

The nature of the diffuse emission above 100 keV from the Galactic ridge

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ABSTRACT

The inner Galaxy is a source of apparently diffuse continuum emission above 100 keV, in addition to the positronium and 511 keV line emission. We compare observational results from INTEGRAL/SPI with those from other instruments in order to give an evaluation of the current experimental situation. We make a comparison with standard models for continuum emission, but these appear inadequate. An additional process such as in-flight annihilation of positrons or knock-on electrons may be required, or a population of undetected sources with hard spectra could be responsible.

See also talk 7.4 by J. Knoedlseder on Thursday

MOTIVATION

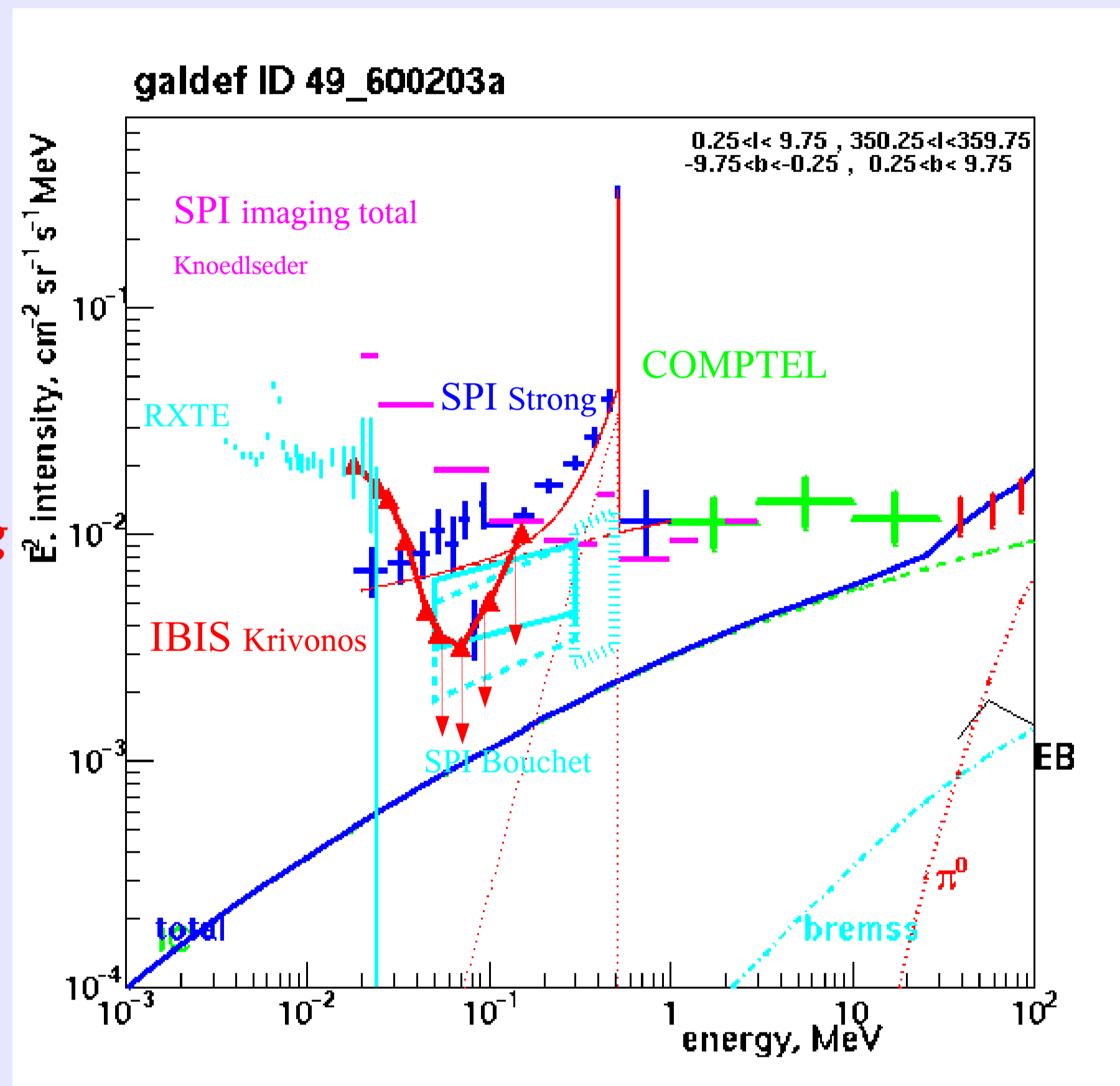
Compare INTEGRAL analyses of the diffuse Galactic continuum

SPI:

Bouchet et al. 2005: *spatial model fitting*
 Strong et al. 2005: *multi-component spatial model fitting*
 Knoedlseder et al. 2007: *MREM imaging*

IBIS:

Terrier et al. 2004: *spatial model fitting*
 Krivonos et al. 2006: *on/off method*



Krivonos et al. 2006: IBIS analysis using on-off method + background modelling, using COBE/DIRBE 4.9μ to trace diffuse emission

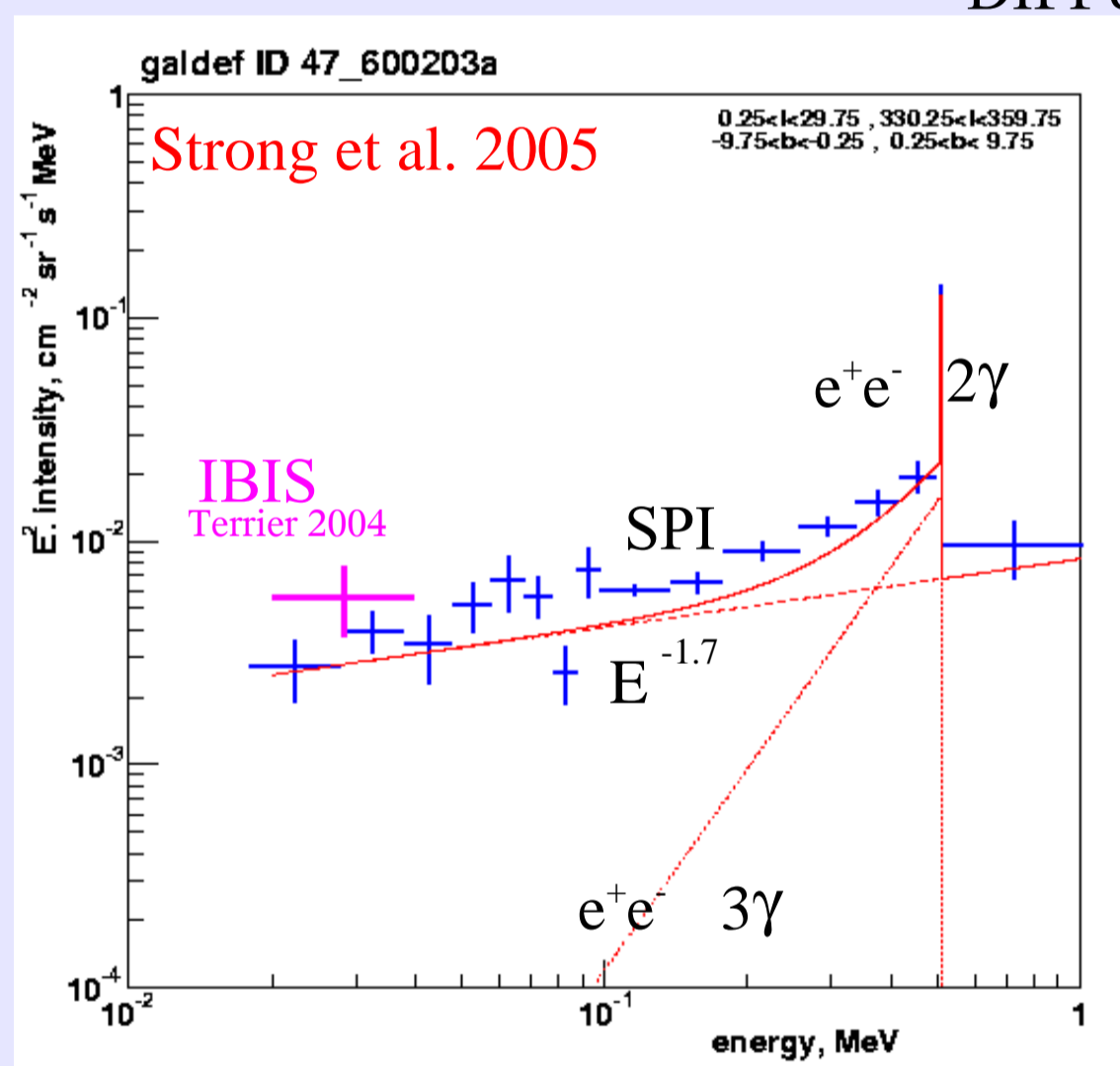
Claim:
 only detected sources contribute to 60 - 200 keV: *no diffuse!*
 20 - 60 keV: unresolved emission exists, but all explained by source populations

SPI: *detection of diffuse continuum hard emission*
COMPTEL: *clear detection of continuum 1 - 30 MeV* (Strong et al 1999)
 how can we reconcile these observations?
 Here we attempt to compare them on same scale

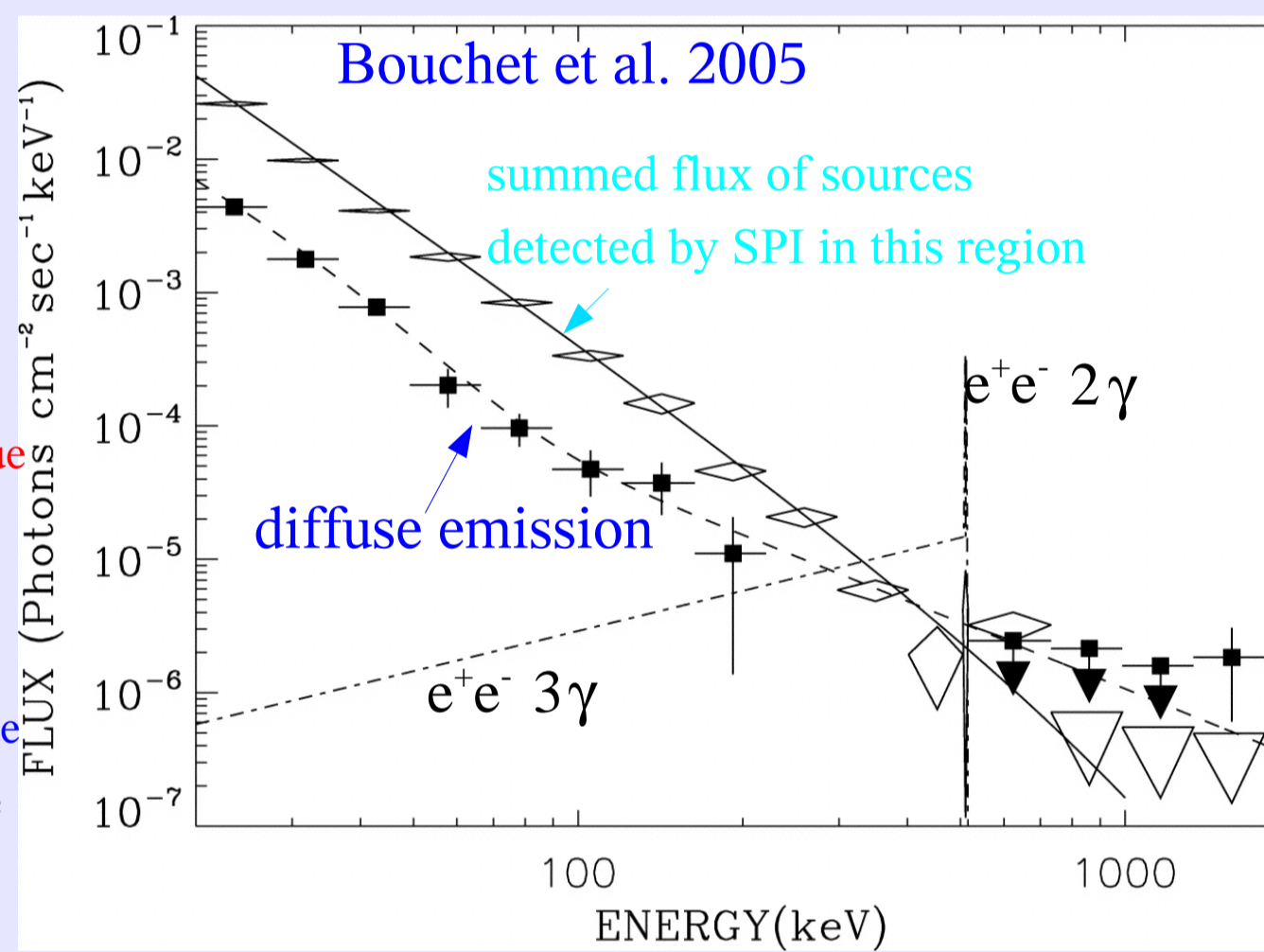
COMPARISON OF DATA

SPI

DIFFUSE SPECTRUM OF INNER RADIAN

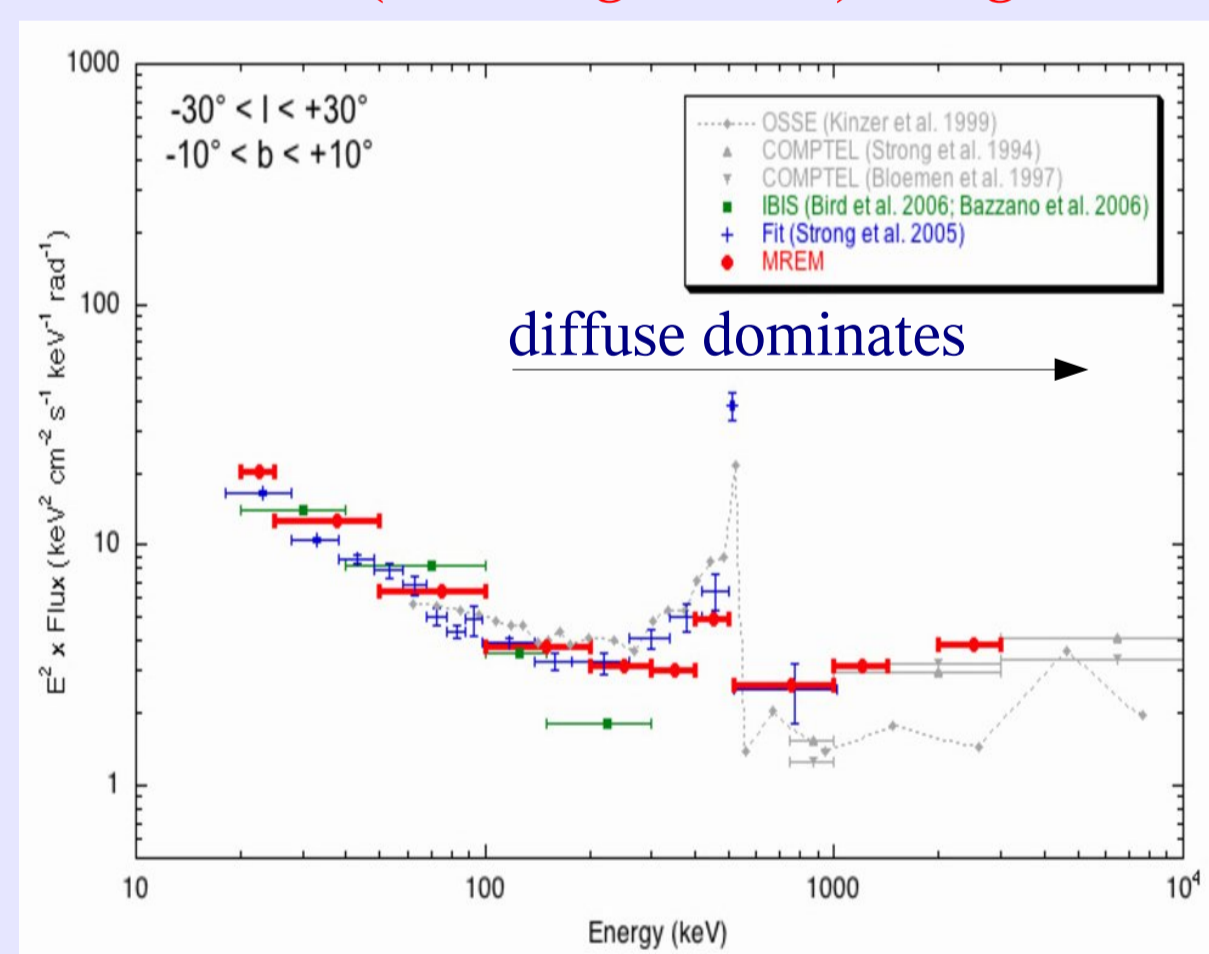


fit to sum of 9 diffuse skymap templates (HI, CO, bulge, various Gaussians - to reproduce the total diffuse emission) + IBIS point-source catalogue + background
 fit to diffuse skymap template + SPI point-source catalogue + background



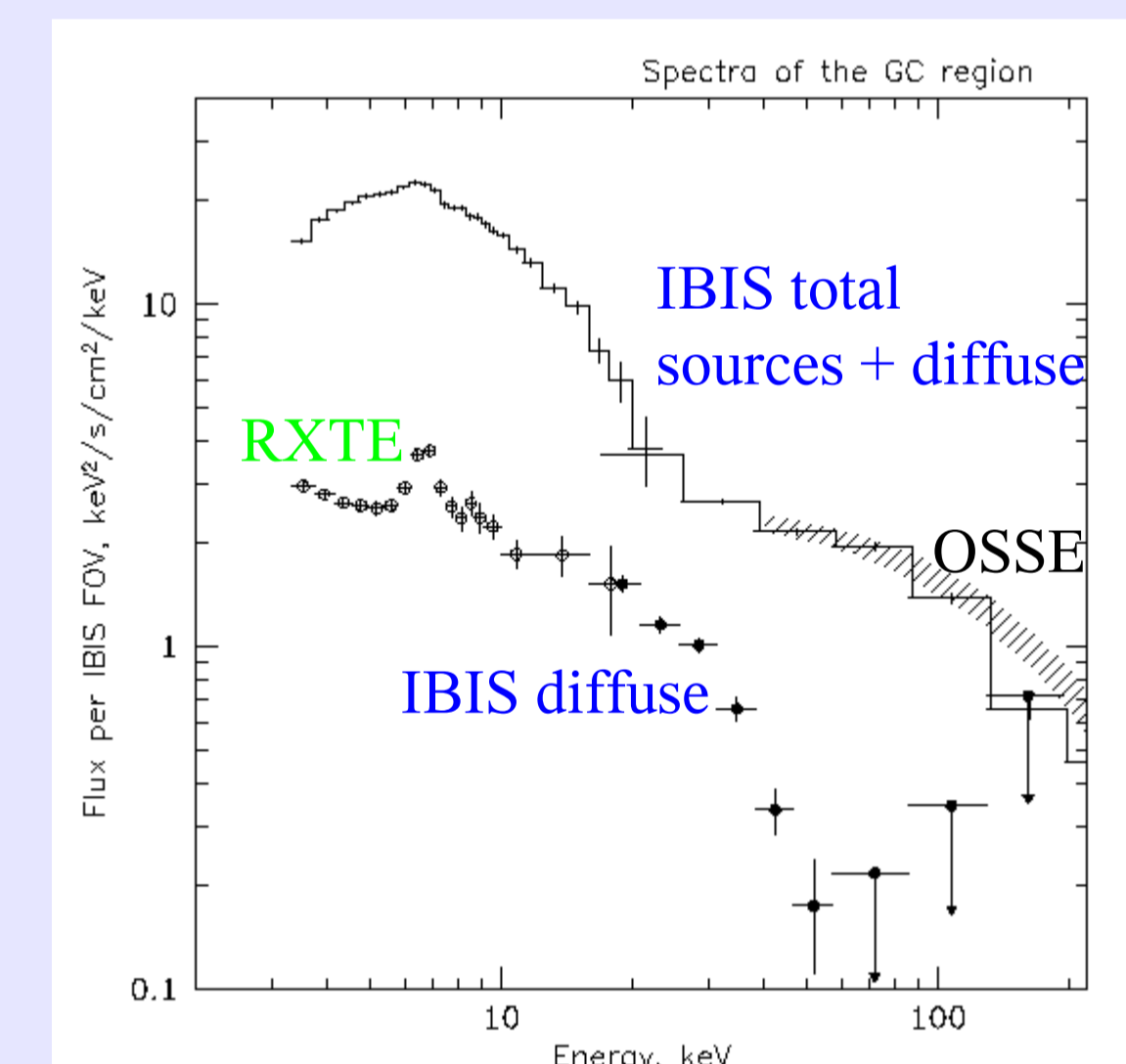
Continuous lines are spectral fits using full SPI energy response matrix

Knoedlseder 2007: total (including sources) integrated over sky image



IBIS

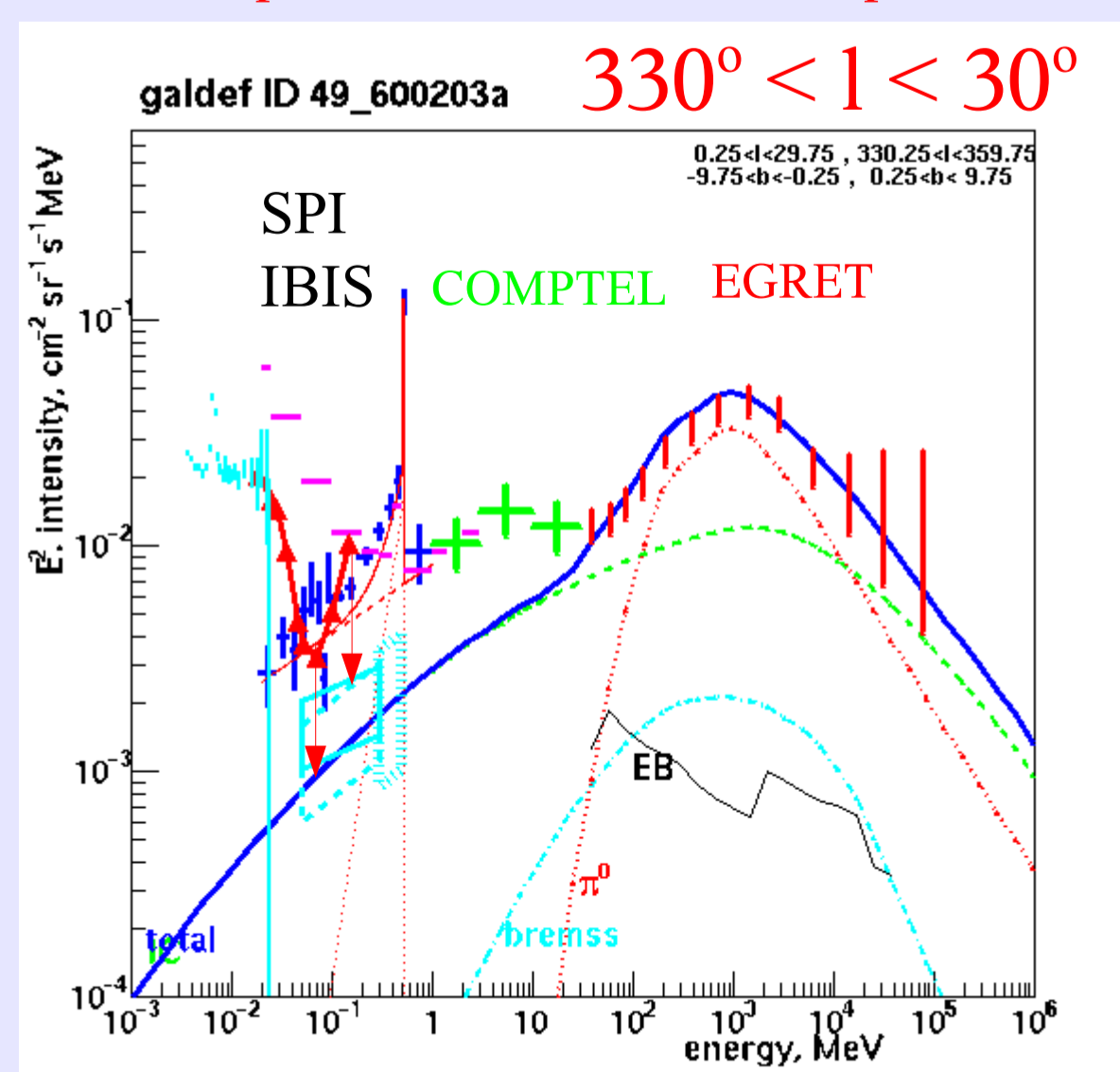
Krivonos et al. 2006



Krivonos et al. have upper limits > 60 keV, which do not contradict the SPI spectrum within a factor 2. Above 200 keV no constraint from IBIS.

INTERPRETATION

Broad-band comparison with GALPROP prediction

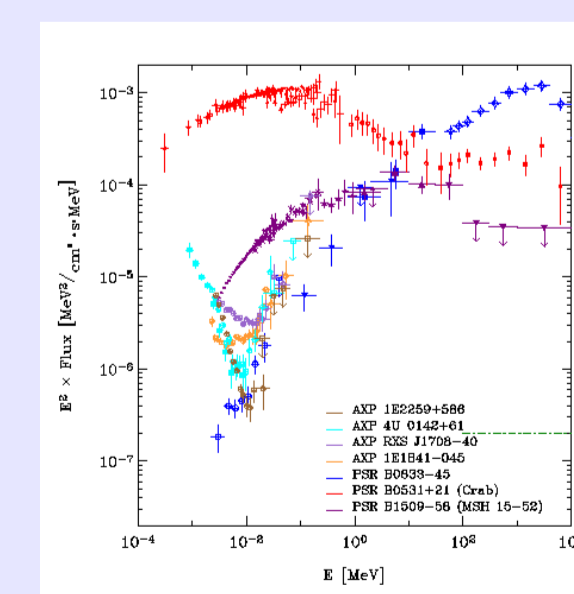


The hard power-law diffuse continuum 100 keV - 10 MeV is not easy to assign to known mechanisms: inverse Compton and bremsstrahlung seem *insufficient*. In-situ electron acceleration (Dogiel et al. 2002) is one possible way to produce the emission avoiding the energetics problem.

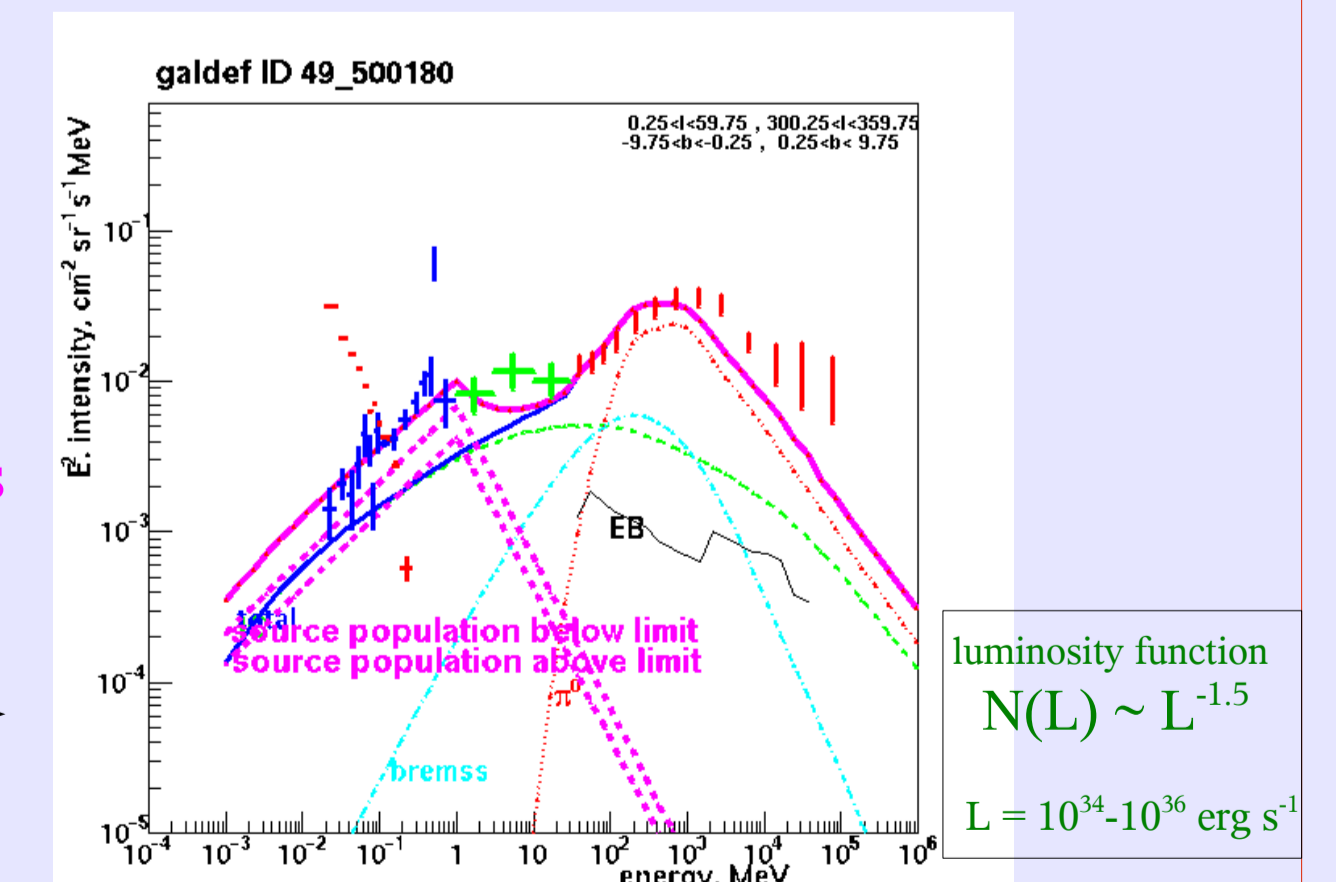
Or maybe it is some other diffuse process: in-flight annihilation of high-energy positrons? or cosmic-ray knock-on secondary electrons?

If the 100 keV - 10 MeV 'diffuse' emission is indeed from sources it will have implications for the GLAST diffuse emission studies, since these sources may also emit >30 MeV.

This is complementary: GLAST will uncover more sources which will help to clarify the spectra and distribution of source populations.



Or - it could be unresolved source populations with hard spectra (pulsars, AXPs):



Source population synthesis showing how the hard power-law ridge emission could come from undetected sources with hard spectra without violating source counts (Strong 2006). The emission from undetected sources is shown in the upper line - - - - and from SPI-detectable sources by the lower line - - - - The total including inverse Compton, bremsstrahlung and undetected sources is shown by - - - - A spectral break at 1 MeV has been assumed for the sources.

REFERENCES

Bouchet et al. ApJ 635, 1103 (2005), Strong et al. A&A 444, 495 (2005), Knoedlseder et al. Proc 6th INTEGRAL Workshop and this conference (2007), Terrier et al. 5th INTEGRAL Workshop (2004), Krivonos et al. astro-ph/0605420 (2006), Strong et al. astro-ph/9811211 (1999)
 Dogiel et al. ApJ 581,1061 (2002), Kuiper et al. ApJ 645, 556 (2006), Strong (2006) <http://www.am.ub.es/bcn06/> : talks