The Gamma−Ray Horizon

Tanja Kneiske[1], Karl Mannheim[1], Dieter Hartmann[2]

[1] Universitäts−Sternwarte Göttingen, Geismarlandstraße 11, D−37083 Göttingen, Germany
[2] Clemson University, Clemson, SC 29634−0978, USA

* The main absorption of GeV/TeV gamma−rays is due to pair production with extragalactic diffuse background photons.
* We use our updated model for the optical to infrared background radiation to study this effect on blazar spectra.
* At low redshift we can use high energy observations of Mkn501. At high redshift we can only make predictions for future observations.
* Assuming that the gamma−ray background is produced only by blazars, we show the absorption effect on the present day background.

Optical to Infrared Background at Different Redshifts

Results for our simple model for the far−infrared to ultraviolet diffuse background produced by stars in galaxies. At high redshift most of th energy is emitted in the IR by dust. At low redshift the optical energy coming from direct starlight is almost equal to the IR.

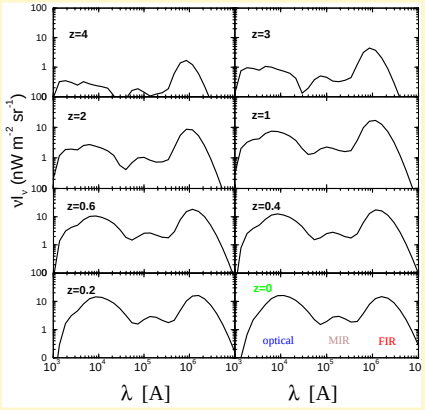

FIG 1. Parameters used in this model are Salpeter−IMF, very low metallicity, flat global star formation rate at high redshift, E(B−V)=0.14. The model is cosmologically independent, because we used observations of the luminositydensity to constrain our parameter.

The IR−background is needed to calculate the absorption of nearby blazar spectra, the optical and UV background for the high redshifted sources.

Mkn501

Using the results from figure 1 we get the intrinsic spectrum of a blazar. The plot below shows the effect on a blazar at a redshift of 0.03. The cut−off energy, which is the energy for an optical depth of 1, is approx 13 TeV.

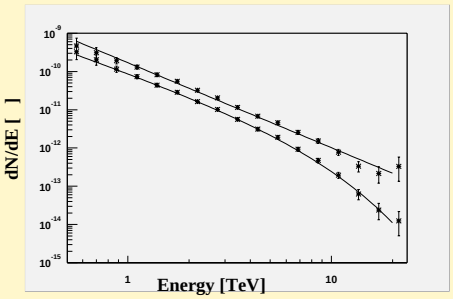

FIG 2. High energy spectrum of Mkn501. Lower data taken from Aharonian 1999. Upper data: calculated/intrinsic spectrum taking absorption into account.

CONCLUSION:
The intrinsic specrum of Mkn501 is consistent with a powerlaw and a spectral index of 2, which is predicted by the SSC−model.

Gamma−Ray Horizon

The absorption effect on high redshift gamma ray sources can be described by the gamma−ray horizon. The spectra of those sources will show a cut−off at GeV energies. We are not able to detect their spectra above this energy (black solid line).

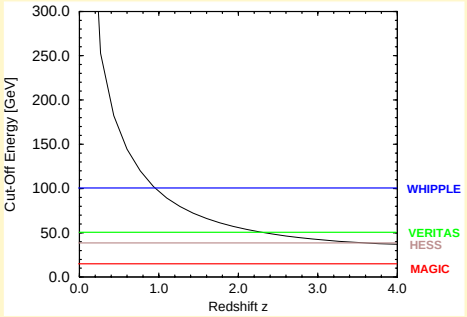

FIG 3. Cut−off energy as a function of redshift. for an optical depth of 1. Also shown are the lower threshold energies of the whipple telescope and three of the next generations cherenkov telescopes.

CONCLUSION:
Existing cherencov telescopes cannot detect sources at high redshift. VERITAS will detect sources up to a redshift of 2, HESS and MAGIC will detect sources to even higher redshifts.

Gamma−Ray Background

We started with the simplest assumptions. Present Day Background is produced only by Blazars. We did not include density evolution, luminosity evolution or reemission of the absorbed energy

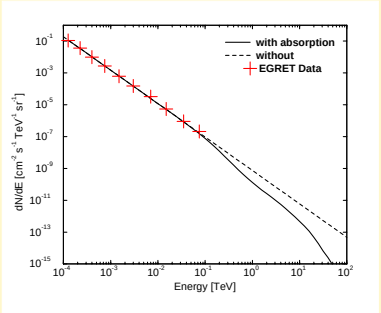

FIG 4. The diffuse background radiation at gamma ray energies.