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Determining the Intergalactic Photon Densities from Deep Galaxy Surveys and the Gamma-ray Opacity of the Universe

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We have calculated the extragalactic IR-UV photon density as a function of redshift, and the resulting IR-UV spectrum of the extragalactic background light. Our empirically-based approach is based on local-to-deep galaxy survey data obtained in different wavelength bands using many space-based telescopes. This approach allowed us, for the first time, to obtain a completely model independent determination of extragalactic photon densities, and also to quantify their uncertainties. Using our photon density results, we were able to place 68% confidence upper and lower limits on the opacity of the universe to gamma-rays as a function of energy and redshift. We compared our results with Fermi analyses of the spectra of extragalactic gamma-ray sources.

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