Galactic foreground of GRBs

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Collaborators:

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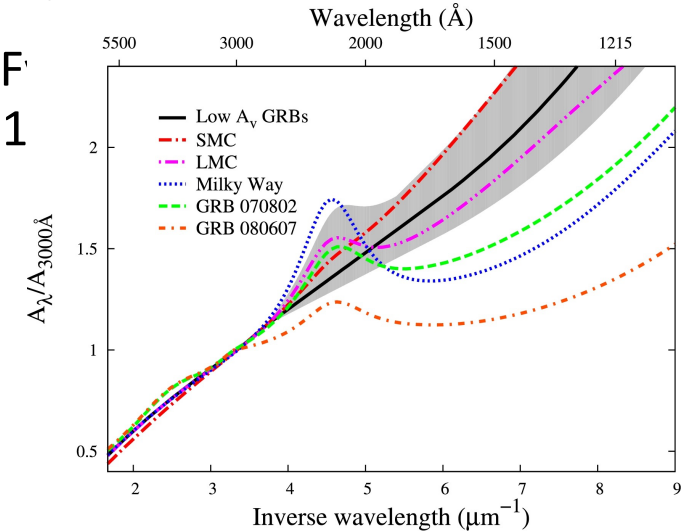
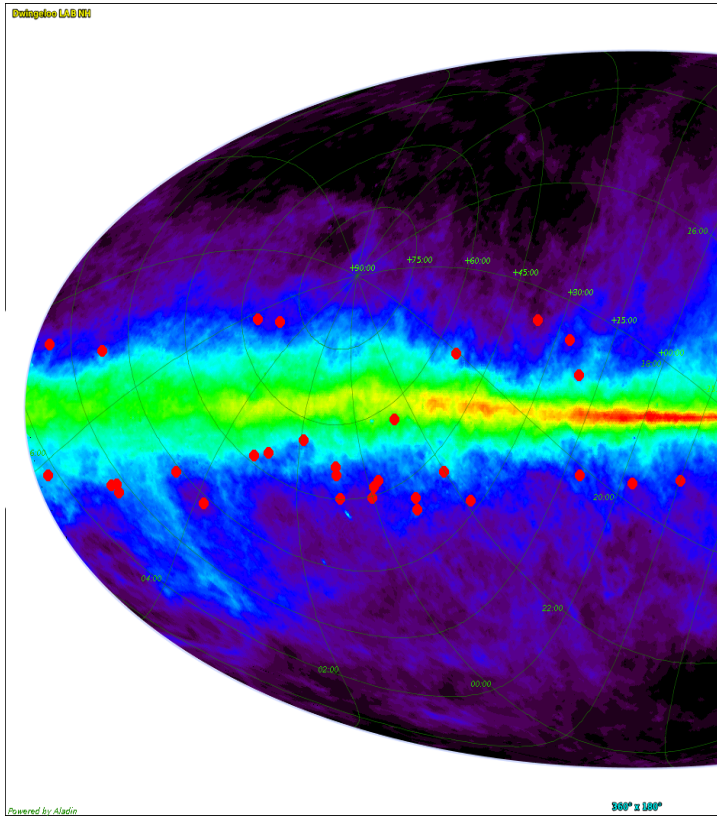
Intrinsic ISM parameters (density, metallicity, …) at the GRB jet (< 200 pc)?

- GRB jet impacts the surrounding medium → afterglow (e.g. Mészáros + Rees 1992; Sari+1998)
- Afterglow: continuum radiation in all wavelengths
- Afterglow X-ray spectrum:
  - Bright and "simple"
  - Approximated as power-law continuum modulated by absorption (Behar+2011; Schady+2011; Zafar+2011; Campana+2012 …)
- Rest frame optical and UV abs. lines (eg. F Elíasdóttir+2009 dust; Perley+2011, Schady+2011
  - Metallicity and extiction peculiarities
- Absorption: intrinsic, CGM, IGM, MW

(eg. Schady 2015 JHEA)



Estimating the Galactic foreground 1. input data



Swift GRBs at low B with known ***z*** overlaid on HI 21cm map

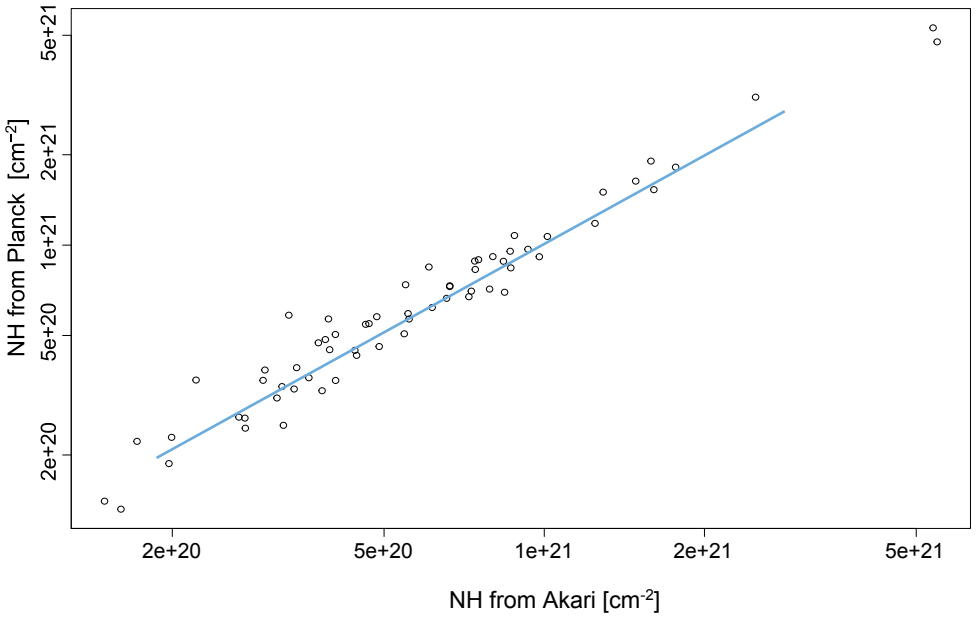
- **Spectroscopy**
- **HI surveys**
  - **LAB 36'** (Leiden Argentine Bonn Survey, Bajaja+1985; Kalberla+2005)
  - **EBHIS 10.8'** (Effelsberg-Bonn HI Survey of Milky Way gas Winkel+2015)
  - **HI4PI 16.2'** (EBHIS+GASS, HI4PI collaboration 2016)
- **IRAS products 5' - 6'**
  - **SFD** (IRAS recalibrated, Schlegel+1998)
  - **SFD recalibrated** (SDSS, Schlafly+2011)

New:

- **PanSTARRS1 E(B-V) 7'-14'** (d < 4.5 kpc stellar photometry, Schlafly+2014)
- **AKARI FIS 2'** (Doi +2015)
- **Planck PR2 A_V 5'** (Planck Collaboration 2016)

Estimating the Galactic foreground 2. data proc.

Correlation of Planck & AKARI based N(H)



Planck A_V PR2

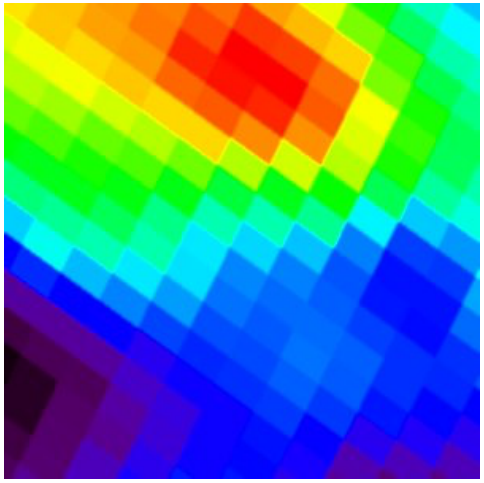
- based on WISE 12µm; IRAS 60µm & 100µm; Planck 857GHz; 545GHz; 353GHz PR2
- Dust model (Drain+Li 2007) renormalized to SDSS QSO

AKARI FIS based N(H)

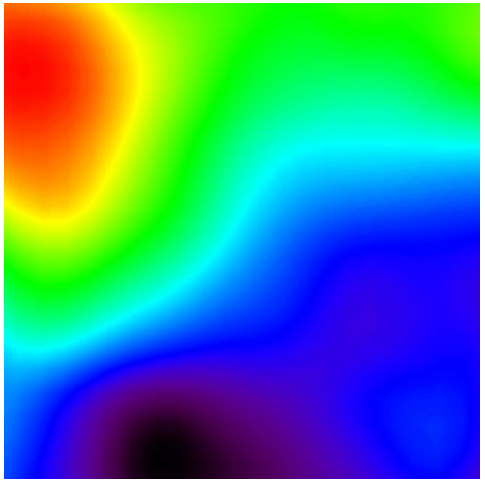
- AKARI Far Infrared Surveyor (FIS, Kawada+2007)
- All sky images 65, 90, 140, 160µm (Doi+2015)
- Zodi subtraction (Ootsubo+2016)
- T_dust → radiance → N(H)
- Smoothed to 5' & correlated with Planck A_V
- 30' x 30' fields selected
- renormalized

Planck maps: http://pla.esac.esa.int/pla/#maps

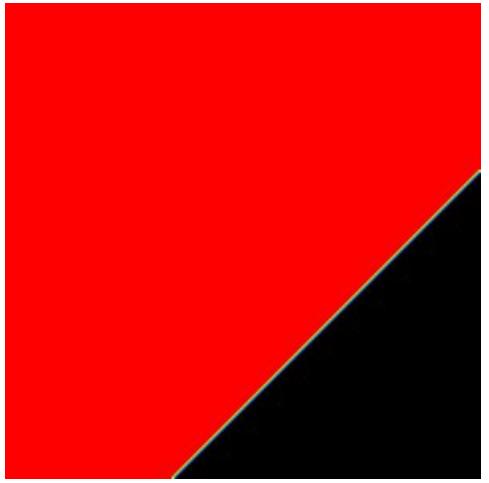
IRAS based N(H)
Schlegel et al. 1998



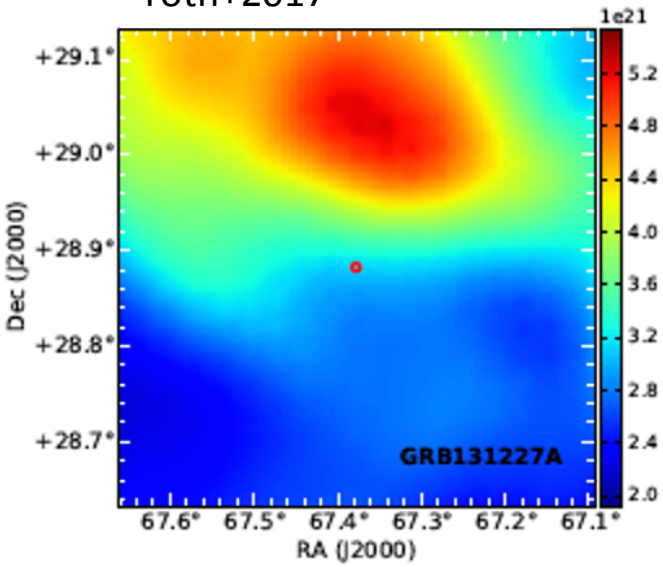
HI 21cm line intensity
Winkel et al. 2016



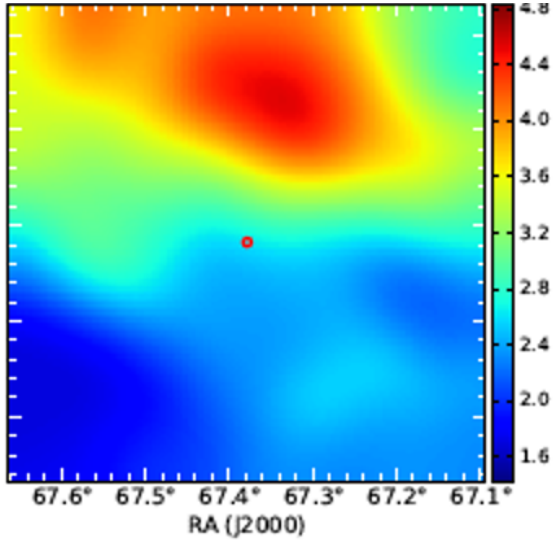
HI 21cm line intensity
Dickey & Lockmann 1990



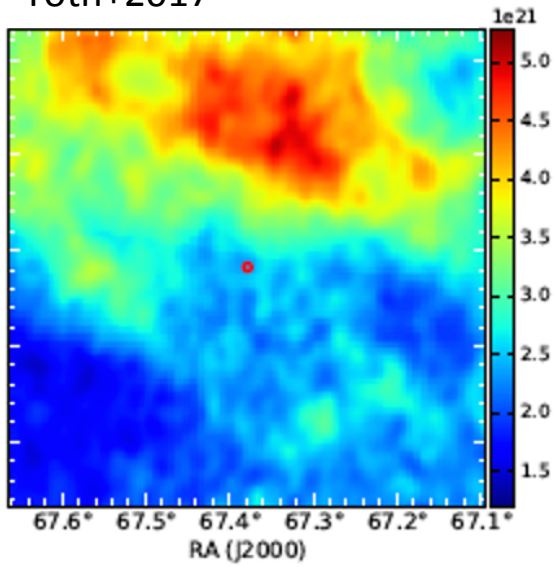
Planck based N(H)
Tóth+2017



AKARI based smothed N(H)
Tóth+2017



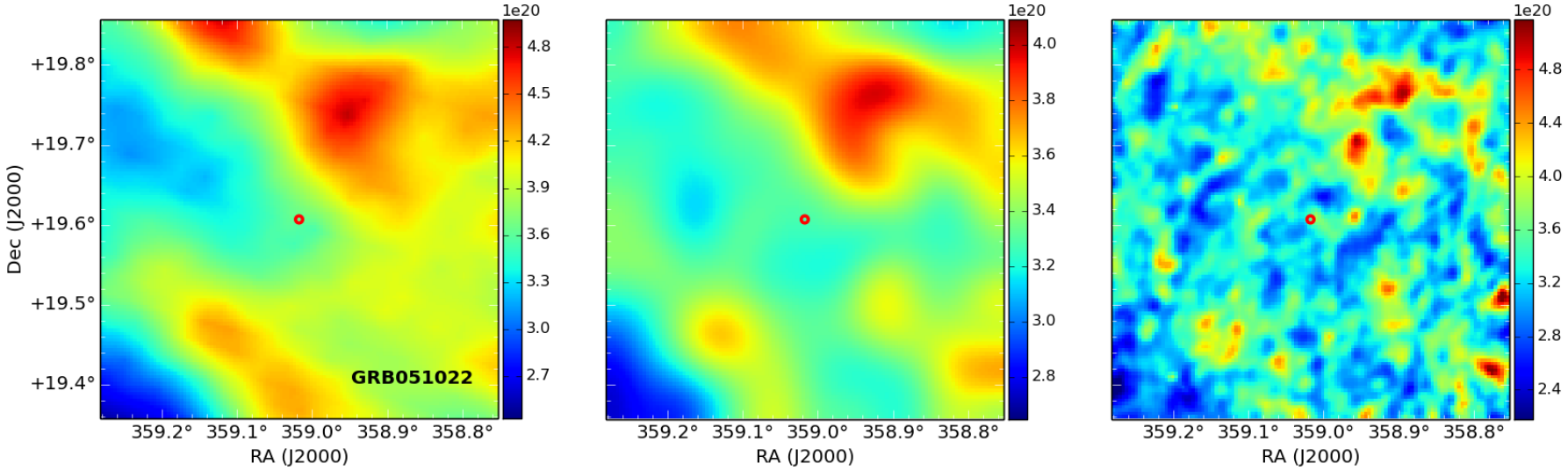
AKARI based N(H)
Tóth+2017



GRB 131227A, z=5.3; N(H) down 20%

GRB 051022A – LGRB in the GRB Ring

- Well known dark LGRB, (no optical afterglow / $A_{V,Int}$)
- Host galaxy
  - SFR = 271 $M_{\odot} yr^{-1}$ (from [OII] line flux); stellar mass: $\log M_* = 10.42 \pm 0.05\ M_{\odot}$ (Levesque+2014); detected in CO 4-3 (ALMA, Hatsukade+2014)
- HI foreground EBHIS: $N(H)_{Gal} = 3.9E+20\ cm^{-2}$

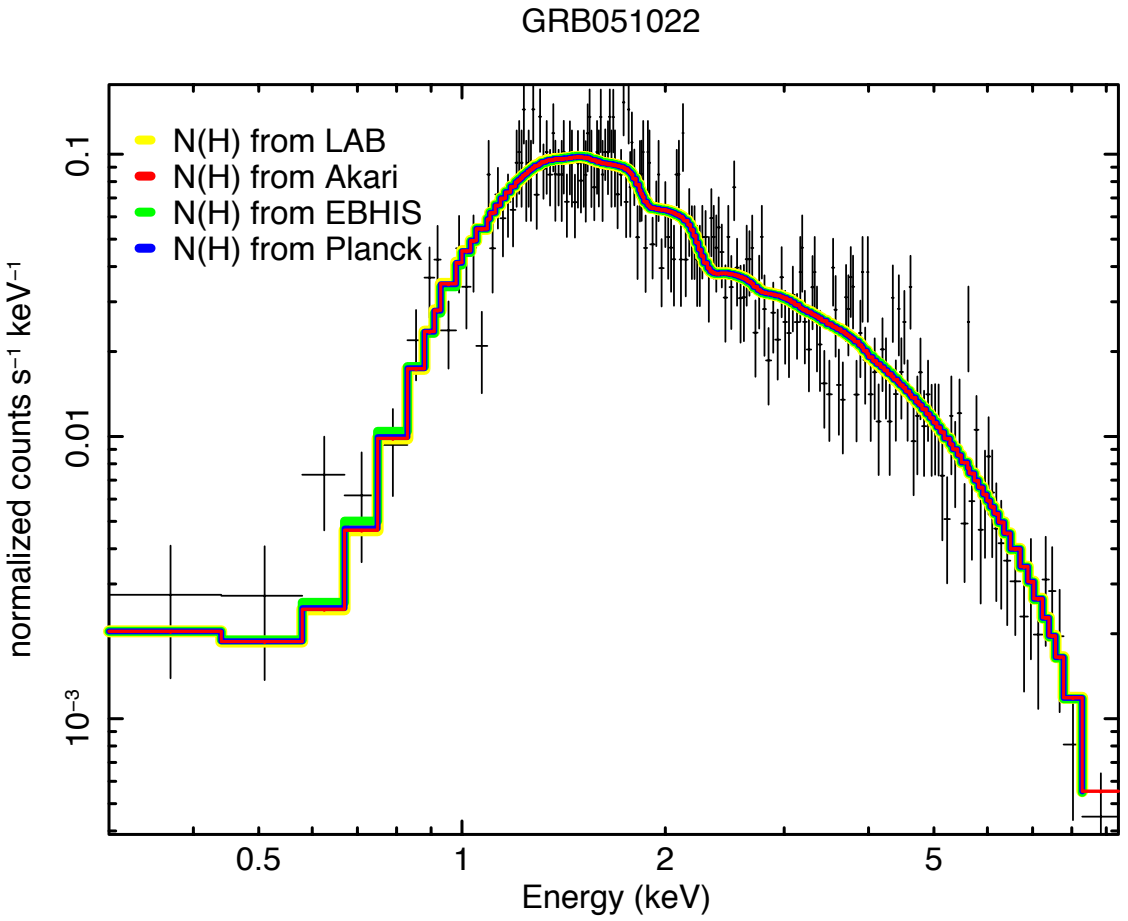


Planck smoothed AKARI FIS AKARI FIS

AKARI: $N(H)_{Gal} = 3.3E+20\ cm^{-2}$ (Tóth+ 2017)

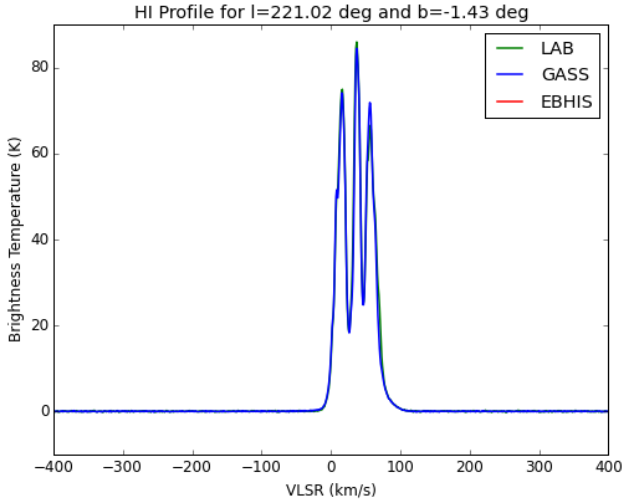
X-ray spectrum of GRB 051022A re-fitted

- Swift-XRT GRB Catalogue (Evans+ 2009)
- analyzed with Xspec (Arnaud 1996)
- same model as in the automatic analysis of the UKSSDC (Evans+ 2009)
- with refined AKARI based foreground $N(H)_{Gal}$
- $N(H)_{Int}$ at host galaxy: 5% higher

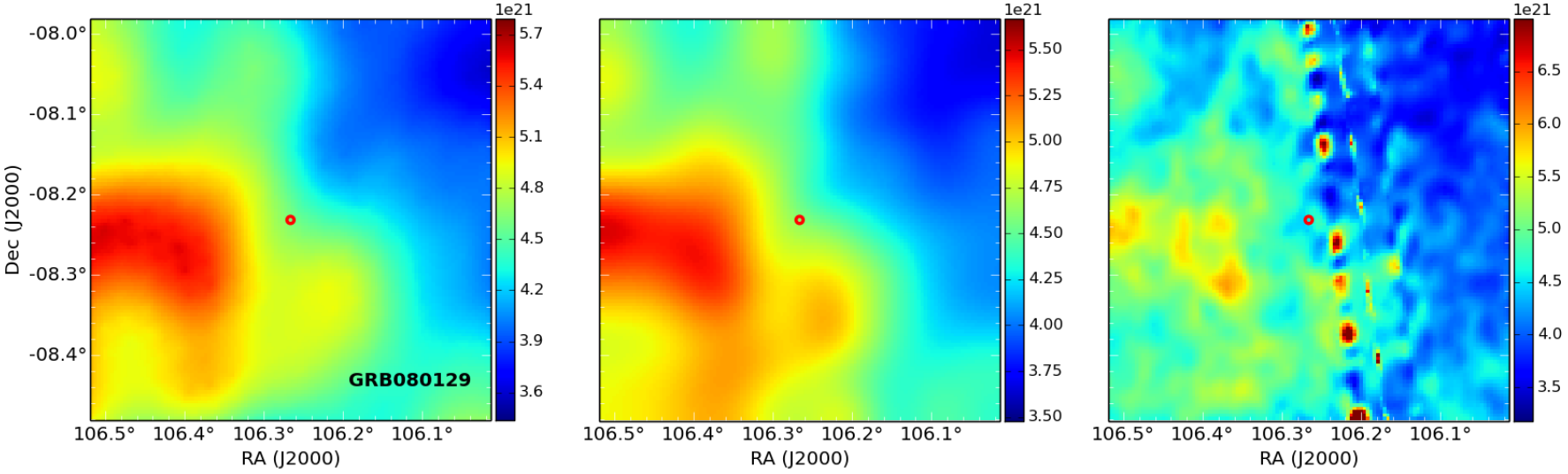


Galactic foreground of GRB 080129

$N(H)_{GASS}$=6.3E+20 cm^{-2} from the GASSIII HI Survey (Kalberla +2015)



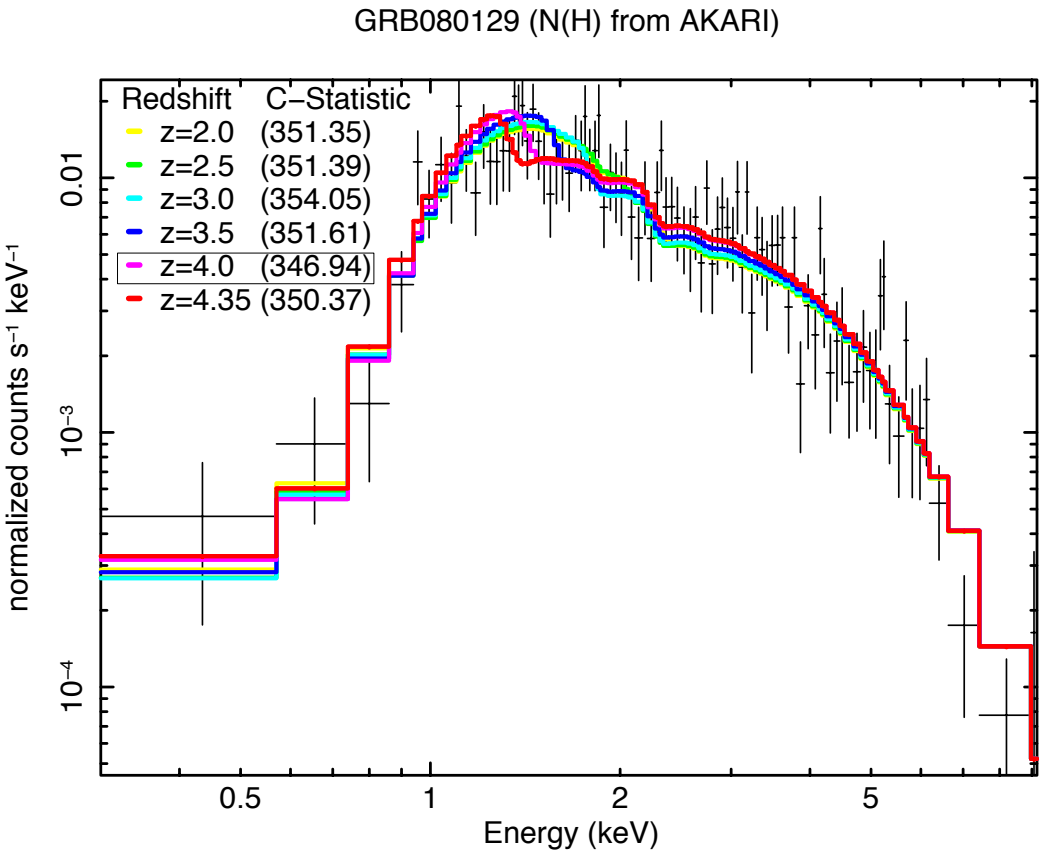
$N(H)_{AKARI}$=4.5E+20 cm^{-2} (artifacts!)



Tóth+ in prep.

X-ray spectrum of GRB 080129 re-fitted

- Swift-XRT GRB Catalogue (Evans+ 2009)
- analyzed with Xspec (Arnaud 1996)
- same model as in the automatic analysis of the UKSSDC (Evans+ 2009)
- with refined AKARI based foreground $N(H)_{Gal}$
- $2< z < 4.35$ variation with fixed $N(H)_{Int}$



See also posters: S11.9 and S11.3

Tóth+ in prep.

Summary

- IR measurements reveal the Galactic foreground
- $N(H)_{Gal}$ typically slightly lower than LAB estimates
- Resolution matters (a bit)
- Slightly higher intrinsic N(H)
- GRB redshift is important (Campana+2012)

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