120422A and Its Connection to Low and High-L GRBs

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Galaxies meet GRBs at Cabo de Gata

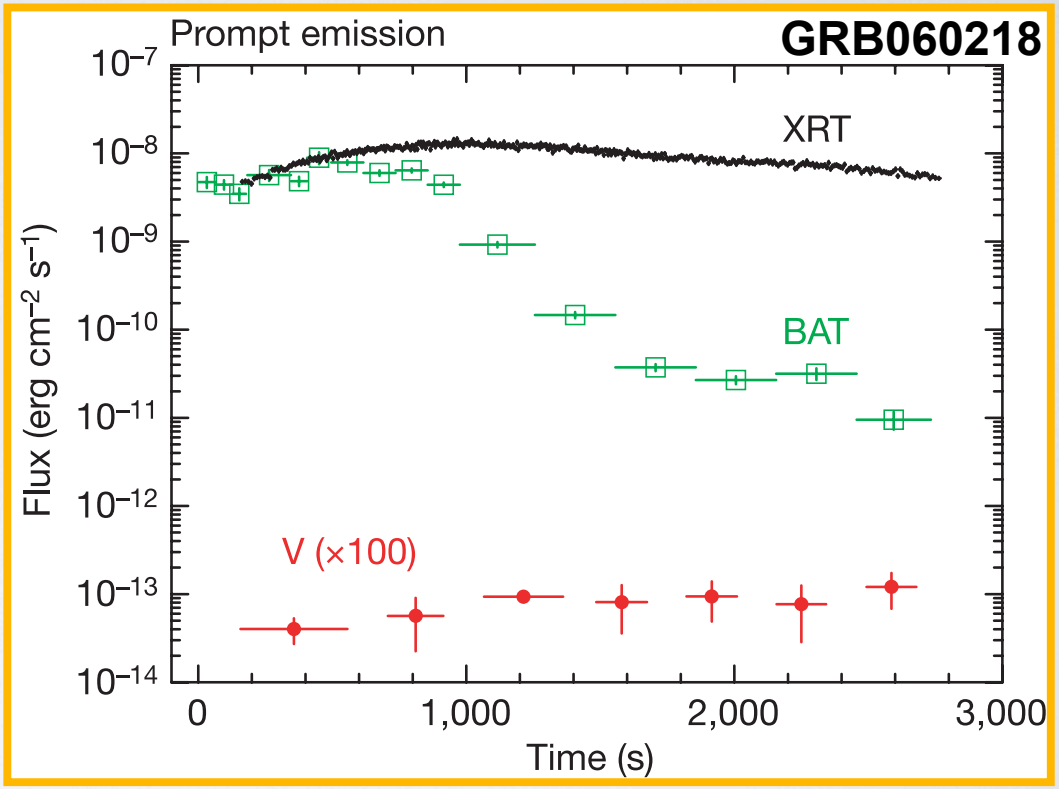
Cabo de Gata, 26 September, 2013

What Are Low- and High-L GRBs?

Low-*L* GRBs

- $E_{iso} \sim 10^{48}$-10^{49} erg
- $T_{90} \sim$ 10-2000 s
- $L_{iso} < 10^{48.5}$ erg/s

- Smooth single peaked light curves
- $E_{peak} < 150$ keV
- $\theta > 20°$
- only found at low-*z*
- almost all GRB-SN are associated with low-*L* GRBs



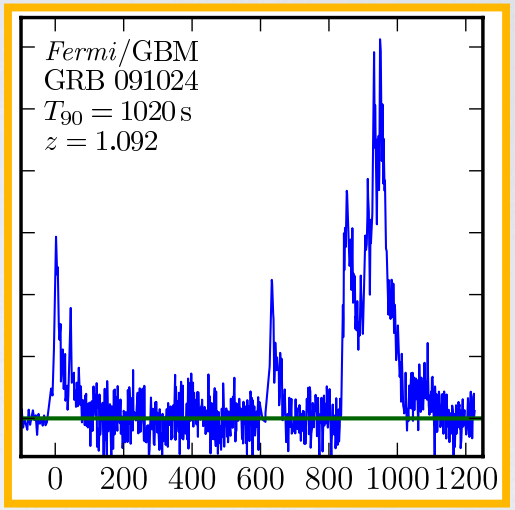
Campana+ 2006

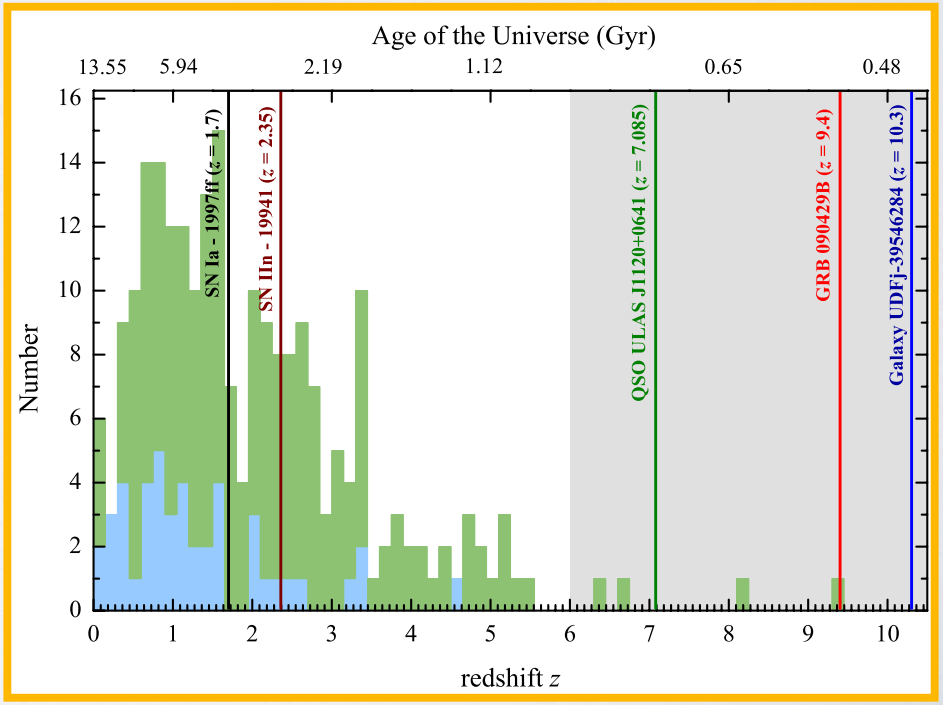
What Are Low- and High-L GRBs?

High-*L* GRBs

- E_{iso} ~ 10^{50}-10^{54} erg
- T_{90} ~ 2-1000 s
- L_{iso} > $10^{49.5}$ erg/s
- z > 0.3

- Erratic multi-peaked light curves
- $E_{peak,r}$ ~ 320 keV
- θ ~ 2º

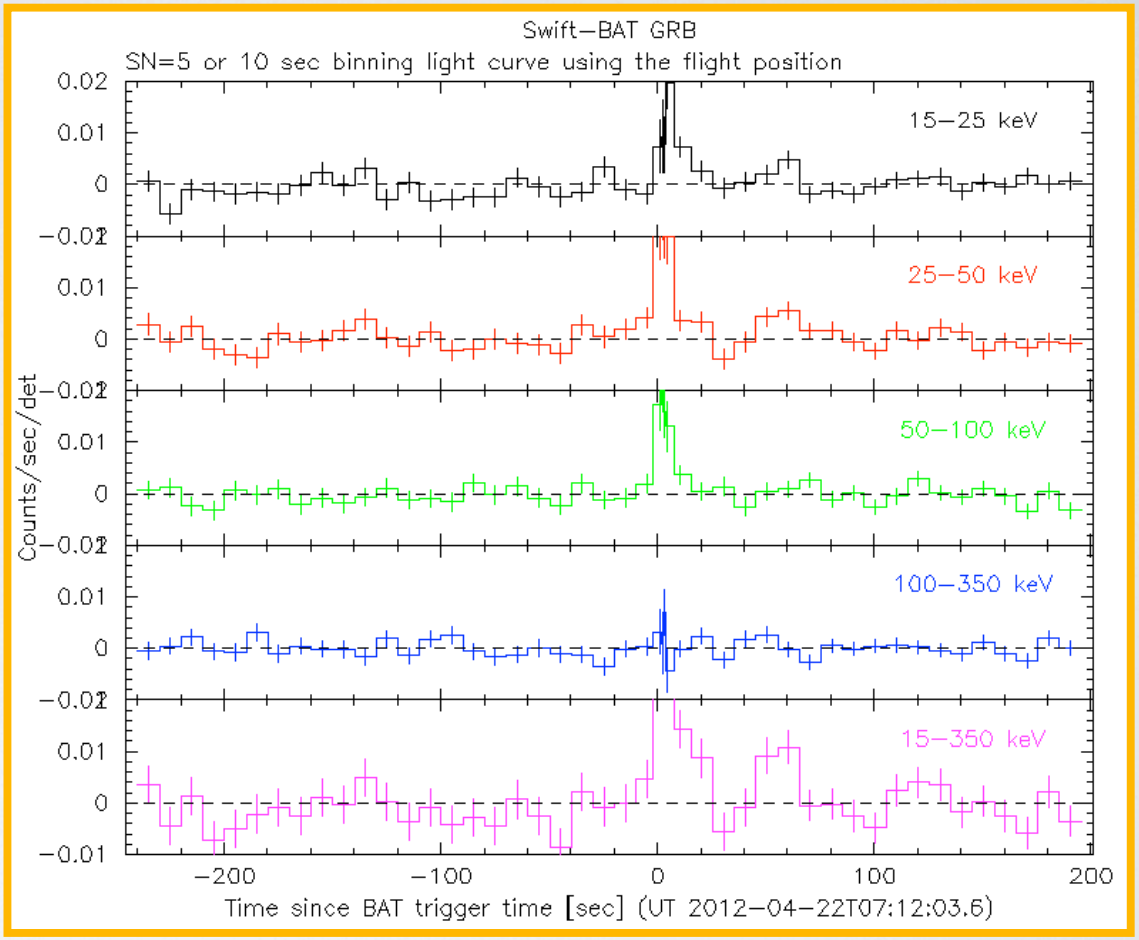




The Inbetweener

GRB120422A

- $z = 0.283$
- $E_{iso} \sim 4.4\ 10^{49}$ erg
- $T_{90} \sim 7$ s
- $L_{iso} \sim 8 \times 10^{48}$ erg/s

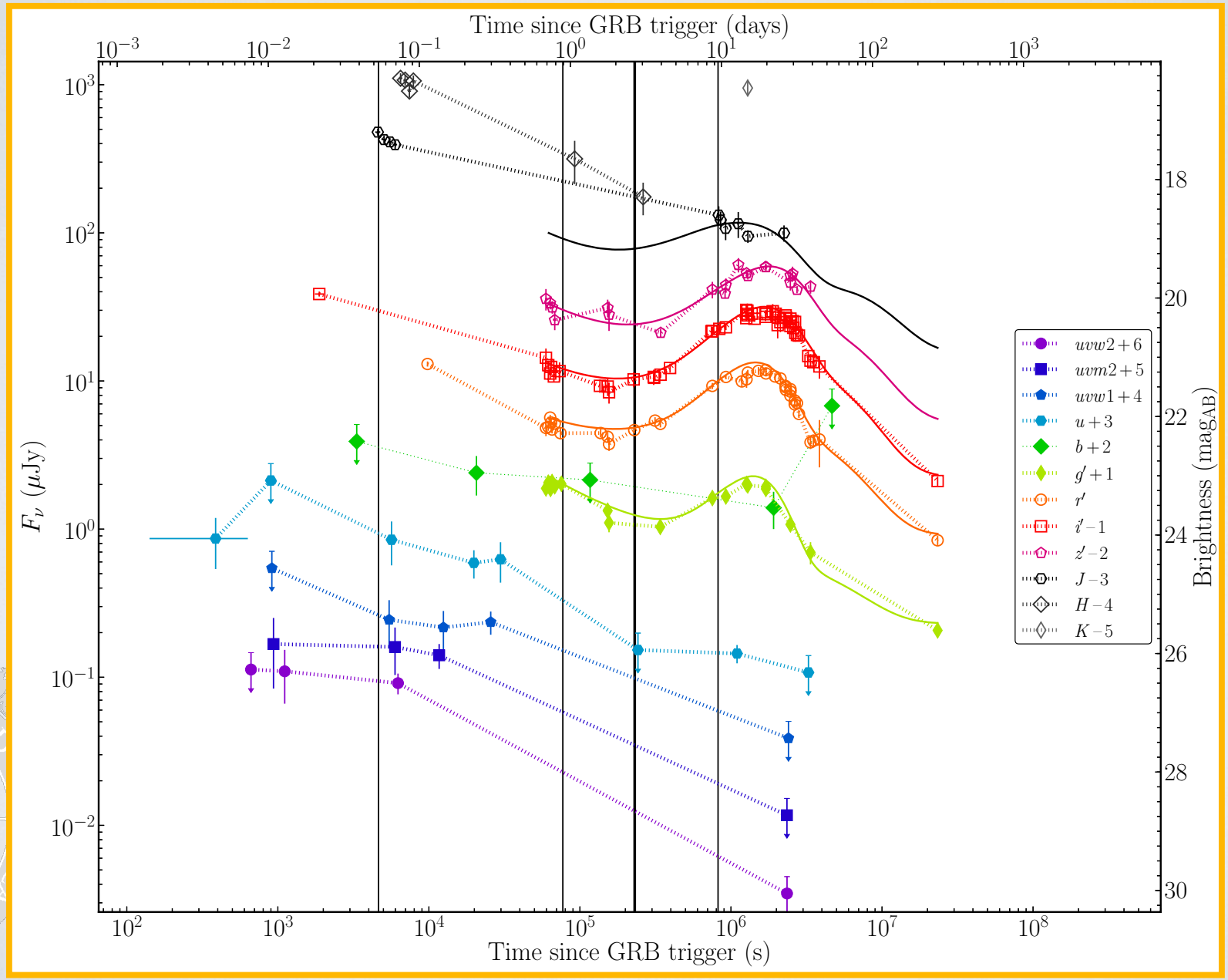


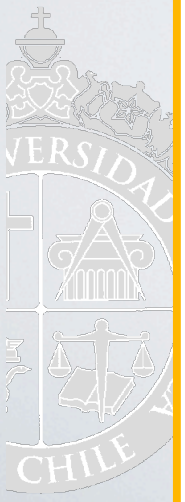
http://gcn.gsfc.nasa.gov/notices_s/520658/BA/

The Data

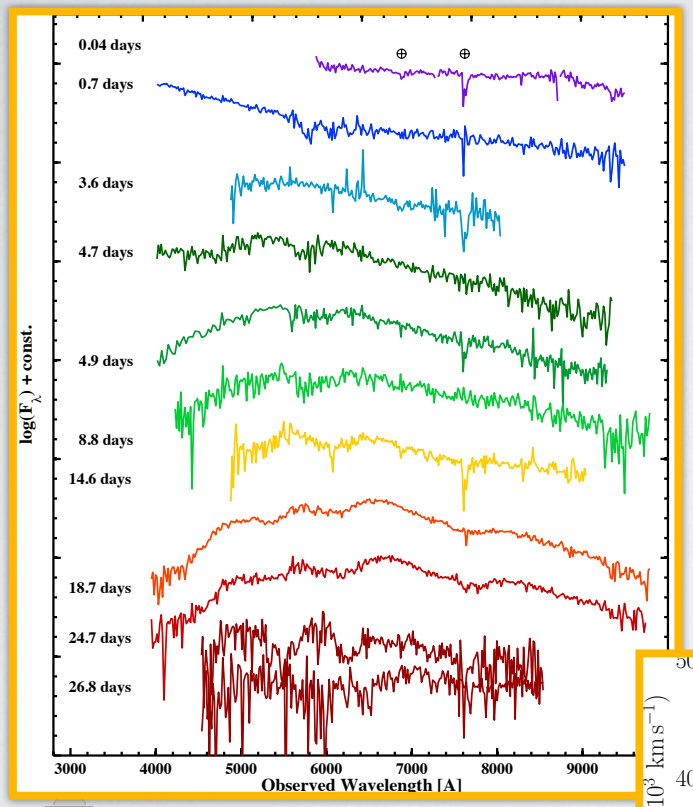
- **NIR/Optical/UV Imaging**
  - **Wavelength range**: 200-2500 nm
  - **Duration**: **100 s to 270.2 days**
  - **Observatories/Instruments**: CAHA, Gemini, GMG, GROND, GTC, LT, Magallan, NOT, P60, UKIRT, *Swift*/UVOT
- **Tunable Filter (→ Javier's talk)**
  - **Wavelength range**: Hα
  - **Observatories/Instruments**: GTC
- **Spectroscopy**
  - **Wavelength range**: 300-2500 nm
  - **Resolution**: medium to low
  - **Duration**: **0.05 to 37.7 days**
  - **Observatories/Instruments**: VLT/X-shooter (7), GTC (2), Gemini/GMOS (2), Keck, Magallan
- **Sub-mm observations**
  - **Wavelength range**: 86.7 to 665 GHz
  - **Duration**: **0.05 to 10 days**
  - **Observatories/Instruments**: CARMA, JCMT, PdBI, SMA
- **X-rays**
  - **Wavelength range**: 0.3-10 keV
  - **Duration**: **0.05 to 47 days**
  - **Observatories/Instruments**: *Swift*/XRT, *XMM/Newton*

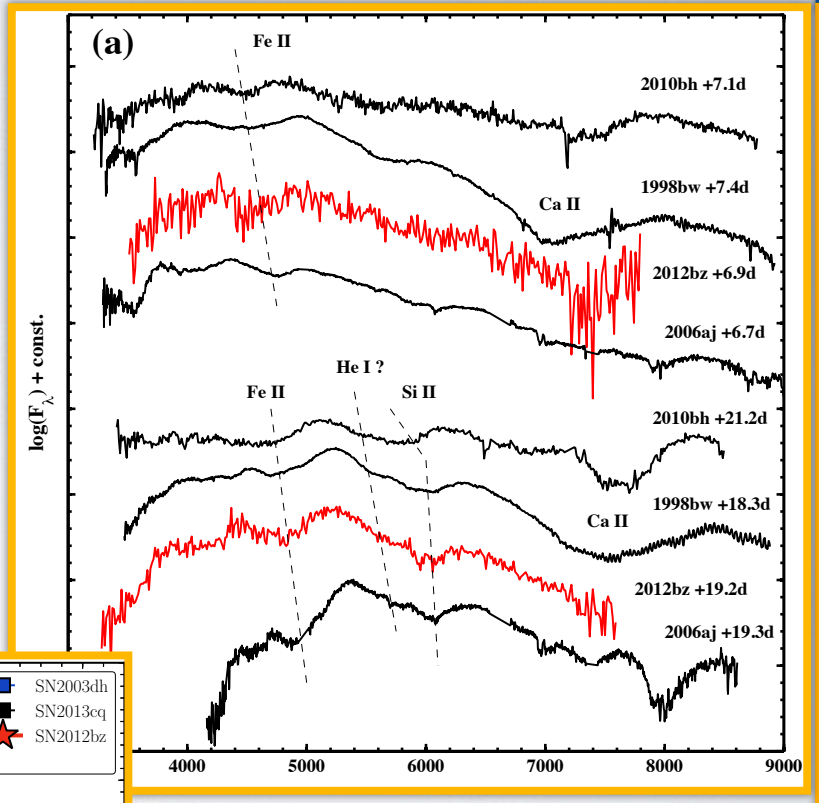
The Light Curve of The Optical Transient

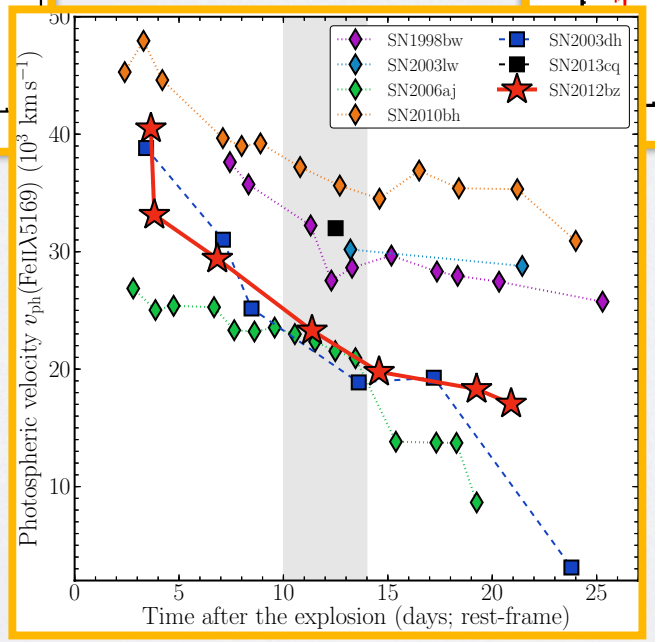




The Supernova - SN2012bz



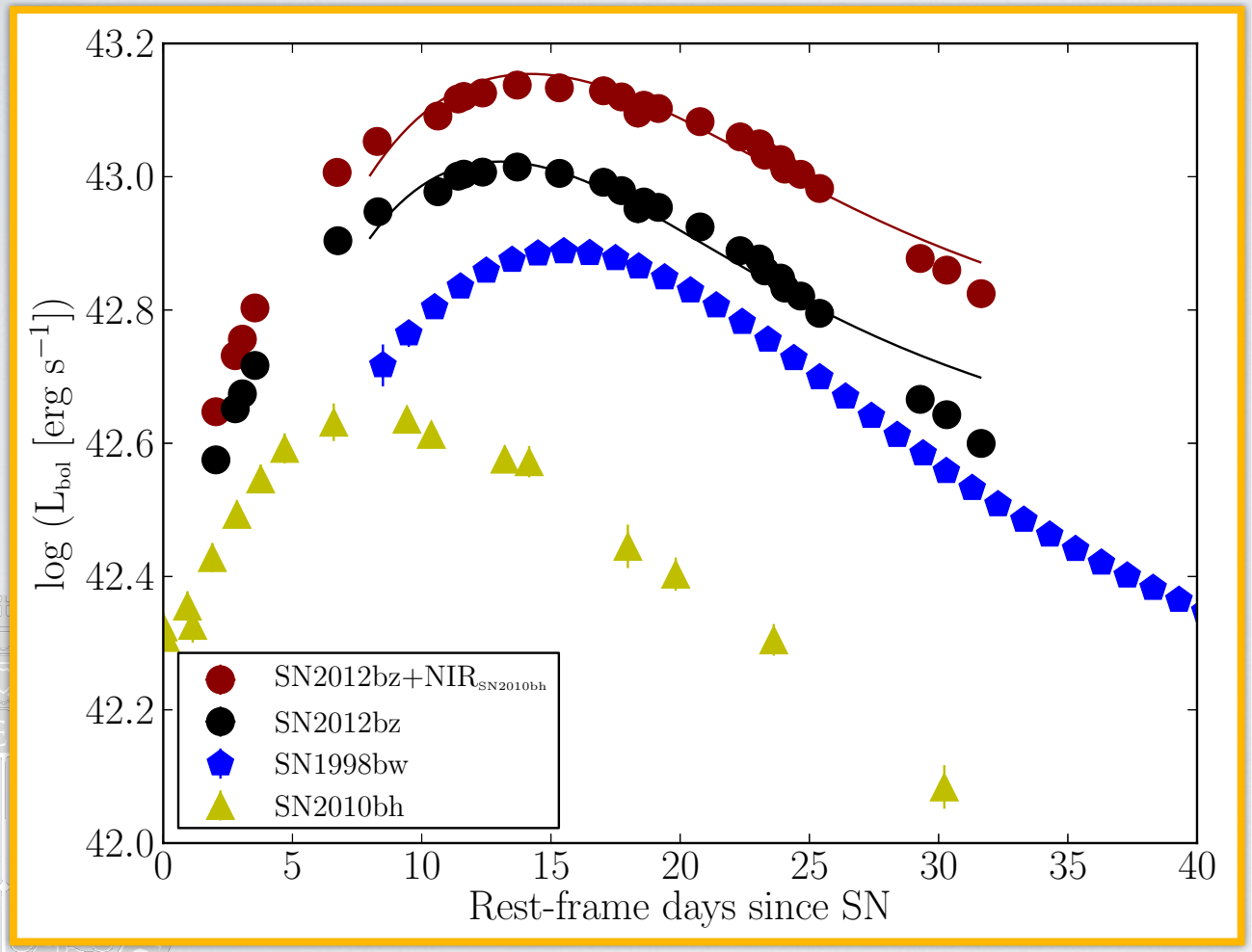




26 Sep 2013

S. Schulze, 120422A and its connection to high and low-L GRBs

The Supernova



coverage: 300-800 nm

without NIR

M_{Ni} ($M_\odot$) = 0.40

M_{ej} ($M_\odot$) = 4.72

E_{kin} (erg) = 3.29 ×10^{52}

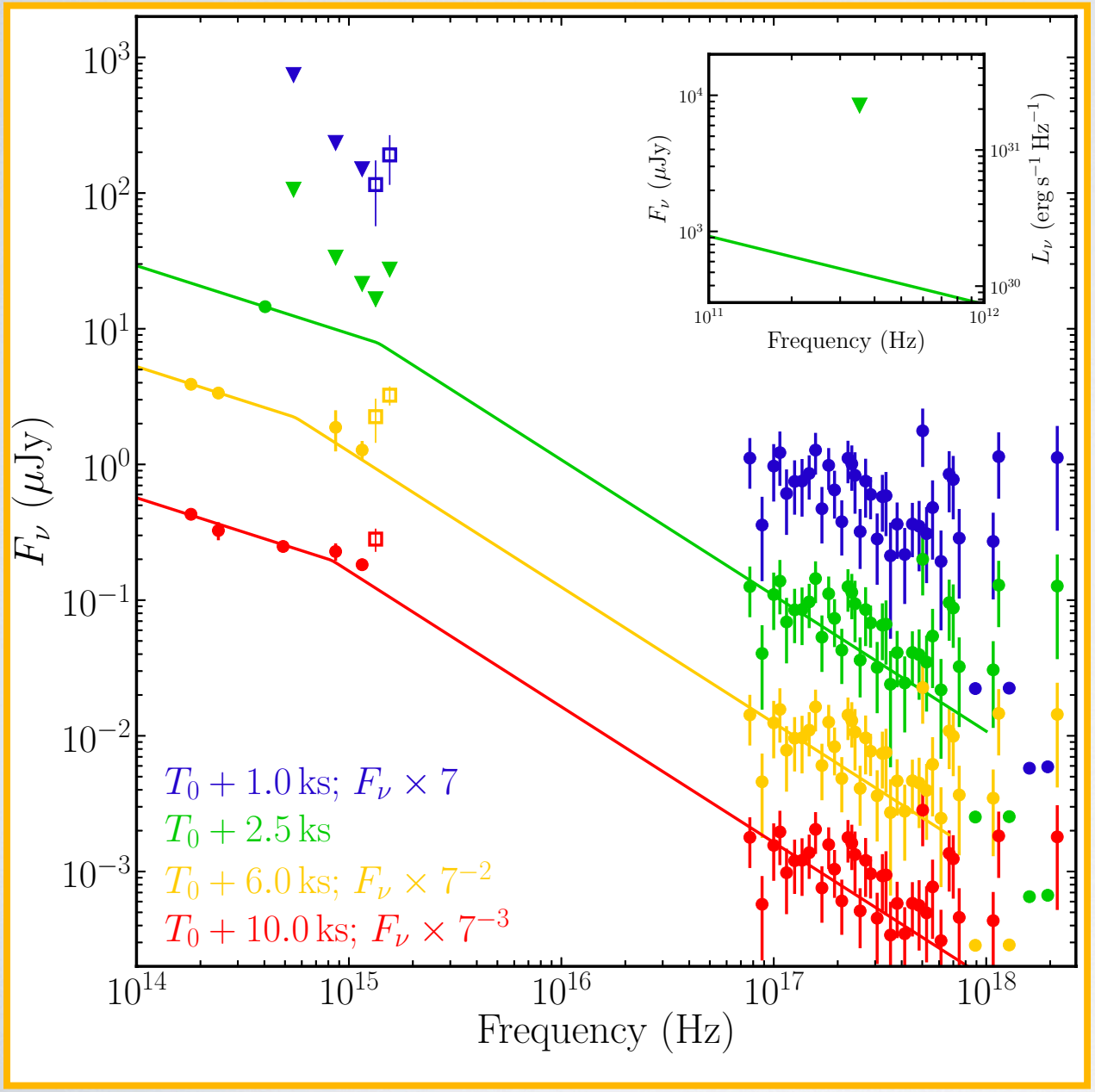
with NIR

M_{Ni} ($M_\odot$) = 0.58

M_{ej} ($M_\odot$) = 5.87

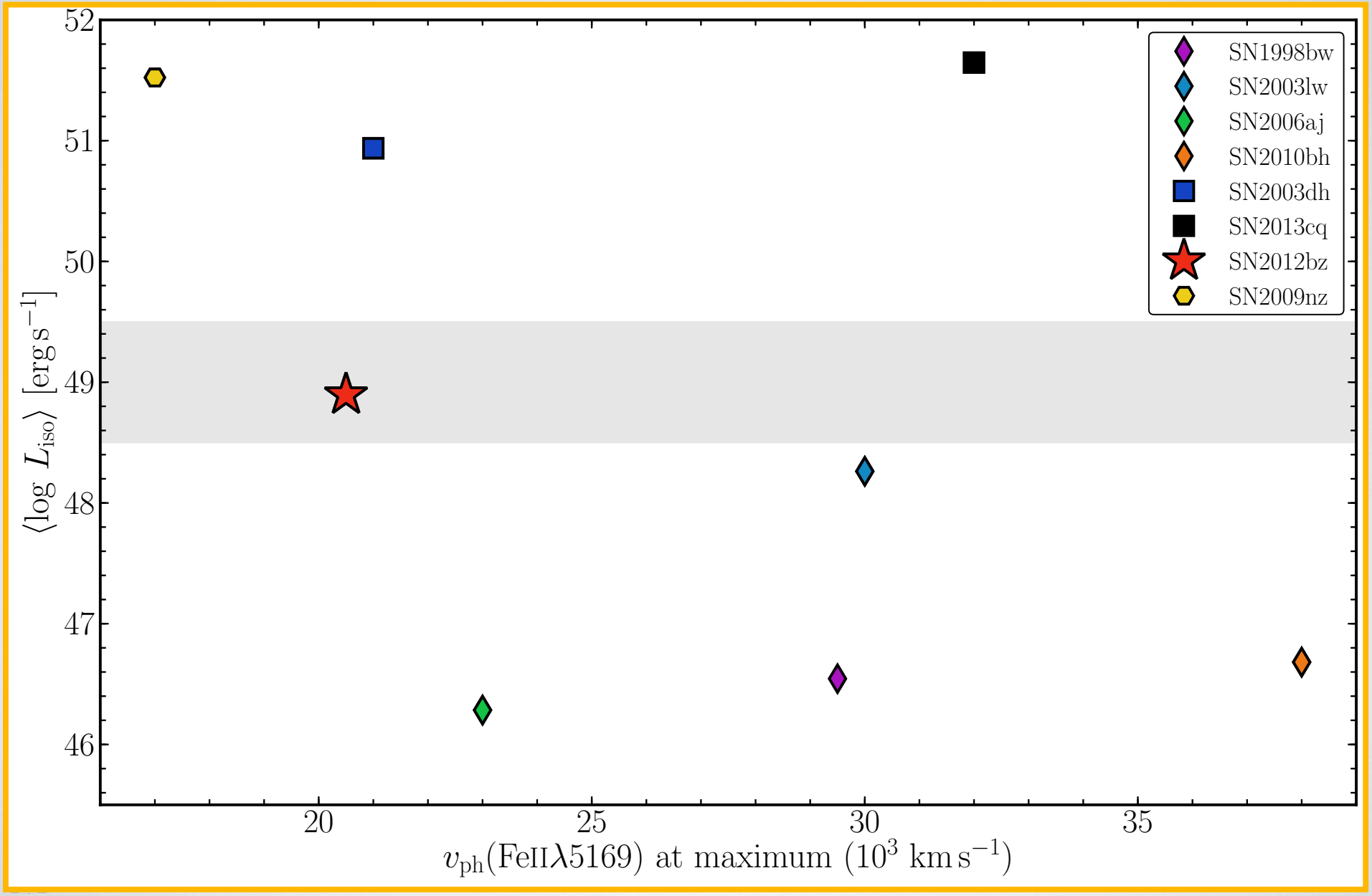
E_{kin} (erg) = 4.10 ×10^{52}

The Afterglow SED

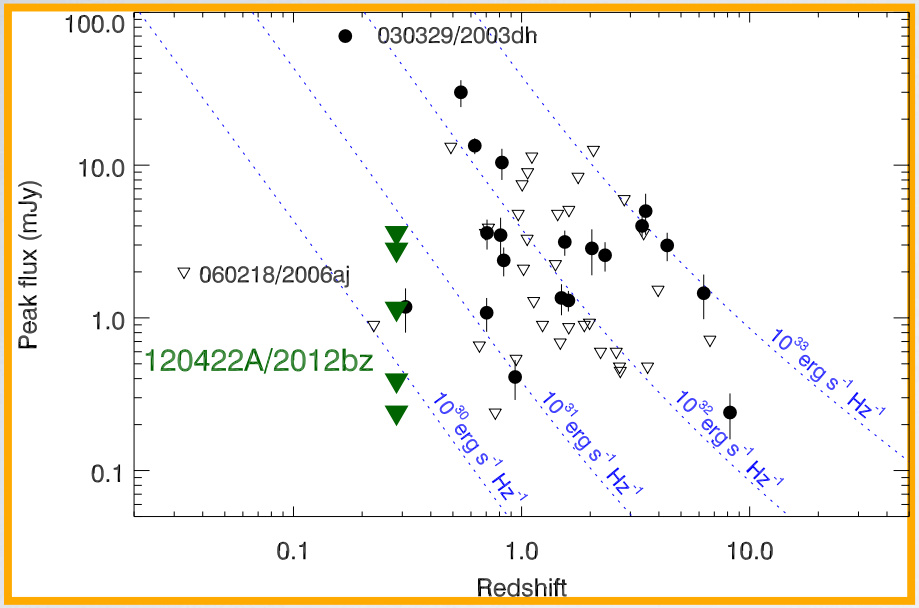


$L_{AG} \sim 10^{30}$ erg s^{-1} Hz^{-1}

Discussion - SN2012bz vs. all GRB-SNe

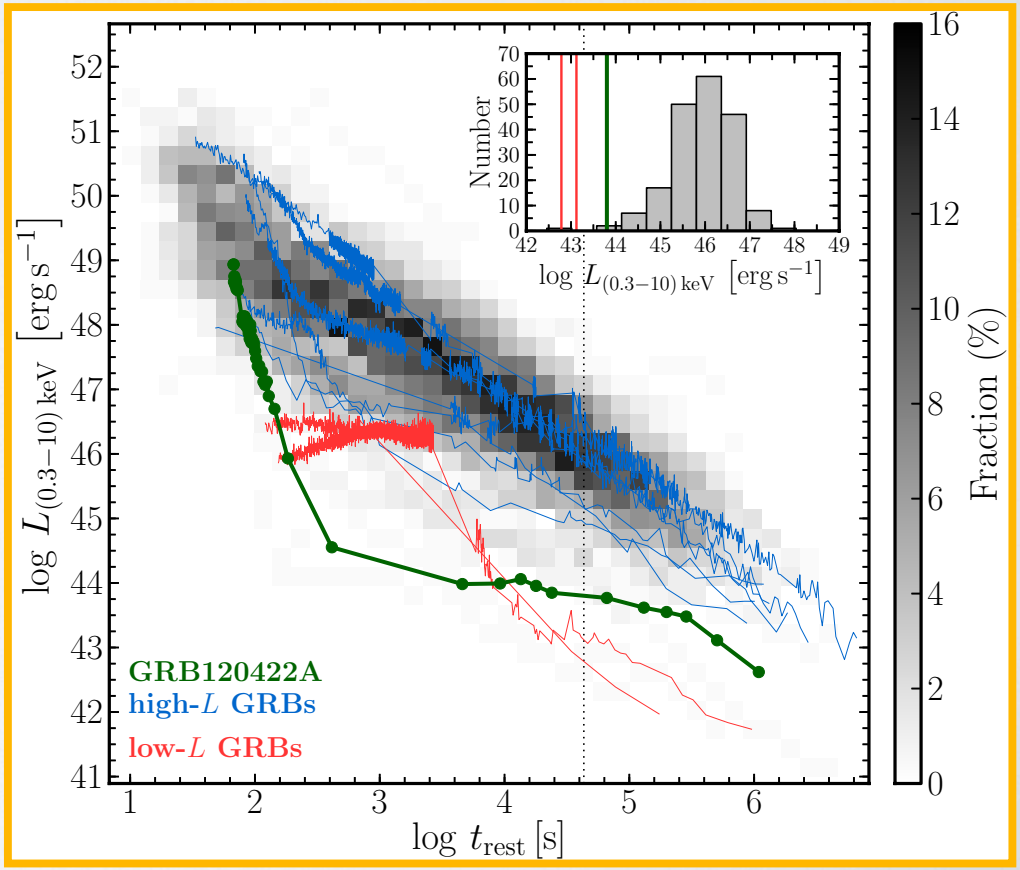


Discussion - The AG vs. All Long GRB AGs



Based on **de Ugarte Postigo+ 2012**

$L_{AG} < 10^{30}$ erg s^{-1} Hz^{-1}



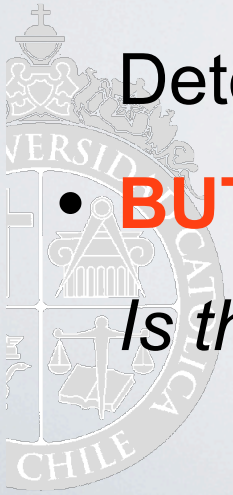
Conclusion

- Between quasi-spherical and jetted GRBs
- **Prompt emission**: normal but weak
- **SN**: most luminous spectroscopically confirmed GRB-SN
- **Afterglow**:

  At the faint end of the observed X-ray AG LF

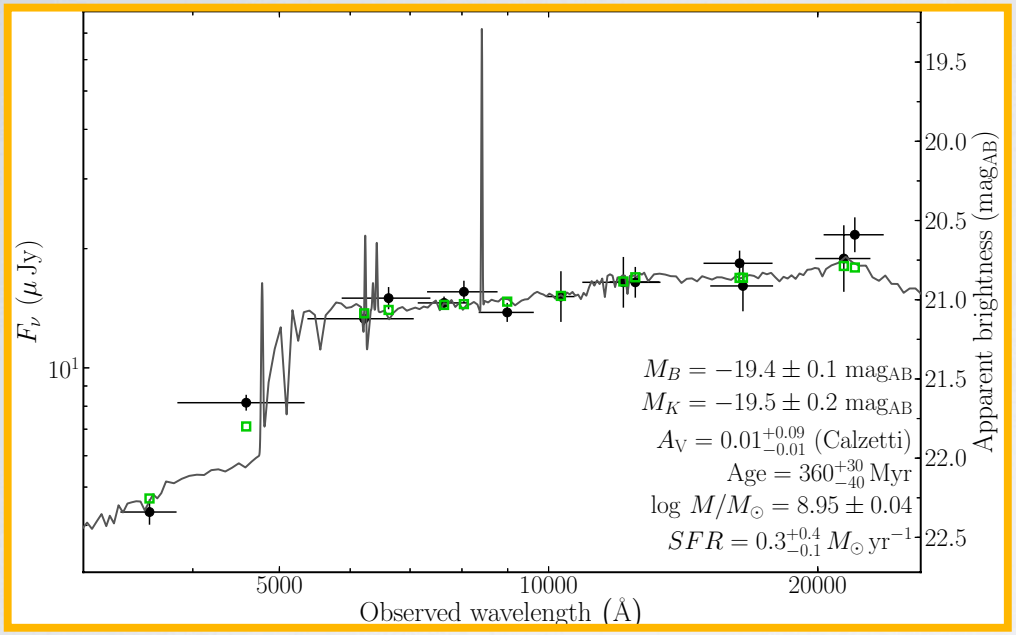
  Detection of AG sets it apart from low-*L* GRBs
- **BUT** the luminosity similar to low-*L* GRBs

Is there continuum between high- and low-L GRBs?

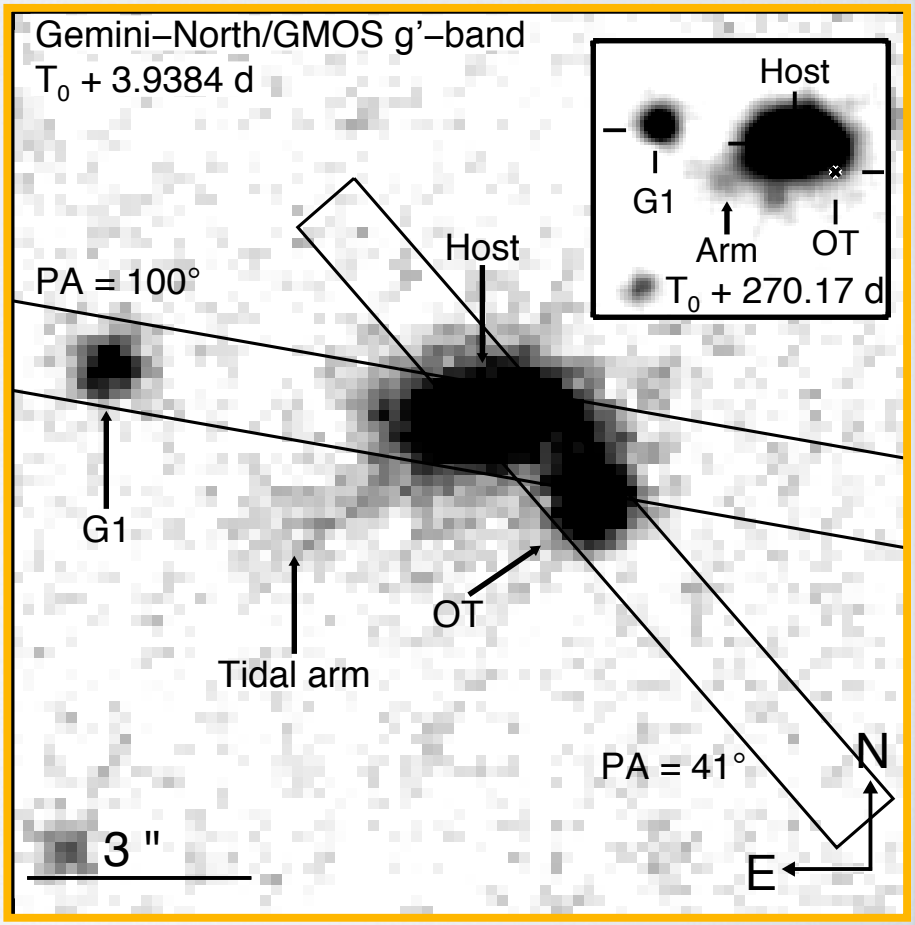


Backup Slides

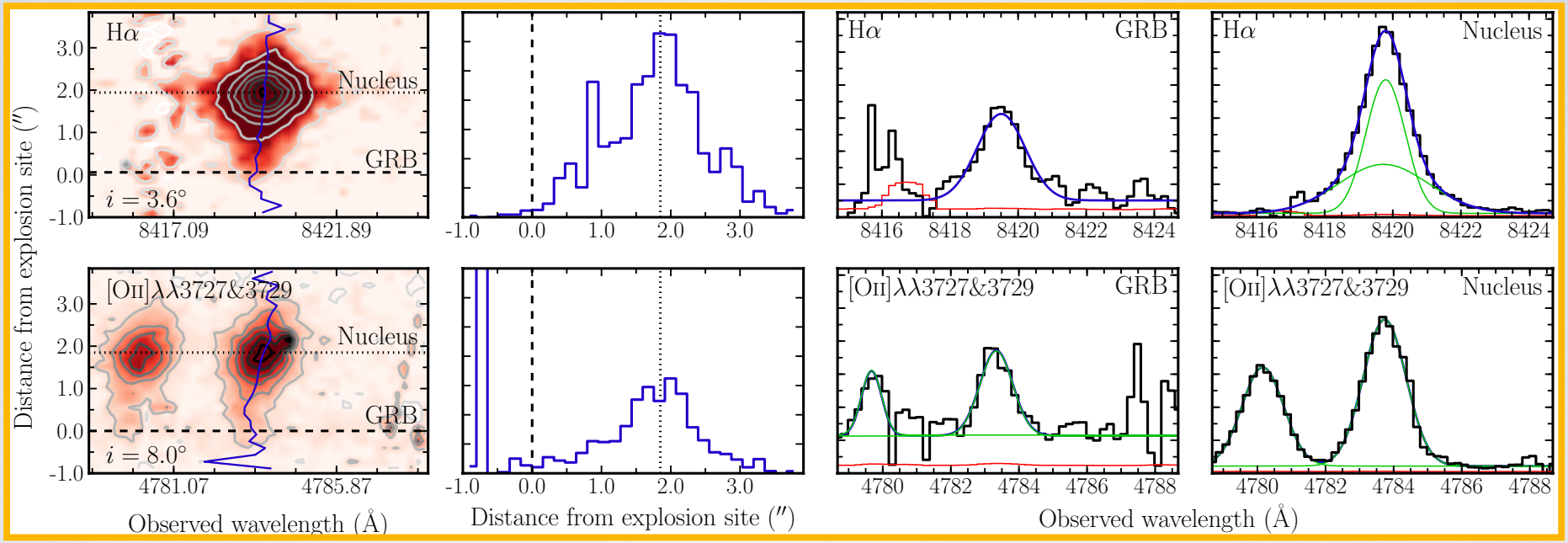
The Host Galaxy I



Parameter	Value	GHost	TOUGH
M_{UV} (mag$_{AB}$)	-17.99	-19.5	< -18.5
M_B (mag$_{AB}$)	-19.4 ± 0.1	-19.9	...
M_K (mag$_{AB}$)	-19.5 ± 0.2	-20.4	< -20.2
A_V (mag$_{AB}$)	$0.01^{+0.09}_{-0.01}$	0.44	...
log $M_\star (M_\odot)$	8.95 ± 0.04	9.45	...
Age (Myr)	360^{+30}_{-40}	1052	...
SFR ($M_\odot$ yr^{-1})	$0.3^{+0.4}_{-0.1}$	1.94	...
$Z/Z_\odot$	0.6	~ 0.3	...
Offset (kpc)	7.3	...	7.0 ± 0.7

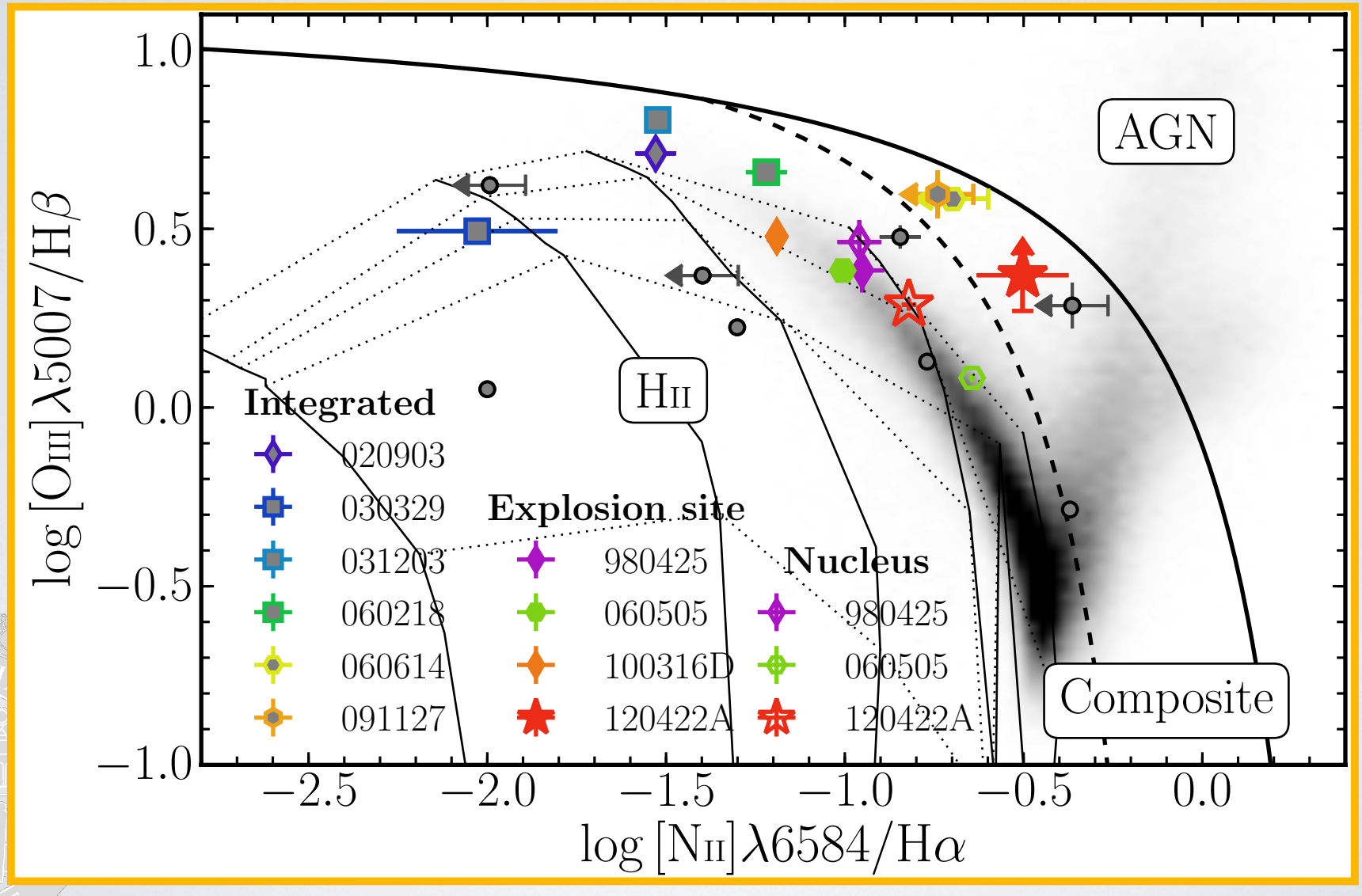


The Host Galaxy II

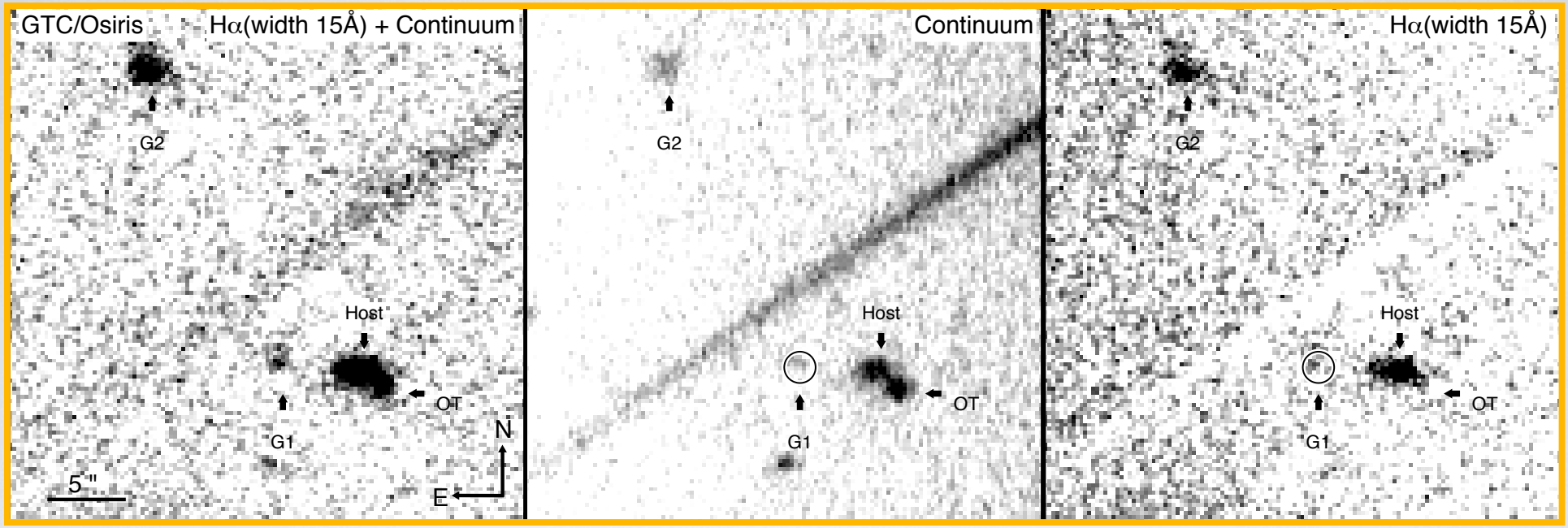


- Different inclination for [OII] and Hα
- No evidence of enhanced SF at the GRB site
- At nucleus, Ha consists of 2 components
- E(B-V) = 0
- SFR(Nuc.) > 0.8 $M_\odot$ yr^{-1}, SFR(GRB) = 0.04 $M_\odot$ yr^{-1}

The Host Galaxy III



The Host Galaxy Environment



Galaxy	RA(J2000)	Dec (J2000)	Distance (kpc)
Host	09:07:38.51	+14:01:08.46	7.3
G1	09:07:38.87	+14:01:09.12	28.7
G2	09:07:39.43	+14:01:27.83	107.8
G3	09:07:42.86	+14:00:15.40	355.8