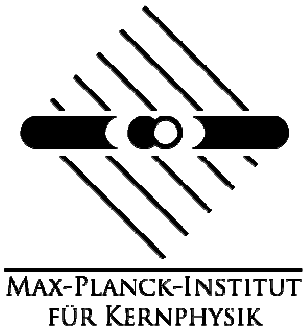
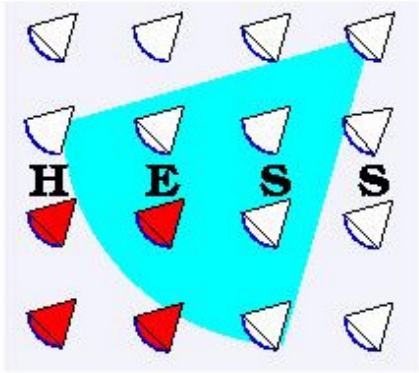
Search for Very-High-Energy Gamma-Ray Emission from GRB100621A with H.E.S.S.





Dirk Lennarz

P. Chadwick, W. Domainko, G. Rowell, P.H.T. Tam, Y. Gallant, D. Horns, G. Pühlhofer, C. Stegmann, S. Wagner for the H.E.S.S. collaboration

Schule für Astroteilchenphysik

08 October 2011

Overview

- What are GRBs?
- What is the H.E.S.S. experiment?
- What was special about GRB100621A?
- What are the results?

Gamma-ray bursts (GRBs)

- Extremely bright flashes of radiation, typically observed in the keV range
- First detection: 1967 on *Vela* military satellite
- Large sample of GRBs from Burst and Transient Source Experiment (BATSE)

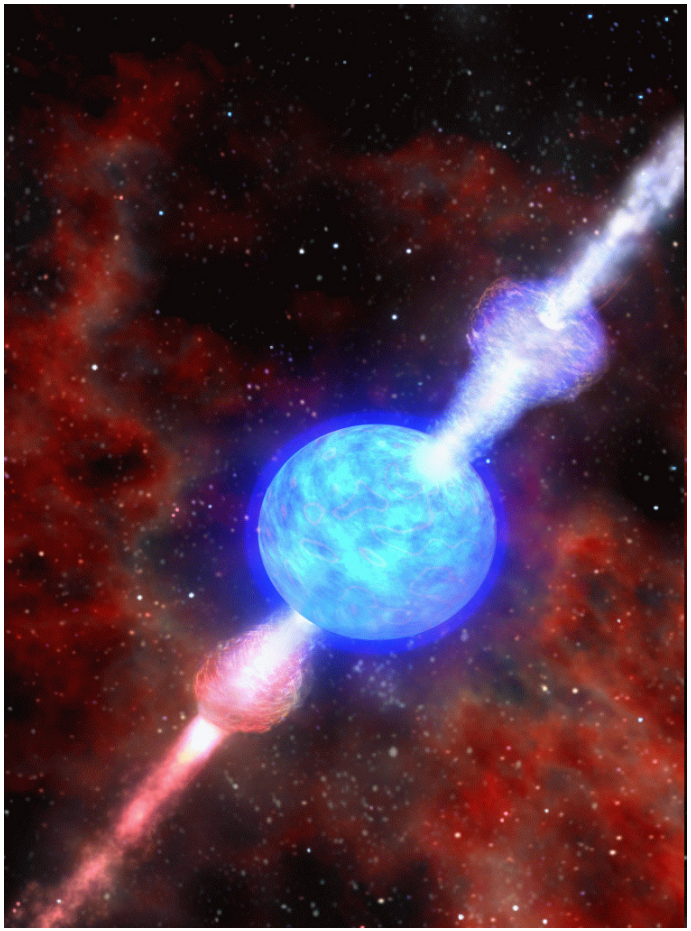
⇒ Two different classes (short vs. long, cut at 2s)

⇒ Completely isotropic (extragalactic?!)

- BeppoSax satellite in 1997

⇒ Allowed redshift measurement

⇒ Indication of SN/GRB connection



Artist impression of a GRB. Credit: NASA/Dana Berry, SkyWorks Digital

H.E.S.S. Telescope System

- **H**igh **E**nergy **S**tereoscopic **S**ystem in Namibia
- 4 Imaging Atmospheric Cherenkov Telescopes
- Detect γ-rays from air showers between ~100 GeV and ~100 TeV
- Sensitivity (5σ): 5% Crab in 1h

H.E.S.S. GRB programme

- Already started in 2003
- Followed up >40 GRBs
- No indication of emission

⇨ Upper limits are among the most stringent derived for VHE γ-ray observations of GRB

⇨ Is H.E.S.S. sensitive enough?

Fermi γ-ray Space Telescope

γ-ray Burst Monitor (GBM)

- Large field of view ("all sky")
- Energy range ~10 keV - 1 MeV

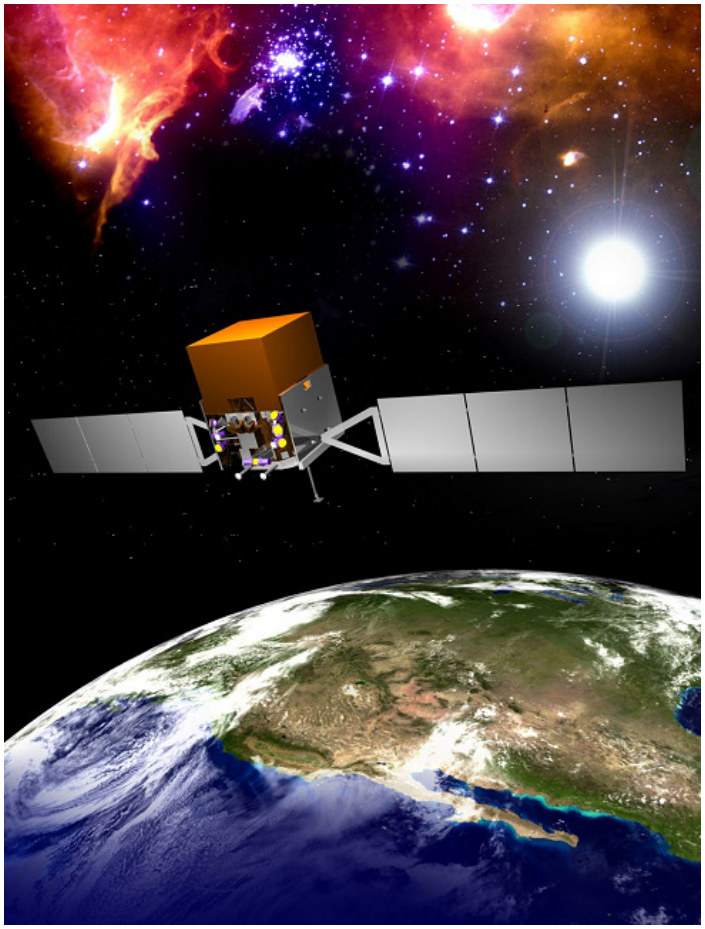
⇨ ~ 250 GRBs per year

Large Area Telescope (LAT)

- 20% of sky
- Energy range ~30 MeV-300 GeV

⇨ ~26 GRBs so far

⇨ <10% of GRBs are seen in LAT

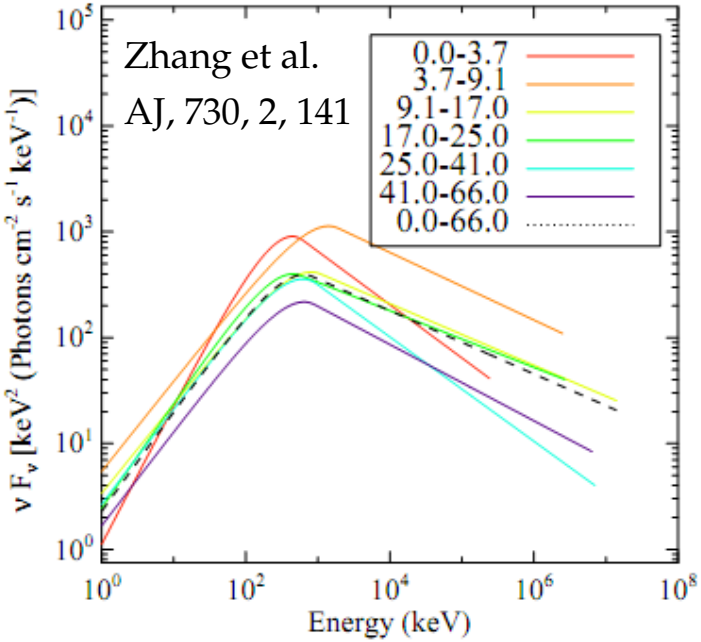


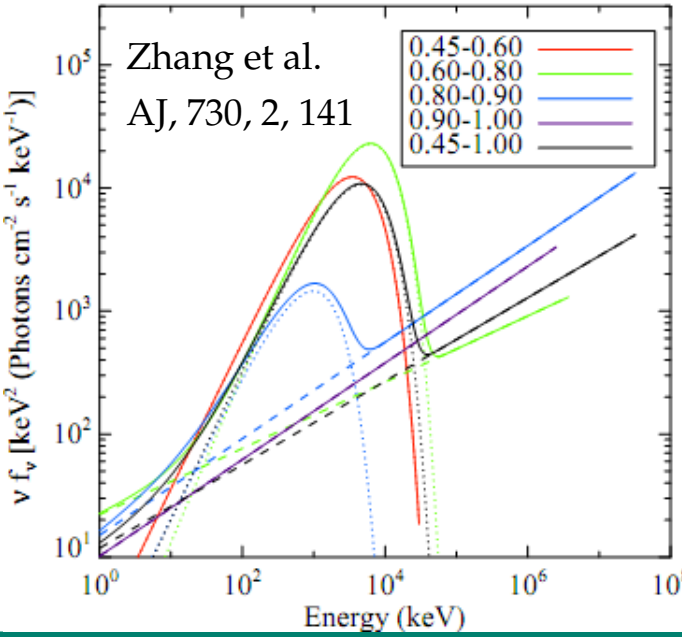
Artist impression of Fermi. Credit: Fermi collaboration

Fermi input for H.E.S.S.

<u>More than 75% of LAT GRBs</u>

- Extrapolation of Band function into GeV
- No high energy cut-off



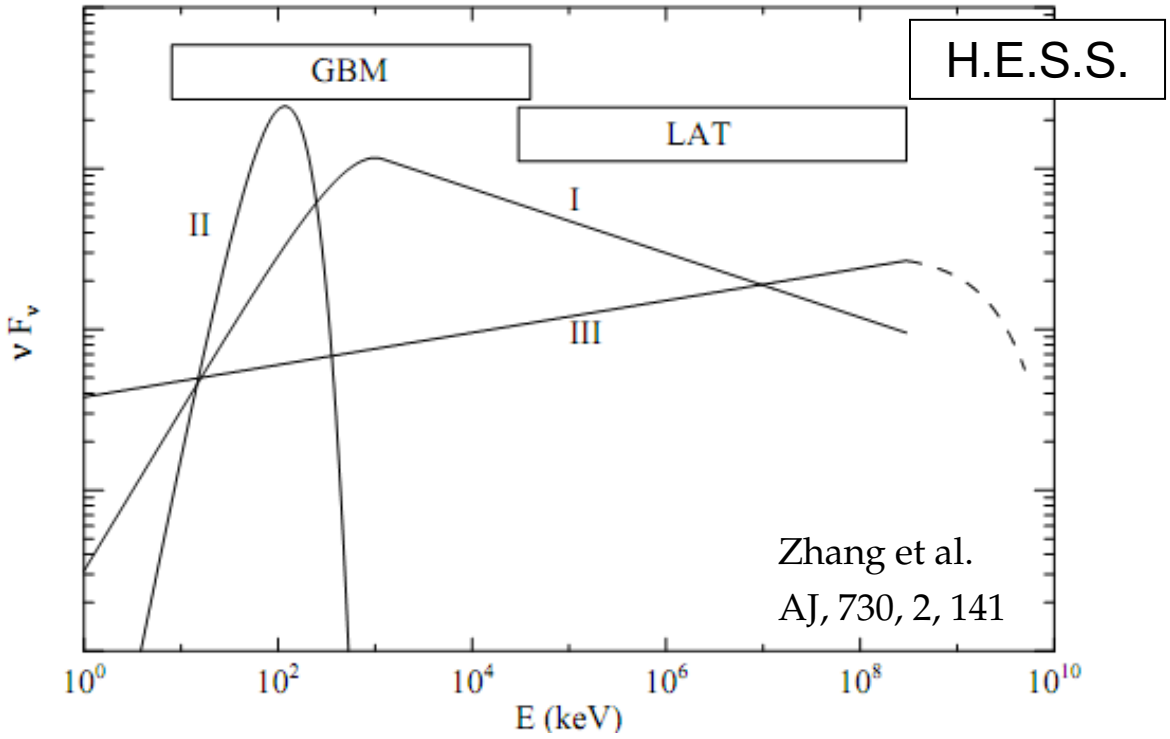


<u>"Extra Power Law" GRBs</u>

- High energy component
- No high energy cut-off!

For both cases: extrapolation into TeV yields detectable flux for H.E.S.S.!

New Questions



<u>Band-type GRBs</u>

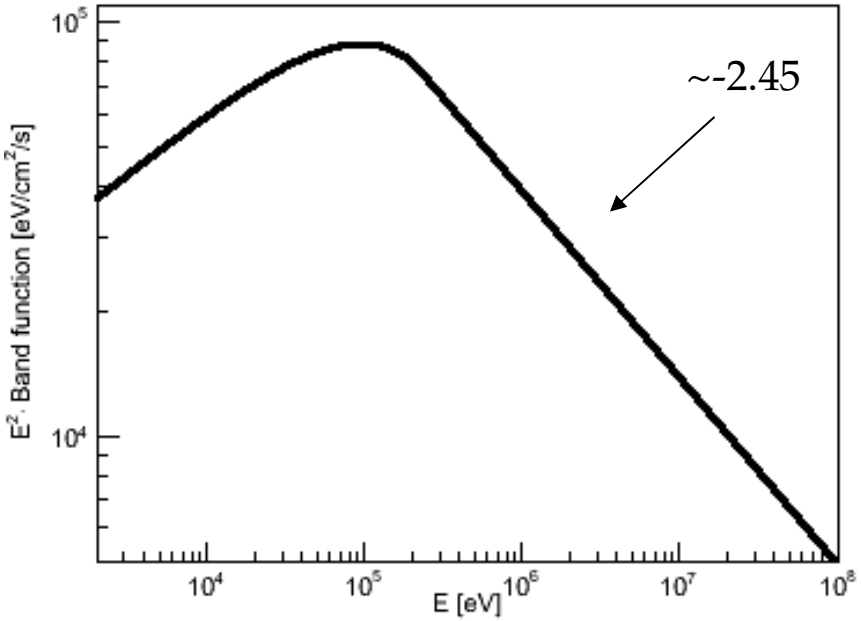
- Band function in TeV range?
- Or high energy cut-off?

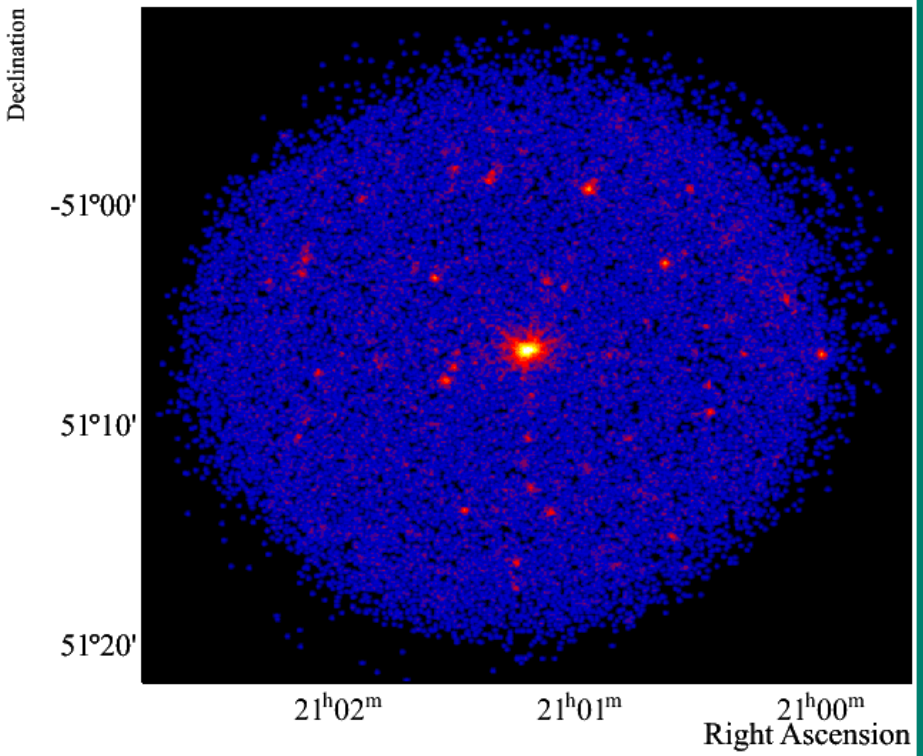
<u>"Extra power law" GRBs</u>

- Where is the cut-off?

GRB 100621A

- Brightest X-ray source Swift ever detected
- No radio or optical afterglow reported, but NIR
- Redshift: 0.542 (close!)
- No Fermi observations reported
- Band function from *Konus-Wind*





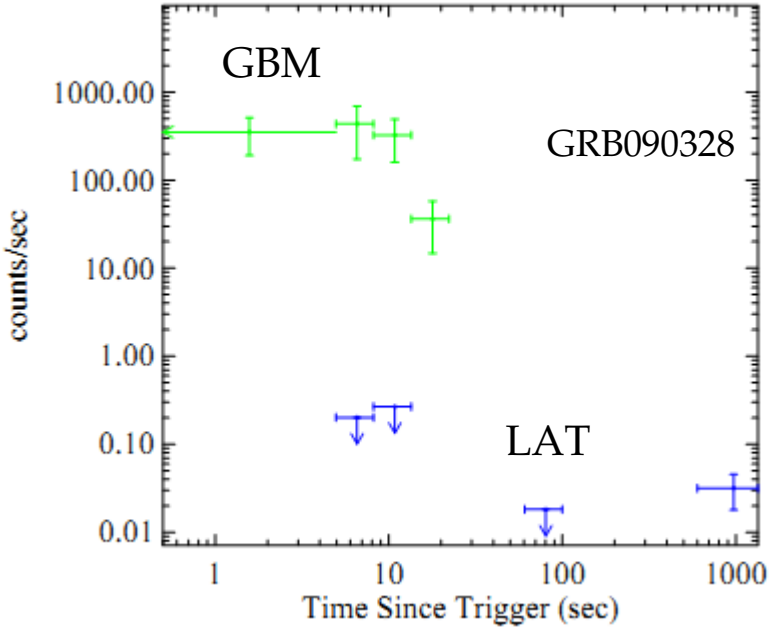
Smoothed count map from Swift

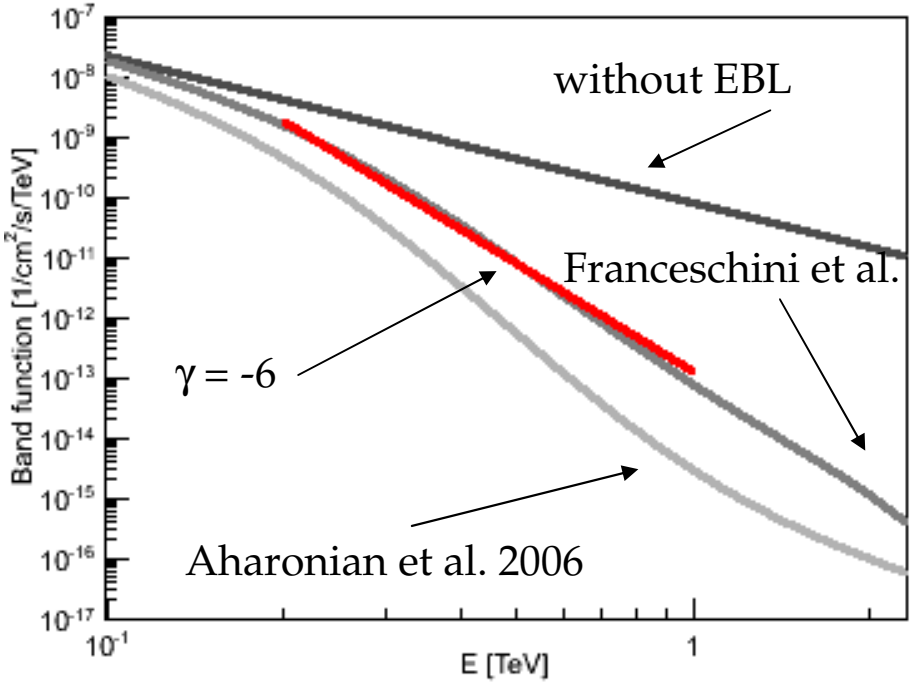
GRB 100621A in H.E.S.S.

- Swift trigger: 03:03:32 UT
- Start of data taking: 03:14:55 UT
- Two runs (each 28 mins) ~700s after trigger

⇨ Time scale on which LAT emission was observed

Zhang et al.
AJ, 730, 2, 141





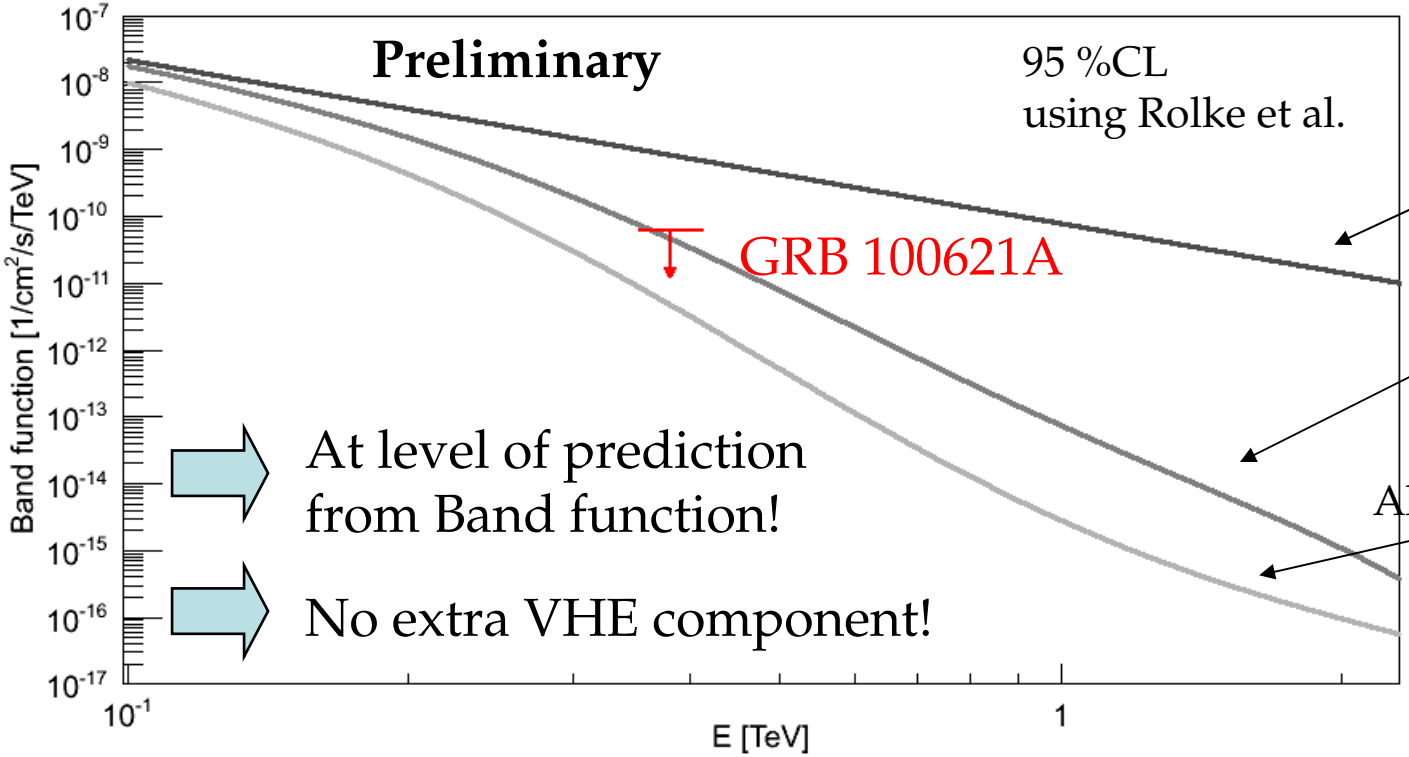
Flux prediction

- Extrapolate Band function to TeV
- Attenuate spectrum with EBL models

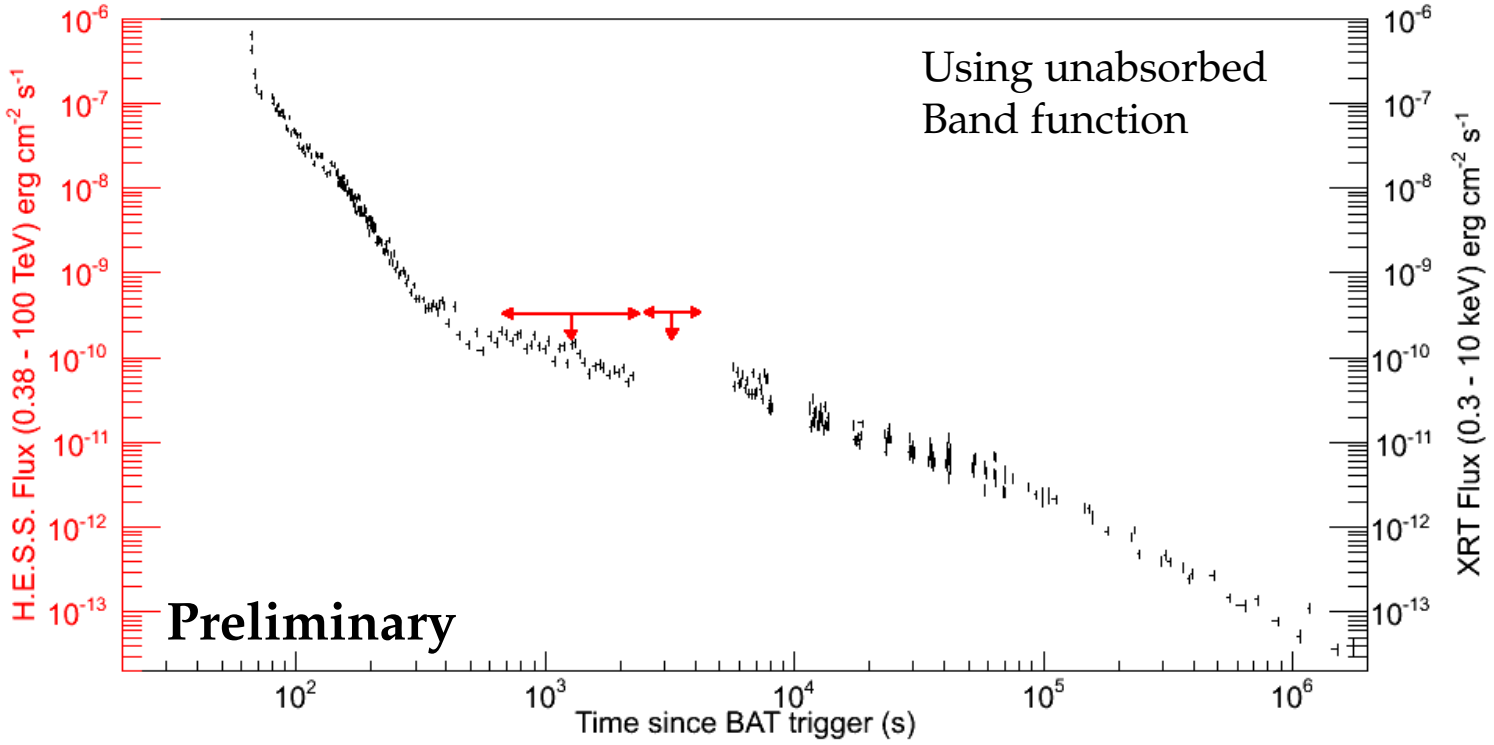
Results I

- Reflected background estimation method
- Loose cuts with reduced energy threshold
- Energy threshold of ~380 GeV

No indication of emission (<1σ)



Results II



VHE upper limit has to be taken into account when modelling the X-ray afterglow from synchrotron emission

Summary

- GRB 100621A was the brightest X-ray source Swift ever detected
- Small redshift, favourable position and short follow-up time made this GRB a prime target for H.E.S.S.
- No significant signal was seen
- GRB 100621A unlikely to have an “extra power law” in H.E.S.S. range
- H.E.S.S. can test the Band function extrapolation in the TeV range and provide important input to the afterglow modelling

Outlook

H.E.S.S. II

- Lower energy threshold (~50 GeV)
- Faster slewing (>50 % faster)

Will improve chances of GRB detections!