



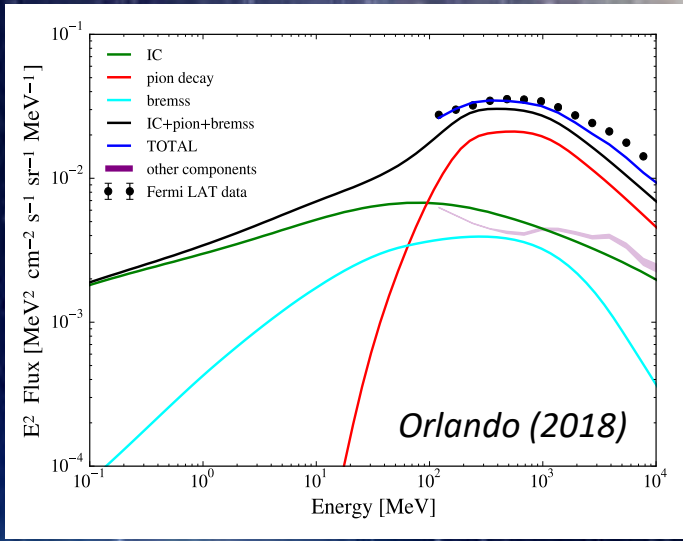
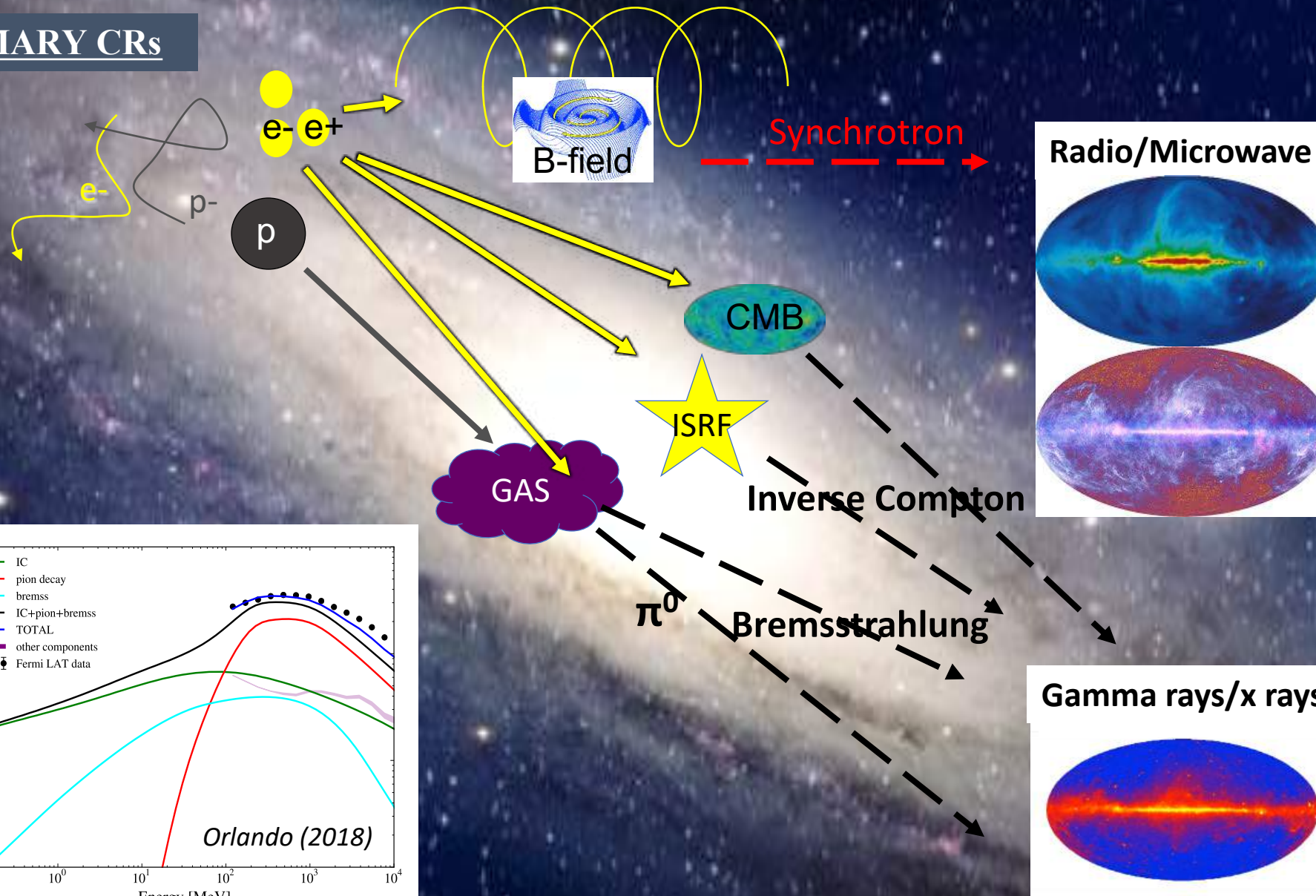
The MeV Excess in the Inner Galaxy

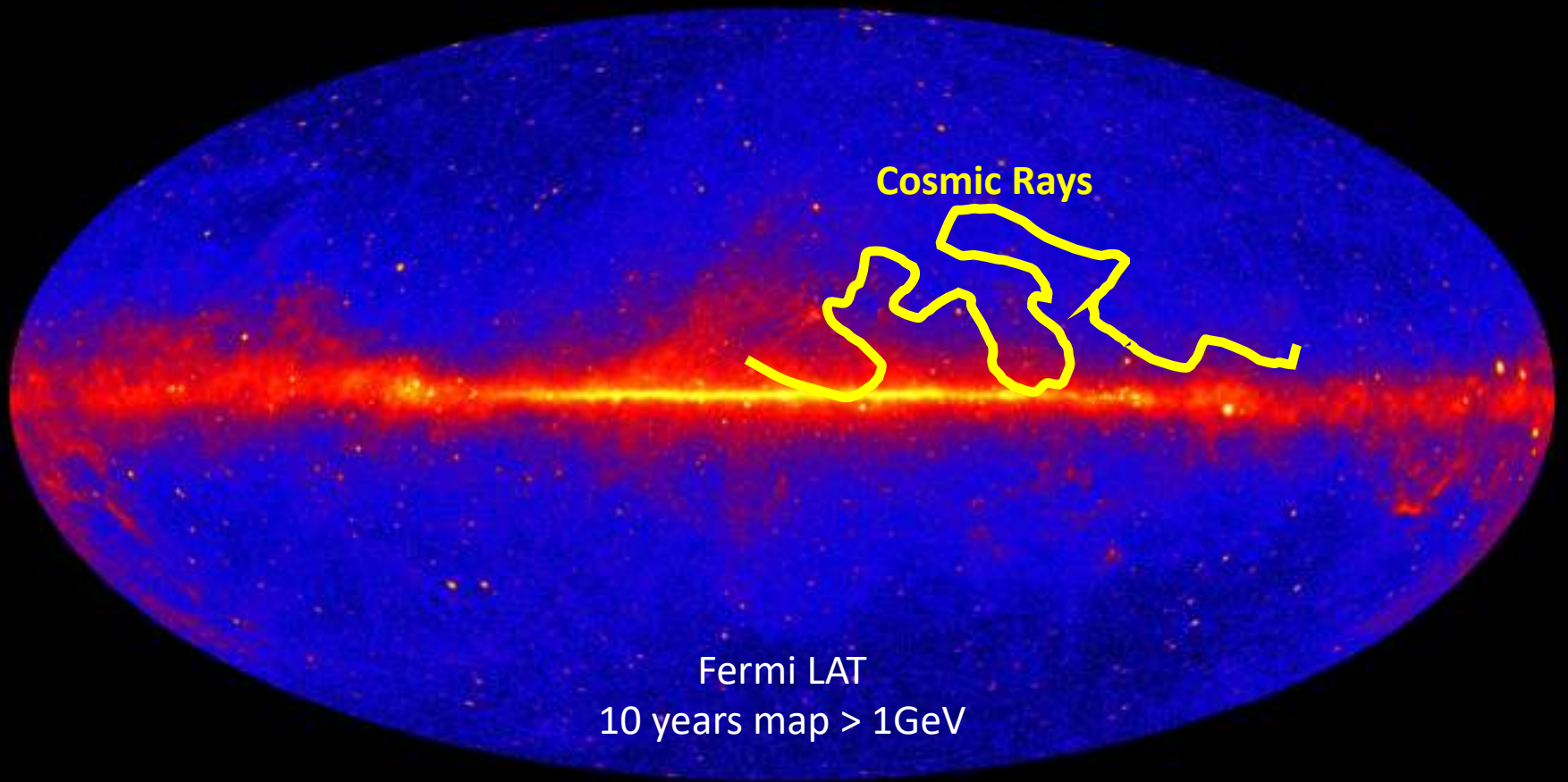
Elena Orlando

INTEGRAL Workshop – Oct 2024

Interstellar Emission

PRIMARY CRs





Cosmic Rays

Fermi LAT
10 years map > 1GeV



GeV Excess

Sources?

Truly diffuse?

Many works
(e.g. *Ackerman et al.*
2017 ApJ 840, 1
and references therein)

Inner Galaxy >1 GeV

Ajello et al. (2016) ApJ

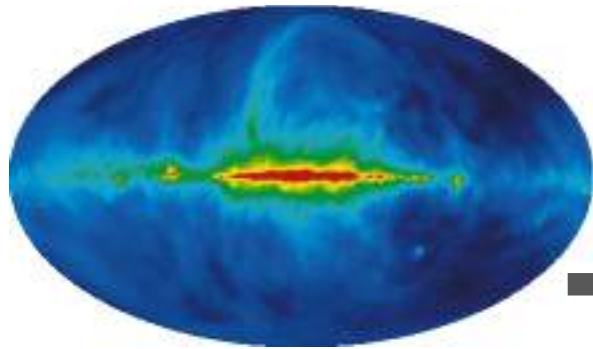


- 1) IC dominant and brighter than predicted by standard models
- 2) Hardening in the inner Galaxy with respect to standard models

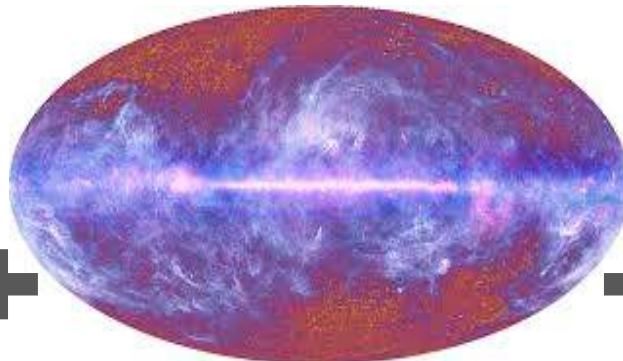
- Enhanced Inverse Compton? - Unresolved sources? - Dark Matter? -

Our Approach

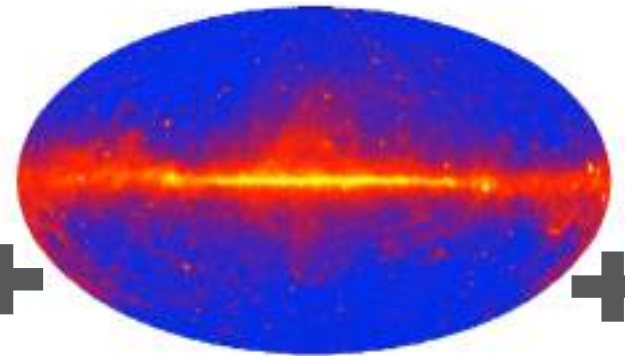
Orlando (2018) MNRAS 475, 2724
Orlando (2019) Phys.Rev.D 99, 043007



Radio at 408 MHz



Microwaves at 30 GHz



Gamma rays at 1 GeV

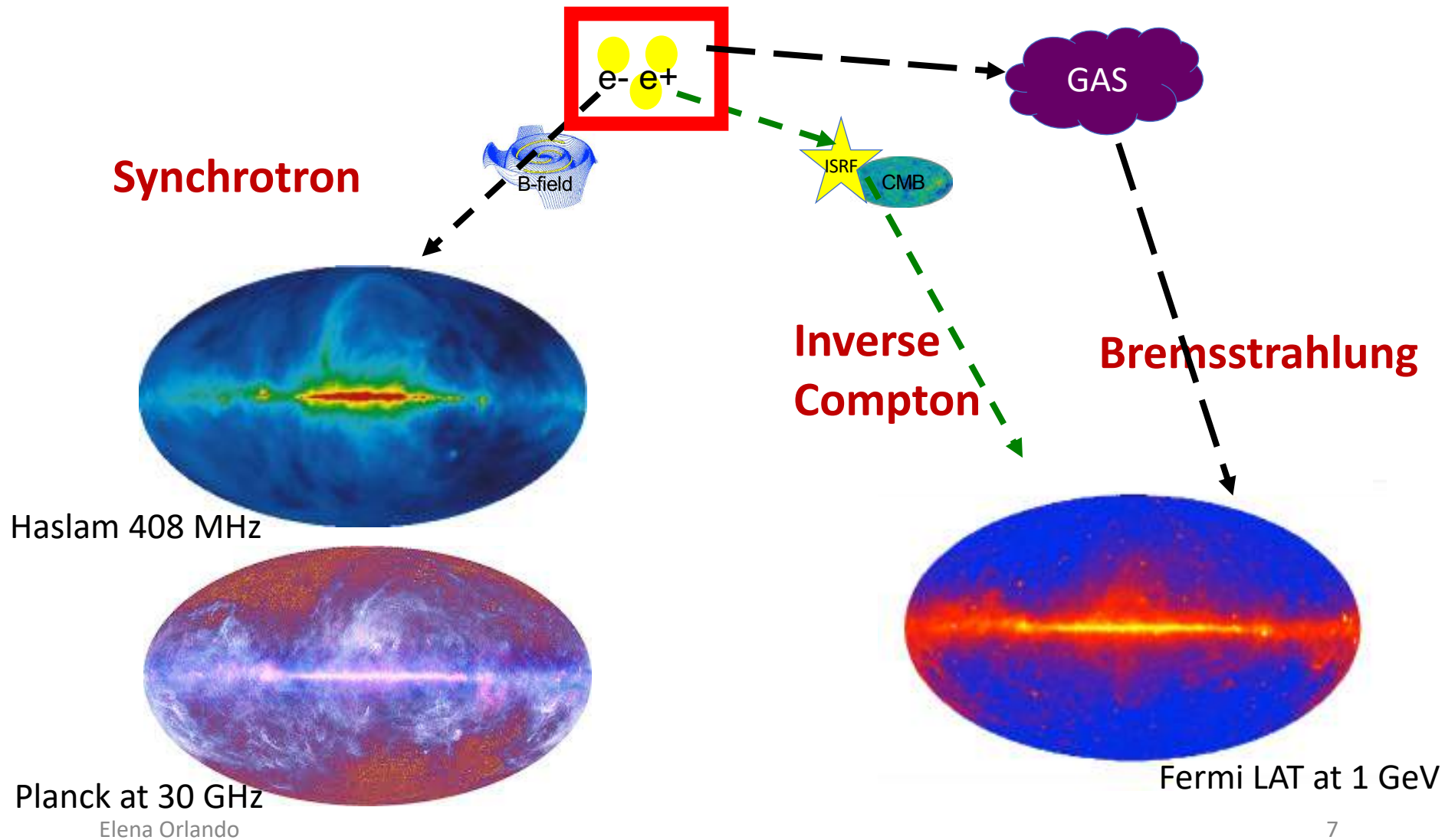


Elena Orlando



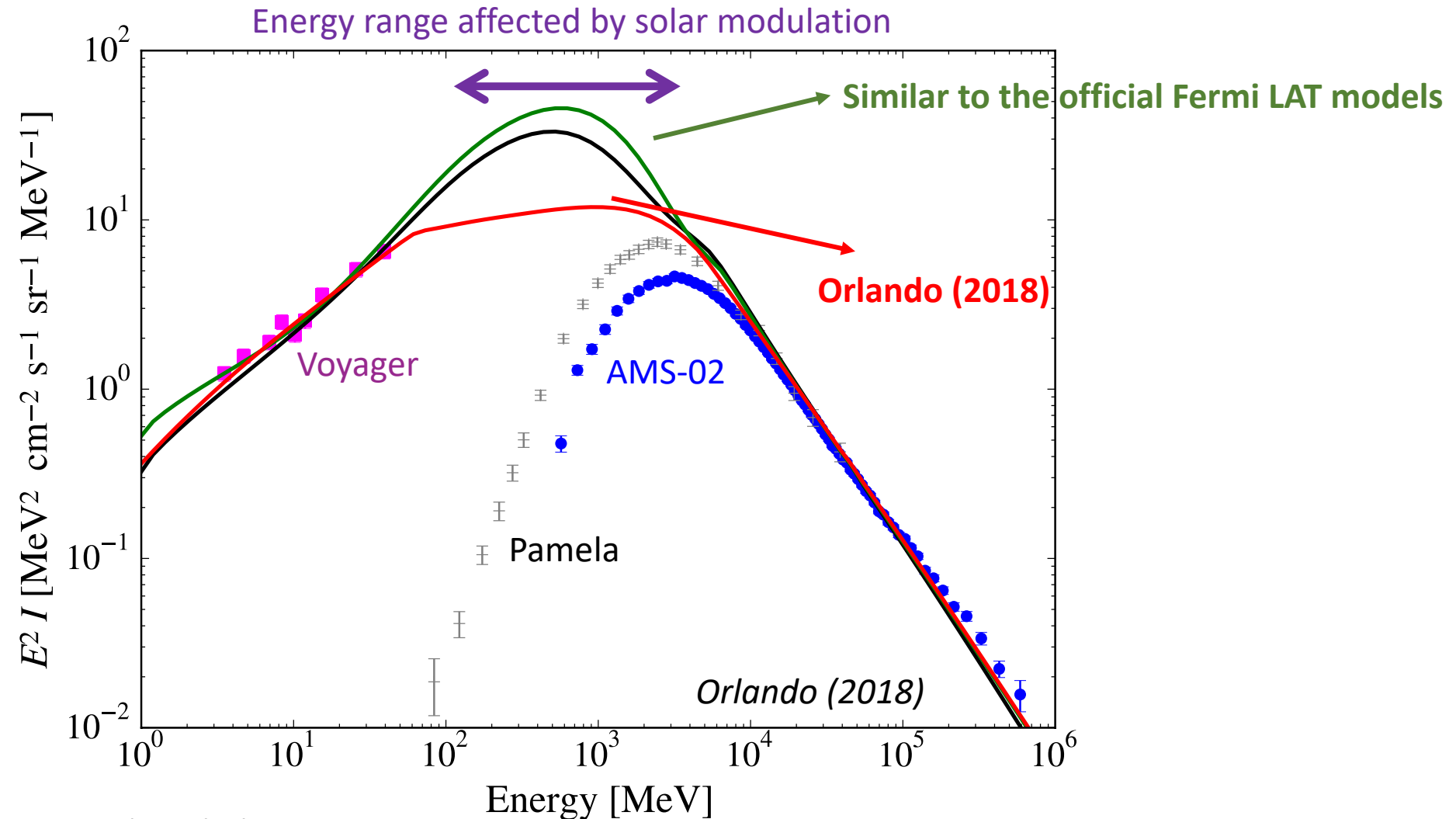
Inclusion in GALPROP of synchrotron modeling
with 3D B-fields and polarization
(Strong, Orlando, Jaffe, 2011 A&A, 534, 54
*Orlando & Strong 2013 MNRAS 436, 2127)*⁶

Relation Radio/Gamma

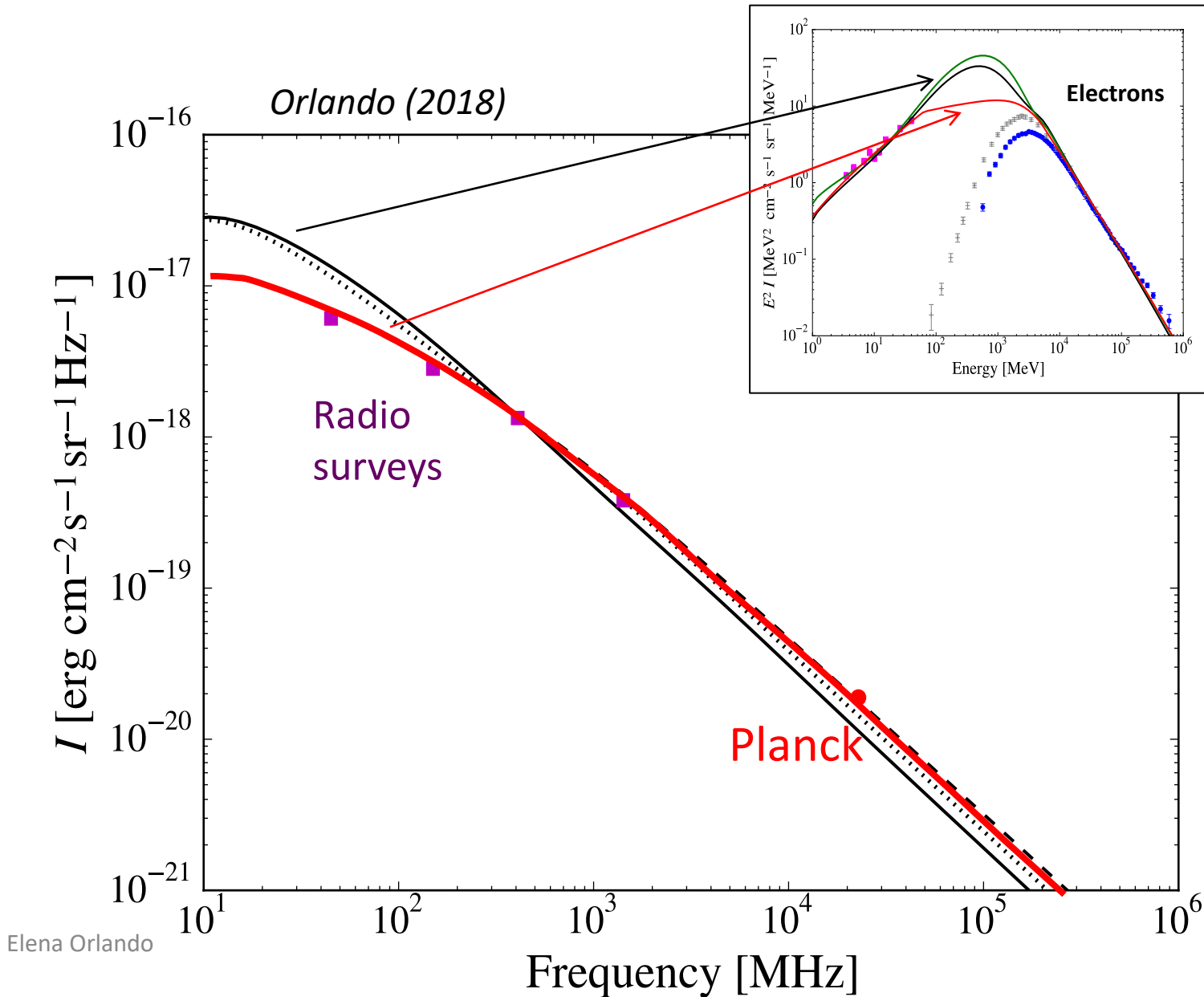


Results: Local Interstellar electrons

GALPROP models



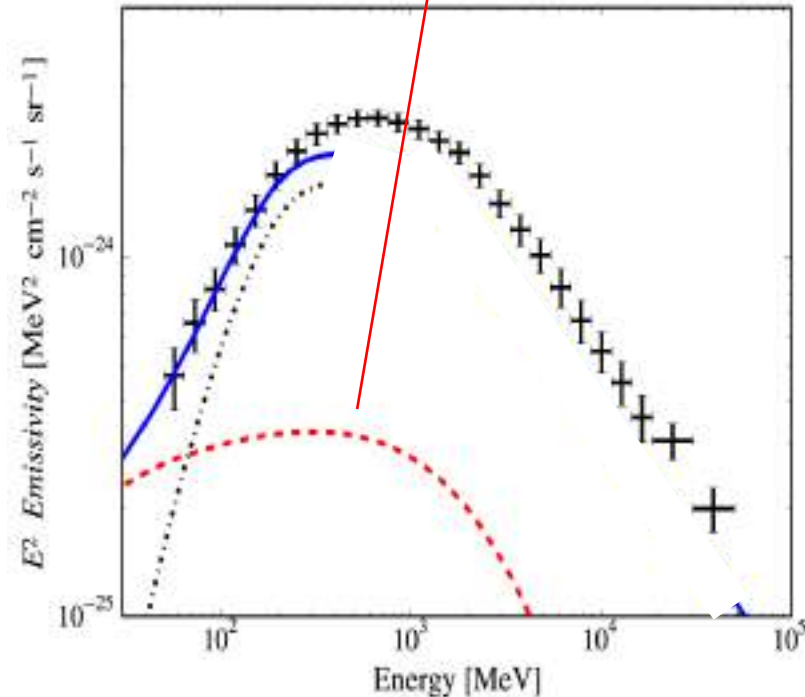
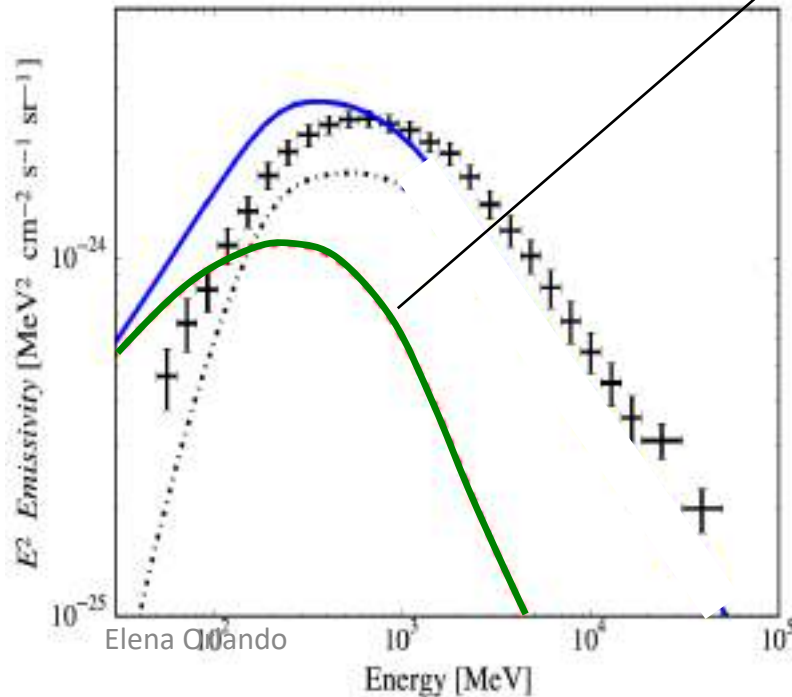
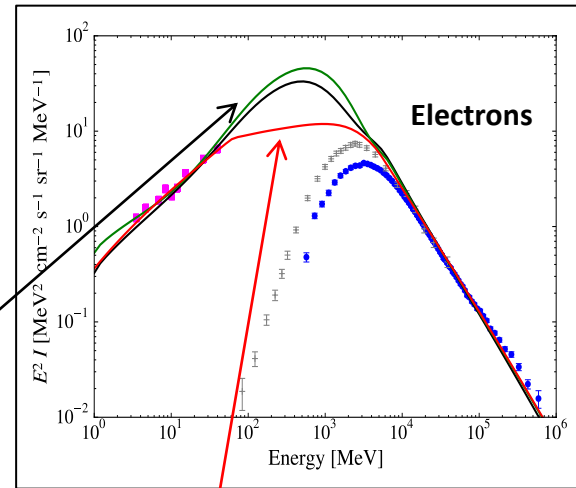
Interstellar **Electrons** from Synchrotron Data



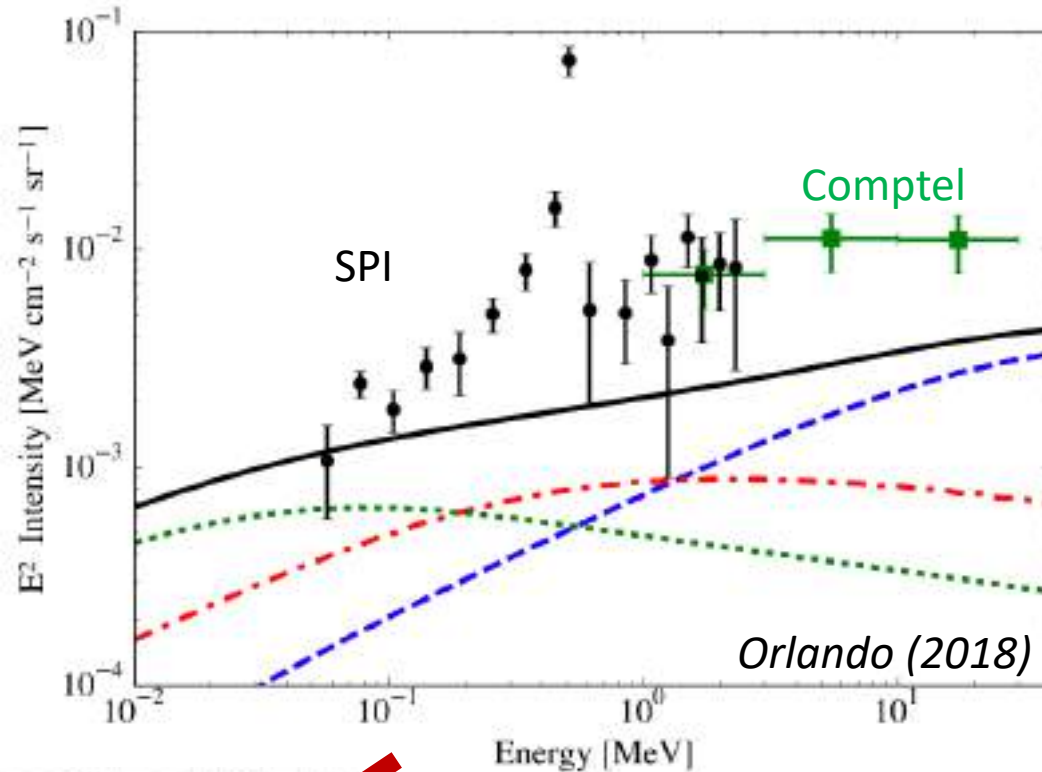
Interstellar **Electrons** from Gamma-Ray Data

Orlando (2018)

How does this
affect INTEGRAL?



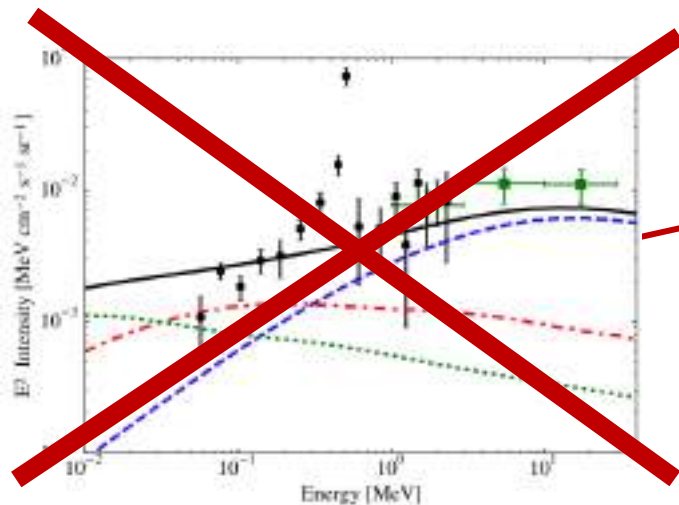
The MeV Excess



SPI data of the diffuse from *Bouchet et al., ApJ. 2011, 739,29*

(Other data (e.g. Sigert et al. 2022) can't be directly compared being for a different region)

OK with Fermi and radio data!



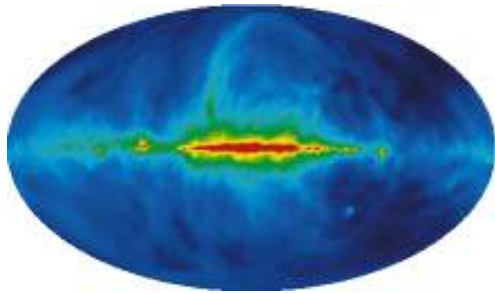
It would overproduce Fermi and radio data!



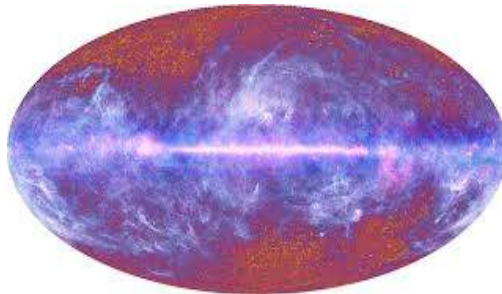
Possible contamination by sources!

Inverse Compton and Magnetic Fields

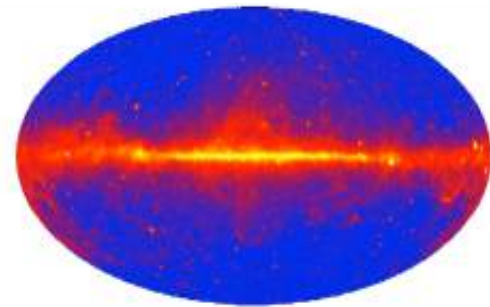
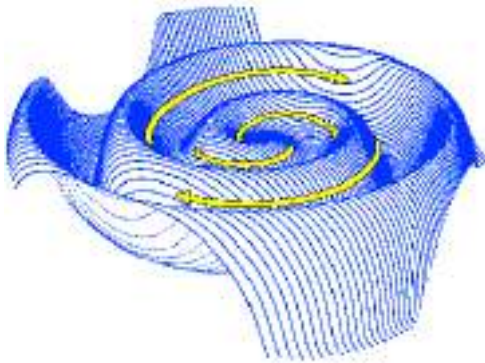
Orlando (2019)



Radio surveys



Planck - microwaves

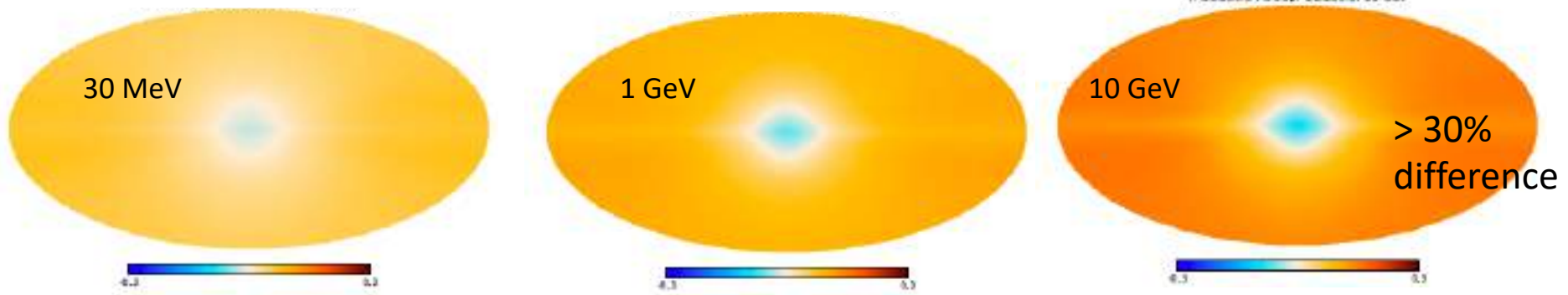


Fermi LAT – gamma rays

Inverse Compton and Magnetic Fields

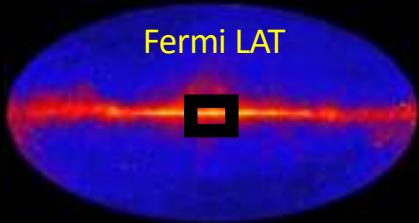
Orlando (2019)

$$(IC_{\text{OLD}} - IC_{\text{NEW}}) / IC_{\text{OLD}}$$



Updated B-fields produce brighter IC in the inner Galaxy than predicted by standard models and the emission increases with energy

The Inner Galaxy: interstellar emission or sources?

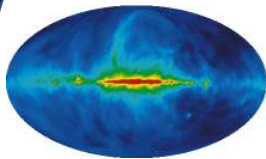


Cosmic rays



PROBLEM:
large-scale
interstellar
model
uncertainties

OUR SOLUTION:



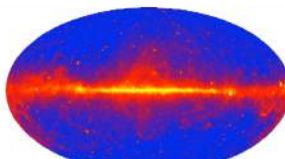
Radio Surveys

+



Microwaves

+



Gamma Rays

+



Cosmic Rays Measurements

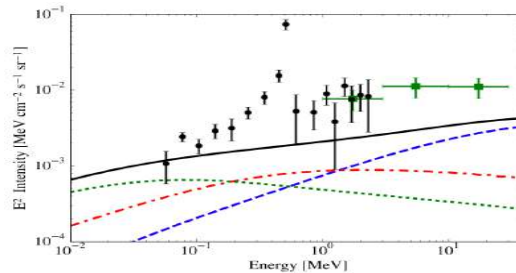
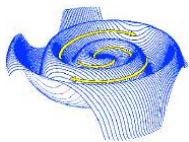
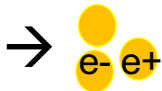
+



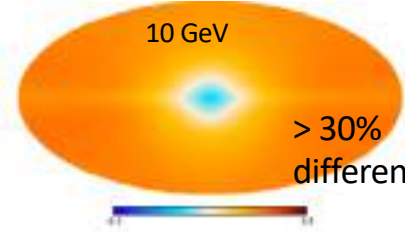
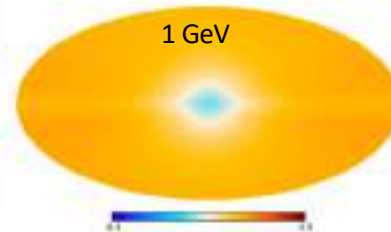
Our Cosmic-Ray
Propagation Models



SELECTED RESULTS:



Inverse Compton Gamma Residuals ($IC_{COLD} - IC_{NEW}$) / IC_{COLD}



> 30%
difference

Updated Magnetic Fields models produces brighter IC in the inner Galaxy than predicted by standard models used for Fermi LAT analyses