Workshop Enjoy the Universe with COLIBRÍ!

Spectroscopy follow-up of GRBs

NASA/STScI

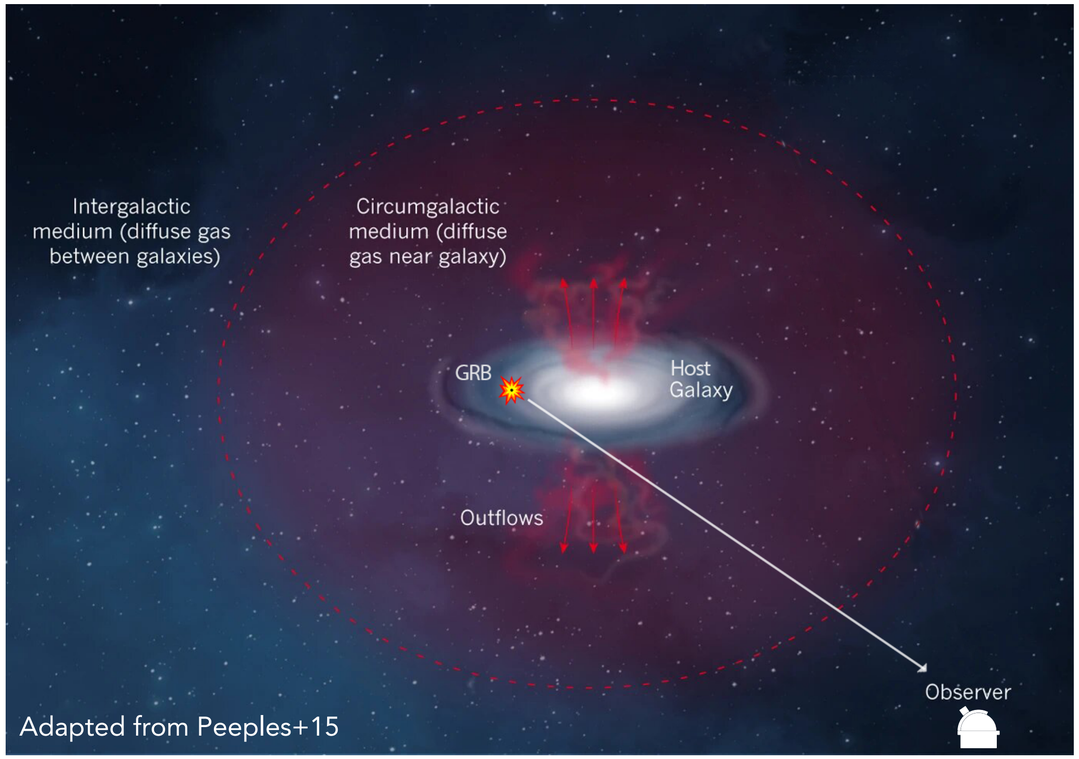
Benjamin Schneider (LAM)

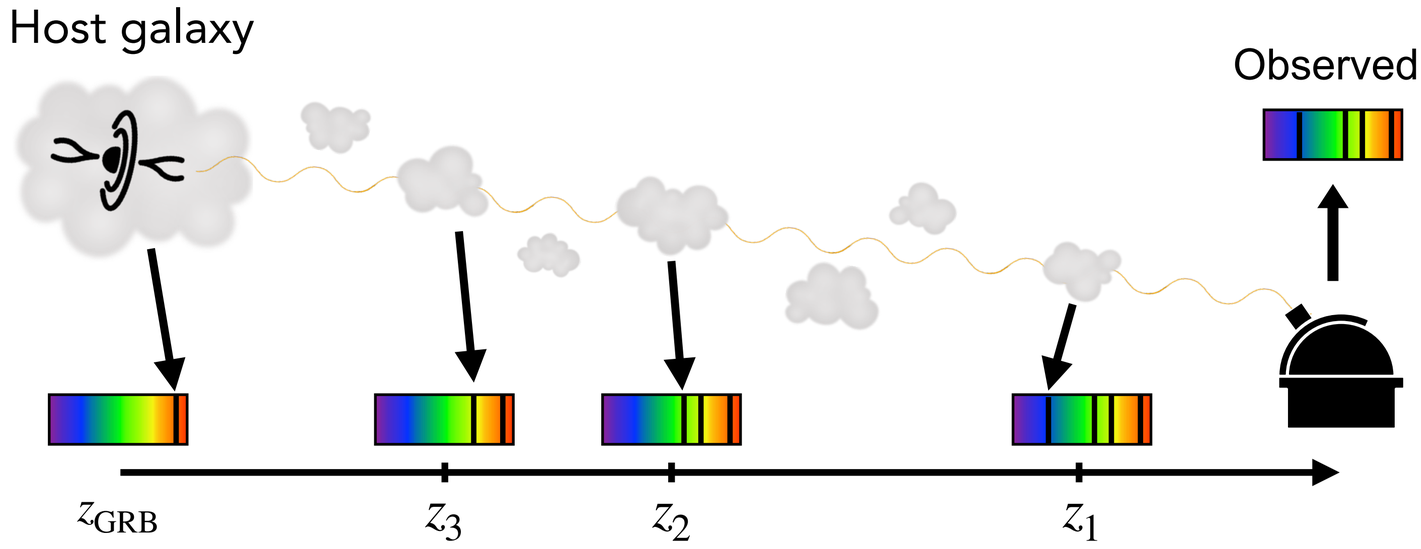
2025-12-02 | OHP, France

LAM
LABORATOIRE D'ASTROPHYSIQUE
DE MARSEILLE

GRBs and their us as cosmic probes

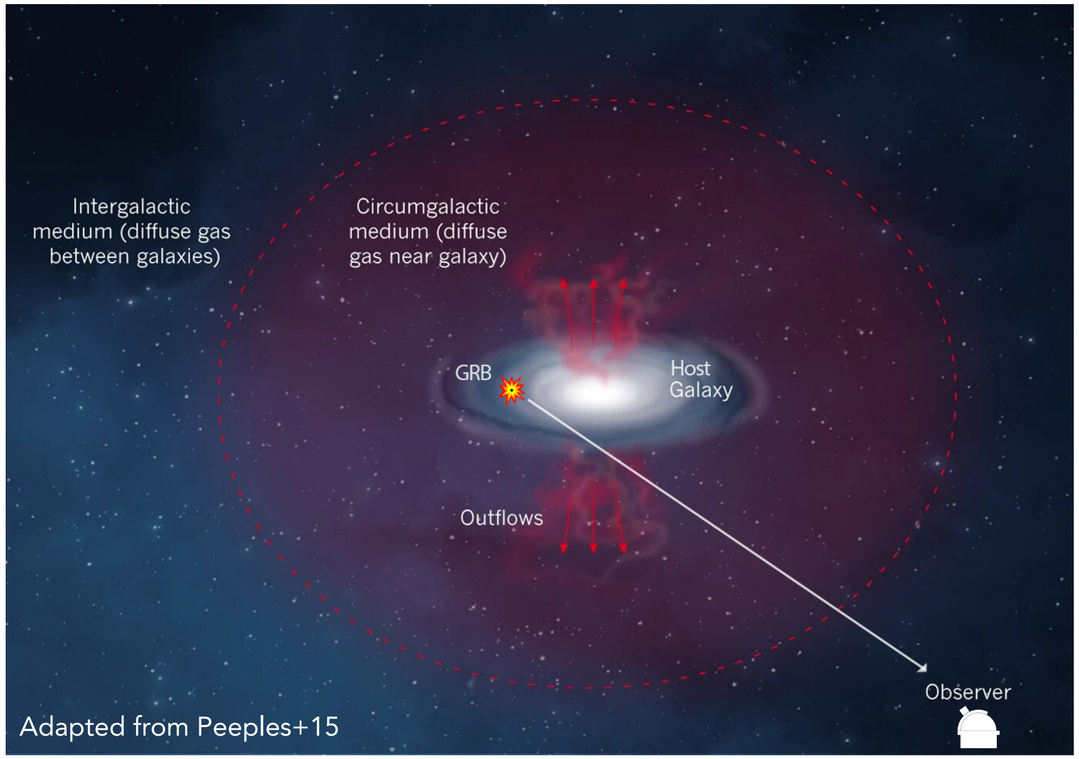
- Beacon providing a detailed view of the interstellar medium (ISM)
- Independently of the brightness of the host galaxy
- Visible over a wide redshift range (z > 8)
- Afterglows are modeled using simple power laws

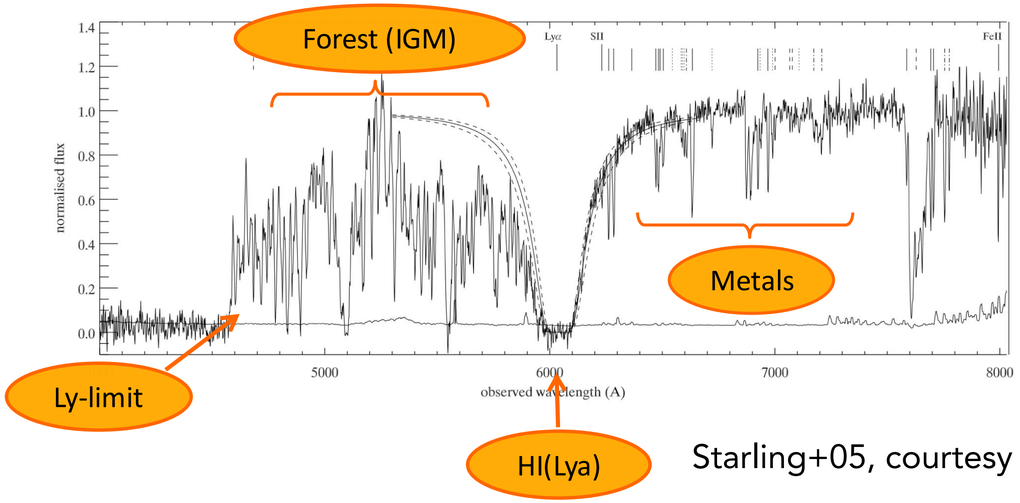


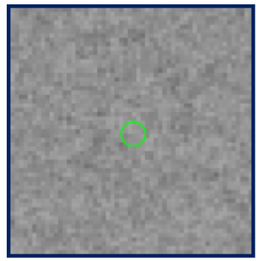


GRBs and their us as cosmic probes

- Beacon providing a detailed view of the interstellar medium (ISM)
- Independently of the brightness of the host galaxy
- Visible over a wide redshift range (z > 8)
- Afterglows are modeled using simple power laws



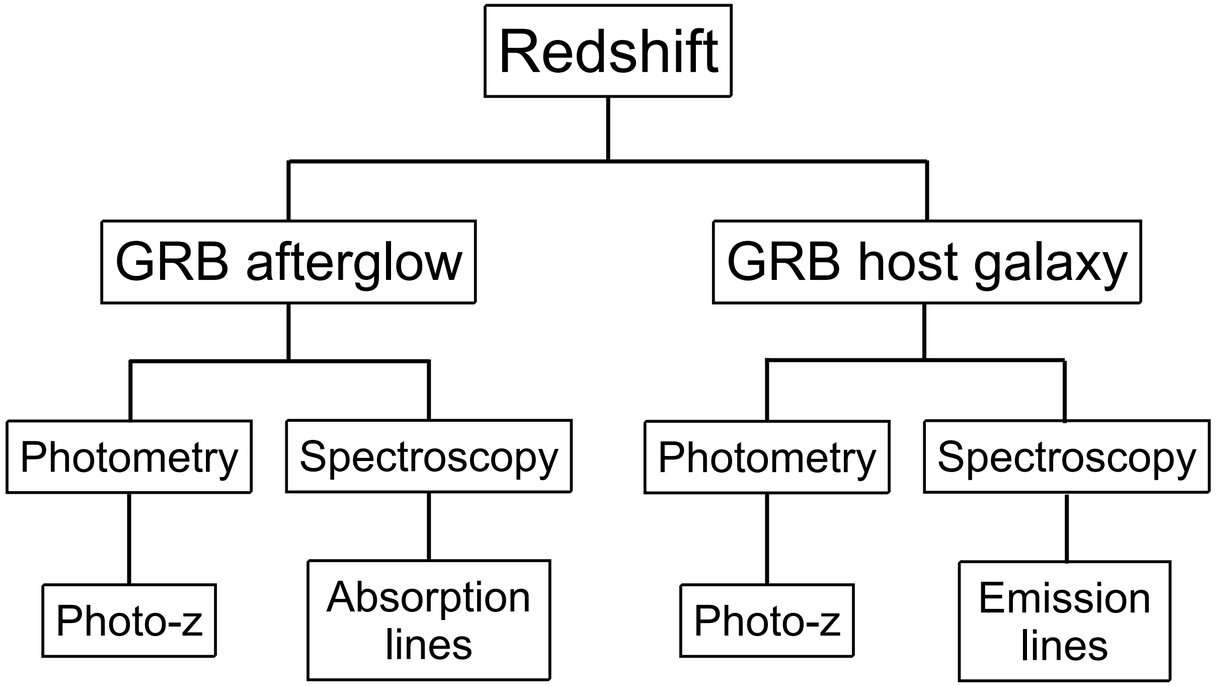




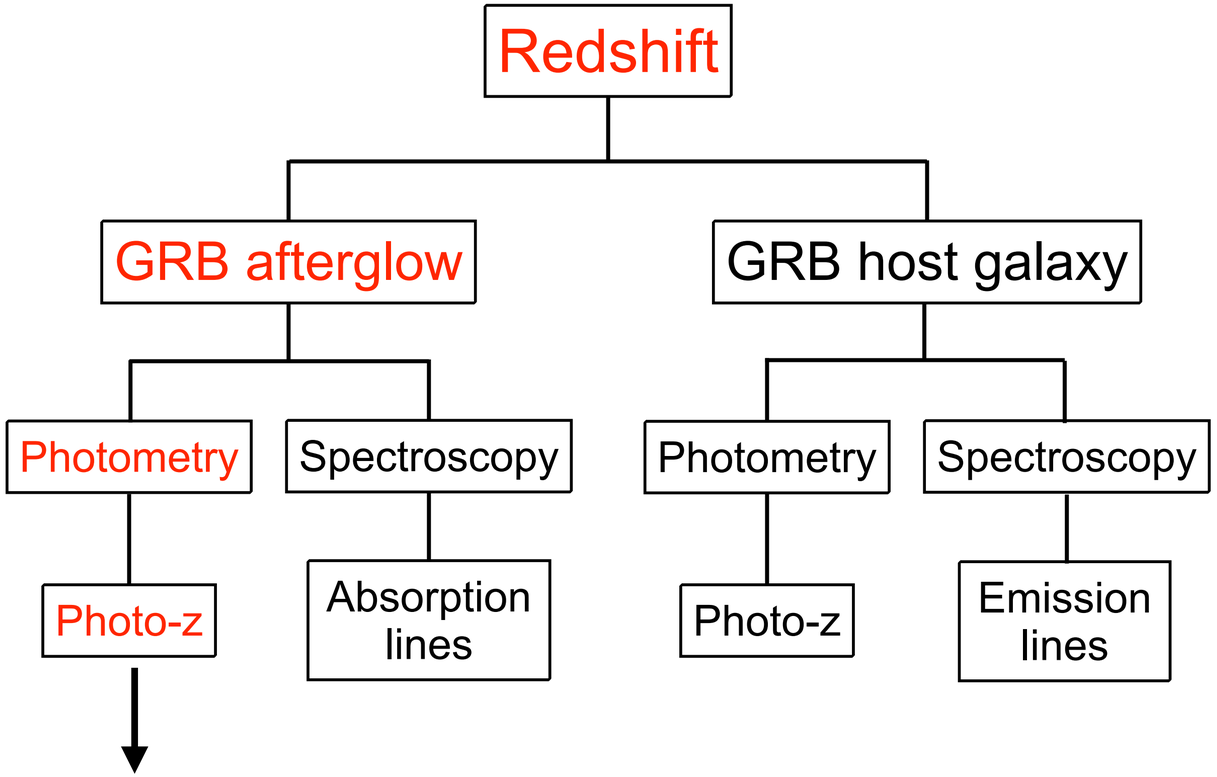
z = 3.97
r > 28.5

Starling+05, courtesy of N. Tanvir

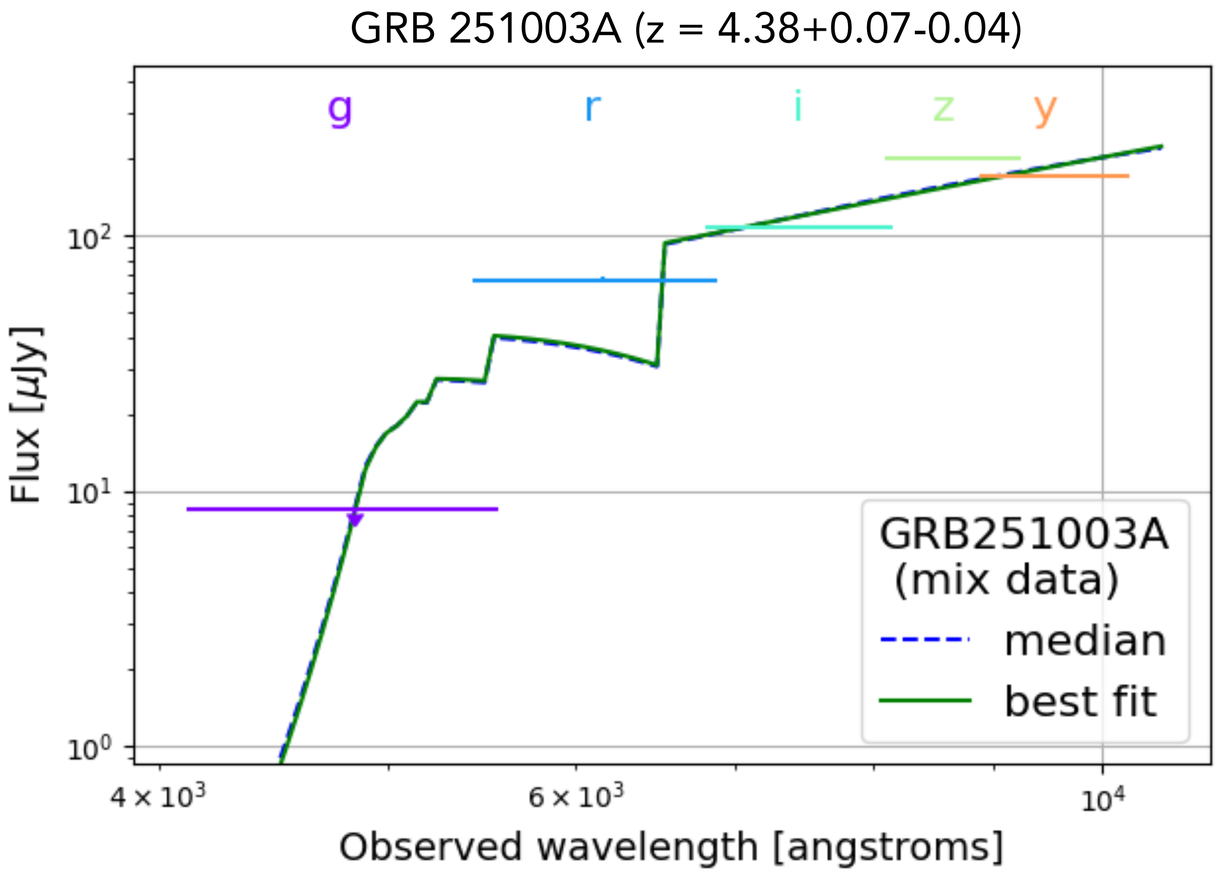
Possible way to measure a redshift for a GRB



Possible way to measure a redshift for a GRB

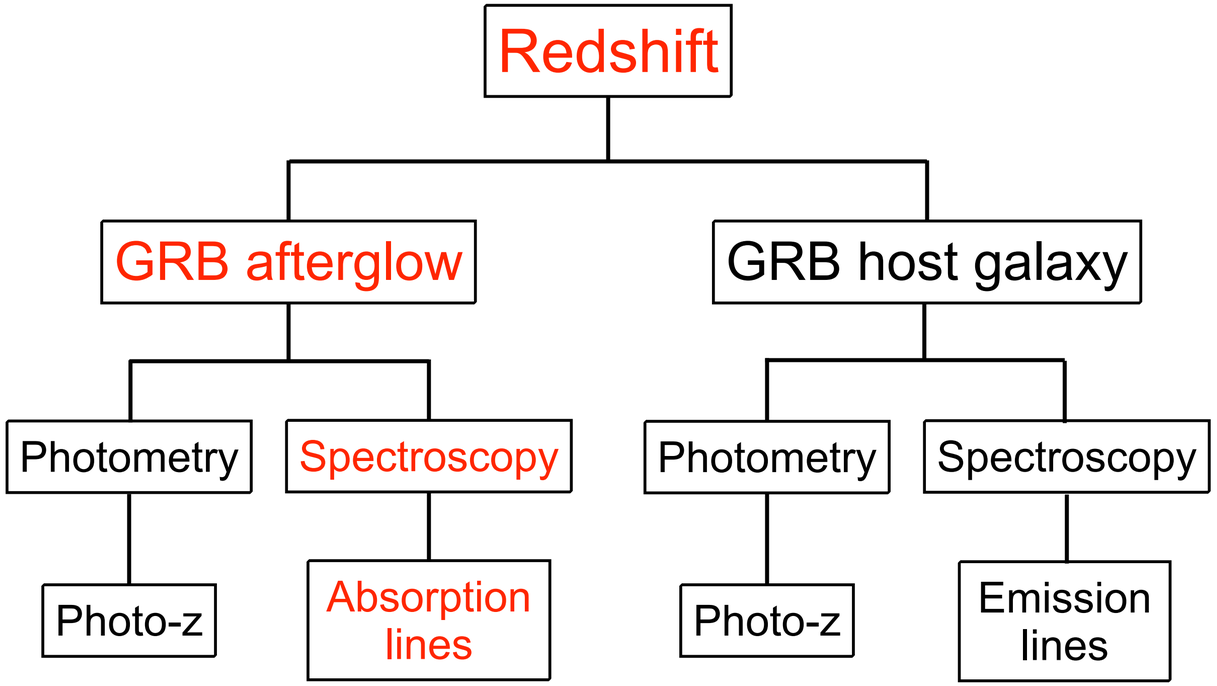


See Ny-Avo talk!



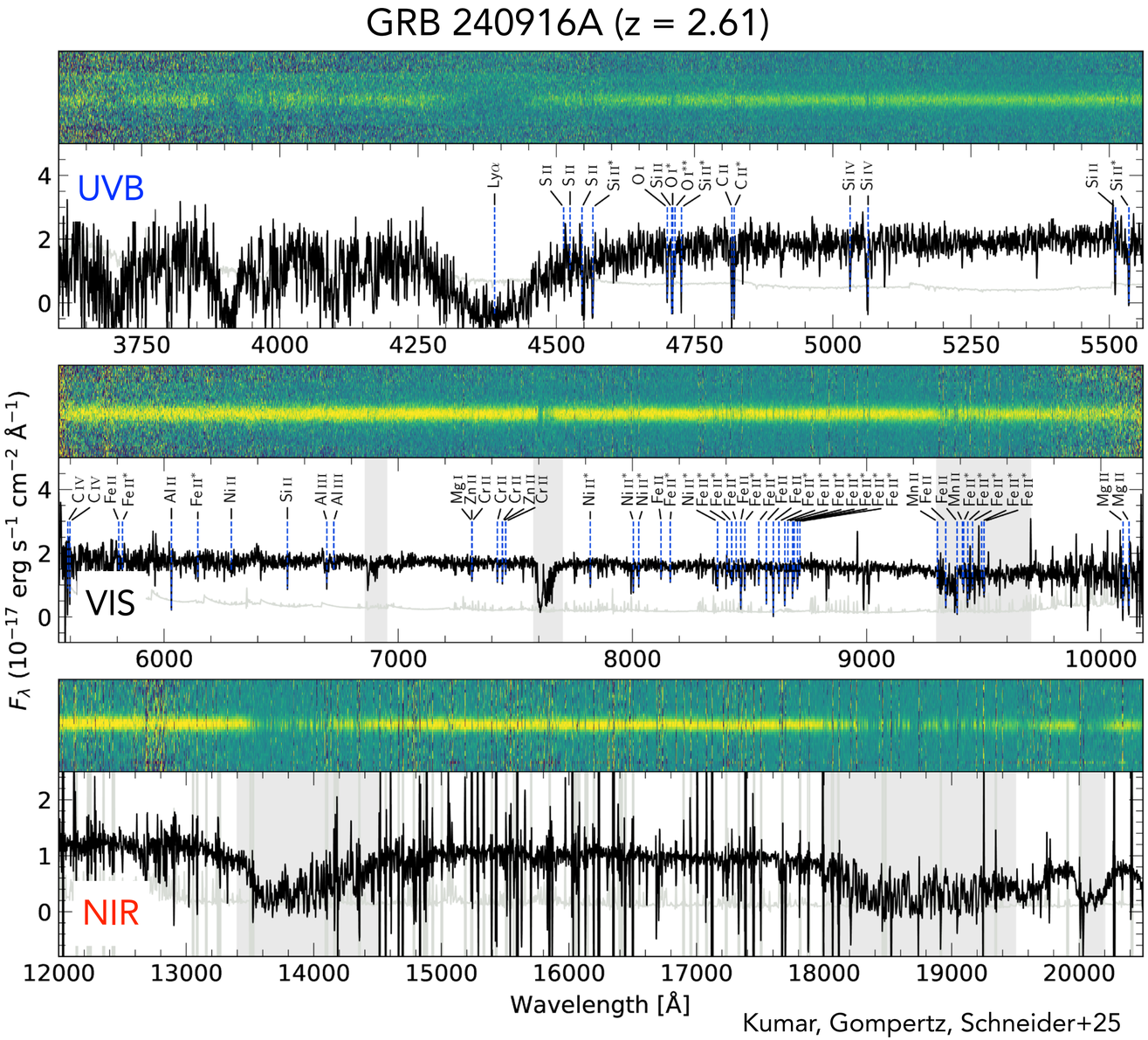
- Pros: fast
- Cons: only possible for GRBs at z > 3

Possible way to measure a redshift for a GRB

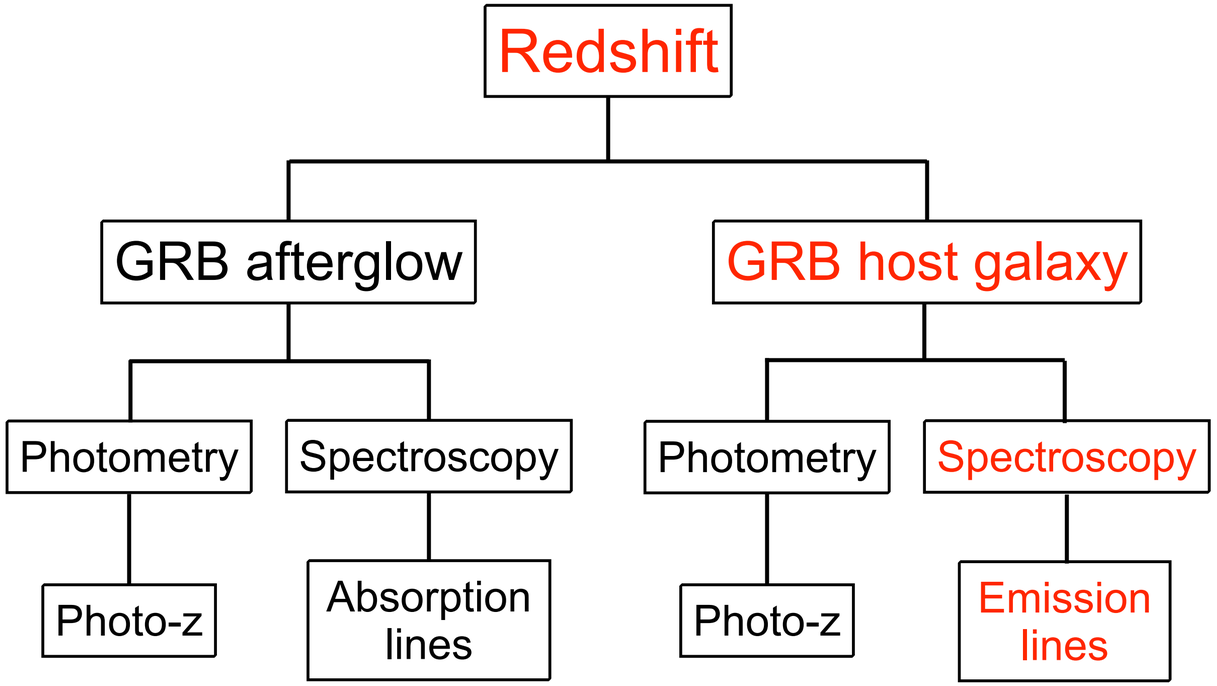


✓Lyman alpha, abs. lines, fine structure lines

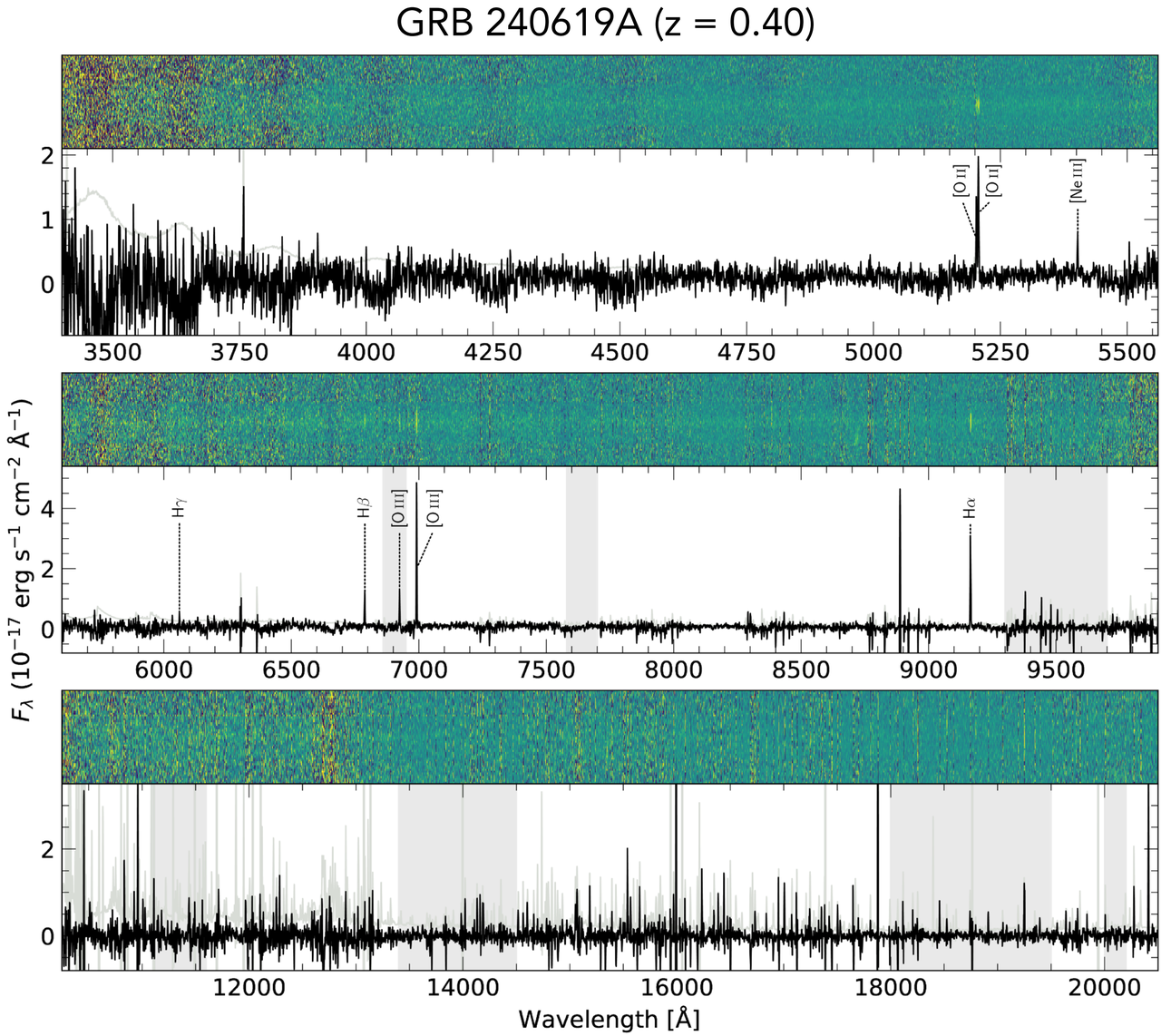
- Pros: reliable and accurate
- Cons: time-consuming, bright source



Possible way to measure a redshift for a GRB

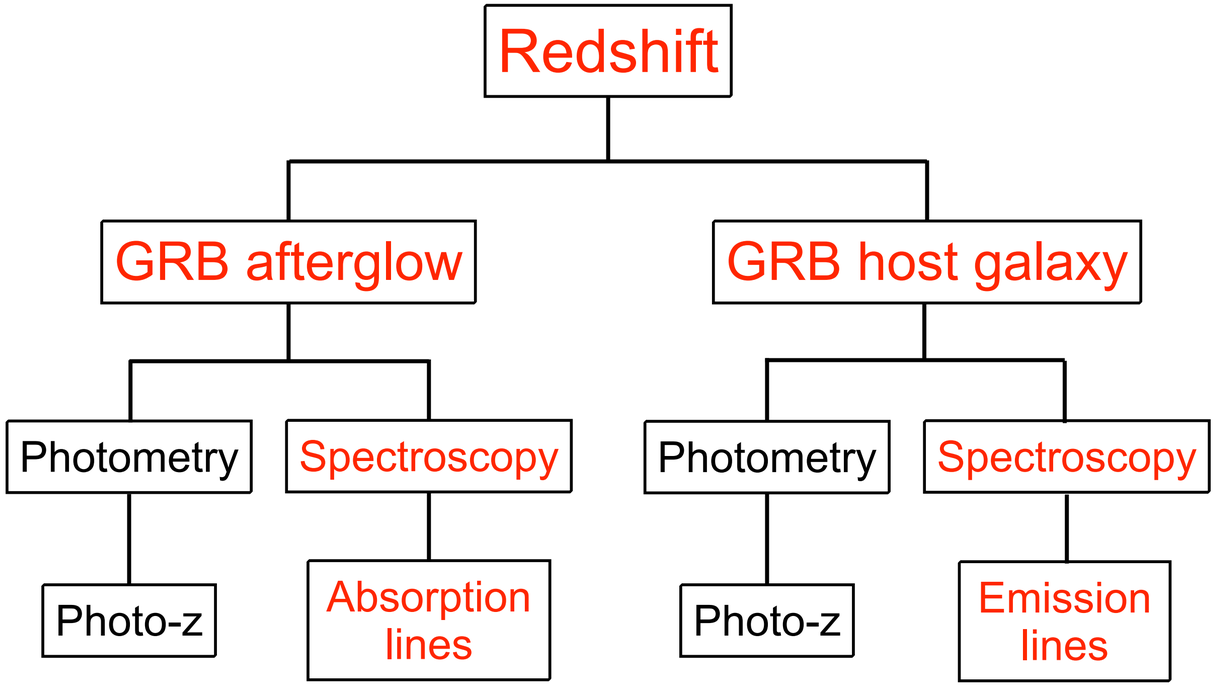


- Pros: reliable and accurate
- Cons: time-consuming, host association

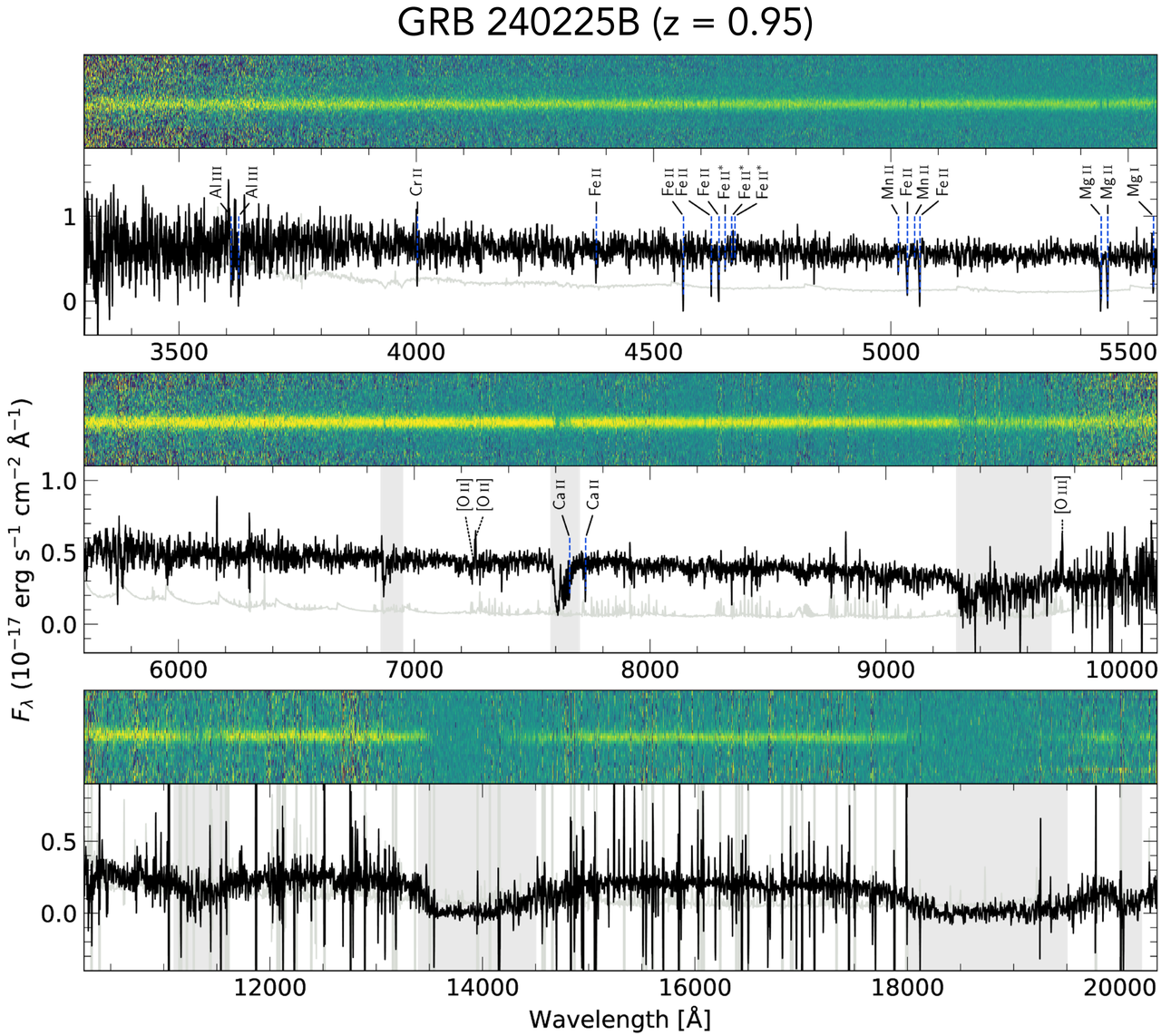


Kumar, Gompertz, Schneider+25

Possible way to measure a redshift for a GRB



- Absorption and emission lines → ideal scenario but fairly rare



Kumar, Gompertz, Schneider+25

Typical criteria & facilities for spectroscopic follow-up

- Not for all bursts:
  - Arcsec position
  - $T_{obs} < T_0 + \text{few hours}$ (bright enough)
  - $A_V < 0.5$
  - Sun/Moon/Stars distance
- Facilities
  - VLT, GTC, Gemini, Keck, …
  - SOXS, NOT, OHP/MISTRAL, …
  - (Future) ELT, TMT, …


GTC (Gran Telescopio Canarias)

Stargate collaboration

- **Large program on VLT** (PIs: Tanvir, Malesani, Vergani):
  - ~50h/semester (X-shooter, FORS2, UVES, MUSE, HAWK-I, ERIS)
  - Photometry, spectroscopy, polarimetry
  - All bursts (SVOM, EP, Swift)
  - Rapid response mode (RRM) → a few minutes: override current obs., service and visitor mode
  - 2 people on duty 1 week (24/7) every ~2-3 months

- **X-shooter = redshift machine (at any z)**
  - UV to NIR (nominally 3000 – 25000 Å)
  - Intermediate resolution (R ~ 6000)
  - r < 22 AB mag for afterglows
  - r ~ 24 AB mag for hosts
  - Out of operations since Oct. 23 (cooling liquid spillage), science operations expected to resume ~Dec. 10

Take away message

- Redshift is **fundamental** to enabling all subsequent analyses of the event
- Swift secured redshifts for **~30%** of GRBs; SVOM aims to reach **~60%**
- Successful spectroscopic redshift measurement requires a **rapid response:**
  - even with 8–10 m telescopes, detecting continuum and absorption features requires a bright source

- COLIBRÍ is a **crucial** component of the follow-up chain, particularly for SVOM/EP events:
  - optical afterglow discovery, photo-z, decay rate, IR imaging (soon)

- COLIBRÍ is located **3 hours west** of the VLT:
  - **Timely** and **efficient** communication is critical
  - Recent GRB 251111A is a good example
  - VLT/RRM can be used for T0+T < 4 hours