

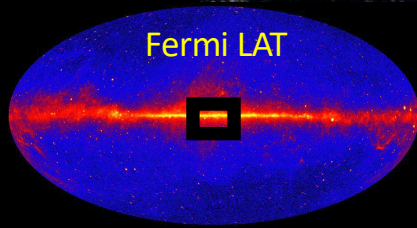
# Updated Interstellar Inverse Compton Models and Dependency from the Magnetic Field

**Elena Orlando**

TeV Particle Astrophysics (TeVPA)

Sep 2023, Napoli

# Diffuse Interstellar Emission

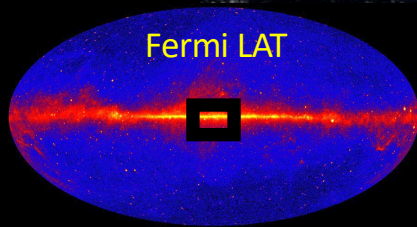


Cosmic rays



**PROBLEM:**  
large-scale  
interstellar  
model  
uncertainties

# Diffuse Interstellar Emission

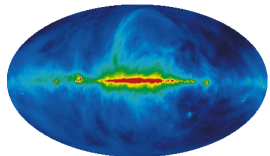


Cosmic rays



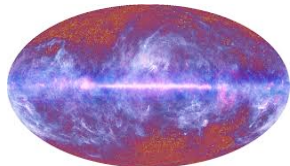
**PROBLEM:**  
large-scale  
interstellar  
model  
uncertainties

## OUR SOLUTION:



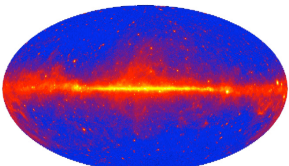
Radio Surveys

+



Microwaves

+



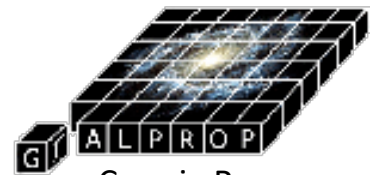
Gamma Rays

+



Cosmic Rays Measurements

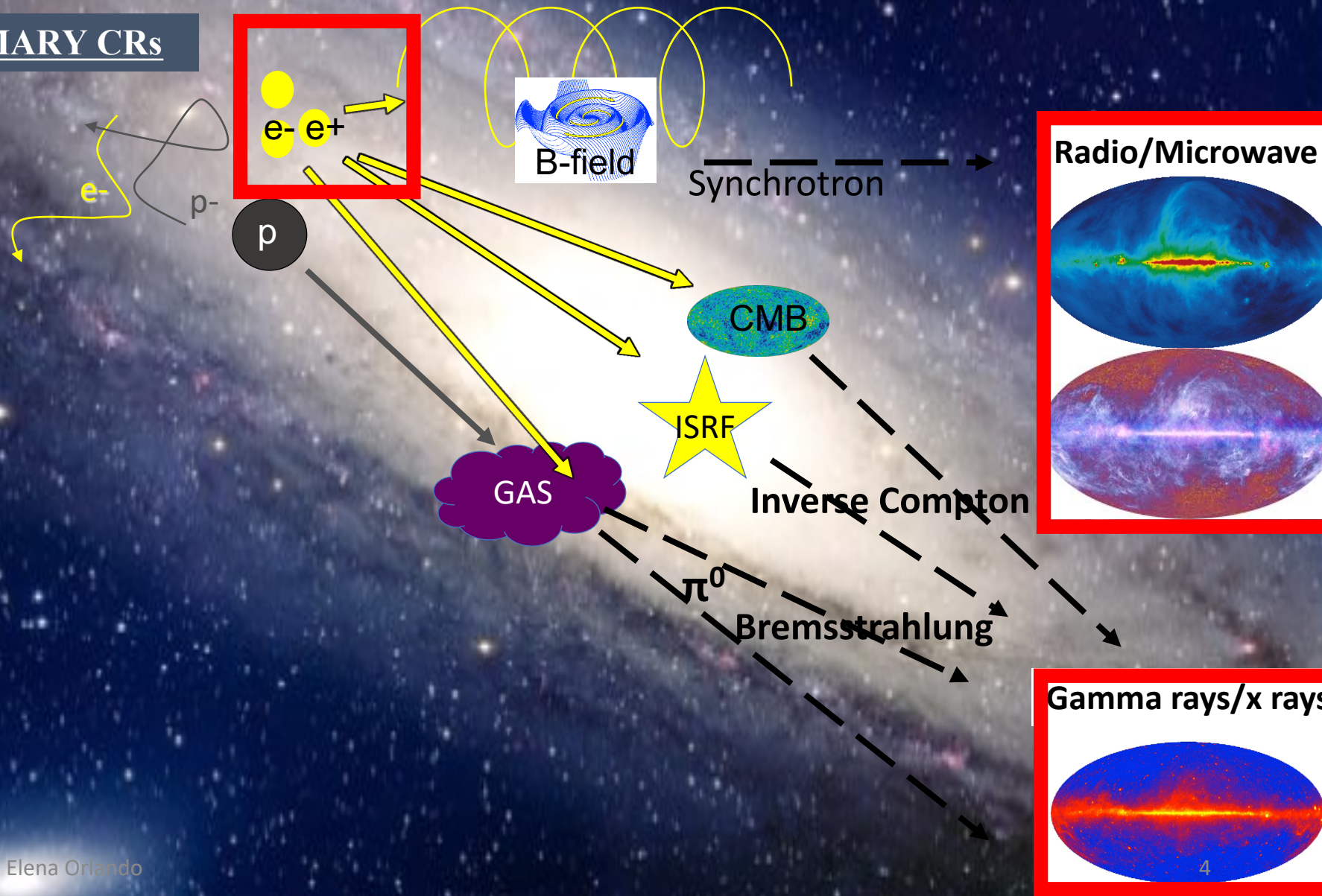
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Cosmic-Ray  
Propagation Models

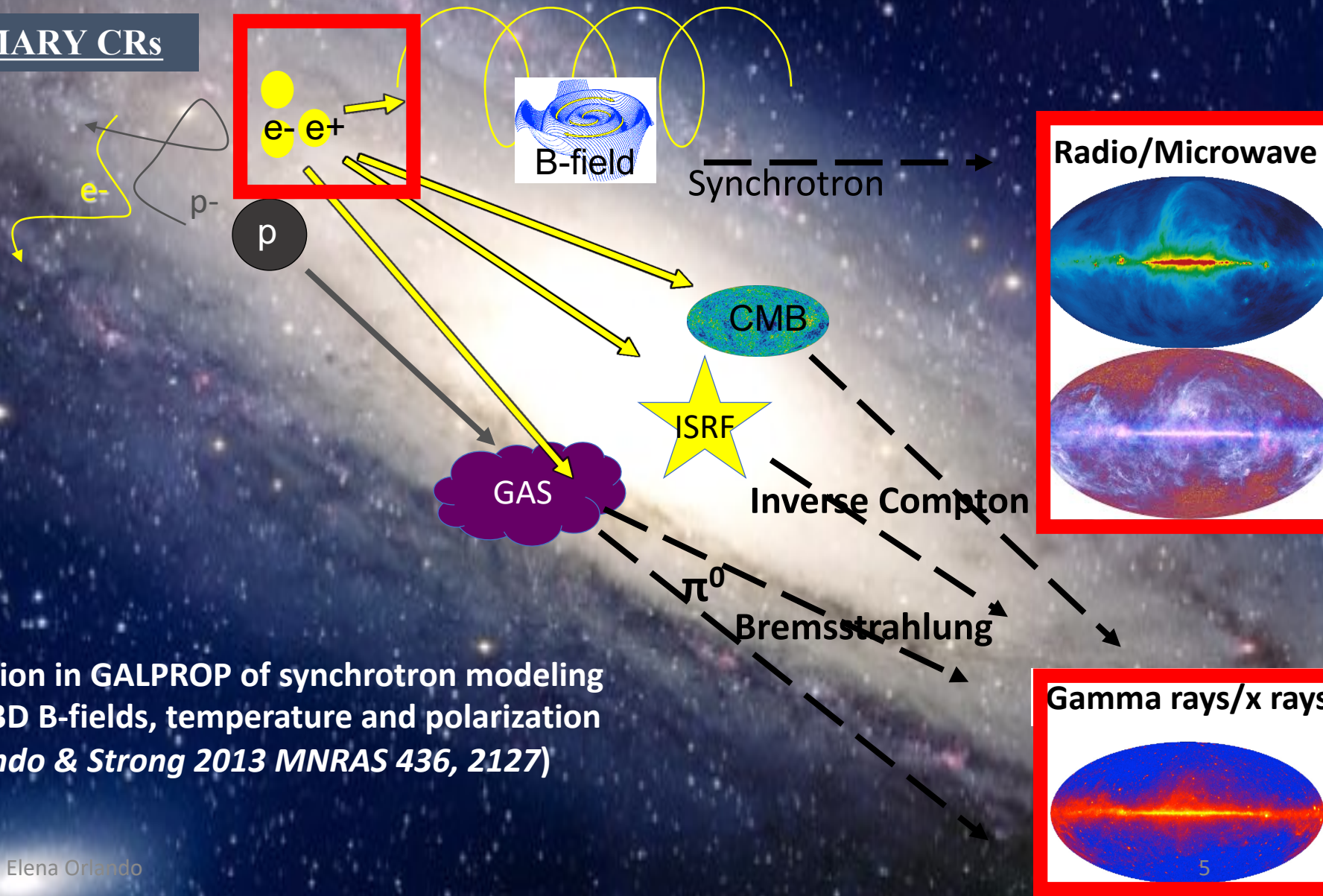
# Diffuse Interstellar Emission

PRIMARY CRs



# Diffuse Interstellar Emission

**PRIMARY CRs**

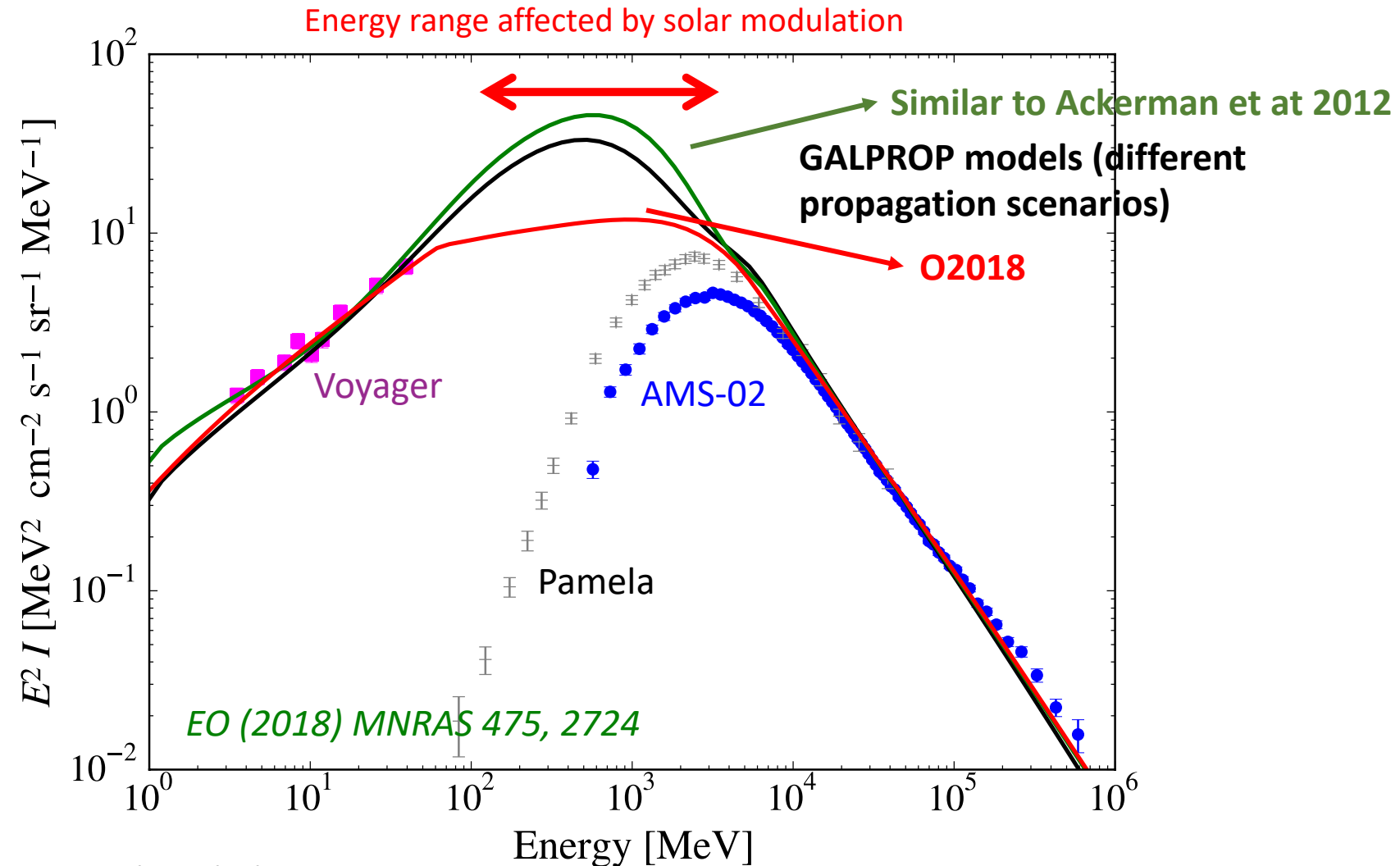


Inclusion in GALPROP of synchrotron modeling with 3D B-fields, temperature and polarization (Orlando & Strong 2013 MNRAS 436, 2127)

Results:

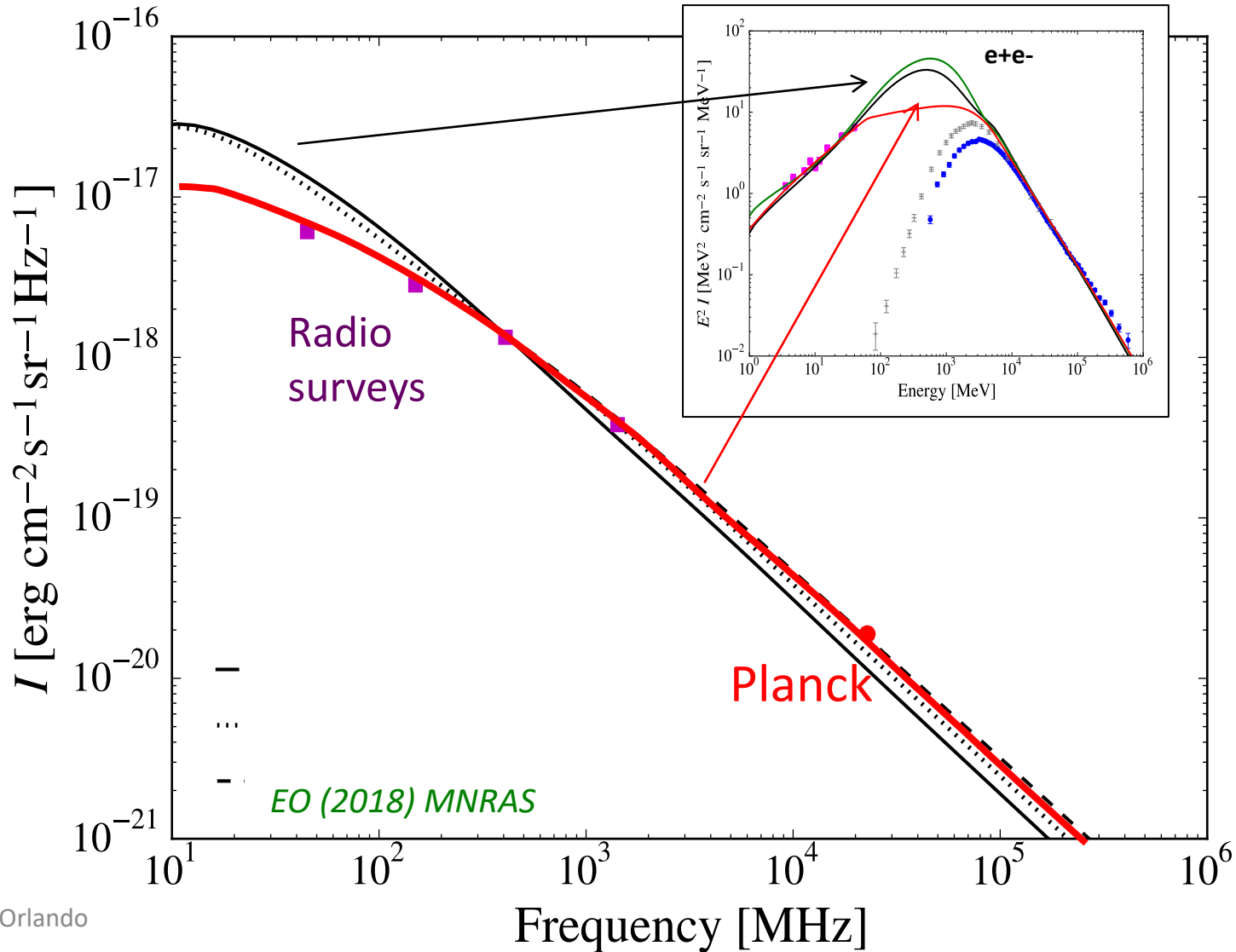
Spectral Effects on the Interstellar Models

# Results: Local Interstellar $e^+e^-$ & Propagation Scenarios



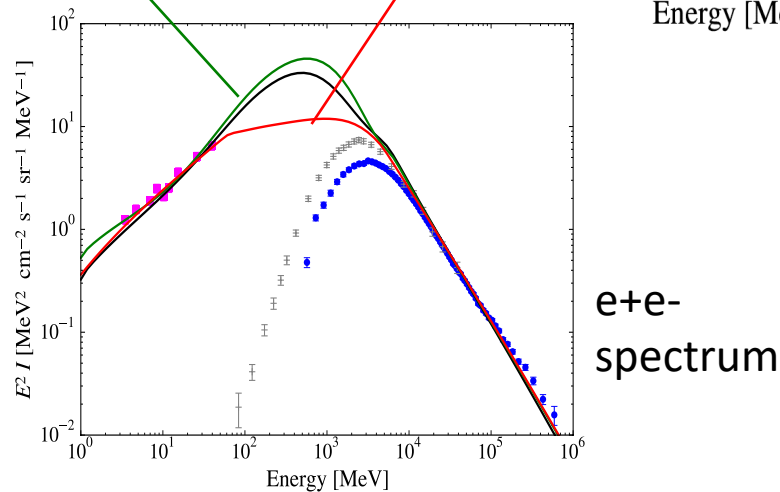
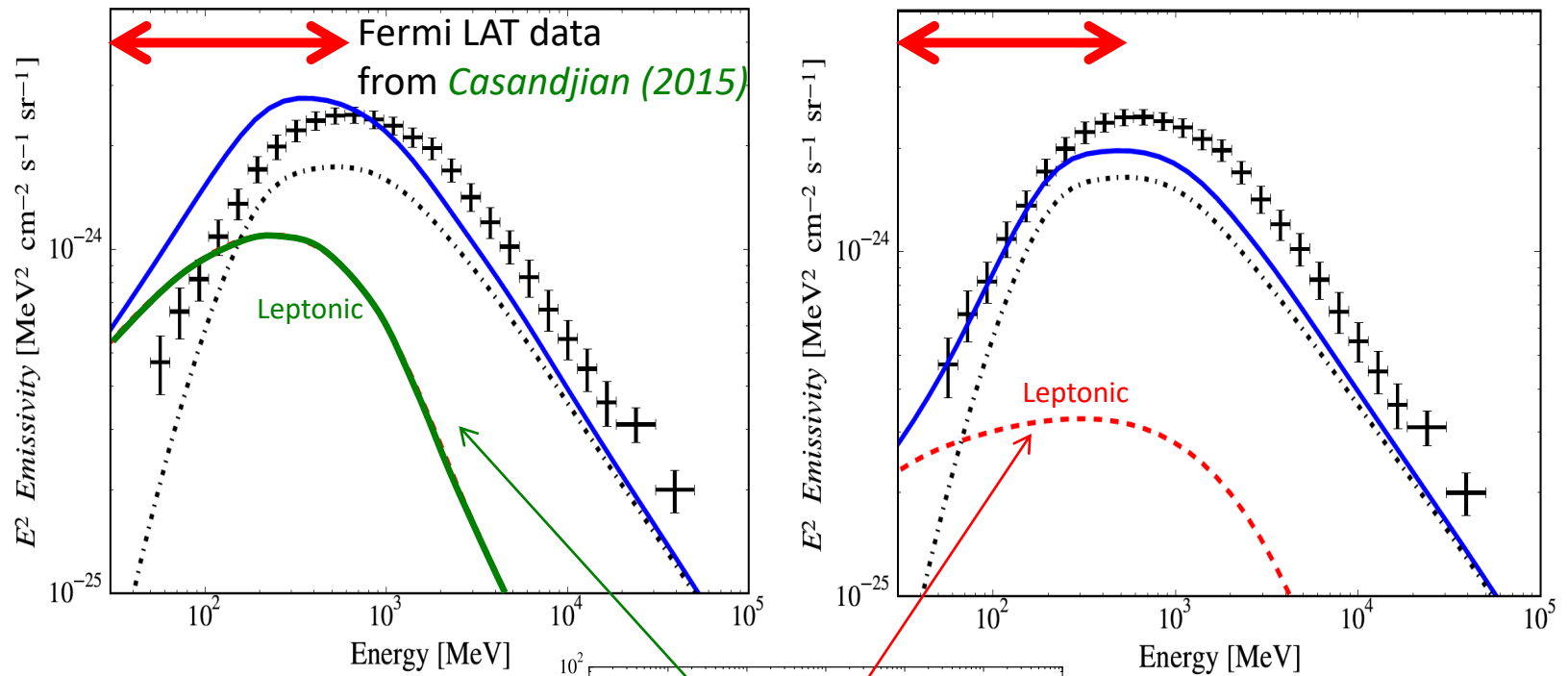
# Synchrotron Spectrum

CR & B-field intensity and data updated with respect to previous works by *Strong, Orlando and Jaffe (2011) A&A* and *Orlando & Strong (2013) MNRAS*.



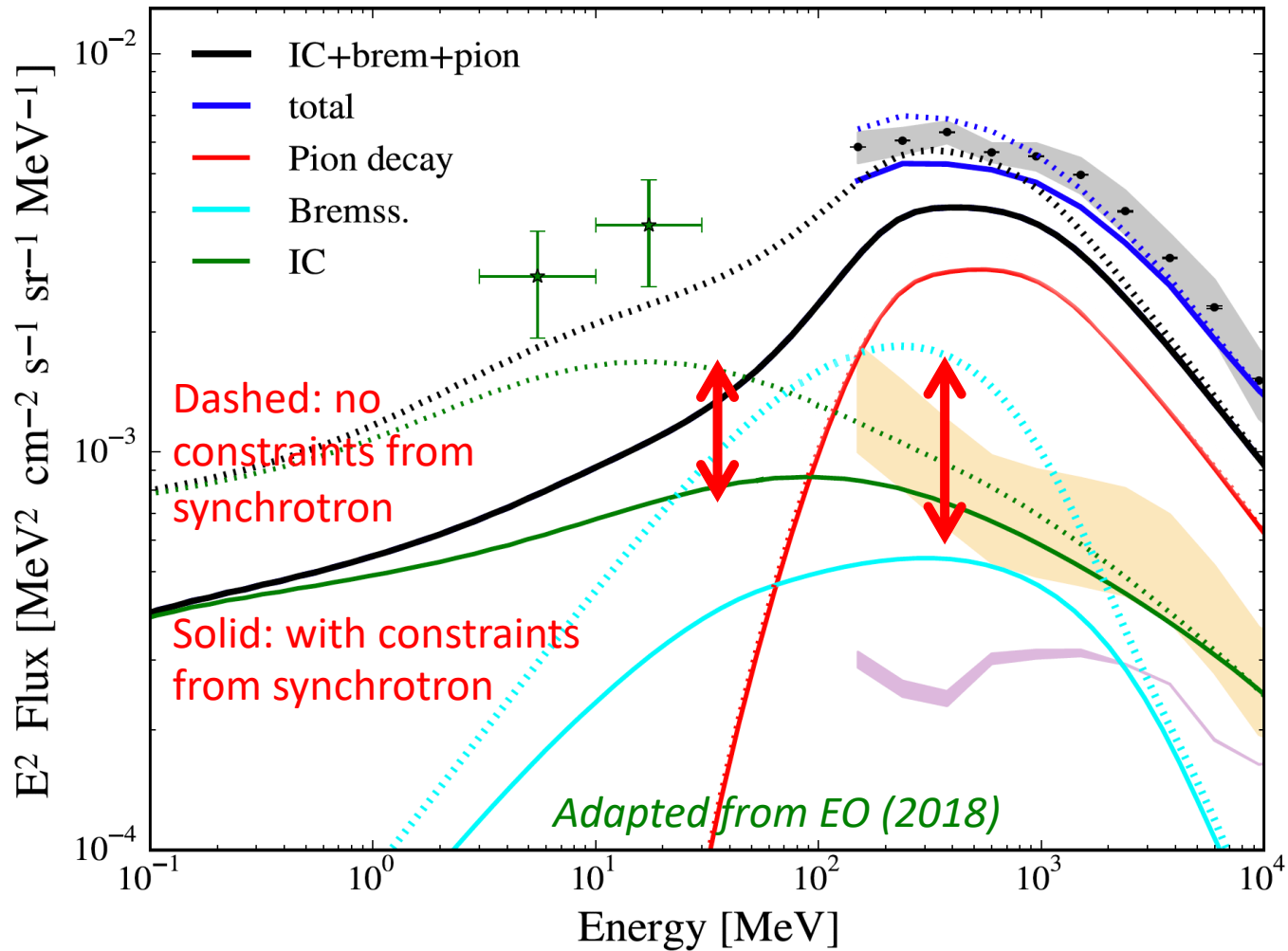


# Local HI Gamma-Ray Emissivity



*EO (2018) MNRAS*

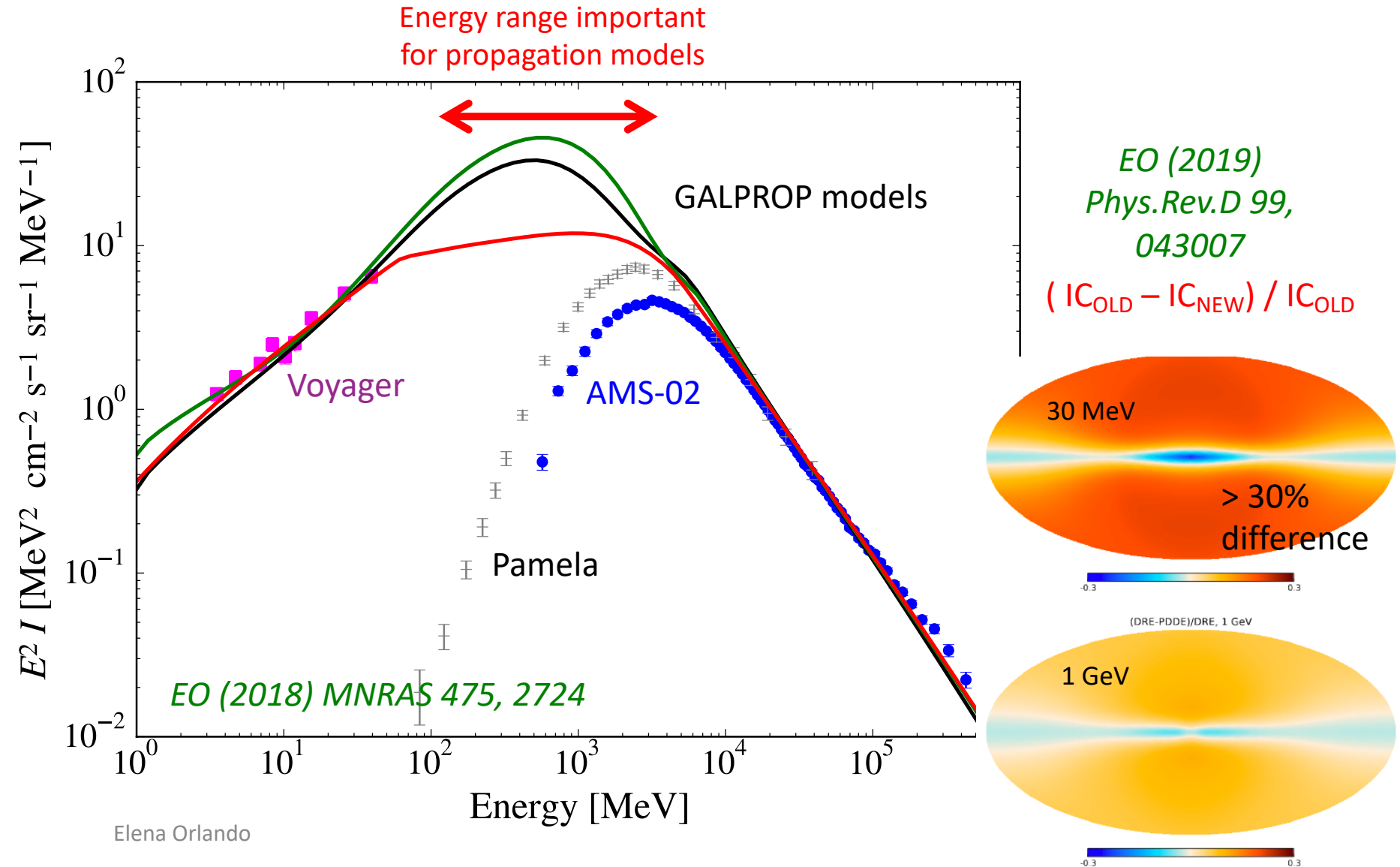
# Gamma at Intermediate Latitudes



Results:

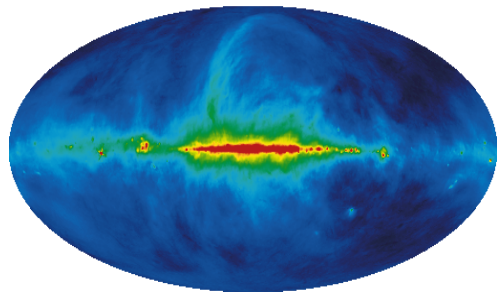
Spatial Effects on the Inverse-Compton Templates

# Results: Effect on Inverse Compton (IC)

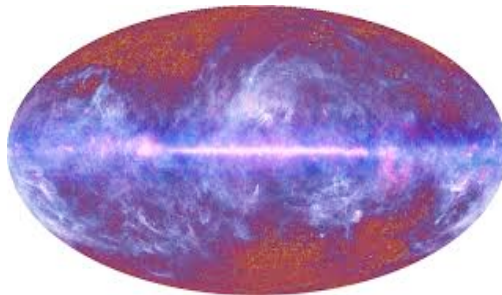


# Results: Cosmic Rays & B-fields

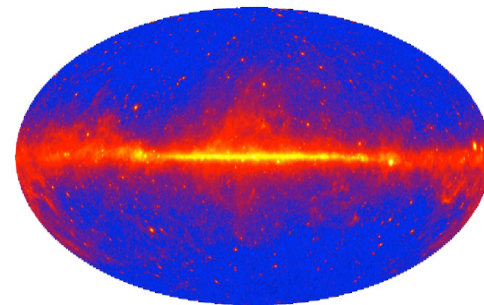
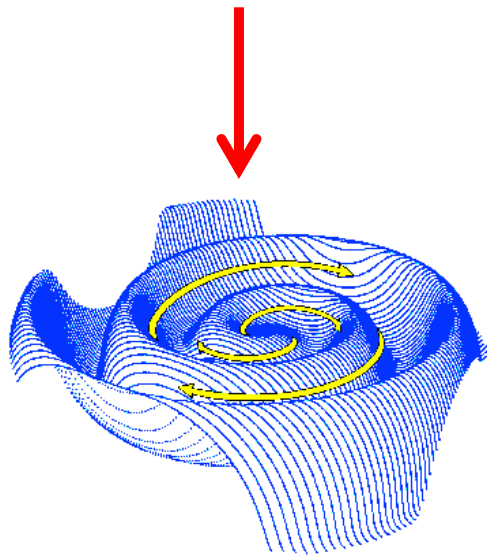
*EO (2019) Phys.Rev.D 99, 043007*



Radio surveys



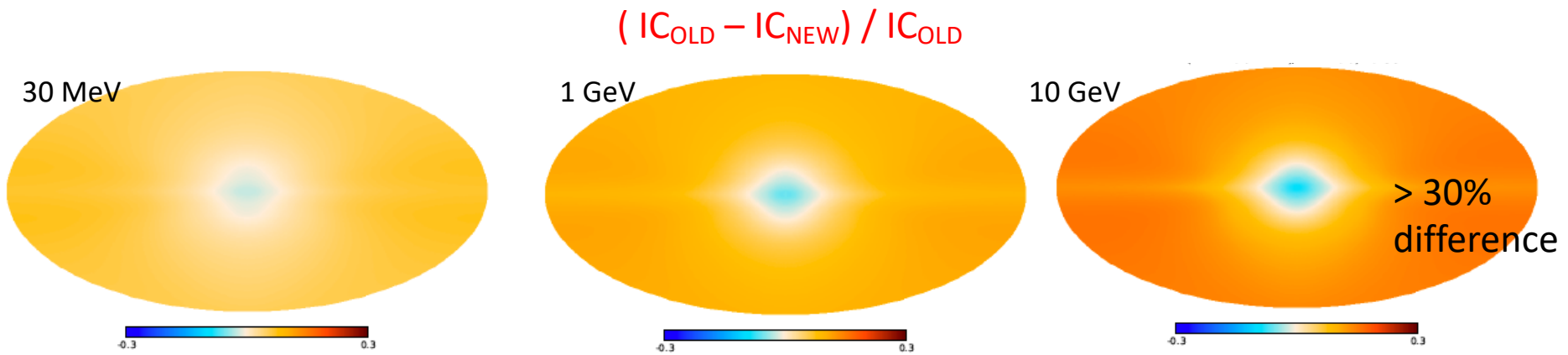
Planck - microwaves



Fermi LAT – gamma rays

# Results: Effect on Inverse Compton (IC)

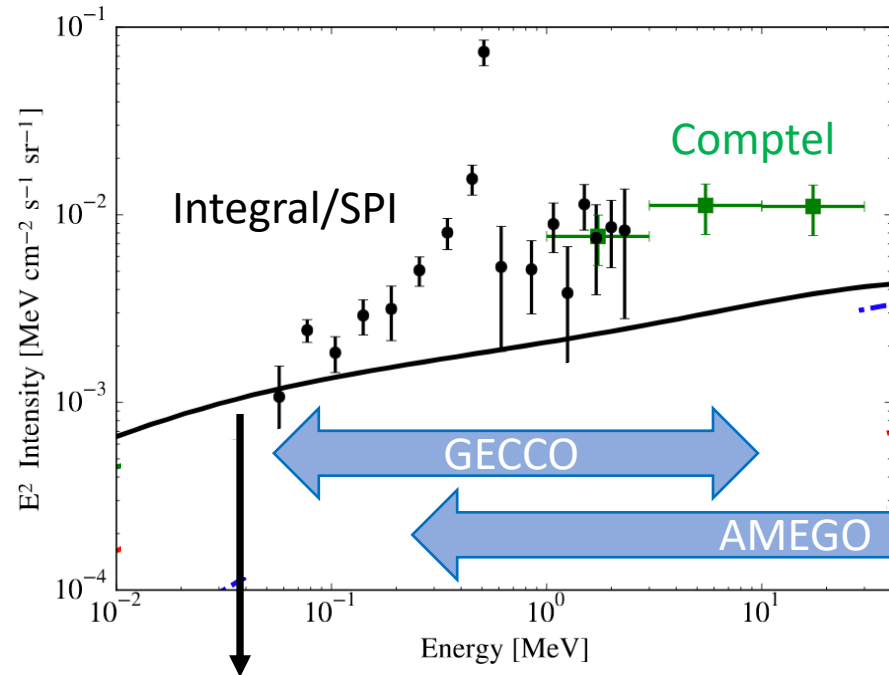
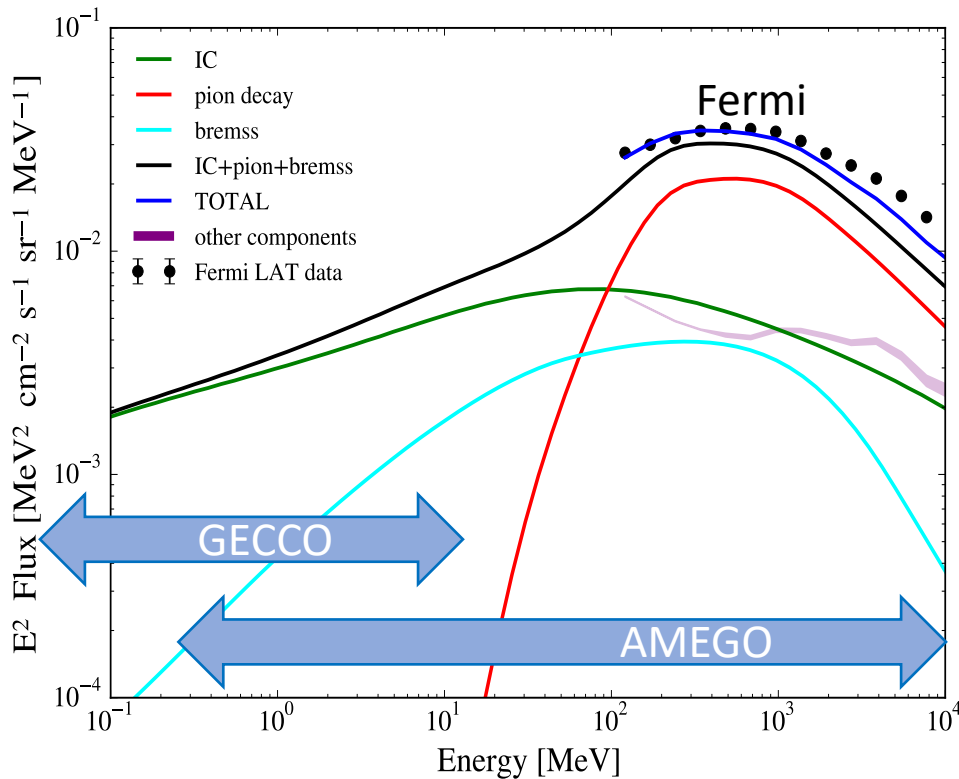
*EO (2019) Phys.Rev.D 99, 043007*



**Updated B-fields** produce a more peaked IC in the inner Galaxy than predicted by standard models and the difference increases with energy

# Gamma-Ray Predictions at MeV (MeV excess!)

Inner Galaxy



A factor of 3 lower than current data from INTEGRAL and COMPTEL  
 -> evidence of contamination by sources (or dark matter...)

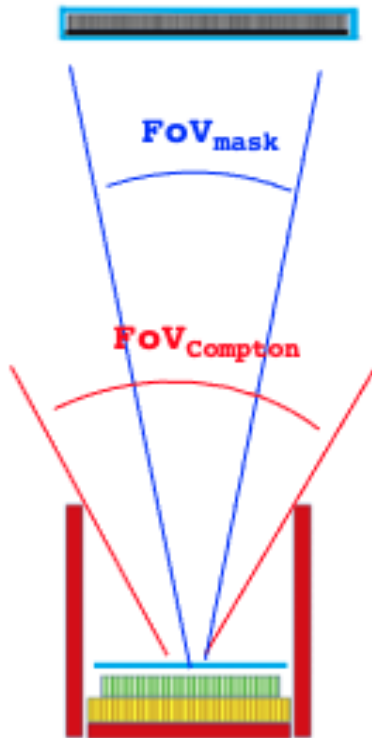
*EO (2018) MNRAS 475, 2724*

*EO (2019) Phys.Rev.D 99, 043007*

*EO et al. (2022) JCAP 7, 36 (GECCO paper)*

# GECCO

Coded Aperture Mask + Compton Telescope



**Energy Range:** 50 keV – 10 MeV

**Angular resolution:**

~arcmin in the Mask mode with 3°- 4° FoV;

3° - 5° in the Compton mode with a 60° FoV (~ 1 sr)

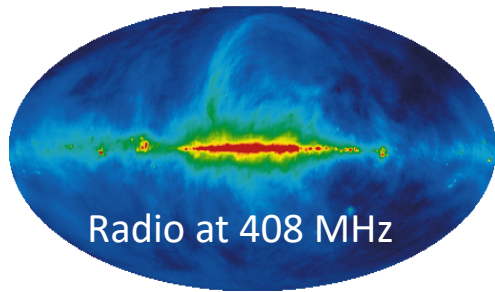
**Sensitivity:**  $10^{-4}$  -  $10^{-6}$  MeV cm<sup>-2</sup> s<sup>-1</sup> over the entire range

*Orlando, Bottacini, Moiseev et al. (2022) JCAP 7, 36*

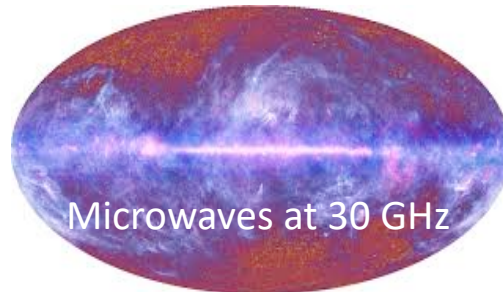
*GECCO PI: Alex Moiseev*



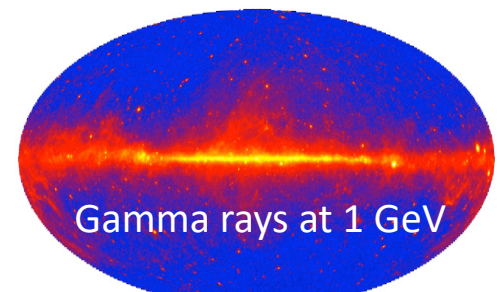
# Summary: Our Multimessenger Study



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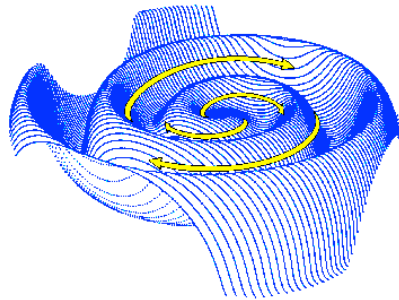
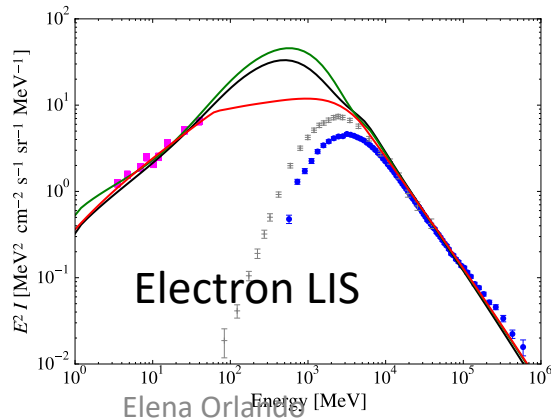
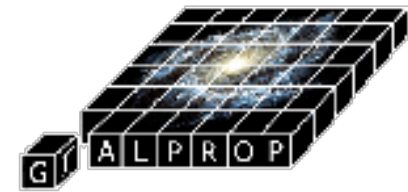
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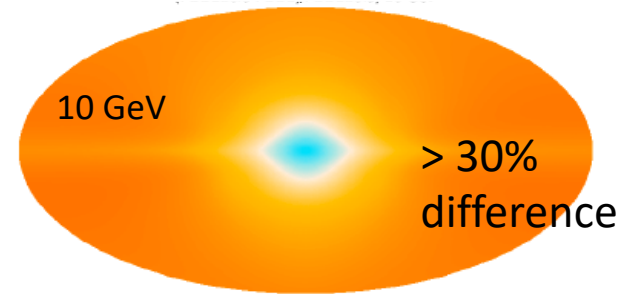
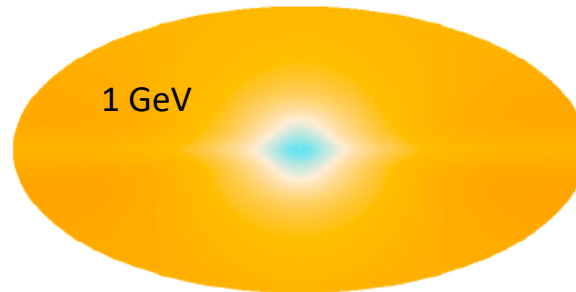
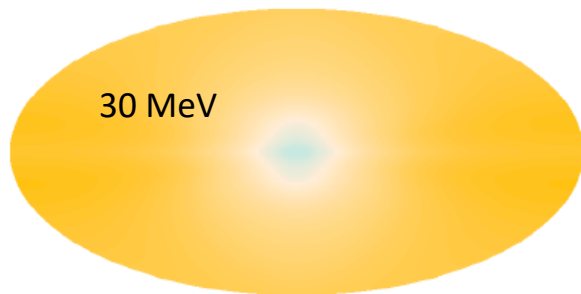
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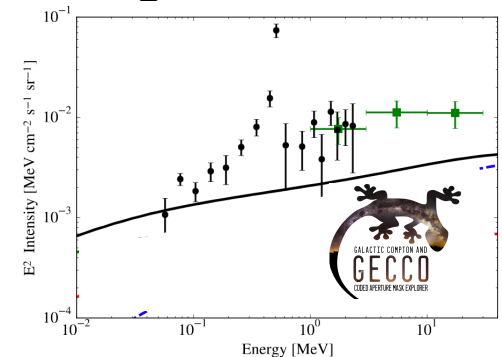
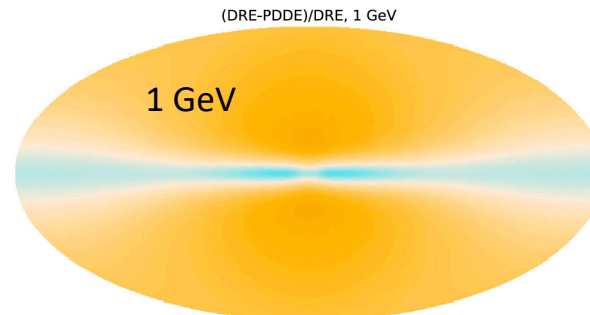
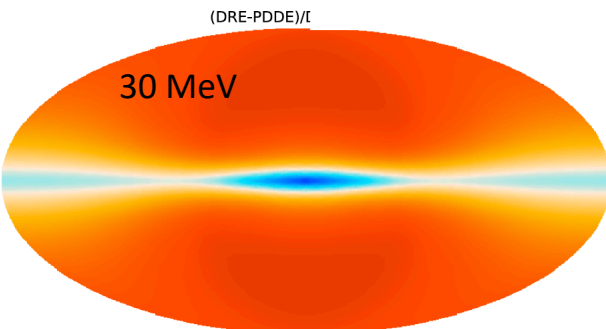
# Summary: Effects on the IC spatial templates

**Updated B-fields** produces a more peaked IC in the inner Galaxy than predicted by previous models for any photon field and gas model used and the difference increases with energy

$$(IC\ old - IC\ new) / IC\ old$$



**Alternative propagation scenarios** produce brighter IC in the plane than predicted by previous models for any photon field and gas model used



**THANK YOU FOR YOUR ATTENTION!**



back up

# GECCO

