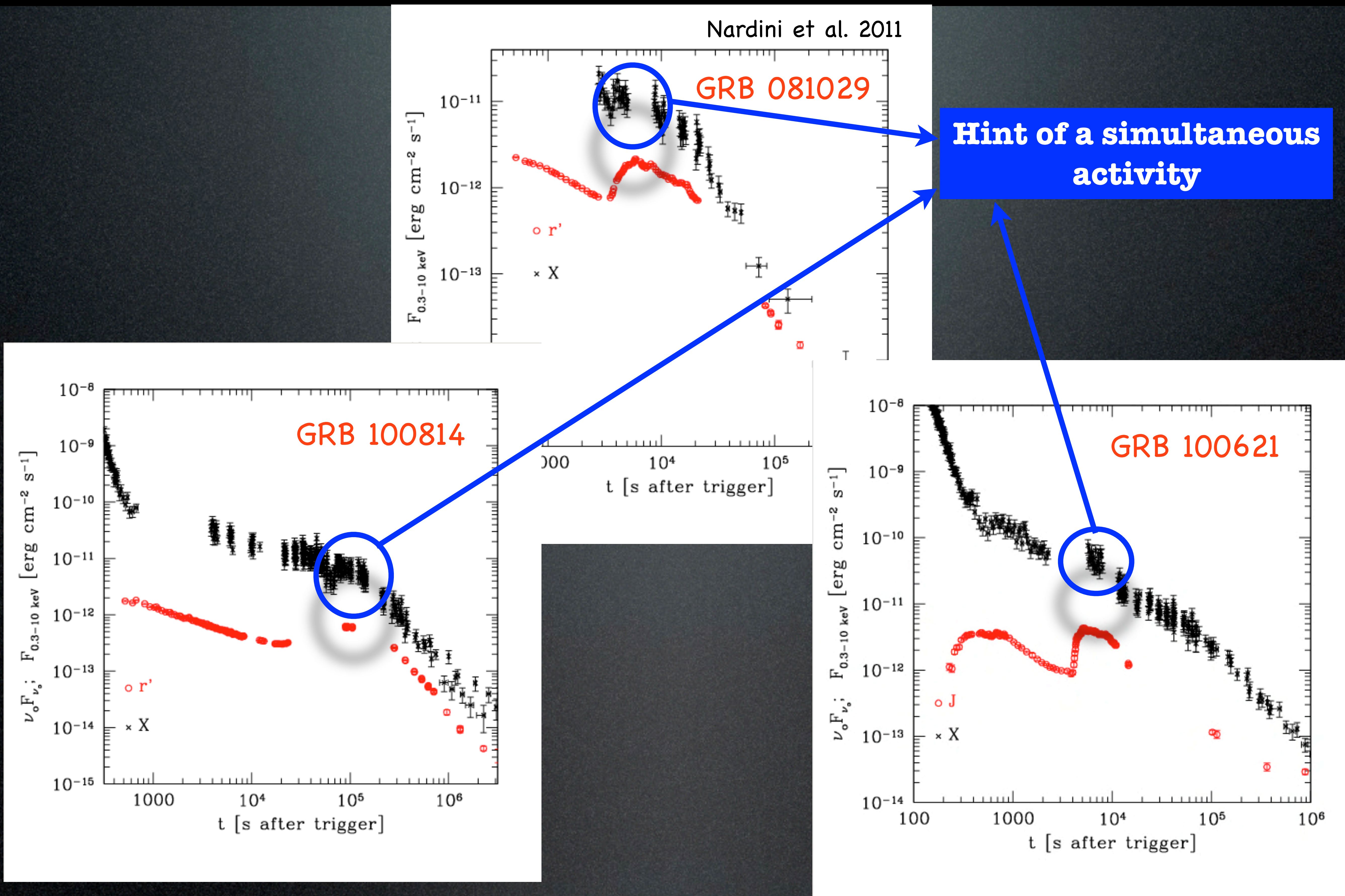






No bright X-ray flare

What can we infer from the X-rays?



CONCLUSIONS

- Optical-NIR late bumps are not uncommon
- Optical-NIR late bumps are chromatic
- Inconsistent with most commonly invoked scenarios
- Late reactivation of the central engine is a possible solution
- Still missing the observational “smoking gun”


Thank you all

OPTICAL-NIR REBRIGHTENINGS IN THE MULTI-COLOUR IMAGING ERA