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# Limits on MeV Gamma-Ray Emission from Active Galaxies and Other Unidentified High-Latitude Gamma-Ray Sources Observed with COMPTEL

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**Abstract:** We have established cumulative flux limits in the COMPTEL energy range (0.8-30 MeV) for a large sample of active galactic nuclei (AGN) of general interest. Our target list consists of both known and unidentified gamma-ray sources at high Galactic latitudes ($|b|>10^o$). Limits to the time-averaged MeV-emission measured with COMPTEL are derived from all-sky maximum-likelihood significance and flux maps produced using the full COMPTEL dataset spanning the entire nine-year period of the CGRO mission (April 1991-June 2000). The flux limits described here will be used to assess the contribution of AGN to the diffuse gamma-ray background measured in the MeV regime, and may serve to constrain the emission processes operative in high-energy cosmic sources. These results will also complement those anticipated from the high-energy GLAST mission scheduled for launch later this year.

## Introduction

The Imaging Compton Telescope (COMPTEL) aboard the Compton Gamma Ray Observatory (CGRO) operated from April 1991 to June 2000 and was sensitive to medium-energy gamma radiation from 0.8 to 30 MeV. As a wide-field, imaging instrument COMPTEL carried out the first comprehensive survey of the sky at MeV-energies with an angular resolution of 1-3 degrees and an energy resolution of 5-10% FWHM [1,2]. The medium-energy gamma-ray regime is of prime importance in the study of the broadband properties of a number of classes of astrophysical sources. For active galactic nuclei (AGN) in particular the power per natural logarithmic frequency interval ($\nu F_\nu$) is known to peak in the gamma-ray region of the spectrum. Spectral breaks are typically required to join observations spanning several decades in energy around the MeV gamma-ray band [3,4]. To more fully characterize the broad-band properties of high-energy AGN and related sources, we have undertaken a systematic search through COMPTEL all-sky maps for evidence of MeV emission from known or suspected gamma-ray sources at high Galactic latitude ($|b|>10^o$). Here we describe our analysis methods and general results. This project is an extension of earlier work using COMPTEL datasets covering a more limited period of the CGRO mission [5-7]. A full listing of the upper limits obtained will be presented in the Second COMPTEL Source Catalogue, in preparation.

## COMPTEL Data Processing

The limits presented here on MeV-emission from AGN and related high-latitude sources were derived using COMPTEL all-sky maximum-likelihood significance and flux maps covering the entire nine-year CGRO mission (1991-2000). The all-sky maps were produced from standard-processing COMPTEL datasets for individual CGRO viewing periods, in four standard energy bins spanning the sensitive range of COMPTEL (0.8-1, 1-3, 3-10, and 10-30 MeV). Event selec-

tions and data processing followed COMPTEL team-standard methods [8]. The maximum-likelihood optimization procedure employed background models determined for individual viewing periods. Models incorporating the diffuse Galactic emission (based on HI, CO, and inverse-Compton components), the isotropic diffuse extragalactic gamma-ray background, and strong or known sources (such as the Crab) have also been included as part of the iterative maximum-likelihood fitting procedure [9]. An all-sky COMPTEL maximum-likelihood significance source map is presented in Figure 1.

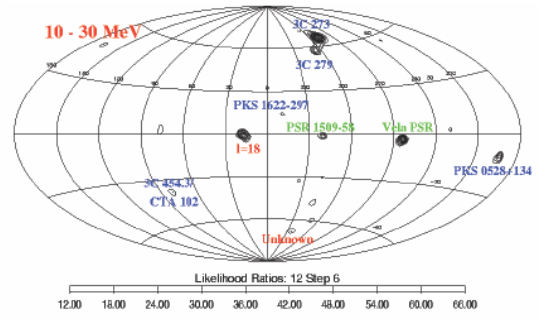


Figure 1: COMPTEL all-sky maximum-likelihood point-source map over the energy range 10-30 MeV. Detected AGN are labeled in blue, pulsars are indicated in green, and as-yet-unknown sources of MeV emission in red.

## Candidate Target Selection

A candidate source list of over 300 celestial objects was compiled for this study. The distribution of the target objects is indicated by category in Figure 2. Emphasis in candidate selection was placed on known or suspected gamma-ray AGN sources at high Galactic latitudes, particularly those detected in neighboring energy bands to COMPTEL by the CGRO EGRET instrument. The majority of objects in the target list are identified as likely gamma-ray blazars (~90) in the Third EGRET (3EG) Catalog [10]. Also included are the ~170 as-yet-unidentified EGRET sources taken from the same compilation.

## Discussion

We will present the time-averaged two-sigma cumulative flux limits in the COMPTEL energy range for our candidate objects. In general, the flux limits presented demonstrate that COMPTEL does *not* detect cumulative time-averaged MeV-emission from the vast majority of high-energy gamma-ray blazars detected with EGRET, nor from well-known X-ray sources such as Seyfert galaxies. This result is consistent with other COMPTEL analyses for individual CGRO viewing periods and for related long-term time-averaged source searches using the full COMPTEL database [4,11]. Dedicated follow-up analysis is in progress for a limited number of apparent source detections that remain to be confirmed.

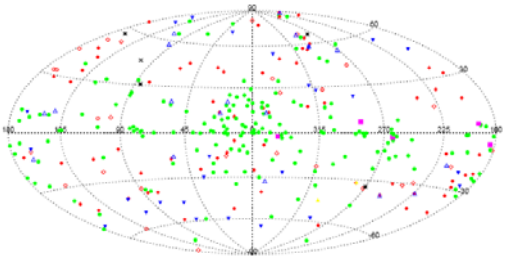

Figure 2: The distribution in Galactic coordinates of the candidate sources used in this study. Sources plotted include EGRET AGN (red), unidentified EGRET sources (green), Seyfert galaxies (blue), and pulsars (purple).

## Conclusions

A full listing of the upper limits obtained will be presented in the Second COMPTEL Source Catalogue, currently in preparation. The flux limits described here will be used to assess the contribution of AGN to the diffuse gamma-ray background measured in the MeV regime, and may also serve to constrain the emission processes operative in high-energy cosmic sources. It is expected that these results will also complement those anticipated from the high-energy GLAST mission scheduled for launch later this year.

## Acknowledgements

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