Diffuse Galactic Radiation

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Propagation of the Cosmic Radiation through Intersteller Space

S. Hayakawa

Department of Physics, Osaka City University

November 25, 1952

 $0.6g \text{ cm}^{-2}$. In the passage through this thickness secondary particles are scarcely produced except photons which are due to the decay of neutral pions. The

SOME PROBLEMS IN GAMMA AND X-RAY ASTRONOMY*

V. L. GINZBURG and S. I. SYROVATSKIJ P. N. Lebedev Physical Institute, Academy of Sciences, USSR, Moscow

(Received July 30, 1964)

It is also evident that the determination of the intensity and the spectrum of gamma-rays may turn out to be a source of information about cosmic rays themselves. The possibility of studying in this way cosmic rays in the metagalactic space is particularly valuable. The magnetic fields in this case are so weak that relativistic

THE PRODUCTION OF COSMIC GAMMA RAYS IN INTERSTELLAR AND INTERGALACTIC COSMIC-RAY COLLISIONS

I: THE KINEMATICS OF p-p INTERACTIONS AND SECONDARY MESON AND HYPERON DECAY AND THE COSMIC GAMMA-RAY SPECTRAL SOURCE FUNCTION

F. William Stecker

SAO Special Report #220 (1966) vol. 220

Gamma 2012

Jean-Marc Casandjian

OSO-3 (Third Orbiting Solar Observatory, launched on 1967) First clear experimental evidence of Galactic diffuse emission



FIG. 8.—Sky map of the γ -ray intensity in galactic coordinates. The element of area on the map to which the formula given in the text applies is approximately 245 square degrees.

Kraushaar et al., ApJ, 1972,177,341

counts per 0.25 degree pixel sqrt color scaling





Wednesday, July 11, 2012

Comptel I- 30 MeV

galdef ID 54_z04LMS E² × Intensity, cm² sr⁻¹ s⁻¹ MeV 0.00<1<30.00,330.00<1<360.00 -10.00<b<-0.00,0.00<b<10.00 Fermi-LAT E>360 MeV unionity (Comptel 🦻 IC 10-3 HESS E>380 GeV bremsstr

10

-2

10

10⁻¹



http://www.mpe.mpg.de/~aws/comptel/aws/skymos/skymos.html

Aharonian et al., 2006, Nature 439, 695



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Fermi-LAT

total diffus

1.1.1.111

10⁴

Energy, MeV

10⁵

10³

10²

A. Strong, Cosmic Rays for Particle and Astroparticle 2011 Physics. arXiv:1101.1381

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The diffuse interstellar emission probes a wide range of the electron and proton spectrum





The diffuse interstellar emission probes a wide range of the electron and proton spectrum



Template fitting: correlate Fermi counts with other wavelength maps or with predictions



Interaction between Galactic CR and nucleons/photons



Template fitting: correlate Fermi counts with other wavelength maps or with predictions



LAT counts correlated with atomic hydrogen







LAT counts correlated with atomic hydrogen



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LAT counts correlated with atomic hydrogen





LAT counts correlated with atomic hydrogen





LAT counts correlated with atomic hydrogen



Template fitting: correlate Fermi counts with other wavelength maps or with predictions

LAT counts correlated with atomic hydrogen



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Comparison between LAT emissivities and emissivities calculated from computed local interstellar spectrum (LIS)



"A excess with harder spectrum possibly associated with Loop I in the northern and southern central region is also observed."

Casandjian, Grenier for the Fermi LAT Collaboration 2009 Fermi Symposium, eConf Proceedings C091122



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Full description of the Fermi bubbles: Su, Slatyer, Finkbeiner, 2010, ApJ, 724, 1044



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Fermi bubble

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Fermi bubble = Fermi peanut

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Fermi bubble = Fermi peanut or Fermi acorn ?

Conclusion

The Galactic interstellar gamma-ray emission first observed at the end of the sixties is now studied from the keV to the TeV.

Fermi-LAT with its large effective area, good angular resolution, energy range and survey scanning mode is an ideal instrument for precise diffuse studies like the HI emissivity.

This emissivity agrees with recent diffusive propagation based electron and proton LIS calculation.

Multi-wavelength studies are needed to support the interpretation of diffuse emission in term of interaction between cosmic-ray and interstellar medium (IR, Integral, Comptel, synchrotron).

New exciting large scale structures were observed, careful foreground and background modeling are still required in the plane to help their interpretation.

CTA will also detect the diffuse emission..