Prompt/Afterglow in the optical/NIR

VT, GWAC, GFTs with possibly other instruments

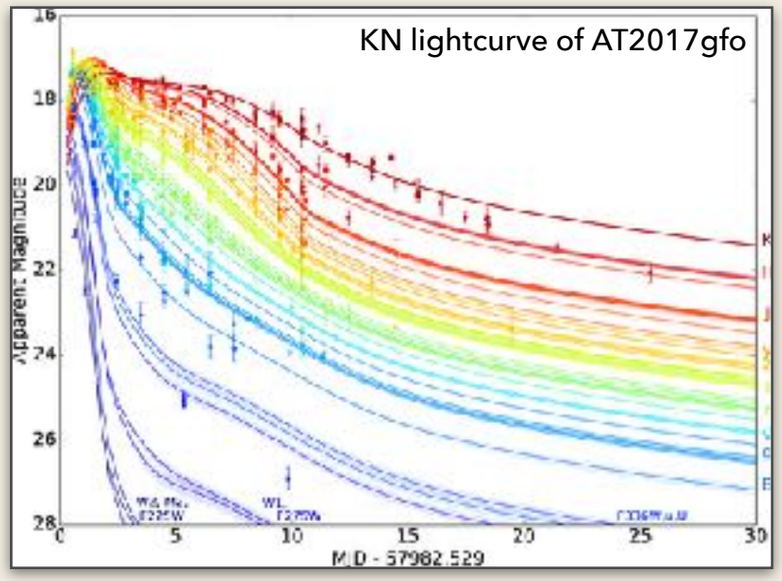
Jesse Palmerio

Focus on afterglow in the optical/NIR

Lightcurve and spectrum

See presentation by:
Frédéric Daigne, Jérôme Guilet & Susanna Vergani

- Can be used to inform many properties (**redshift**, jet opening angle, viewing angle, circumburst medium, reverse shock, supernova (SN), kilonova (KN), host properties, etc.)



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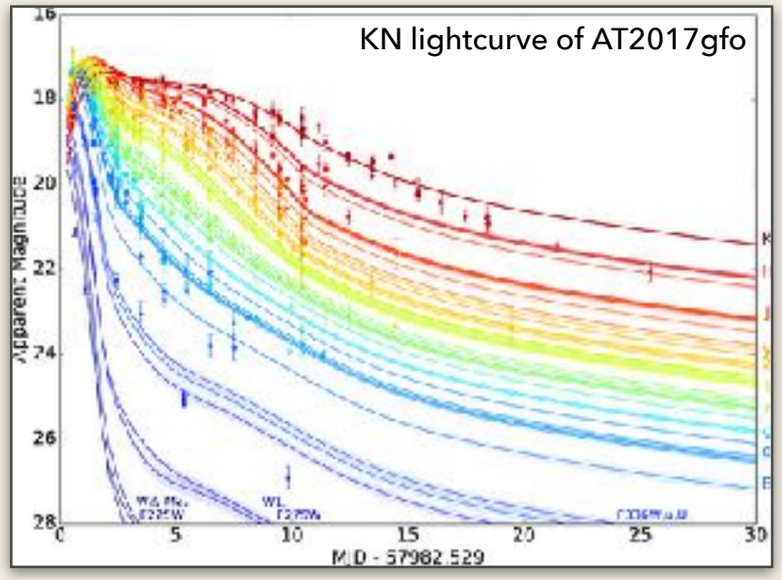
  - ➡ Data acquisition
  - ➡ Data reduction
  - ➡ Data measurement
  - ➡ Data correction



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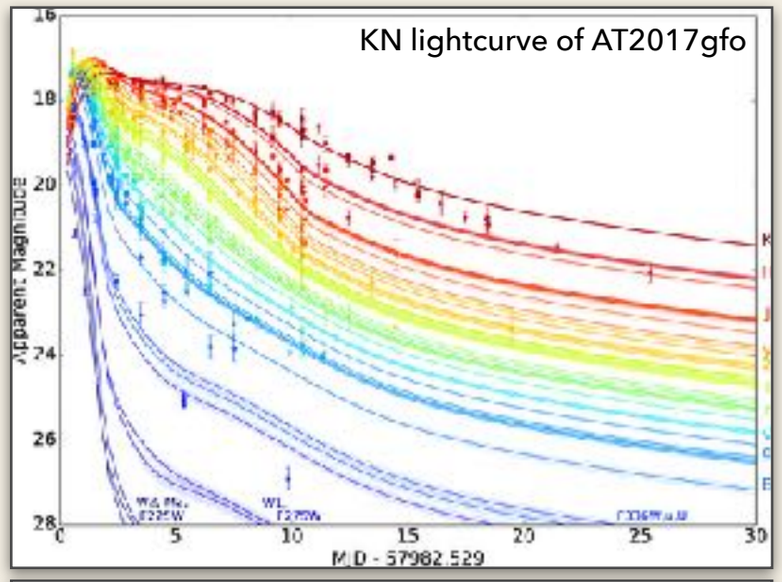
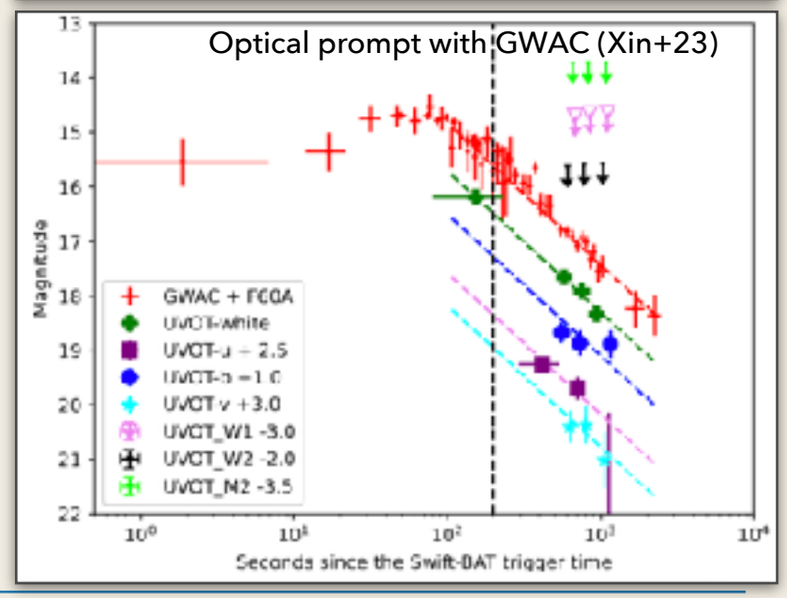
- (Similar considerations in the case of the prompt emission, see e.g. Klotz+06, Racusin+08, Xin+23)





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Data acquisition (photometry)

- **Automatic** for first data points, **manual** for late-time monitoring (e.g. jet-break, SN, KN, host, etc.)
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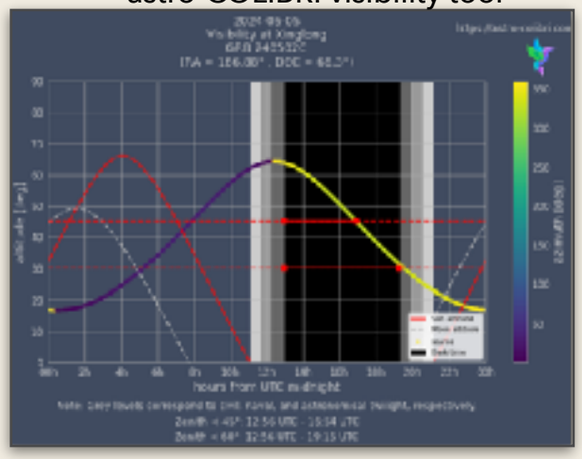
  - When to observe optimally?
    - Local conditions (e.g. elevation, moon, seeing, Earth occultation (VT), …)
    - Physical conditions (e.g. wait for expected SN peak, jet-break)
  - Multi-wavelength coordination (e.g. X-rays/radio for achromaticity of jet-break)
  - Coordination between telescopes (avoid duplication)

astro-COLIBRI visibility tool



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  - What cadence?
    - Need for high-cadence observations for short timescale variations?
    - Space out observations for managing time (e.g. in case multiple GRBs need of follow-up)
  - What bands?
    - Favour red/near-infrared bands for search for KN in case of short GRBs
    - Ignore bands blue-ward of Lyman-limit in case of high-redshift GRBs
  - Polarisation? (automatic RRM, other partners)

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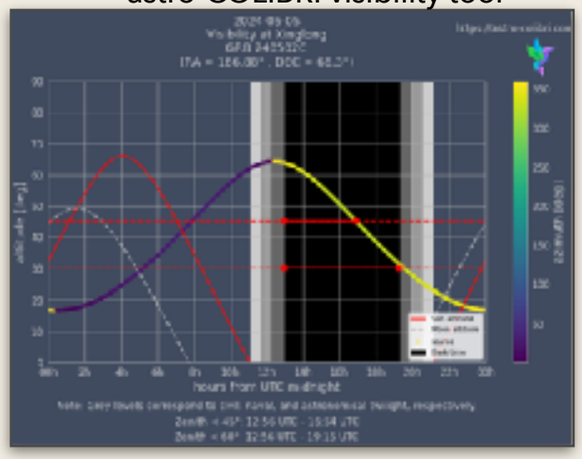

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    - High-cadence early observations (e.g. fine-structure lines variation, KN) ?

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  - What cadence?
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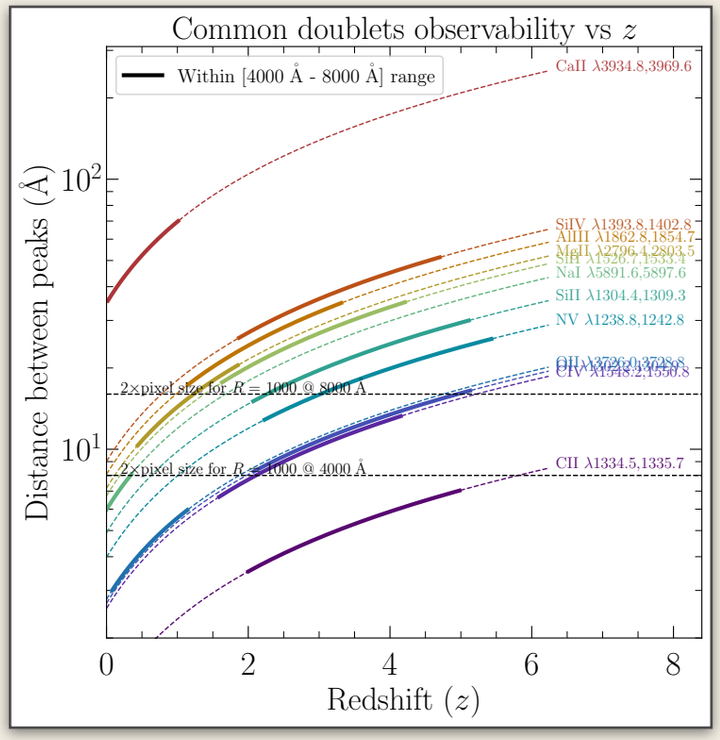
- What wavelength coverage/resolution?
  - Wider wavelength coverage usually better (but trade-off with resolution)
  - Favour red/near-infrared coverage for high-redshift/dust-extinguished
  - Higher resolution if bright (e.g. for fine-structure lines)
  - Lower resolution if faint for better SNR (e.g. to get at least redshift)
- What acquisition mode?
  - Fibre/Slit/IFS (e.g. slit angle to include/avoid nearby host/star)
  - Stare vs nodding (e.g. for sky-subtraction in the NIR)



What do we need to have interpretation-ready data?

Data reduction (photometry and spectroscopy)

- Instrumental corrections and calibrations:
  - Calibration files need to be accessible (bias, flats, etc.)
  - Pipelines need to be operational and need people who know how to use them (rapidly)

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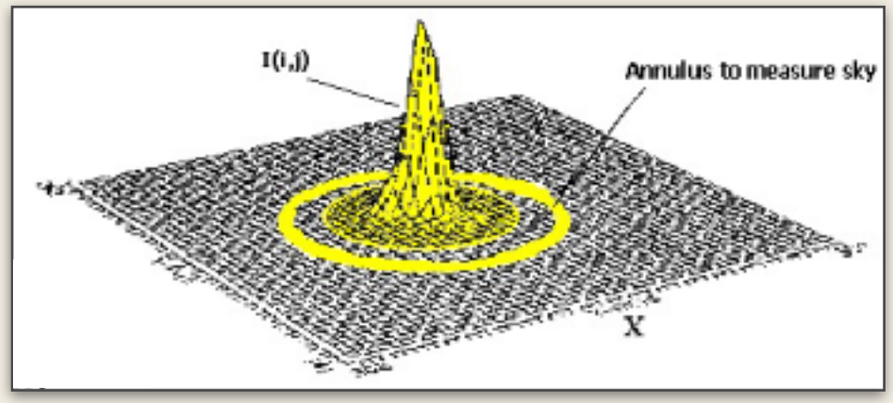
- Photometry:
  - Capability of stacking images but also using individual frames (e.g. if high-cadence is required for very early observations)
- Spectroscopy:
  - Wavelength corrections (e.g. heliocentric, vacuum)
  - Telluric corrections
  - Flux calibration (e.g. in particular for host spectra)

What do we need to have interpretation-ready data?

Data measurement (photometry)



Aperture photometry example.
credit: Malesani

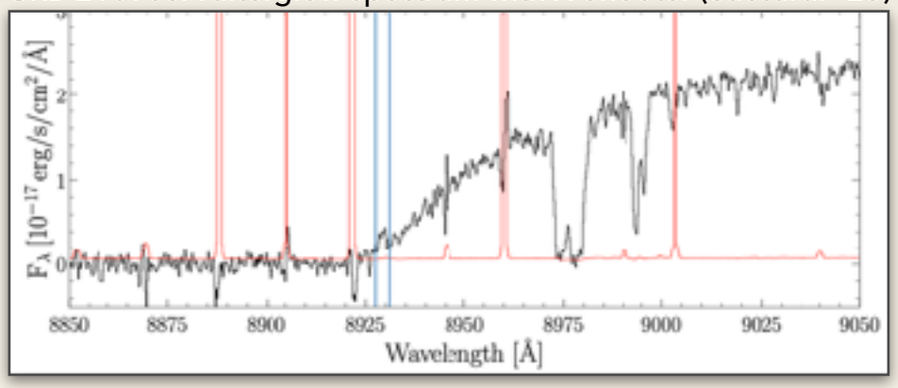
- Measuring meaningful photometry:
  - Aperture photometry vs PSF photometry
    (e.g. in case of nearby bright source or transient inside extended galaxy)
  - Image subtraction (e.g. to look for variability or for removing host contribution)
- Converting to useful photometric and magnitude (AB) system:
  - Need filter transmission curves?
  - Transformations to/from standard systems (SDSS, Johnson(?), etc.)

What do we need to have interpretation-ready data?

Data measurement (spectroscopy)

- Identification of spectral features & emission/absorption lines (e.g. for **redshift** measurement)

GRB 210905A afterglow spectrum with X-Shooter (Saccardi+23)



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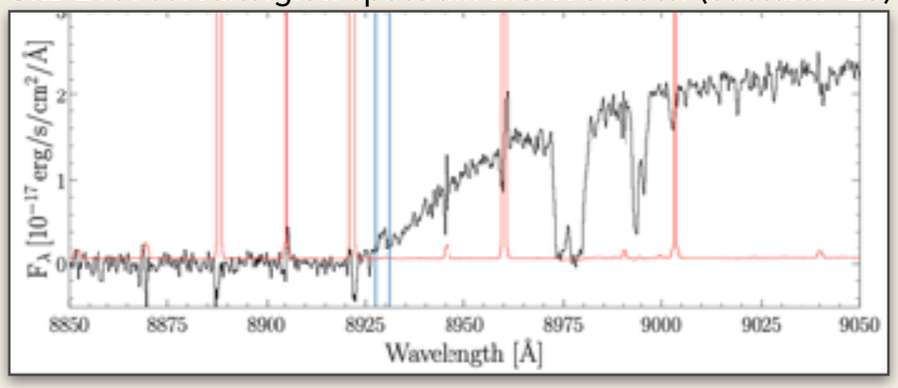

- Identification of spectral features & emission/absorption lines (e.g. for **redshift** measurement)
- Afterglow absorption (e.g. for column density measurements, extinction curve, etc.):
  - Spectrum normalisation (e.g. continuum fitting)
  - Voigt-profile line fitting (e.g. blending, line-saturation, multiple components/systems)
- Host emission (e.g. line fluxes, attenuation, etc.):
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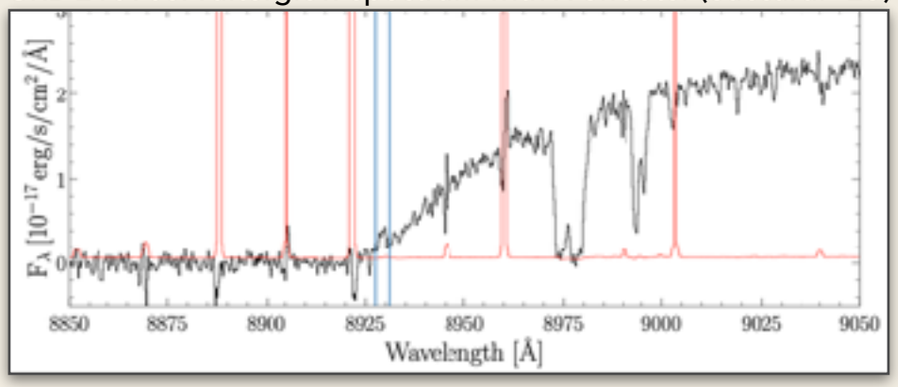
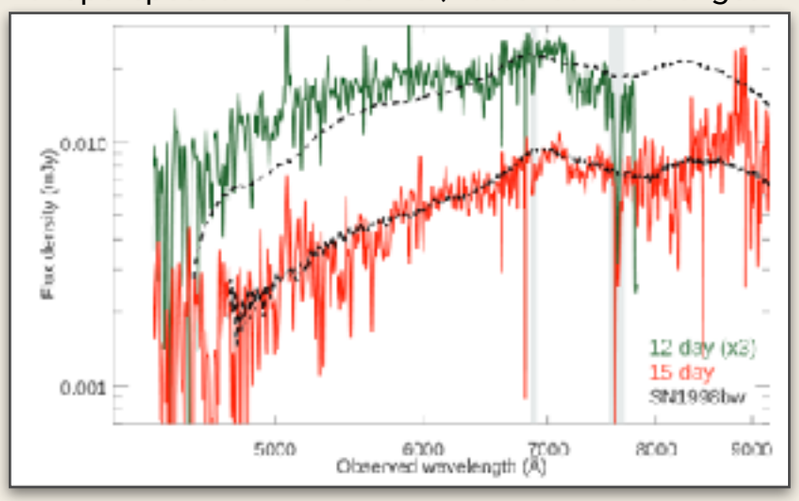
- Host emission (e.g. line fluxes, attenuation, etc.):
  - Continuum estimation (e.g. continuum fitting)
  - Gaussian line fitting (e.g. multiple components)
- Supernova/Kilonova:
  - Template fitting (e.g. SNID)
  - Feature identification

GRB 210905A afterglow spectrum with X-Shooter (Saccardi+23)



SN2023pel spectrum with OSIRIS (Hussenot-Desenonges+24)



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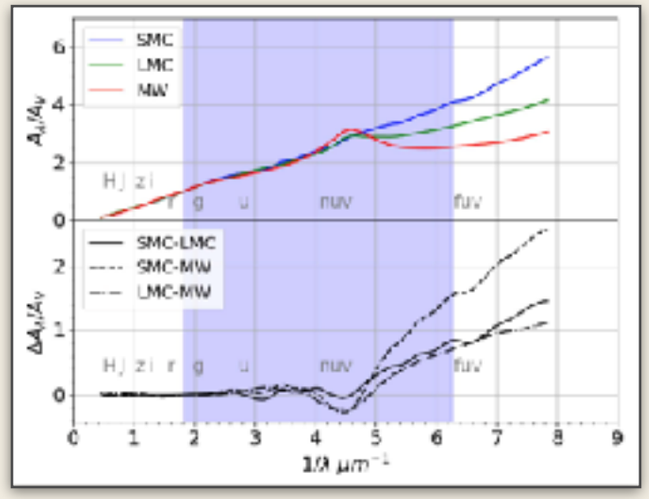
What do we need to have interpretation-ready data?

Data correction (photometry and spectroscopy)

Local extinction curves (Corre+18)



- Correct photometry for physical effects:
  - Absorption due to dust in the Milky Way
  - Absorption due to dust in the host galaxy (e.g. using SED fitting)
  - Contamination due to emission of host galaxy (or nearby extended sources) for the afterglow

See presentation by:
Ny Avo Rakotondrainibe & Veronique Buat

- Correct spectroscopy for physical effects:
  - Absorption due to dust in the Milky Way
  - Absorption due to dust in the host galaxy (e.g. using the Balmer decrement)
  - Balmer absorption due to stellar population in the host

Recap of useful links for follow-up

And open questions

- SVOM Burst Advocates:
  - iFSC-Tools (still in development): https://fsc-integration.svom.org/ifsc-tools/login
  - Chinese BA Tools (still in development): https://svom-gwacn.cn/suss/#/
- Need somewhere that shows which SVOM telescopes have observed, when, etc.
  SVOM CP GRB Table? Chinese BA Tools?
- Need somewhere to retrieve follow-up (reduced or raw) SVOM data.
  SDB?