The Diversity of Kilonova Emission in Short Gamma-Ray Bursts

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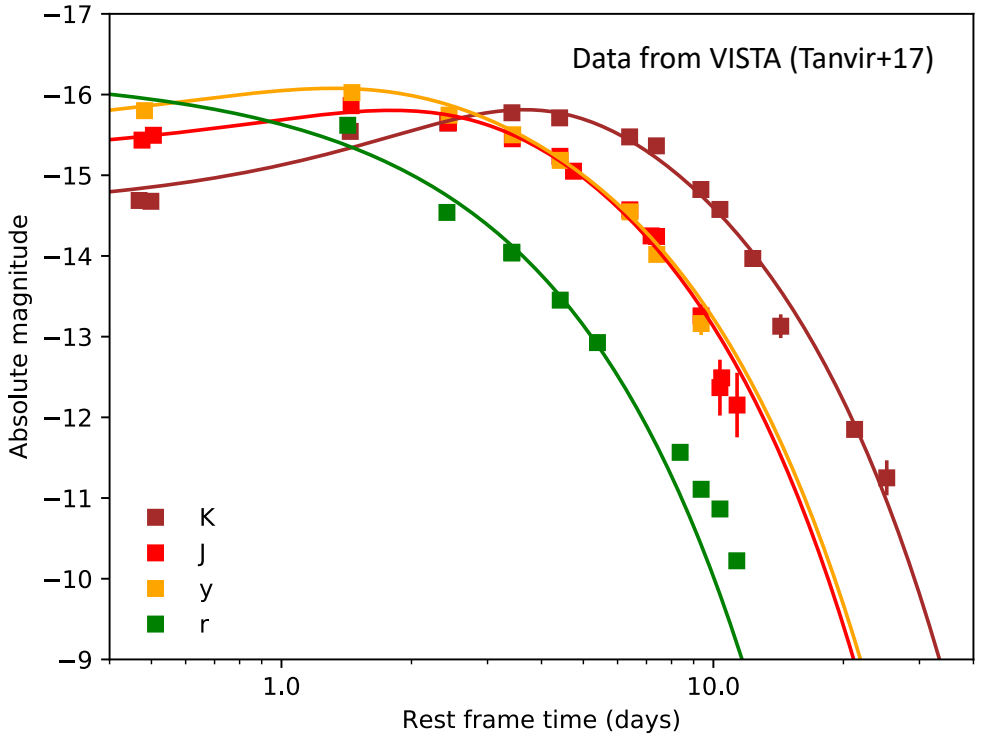
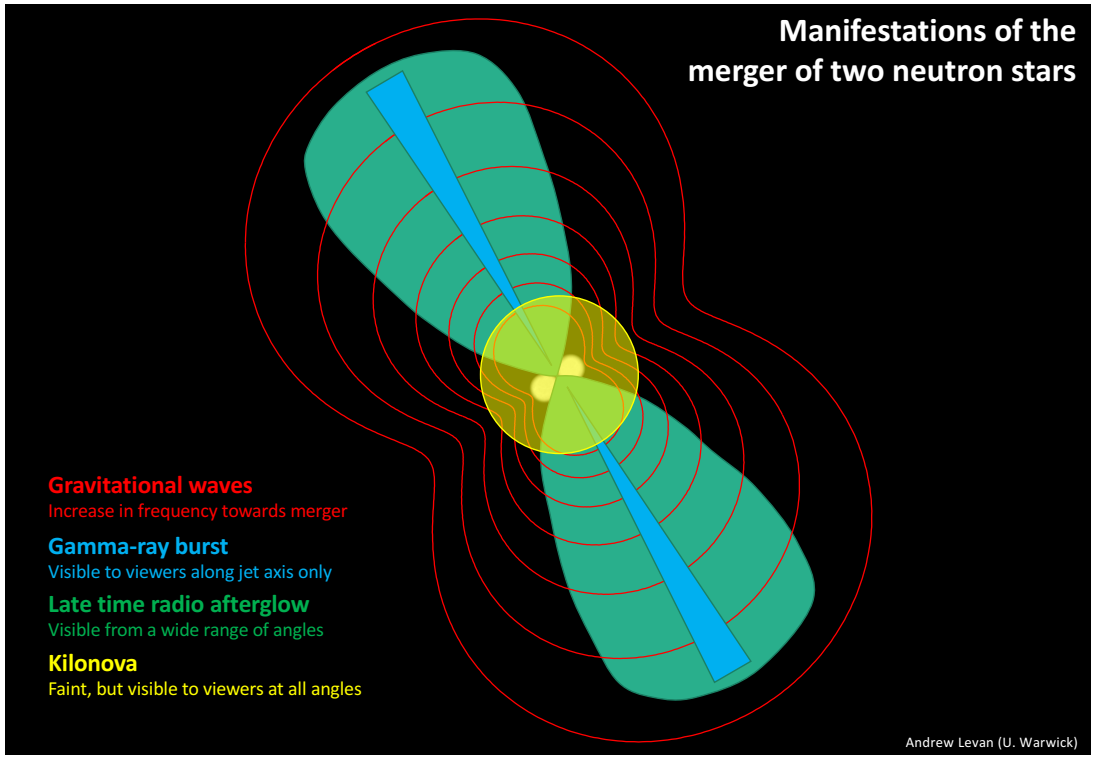
- GRB/GW 170817A confirmed the (long suspected) link between NS binary mergers and short GRBs

- AT2017gfo gave us a template for a kilonova

Are similar events present (but hidden) in the known SGRB population? Are they missing?

How does AT2017gfo compare to the SGRB KN candidates?





We collect 23 SGRBs with z < 0.5 to compare their light curves with AT2017gfo

3 of these are KN candidates: 130603B (Tanvir+13; Berger+13); 060614 (Yang+15); 050709 (Jin+16)

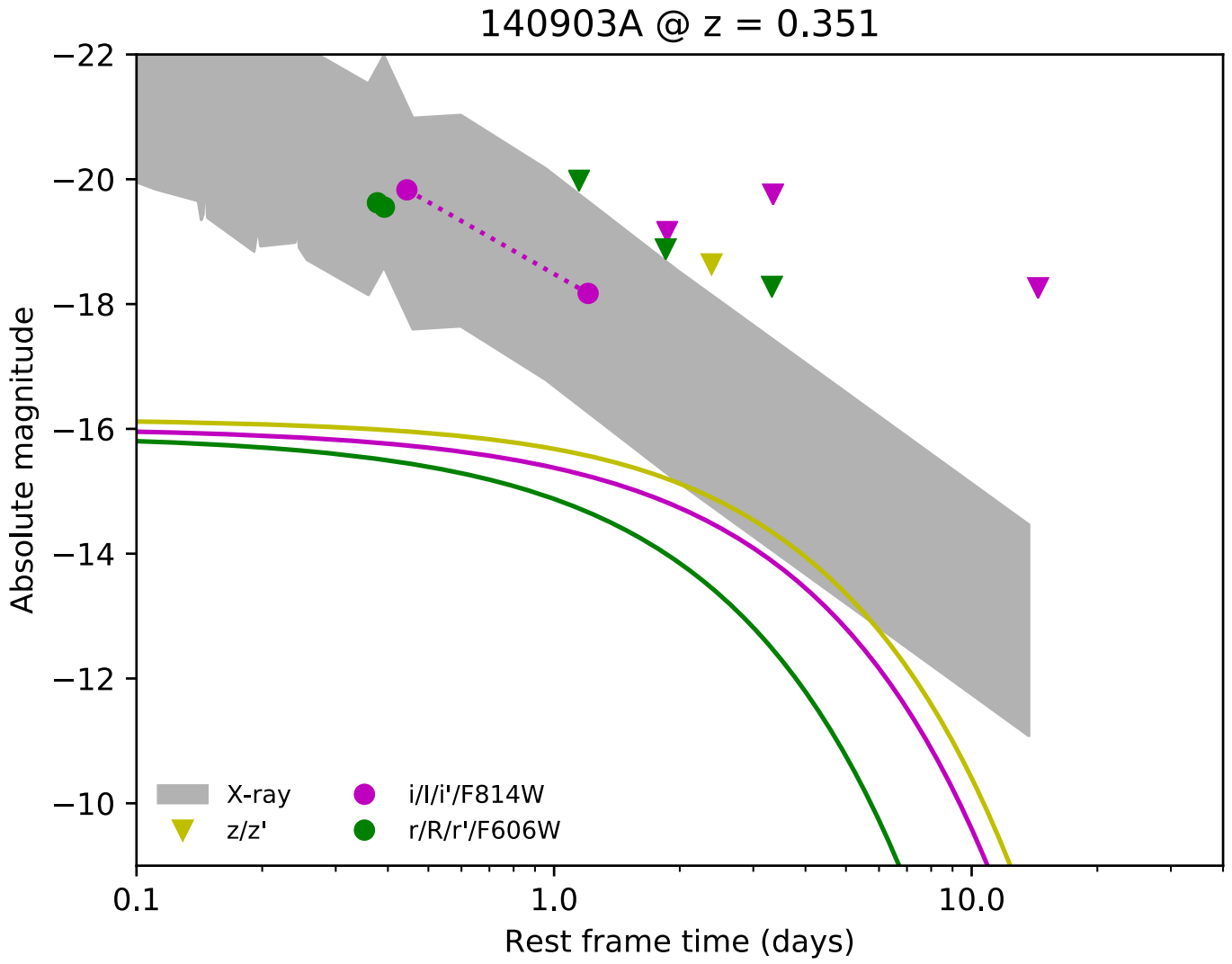
3 more since publishing: 150101B (Troja+18; Gompertz+18); 160821B (Jin+18; Lamb+ in prep); 070809 (Jin+19)

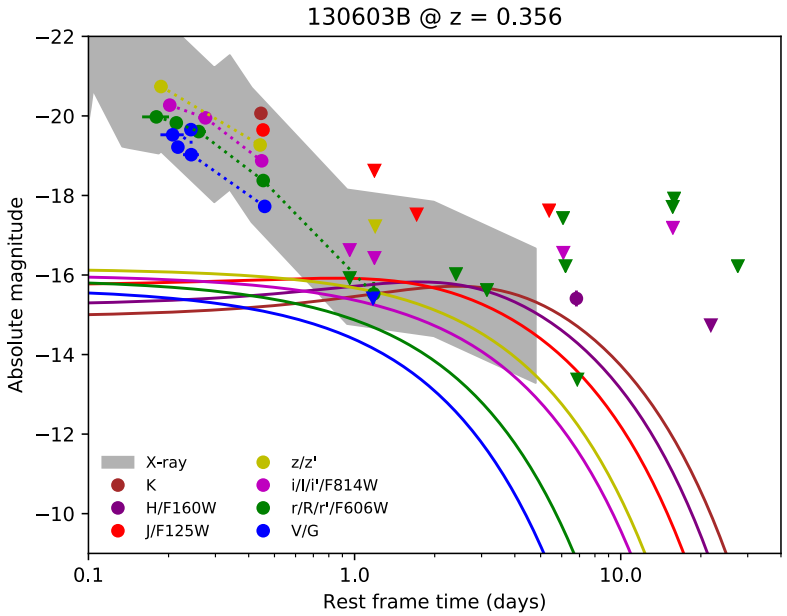
- Observations are shifted to absolute magnitudes (including k-correction)

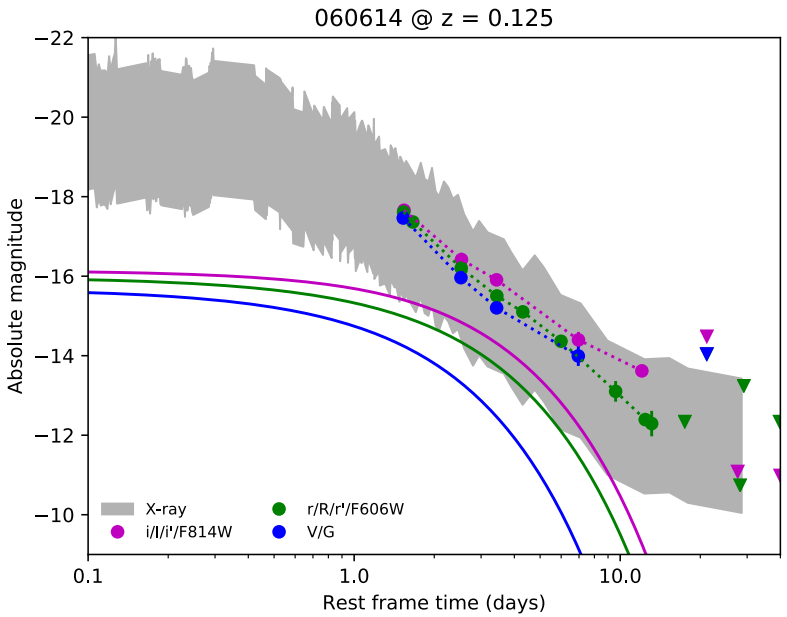
- Bazin fits are interpolated to the relevant rest-frame wavelengths (augmented by fits to UVOT data from Evans+17 where necessary)

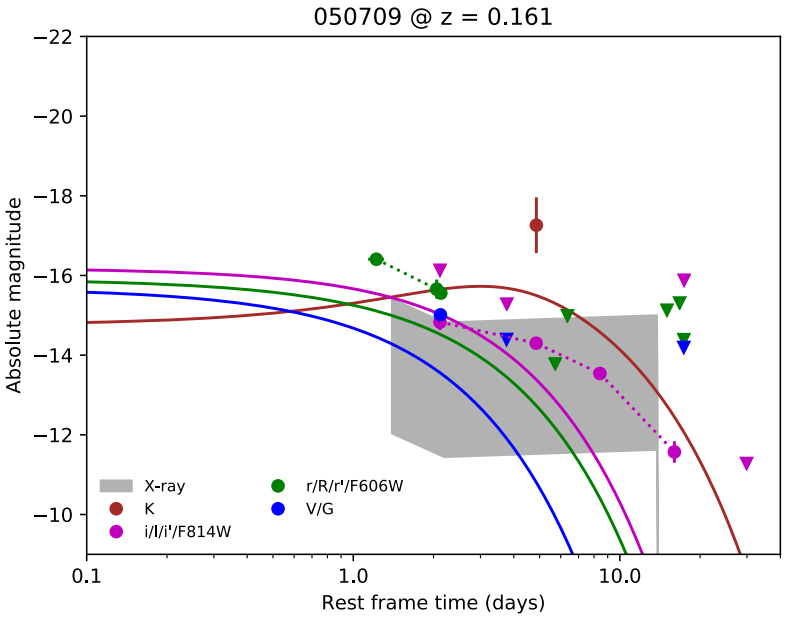
- X-ray observations are extrapolated to the rest-frame r-band (grey band)

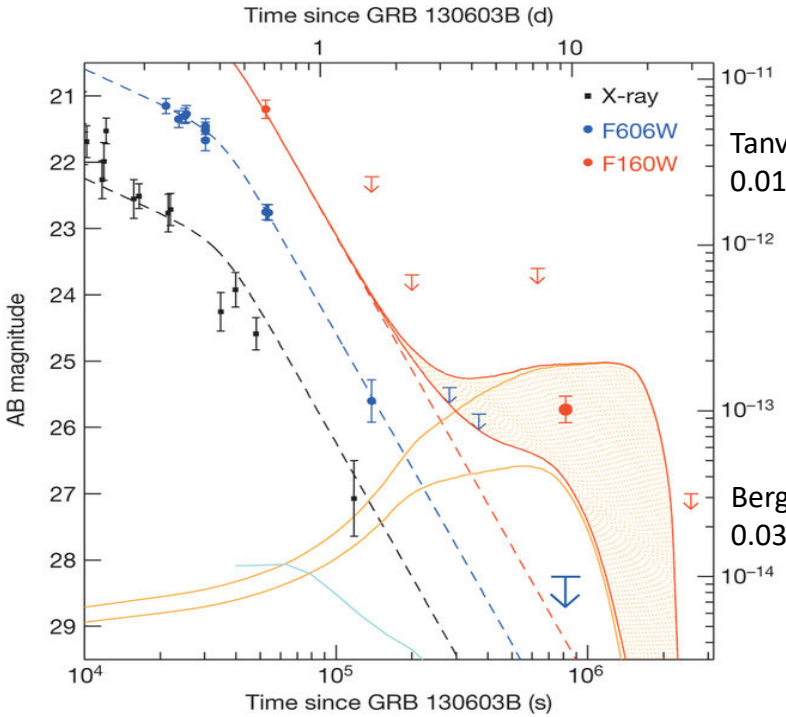
- KN models can then be compared to SGRB observations





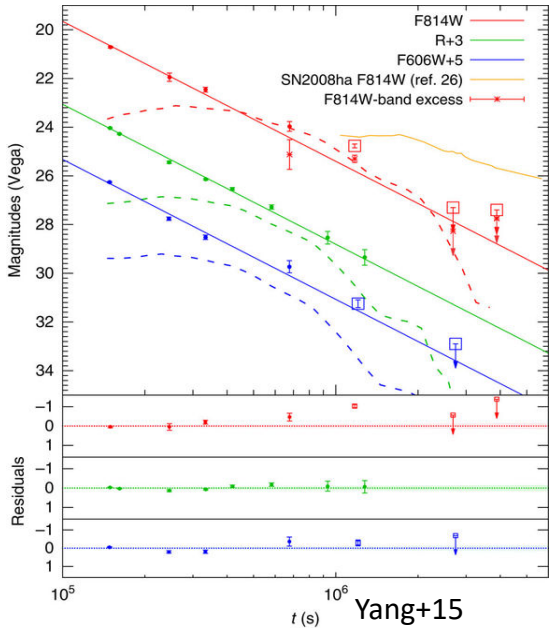






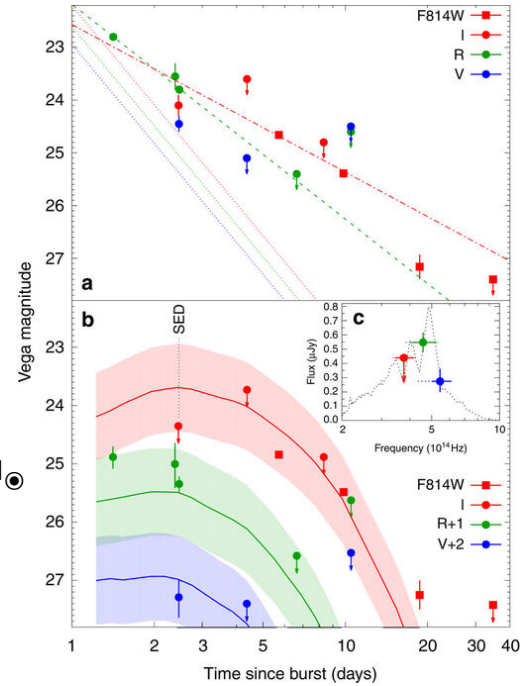
Tanvir+13
$0.01M_\odot \leq M_{ej} \leq 0.1M_\odot$

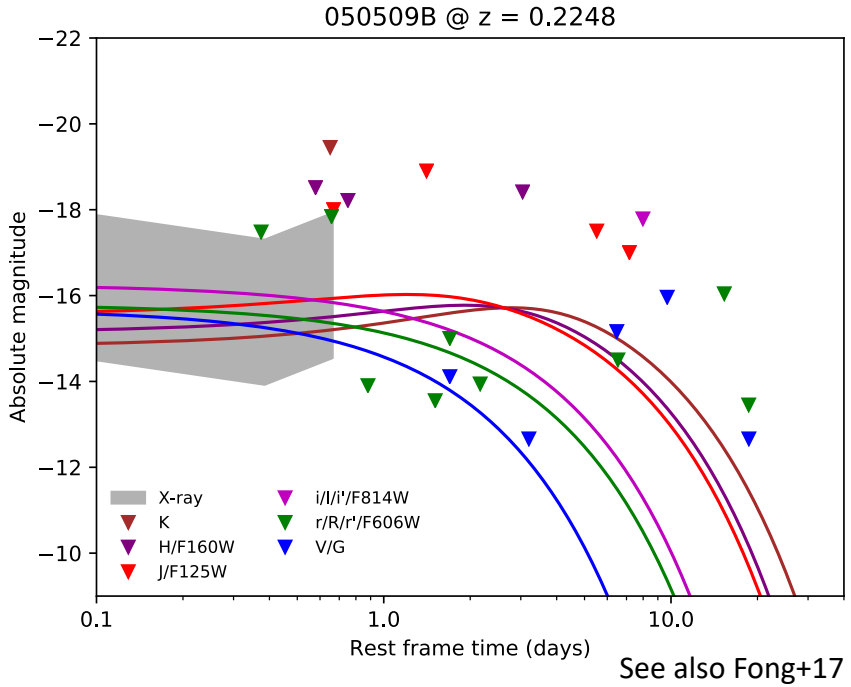
Berger+13
$0.03M_\odot \leq M_{ej} \leq 0.08M_\odot$



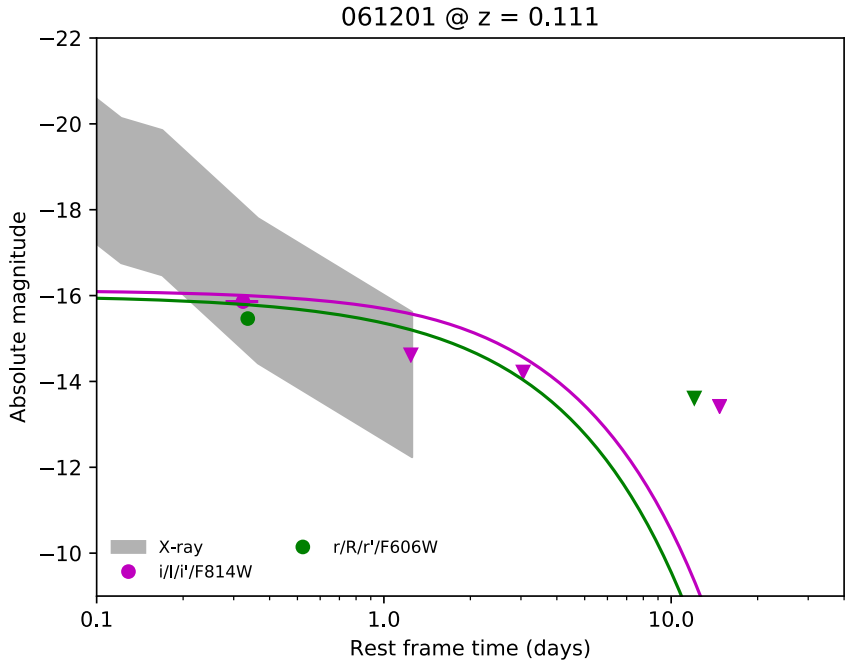
Yang+15
$M_{ej} \sim 0.1M_\odot$

Jin+16
$M_{ej} \sim 0.05M_\odot$





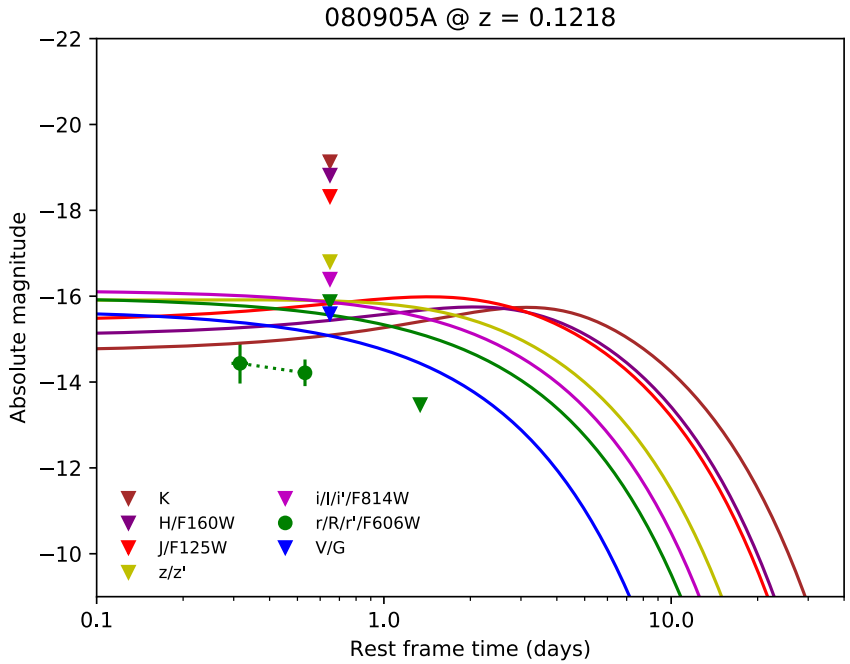
See also Fong+17



Caveats:

- Intrinsic (host galaxy) absorption was not included (not enough data for an SED)

- SGRB redshifts are assigned by putative host redshifts (probabilistic arguments tend to favour massive, lower-z hosts)



Conclusions

We see quite a diversity in KN emission

What could drive such a difference?

Unlikely to be viewing angle:
- Luminosity range exists in SGRB population, hence on-axis
- 150101B may be off-axis (Troja+18) but is the median here (as is the definitely off-axis AT2017gfo)

Mass ratio?

Higher ejecta mass → Brighter transient
Higher ejecta velocity/lower ejecta mass → Faster evolution
Higher opacity ejecta → Later peak

Some SGRBs with KN (e.g. 060614, 130603B) also show late X-ray excesses. Contributions from re-processed X-ray activity? (e.g. Kisaka+2016)

See Gompertz+2018 (ApJ, 860:62)