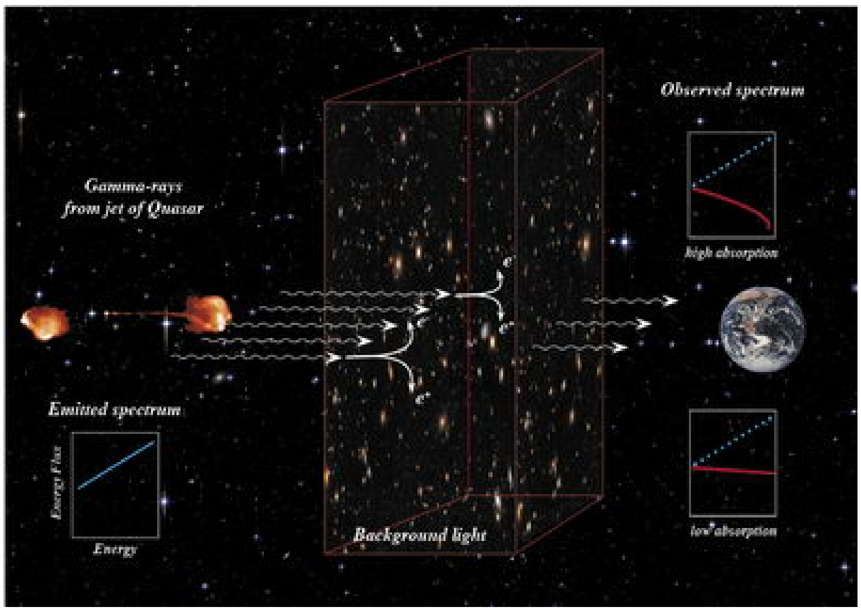
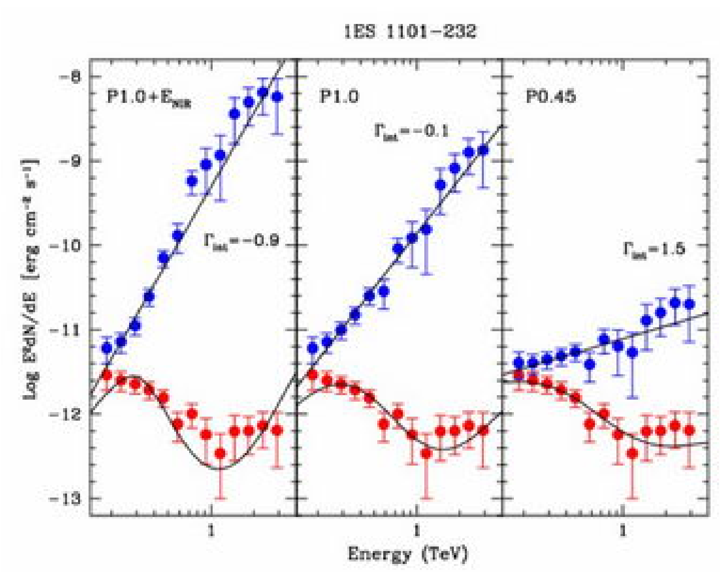
The Search For The History Of The Universe's Light Emission

April 20 2006



A cartoon of the effects of the diffuse extragalactic background light (EBL) on the gamma-ray emission from a distant quasar, before reaching the Earth. The gamma-rays are partly absorbed by colliding with the EBL photons produced by all the stars and galaxies in the Universe. If the density of EBL photons is high (upper graph), absorption is high and the highest energy gamma-rays are lost. So the distribution of measured energies (spectrum) is strongly changed. If instead the density is low (lower graph), absorption is less and the spectrum is not changed as much. (Credit: HESS Collaboration)

The light emitted from all objects in the Universe during its entire history - stars, galaxies, quasars etc. forms a diffuse sea of photons that permeates intergalactic space, referred to as "diffuse extragalactic background light" (EBL). Scientists have long tried to measure this fossil record of the luminous activity in the Universe in their quest to decipher the history and evolution of the Cosmos, but its direct determination from the diffuse glow of the night sky is very difficult and uncertain.



The HESS spectrum of the blazar 1ES 1101-232. The HESS spectrum of the blazar 1ES 1101-232. The observed distribution of energies (spectrum) of the detected gamma-rays is plotted in red. In blue is shown the deduced original distribution as emitted at the source, reconstructed supposing different levels of the diffuse background light. If the level is high (left and centre panel), the original spectrum is dramatically different from the typical distribution expected from such objects, and cannot be easily explained as an intrinsic feature. With a low background light level (right panel), the original spectrum becomes compatible with the normal characteristics of this type of quasar. (Credit: HESS Collaboration)

Very high energy (VHE) gamma-rays, some 100,000,000,000 times more energetic than normal light, offer an alternative way to probe this background light, and UK researchers from Durham University in collaboration with international partners used the High Energy Stereoscopic System (HESS) gamma-ray telescopes in the Khomas Highlands of Namibia to observe several quasars (the most luminous VHE gamma-ray sources known) with this goal in mind. The results, to be published in the April 20 issue of *Nature*, turned out to be rather striking.

Gamma-rays, which are produced in the most violent objects in the Universe, are absorbed in their journey from distant objects to Earth if they happen to hit a photon of "normal" background light. This fog of light in which the Universe is bathed is a fossil record of all the light emitted in the Universe over its lifetime, from the glare of the first stars and galaxies up to the present time.

So, using the distant quasars as a probe and studying the effect of the fossil light on the energy distribution of the initial gamma-rays, astrophysicists used HESS to derive a limit on the maximum amount of this 'extragalactic background light', which is remarkably lower than what previous estimates had suggested.

This result, published in the April 20 issue of Nature, has important consequences for our understanding of galaxy formation and evolution, and expands the horizon of the gamma-ray Universe which is clearly more transparent to gamma-rays than previously believed

Commenting in the findings, Dr Lowry McComb of Durham University, said, "HESS has in the last few years achieved a number of important discoveries concerning high-energy gamma-ray sources in our own Galaxy and has revolutionized high-energy gamma-ray astronomy.

These new HESS results illustrate the power of the instrument for extragalactic astronomy and cosmology. The discovery of lower levels of intergalactic starlight has the interesting side effect that the Universe becomes more transparent to gamma rays and that the telescopes can look deeper into the cosmos, increasing their reach for further discoveries!"

Source: PPARC