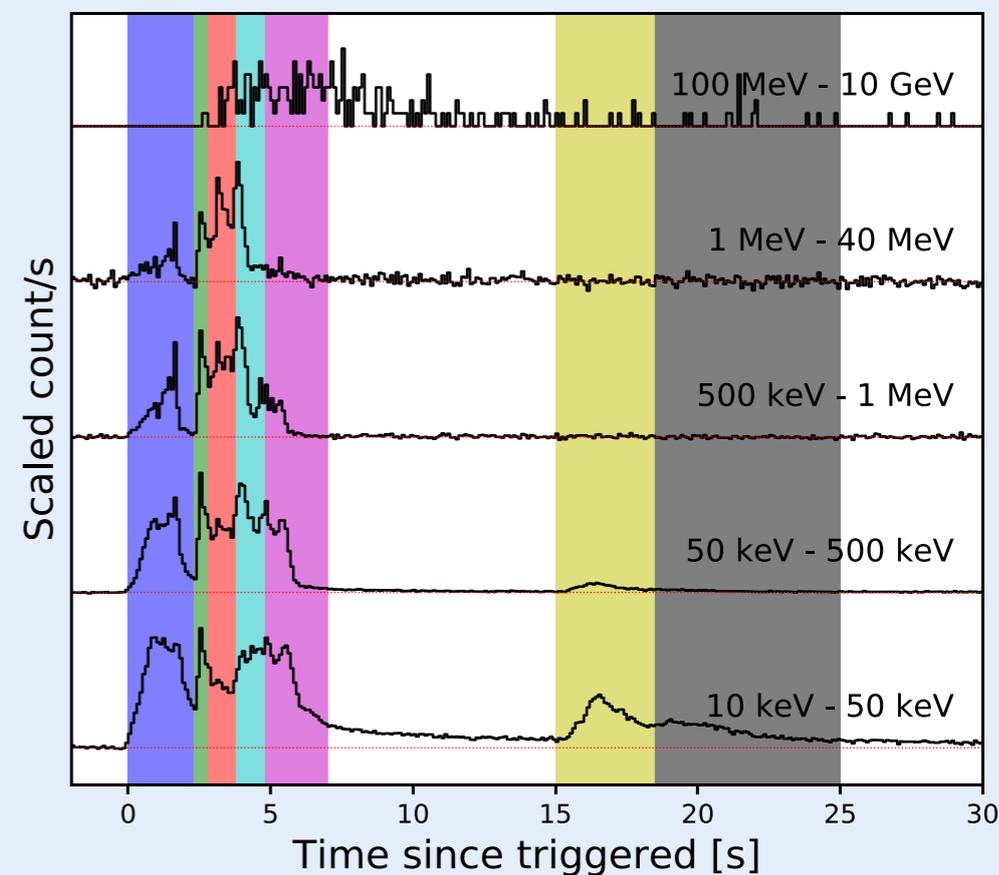
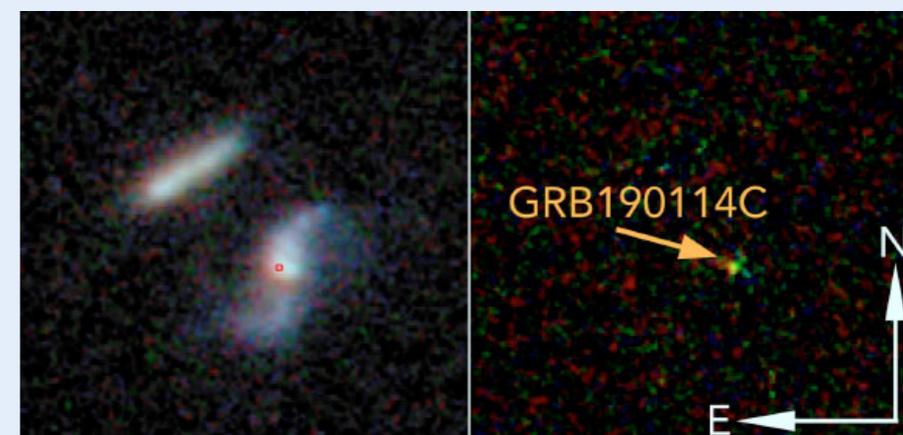


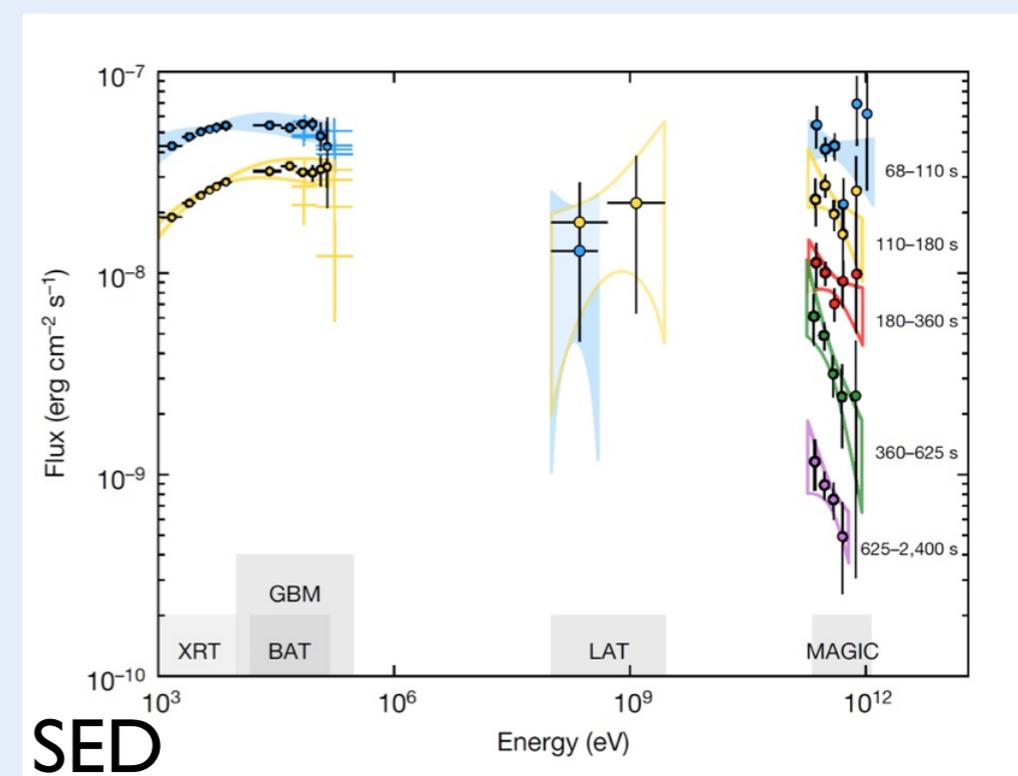
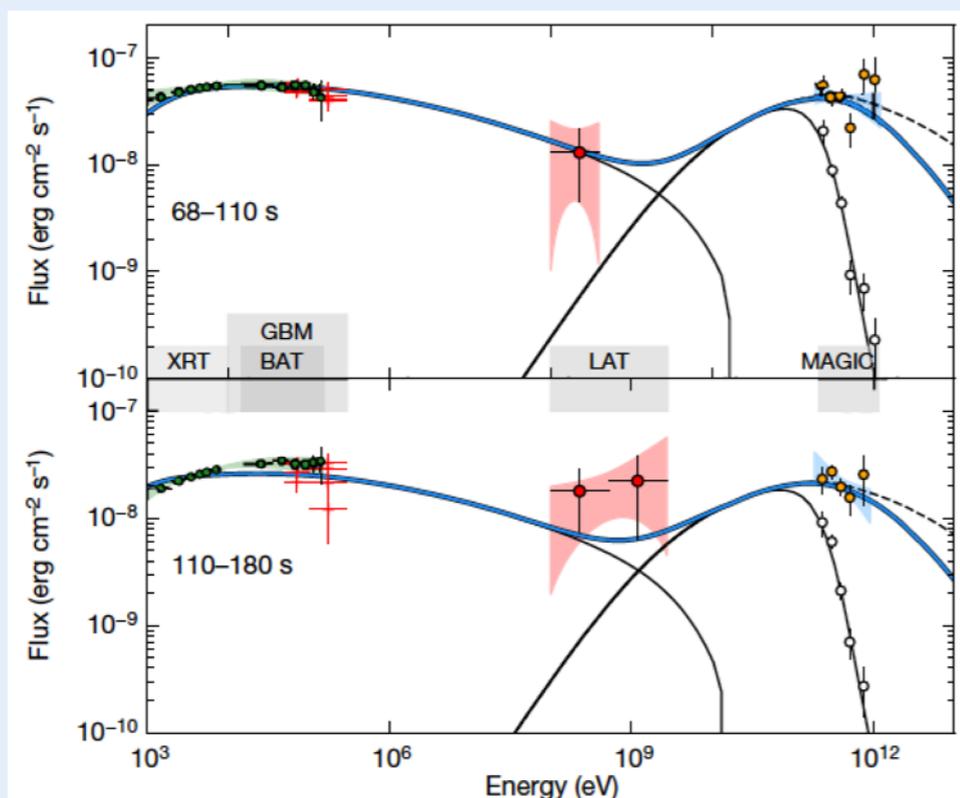
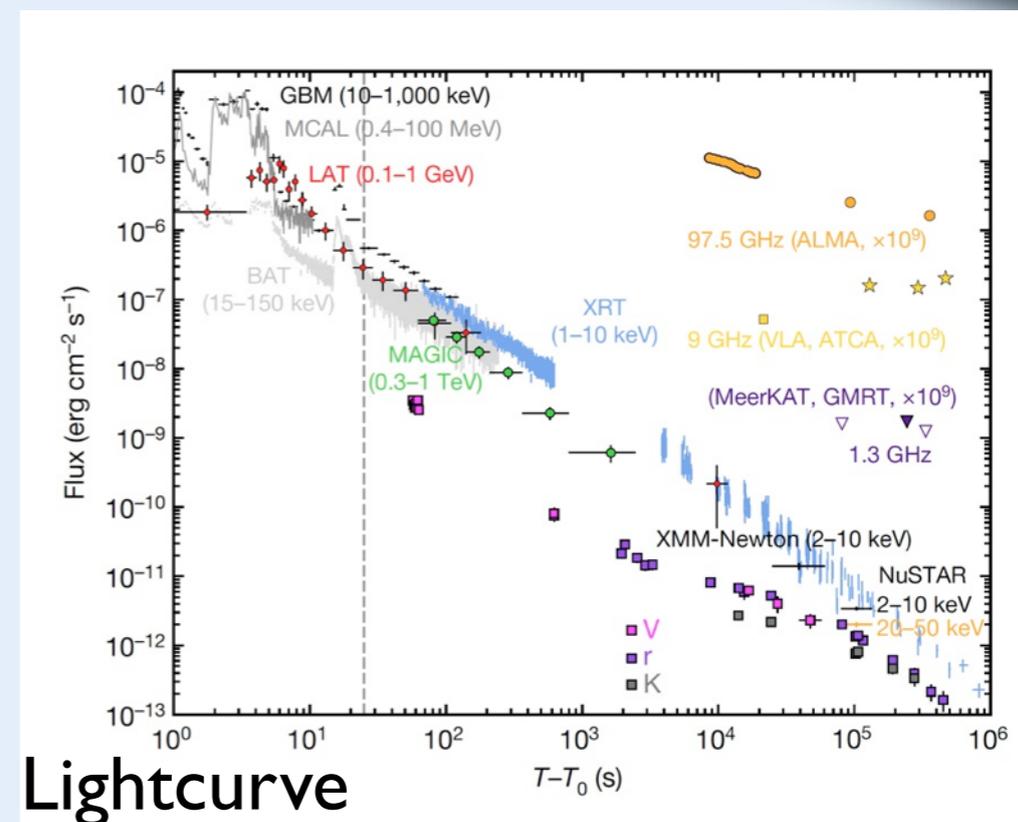
GRB 190114C

- Detected by Fermi/GBM, triggered Swift
- Also observed by AGILE, INTEGRAL/SPI-ACS, Insight-HXMT, KonusWind
- Long: $T_{90} = 36$ s
- $E_{\text{iso}} = (2.4 \pm 0.05) \times 10^{53}$ erg,
 $E_{\text{peak}} = 998.6 \pm 11.9$ keV
 Consistent with Amati relation
- $z=0.4248$ (X-shooter, Selsing et al. GCN 23695)



GRB 190114C

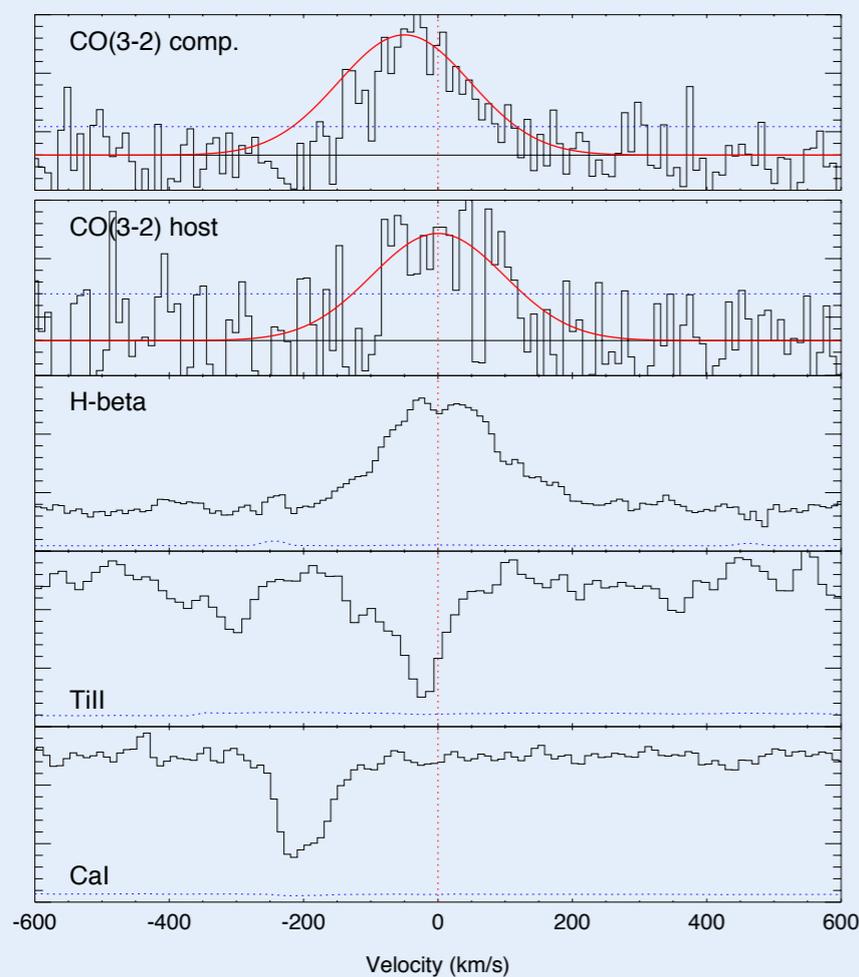
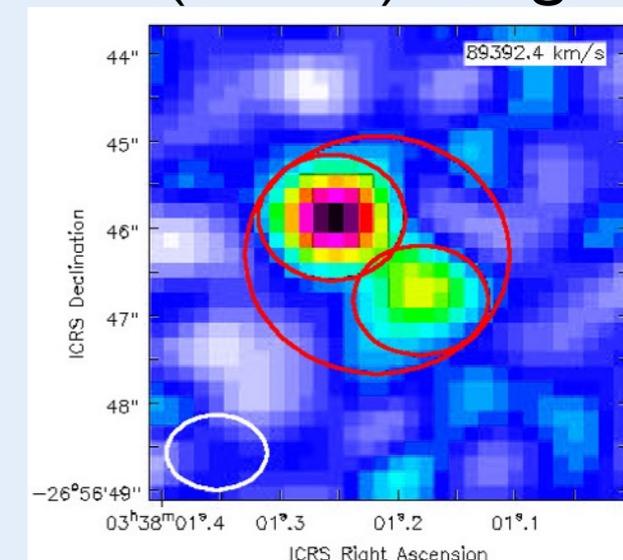
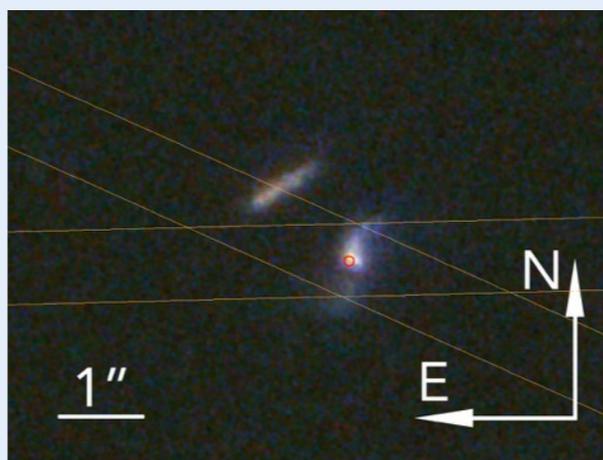
- $z=0.4248$
- First VHE detection (0.3-1 TeV) 1 min after the GRB!
- VHE in excess of extrapolation from afterglow
-> Inverse Compton?



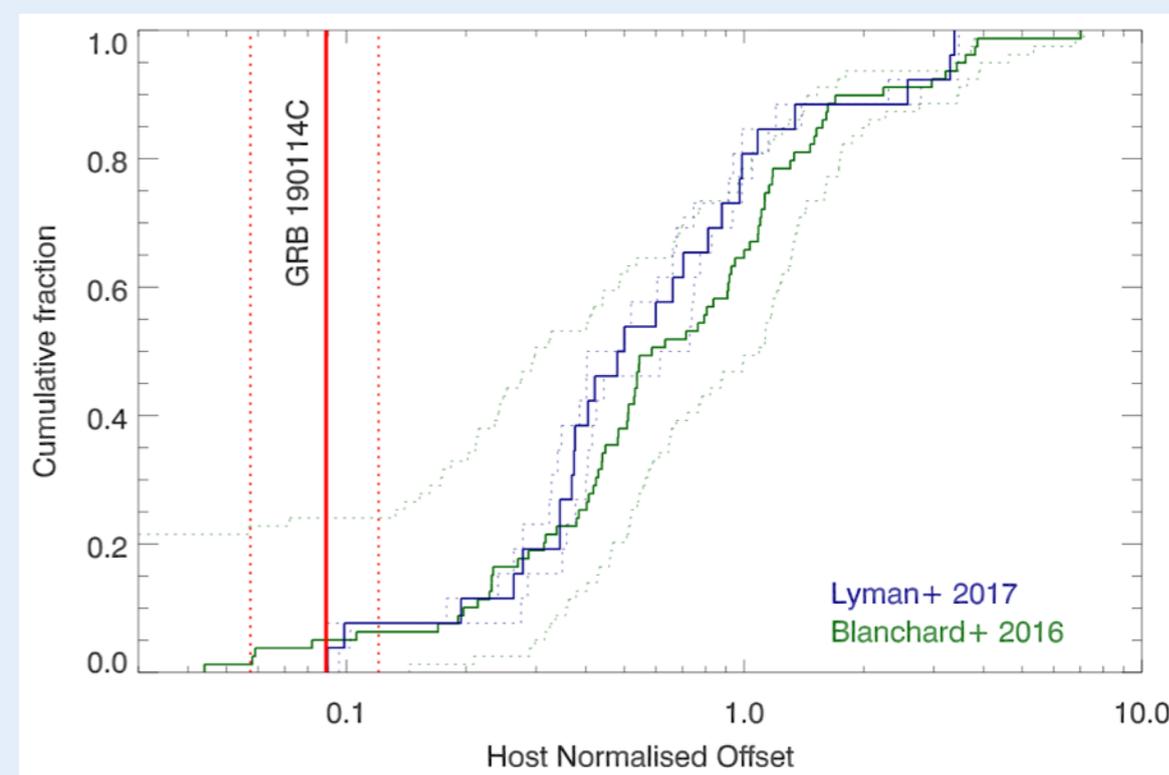
The host galaxy

- (disturbed?) spiral galaxy
- interacting companion
- Strong CO emission
- < 200 pc from galaxy center
nuclear star cluster?

HST and CO (ALMA) images

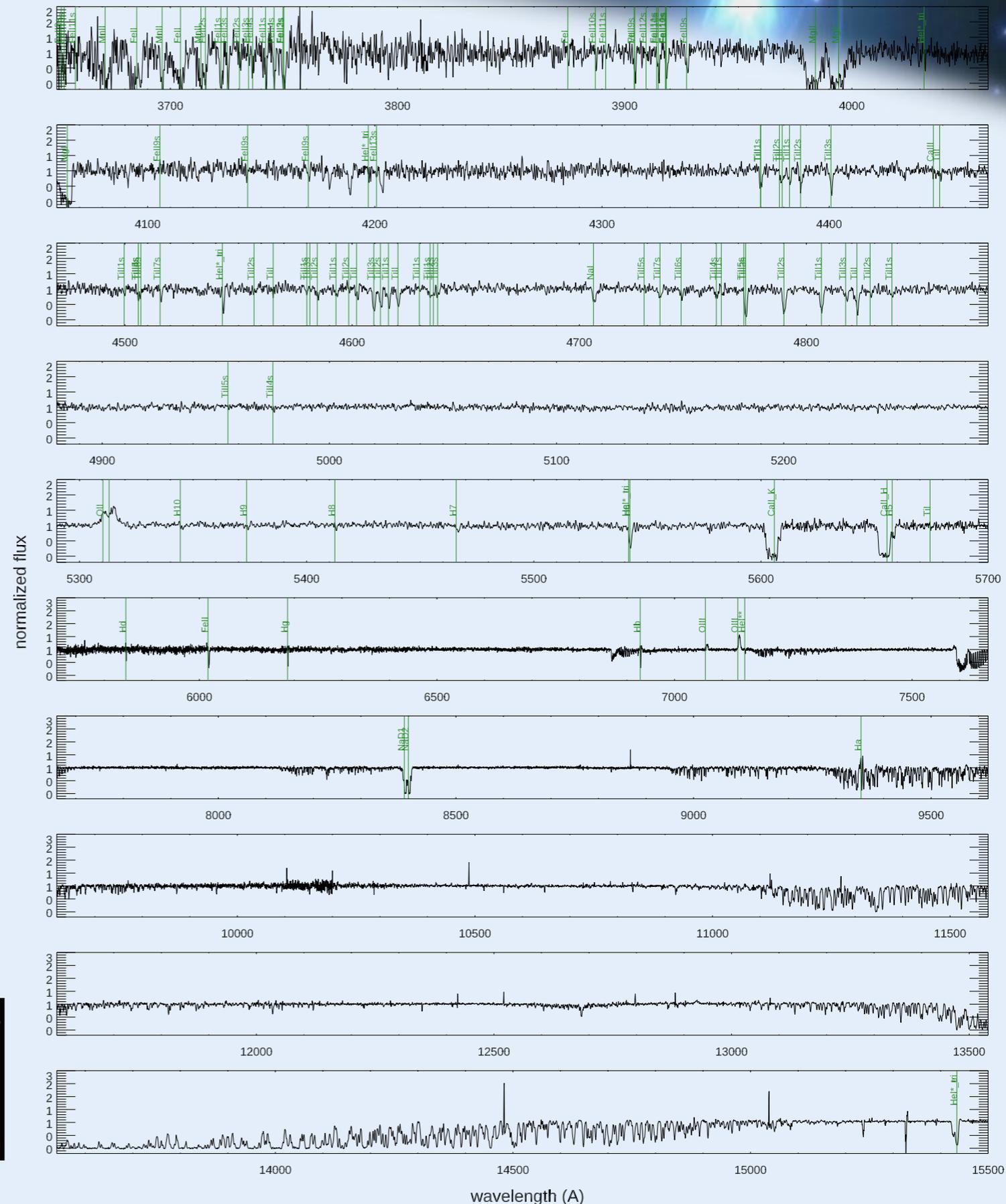


Usually small offset from center



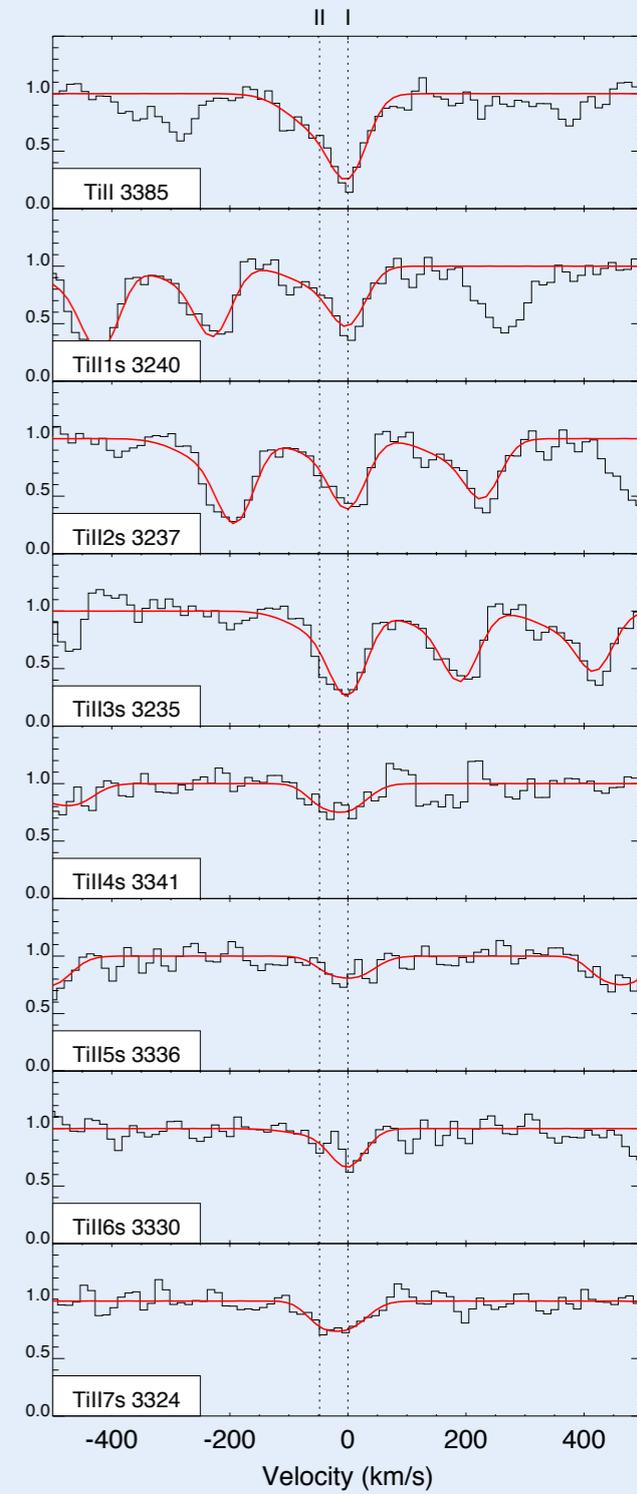
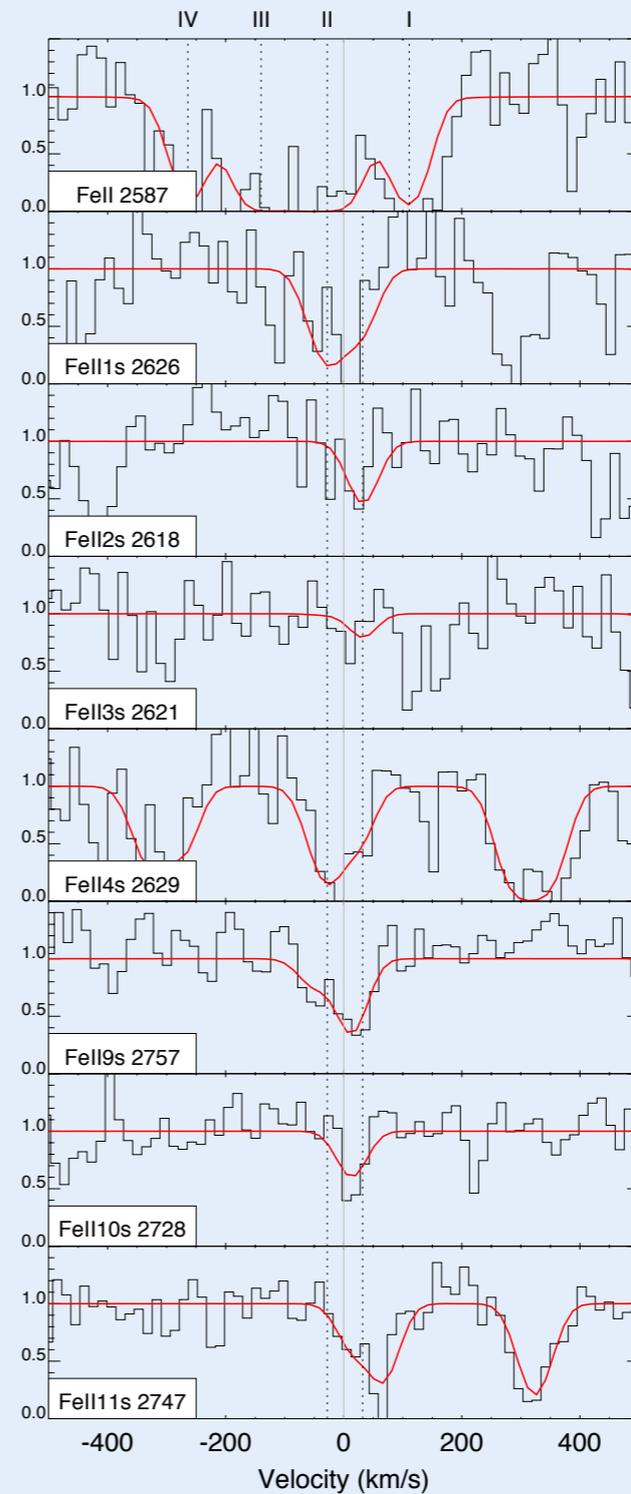
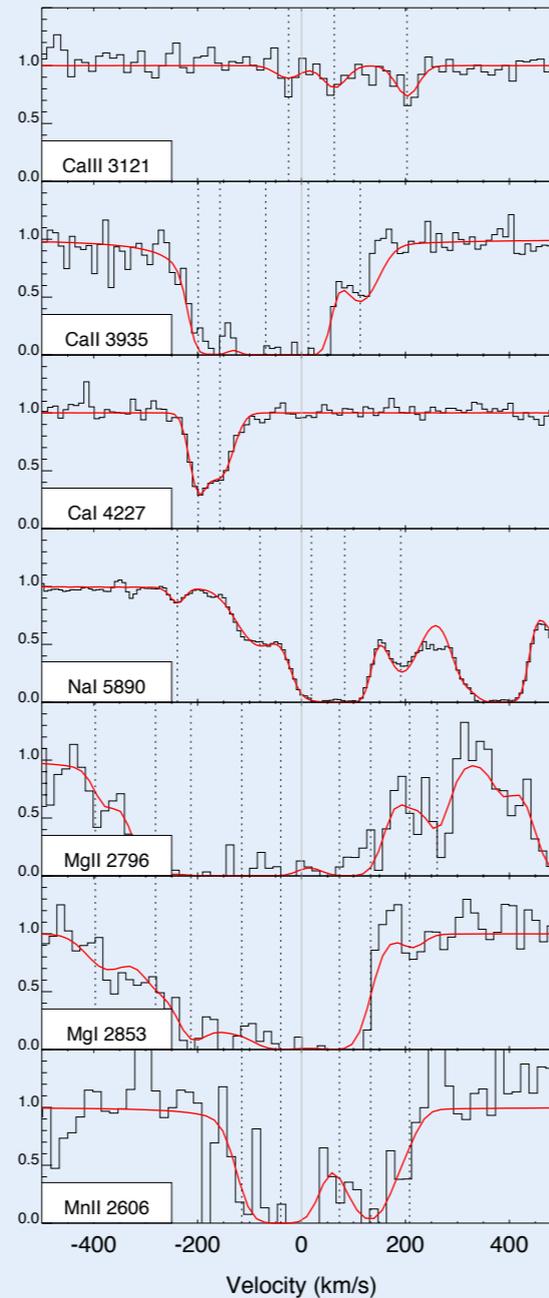
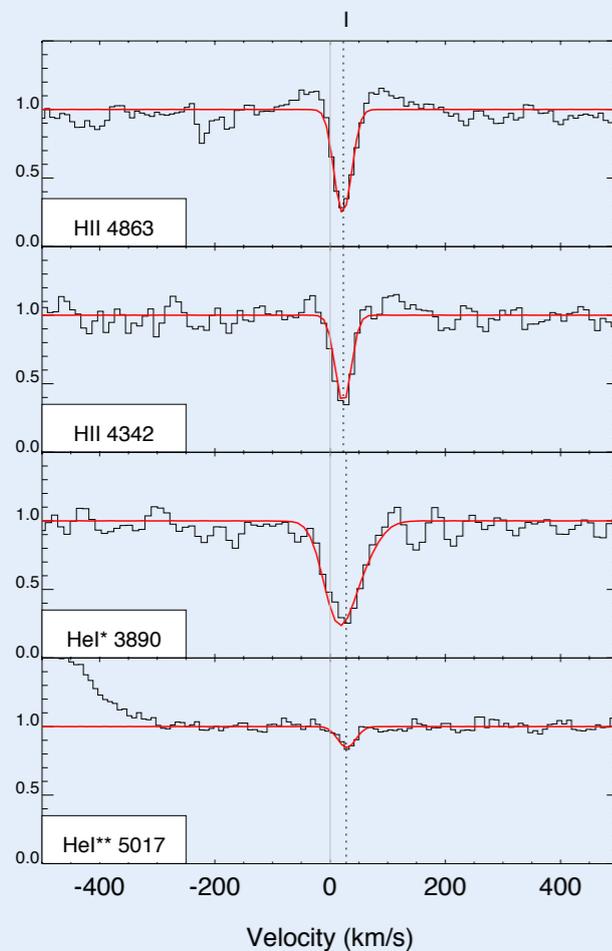
A strange environment

- X-shooter spectra (Stargate collaboration):
5.15 h and 3.25 d
- additional NOT (55min) + GTC
- low $z \rightarrow$ no Ly α
- Fe, Ti, strong CaII+NaD
- emission lines from host
(see de Ugarte Postigo et al. 20)



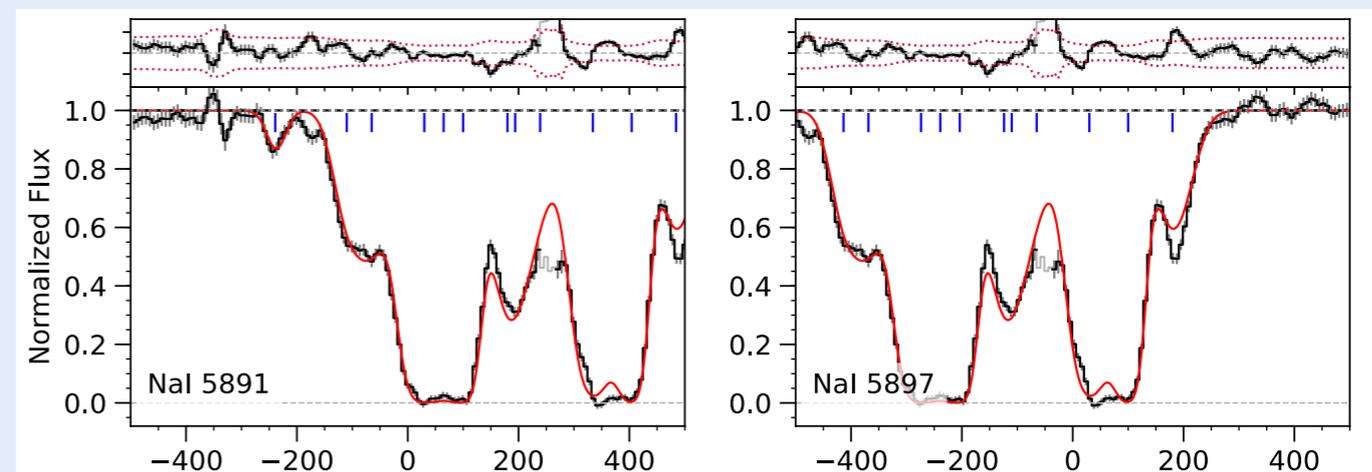
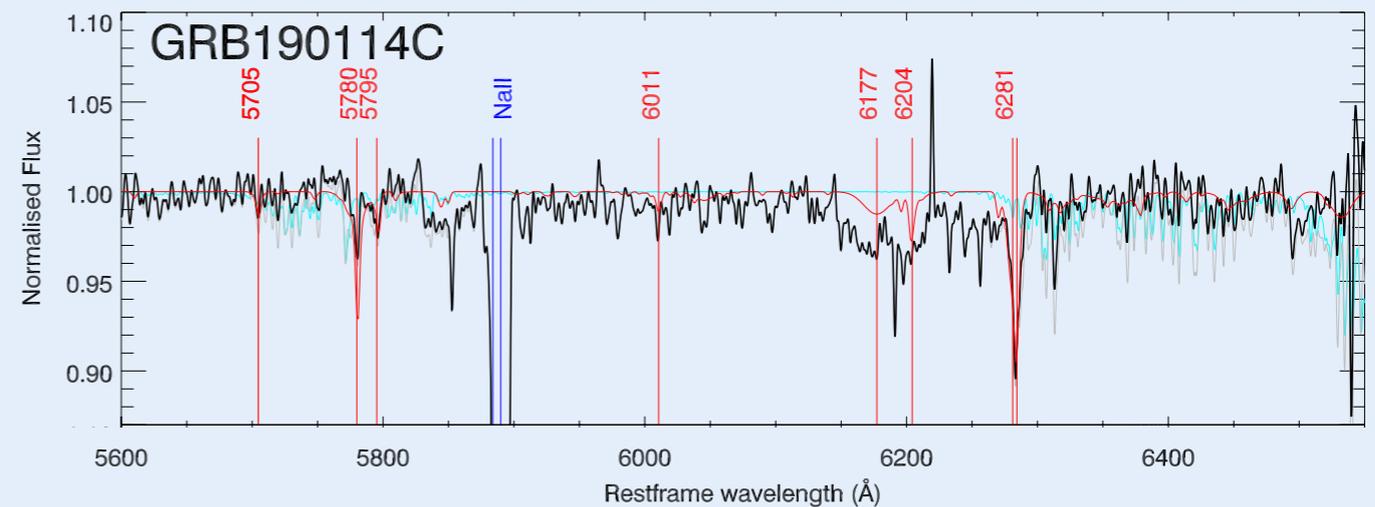
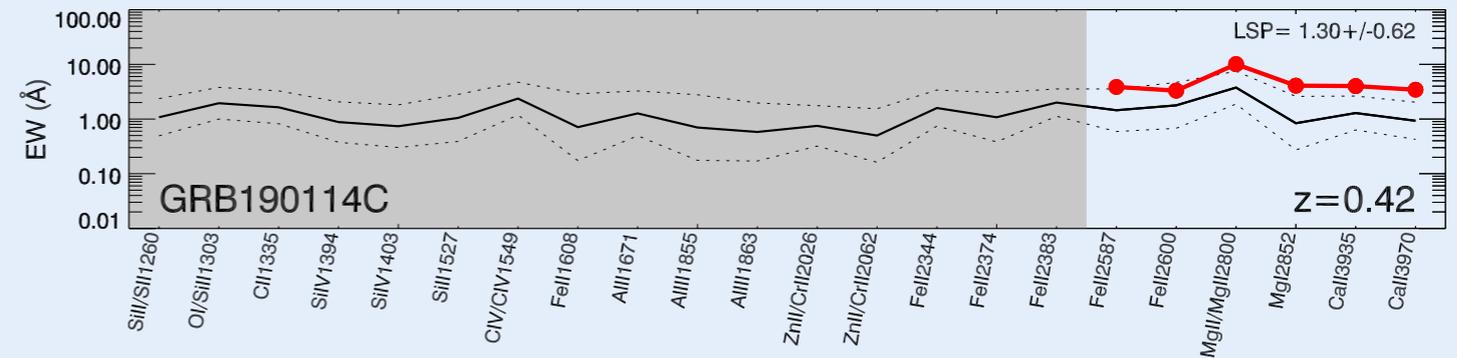
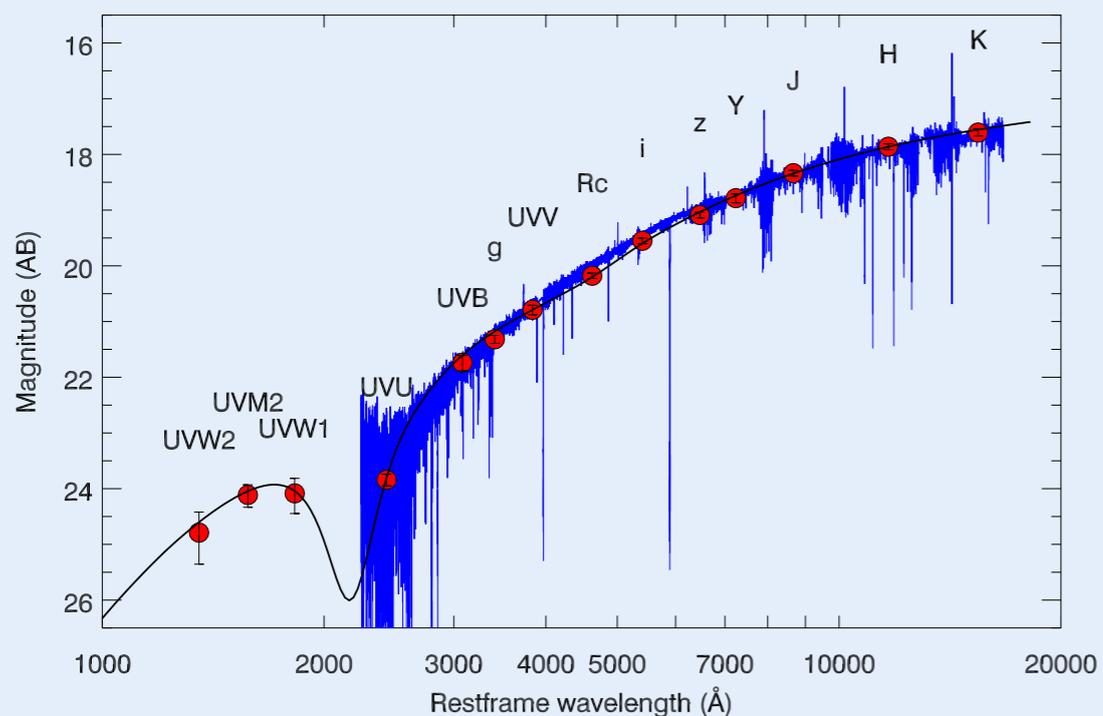
A strange environment

- Till finestructure lines never observed before
- FeII finestructure lines to very high levels
- Excited HeI* and HeI**
- Many components and peculiar velocity field



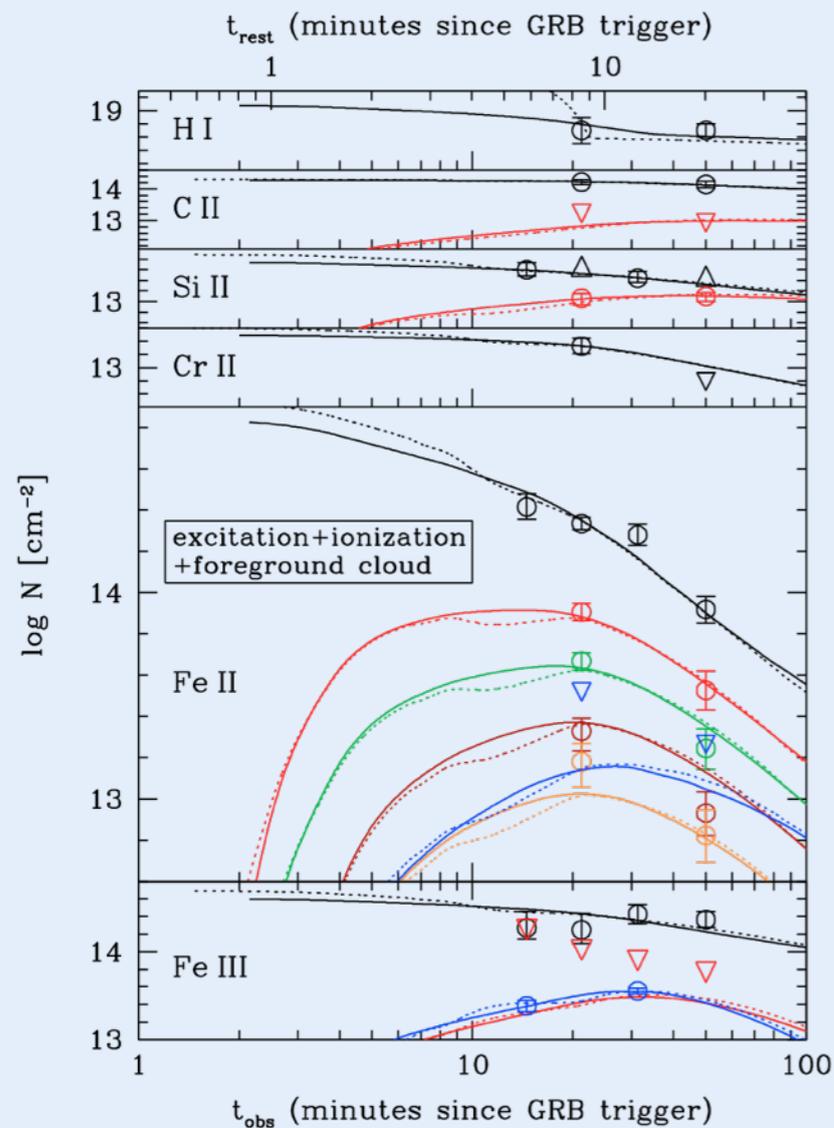
High extinction

- Very strong absorption
- DIBs (never observed in GRBs!!)
- $EW_{\text{NaD}} = 9.4 \text{ \AA}$
Afterglow: $A_v = 2.07 \text{ mag}$
MW-like bump
($\triangleright EW_{\text{NaD}} = 1.4 \text{ \AA}$)



Absorber distance from GRB?

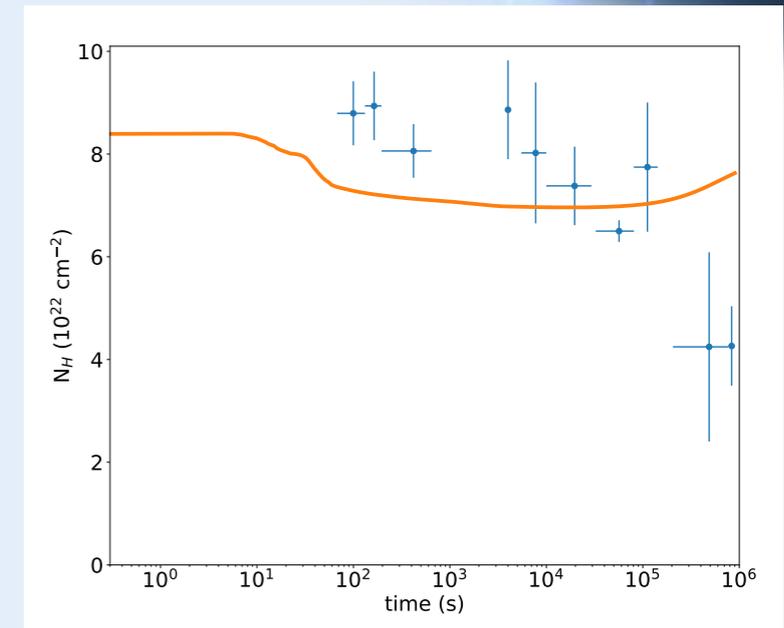
Fine-structure lines of FeII etc.
excited by UV pumping by GRB
-> N or even N(t)



GRB 190114C:

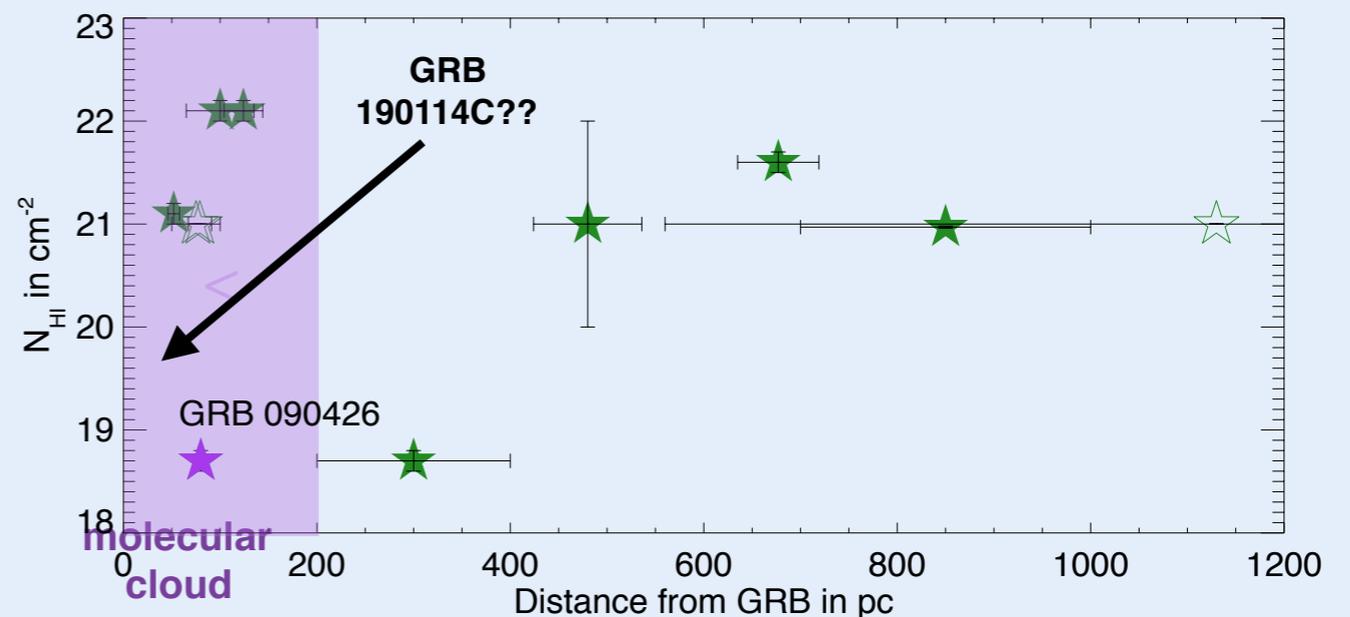
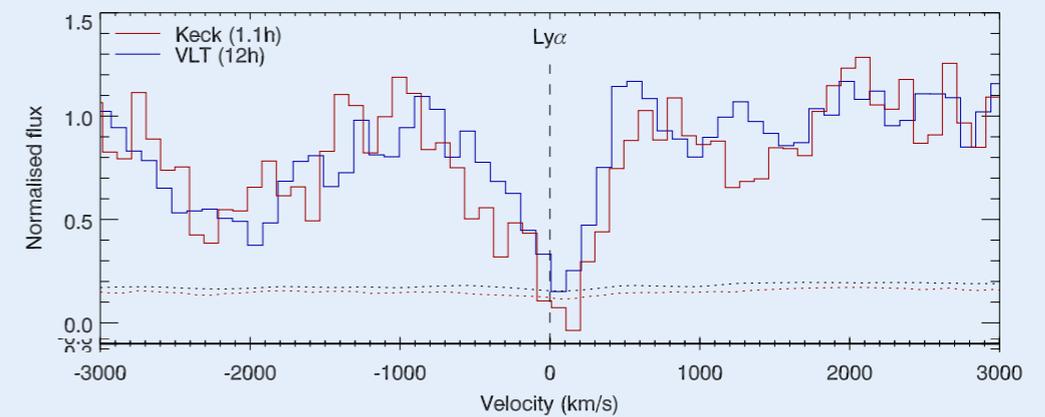
N_{HX} drops

~ factor 2 in 10⁵s
Clumpy absorber?



GRB 090426:

Time dependent
Ly α absorption



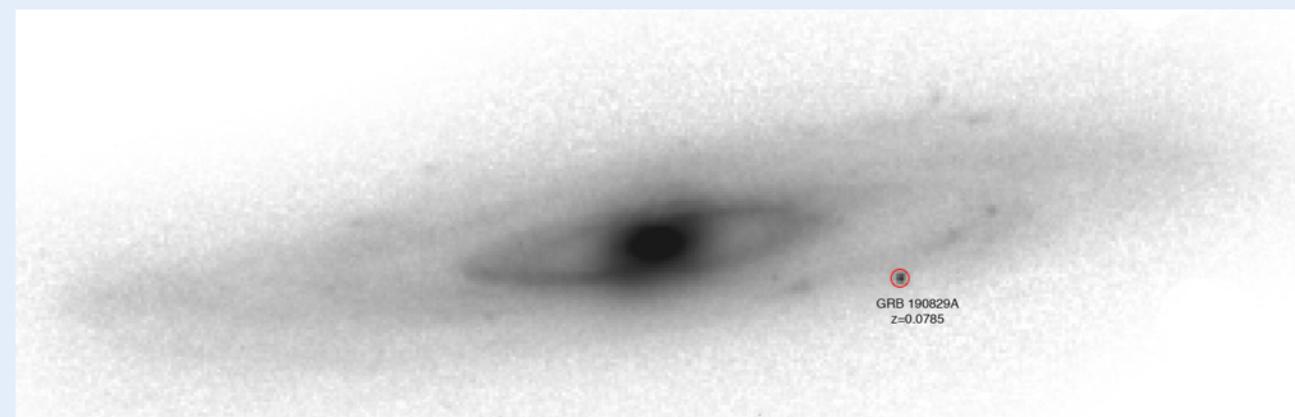
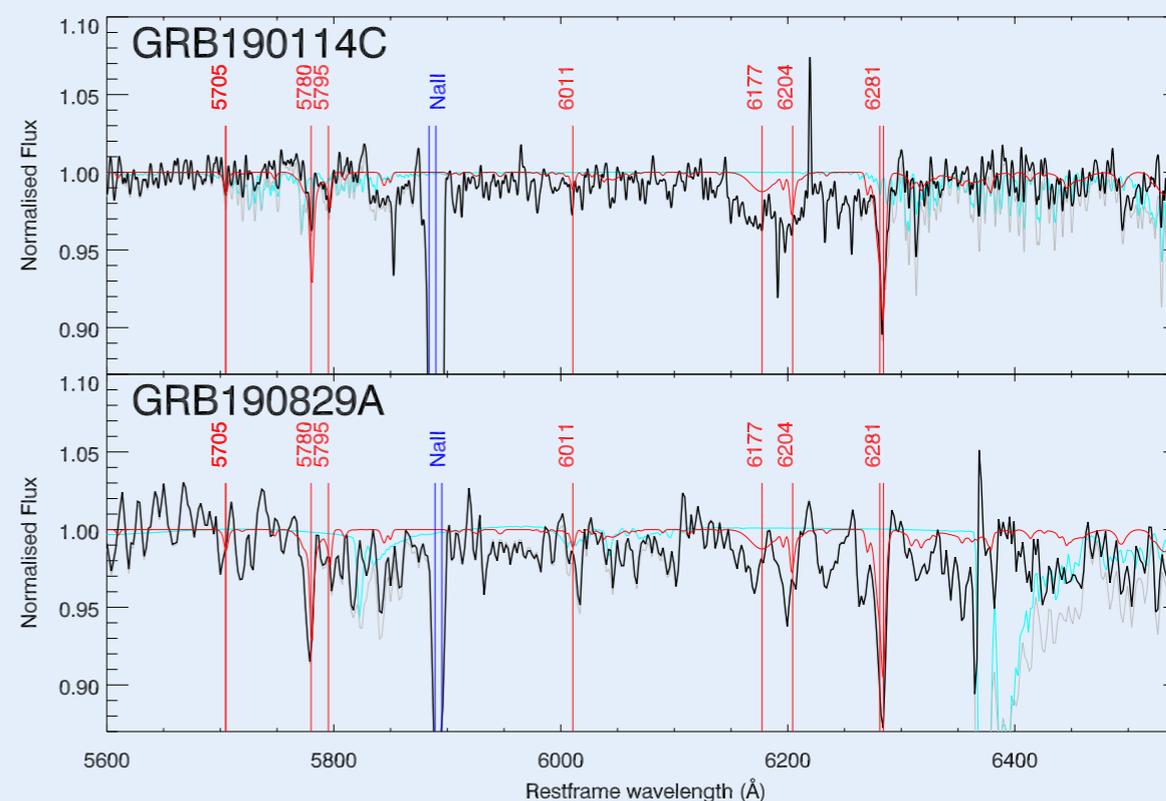
Other VHE GRBs - not so easy??

GRB 160821B (z=0.162):
short, offset from host, weak VHE

GRB 180720B (z=0.653):
H.E.S.S. detection, non-dusty environment

GRB 190829A (z=0.078):
in spiral arm of huge galaxy
high extinction ($A_V 1.5$ mag, $EW_{NaD} 1.7 \text{ \AA}$)
DIBs!
high N_{HX} and time variation

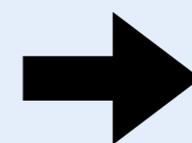
GRB 201216C (z=1.1):
high extinction, too high z for DIBs
high N_{HX} and time variation (\sim factor 4)
unfortunately low S/N spec, only CaH+K



Conclusions

VHE photons inverse Compton from interaction with CSM?

- Interacting, starforming, dusty host with companion
- Peculiar location in galaxy core
- Highly excited states of Till (and Fell) never observed before, exited HeI lines
- High extinction, but not matching afterglow with sightline
- DIBs
- Varying X-ray absorption



VHE production related to dense CSM & interaction with it?
Absorbing material very close to GRB?

What about other GRBs at VHEs??

Are they ultimately similar or are there different processes??