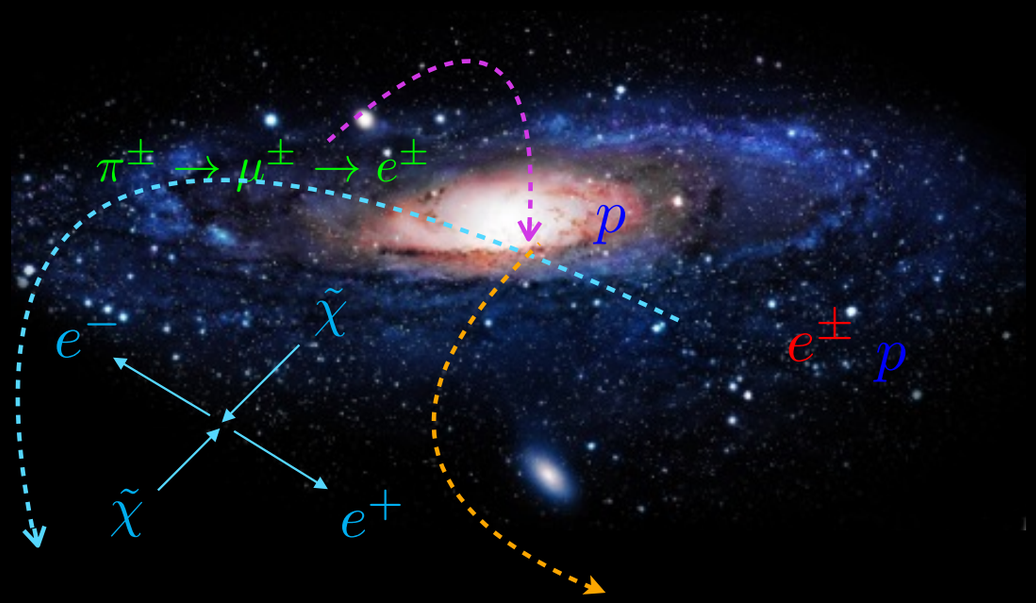
GIUSEPPE DI BERNARDO
DEPARTMENT OF PHYSICS,
UNIVERSITY OF GOTHENBURG, SWEDEN

COSMIC RAYS ELECTRONS AND GALACTIC SYNCHROTRON EMISSION



in collaboration with:

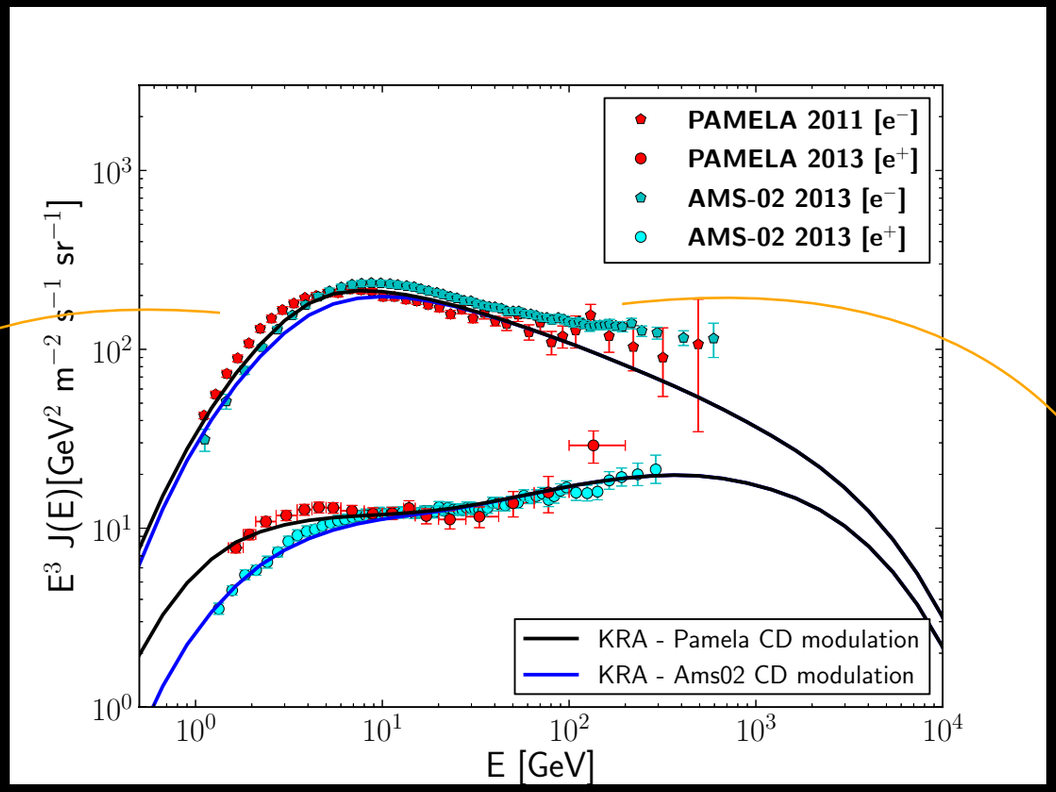
1. Evoli, C. (DESY, Hamburg)
2. Gaggero, D. (SISSA, Trieste)
3. Grasso, D. (INFN, Pisa)
4. Maccione, L. (MPI, Munich)

TeVPA/IDM CONFERENCE
AMSTERDAM, 23-28 JUNE, 2014

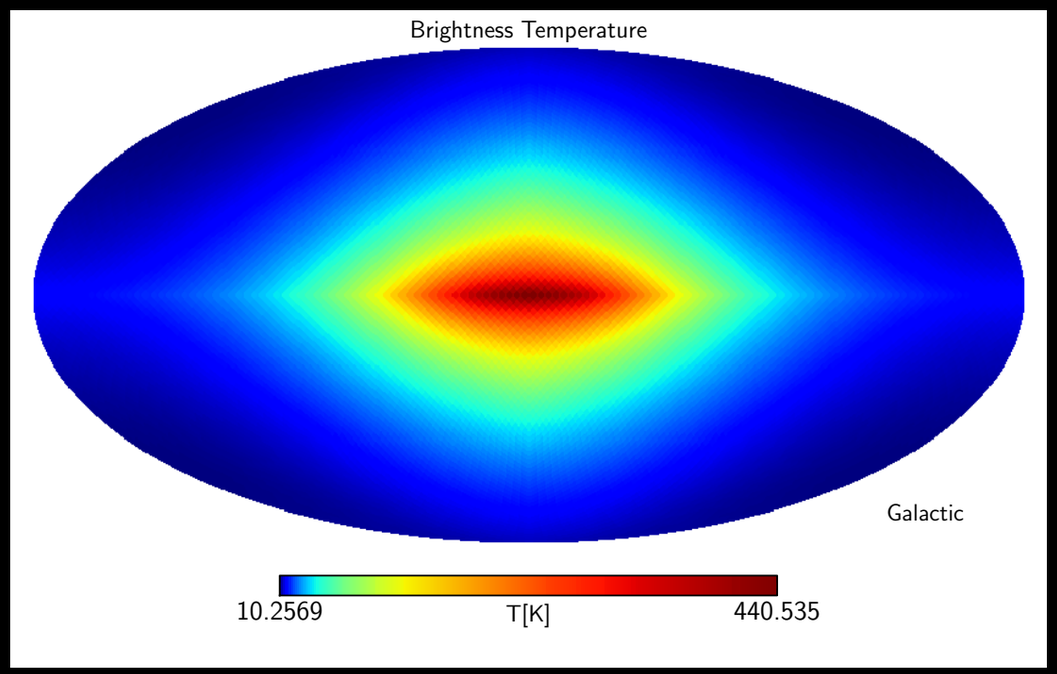
MOTIVATION

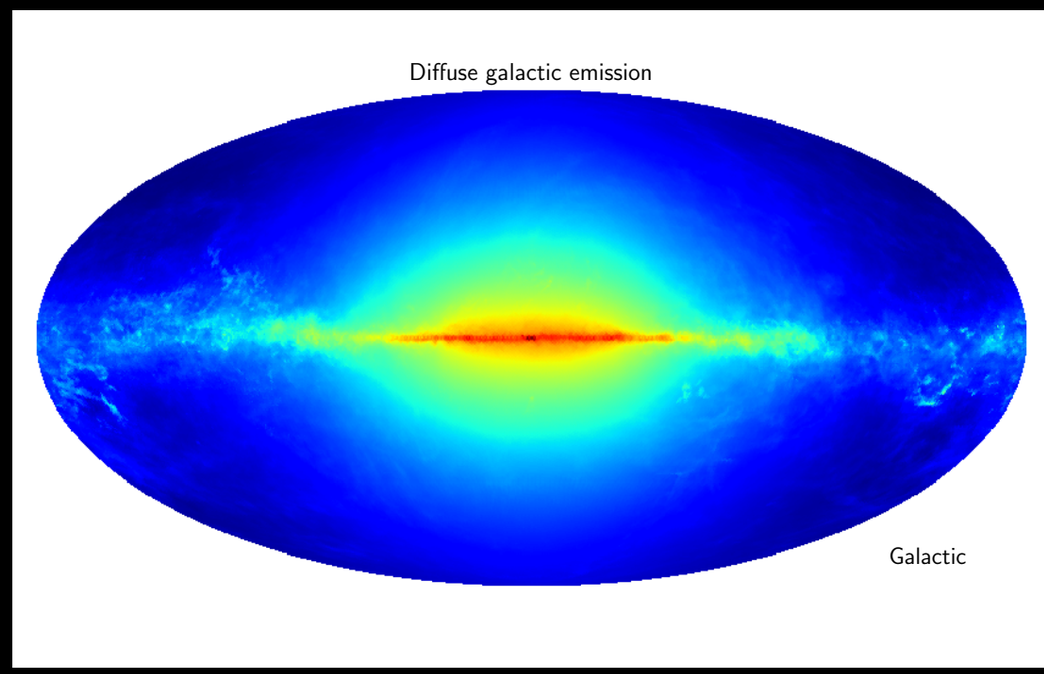
A MULTI-WAVELENGTH STUDY

Galactic Synchrotron Emission



Galactic Gamma Ray Diffuse Emission





DRAGON 3D simulations! for code's details, see D.Gaggero's talk

RELEVANT ISSUES

1.GALACTIC SYNCHROTRON EMISSION: WHAT WE HAVE LEARNED

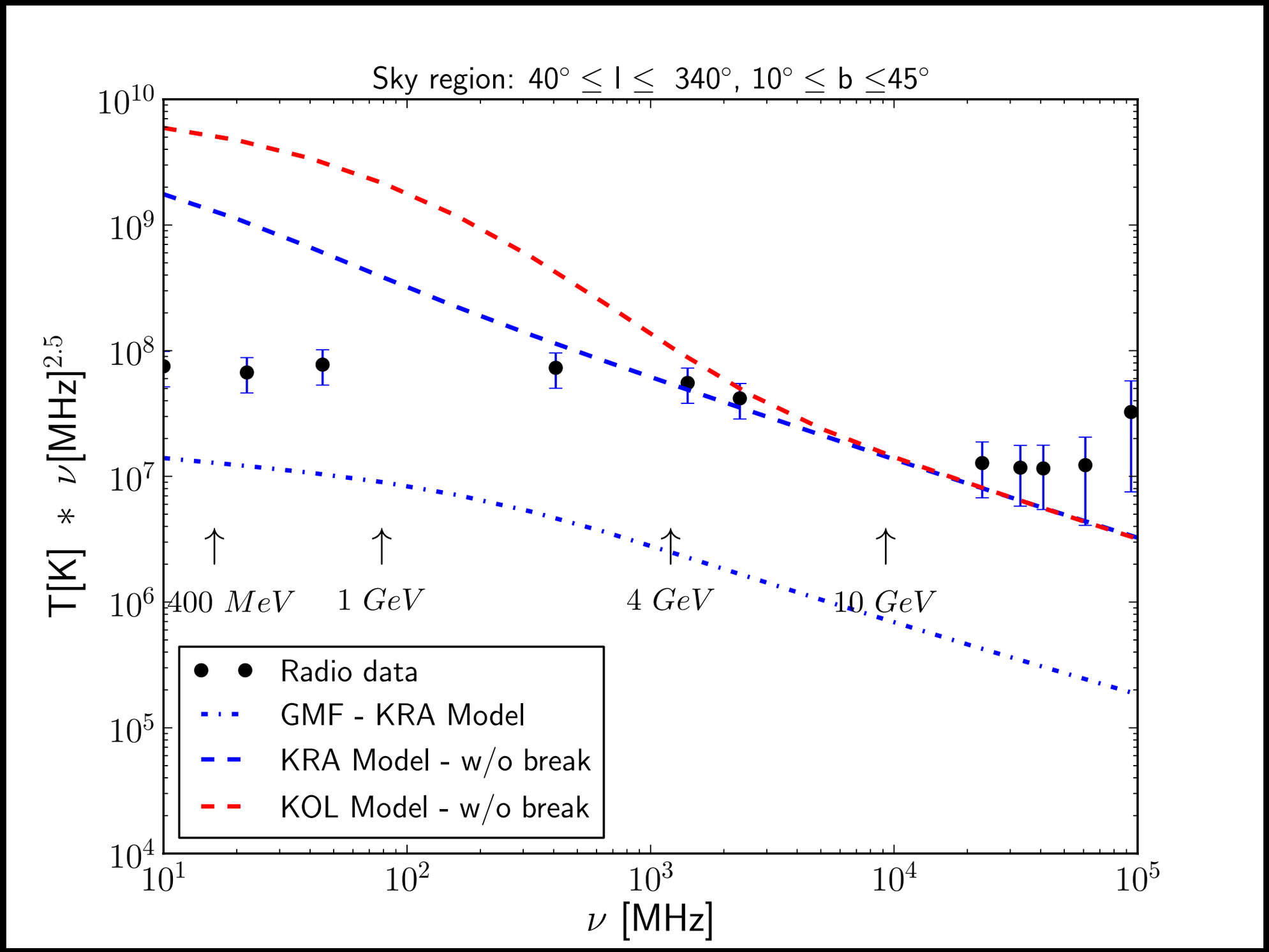
G.DI BERNARDO, C.EVOLI,D.GAGGERO,D.GRASSO,L.MACCIONE,
JCAP, 3 (2013)

GDB, C.EVOLI,D.GAGGERO,D.GRASSO,MACCIONE,
JCAP, 3 (2013)

THE SYNCHROTRON SPECTRUM

TO PROBE THE LOW ENERGY LIS OF

$e^- + e^+$



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JCAP, 3 (2013)

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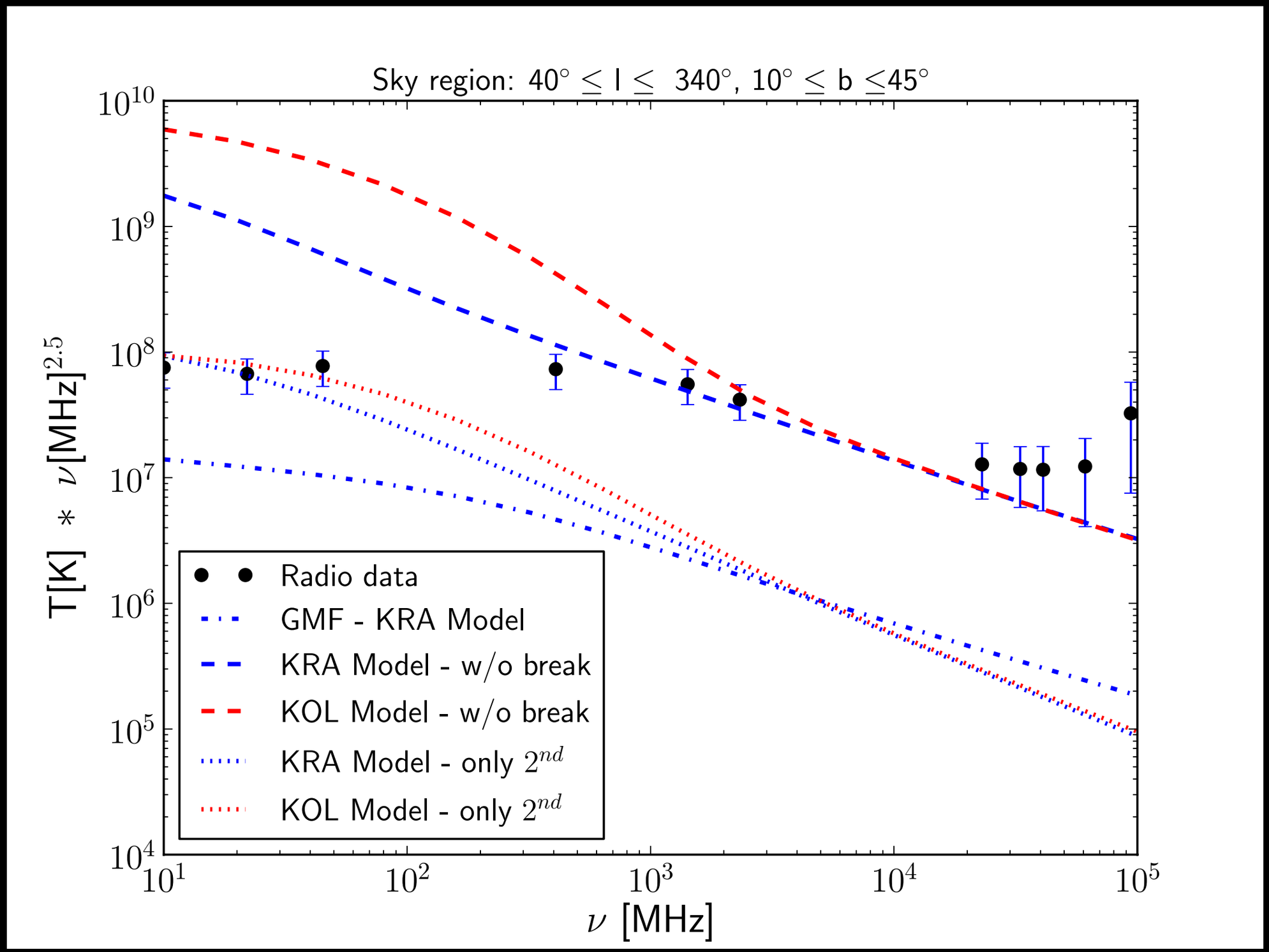

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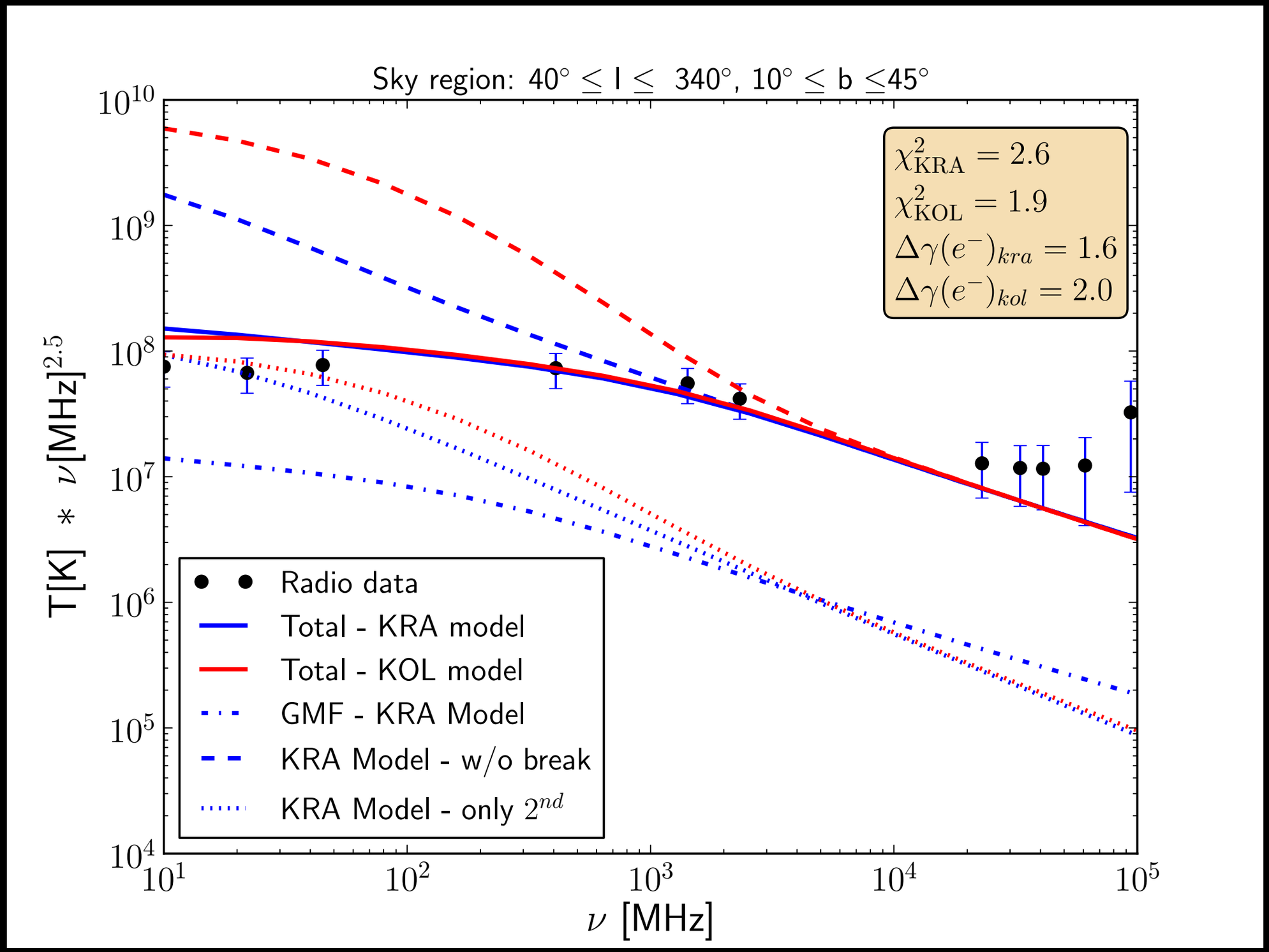


DRAGON 2D

2D MODE

(C.EVOLI,D.GAGGERO,D.GRASSO,L/MACCIONE, JCAP 2008)

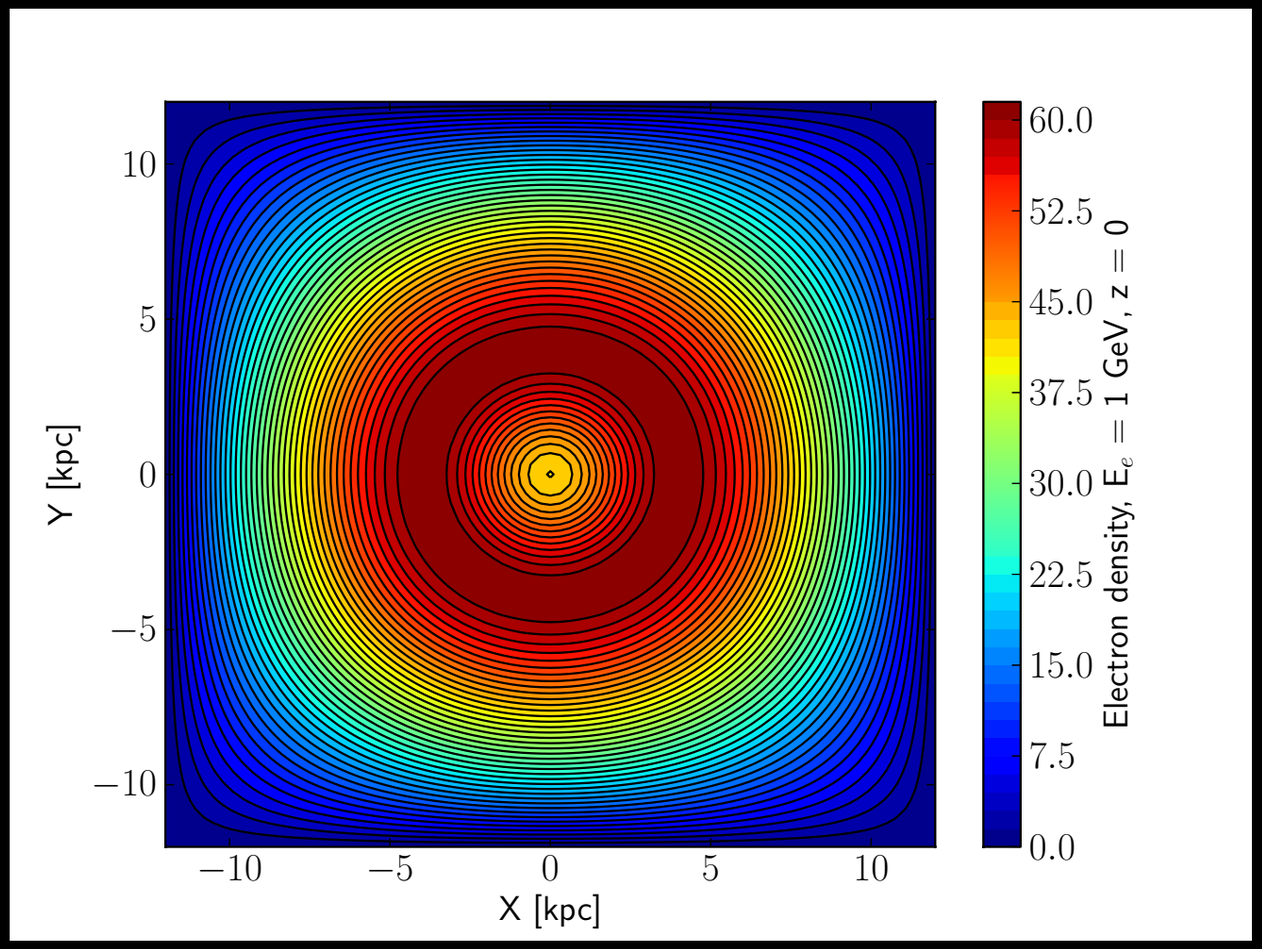
DRAGON 3D

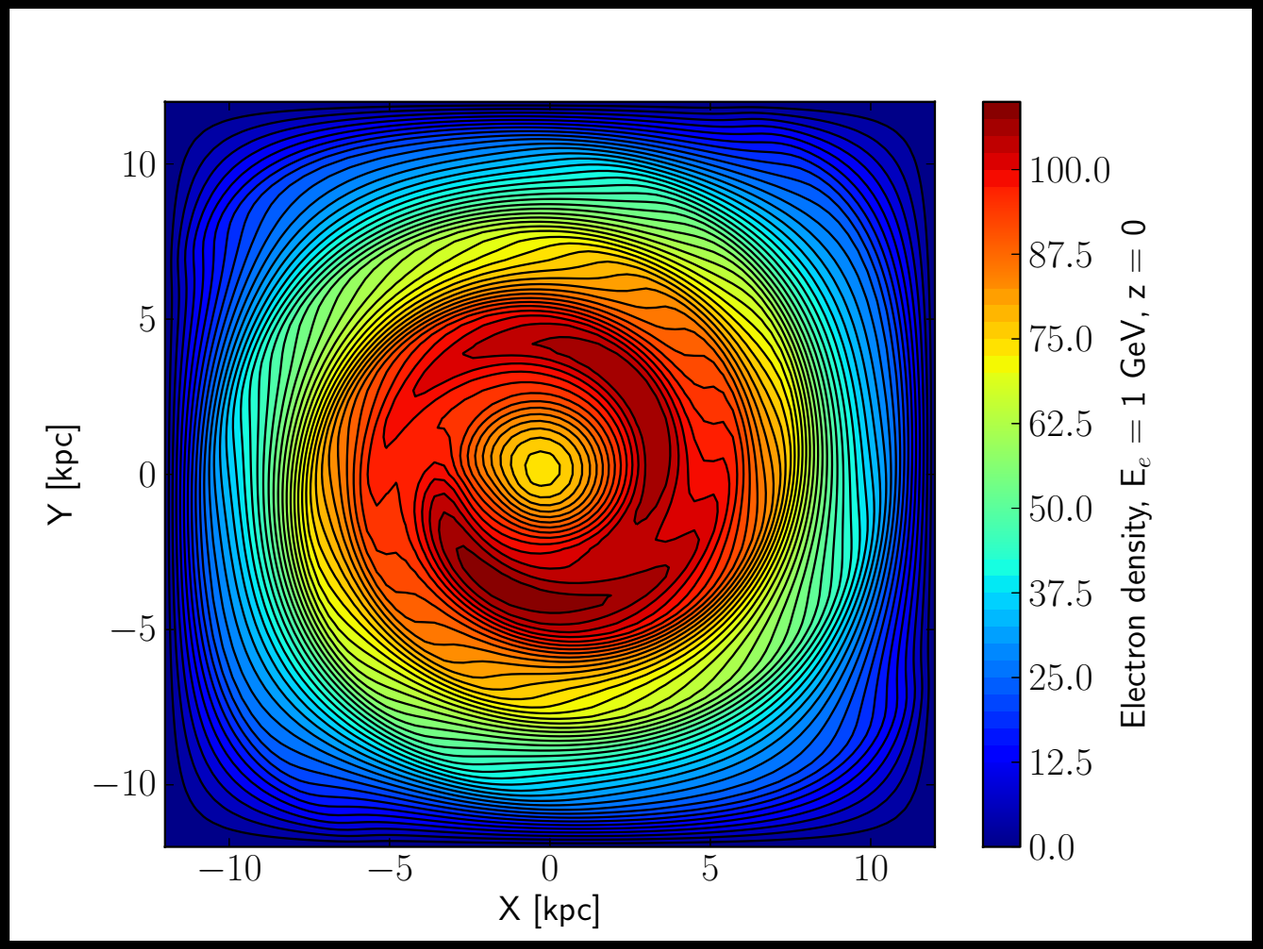
ISOTROPIC VERSION: SOURCES ARE IN THE SPIRAL ARMS

(GAGGERO,D.,MACCIONE,L., GDB, EVOLI,C., GRASSO,D. PHYSICAL REVIEW LETTERS, 111 (2013))

SEE ALSO BLASI & AMATO, JCAP I&II (2012)

@ 1 GeV





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(EVOLI,GAGGERO,GRASSO,MACCIONE, JCAP 2008)

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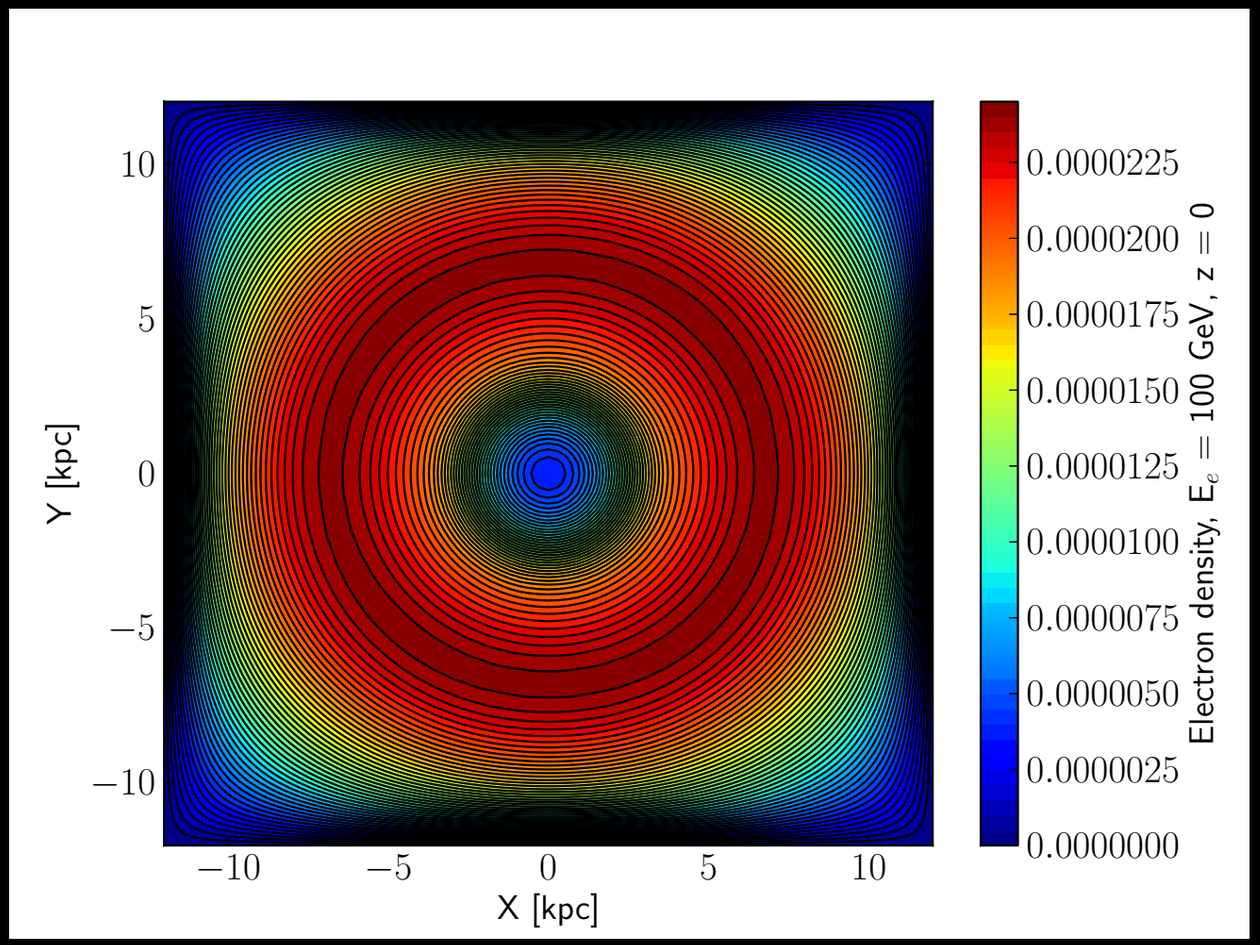
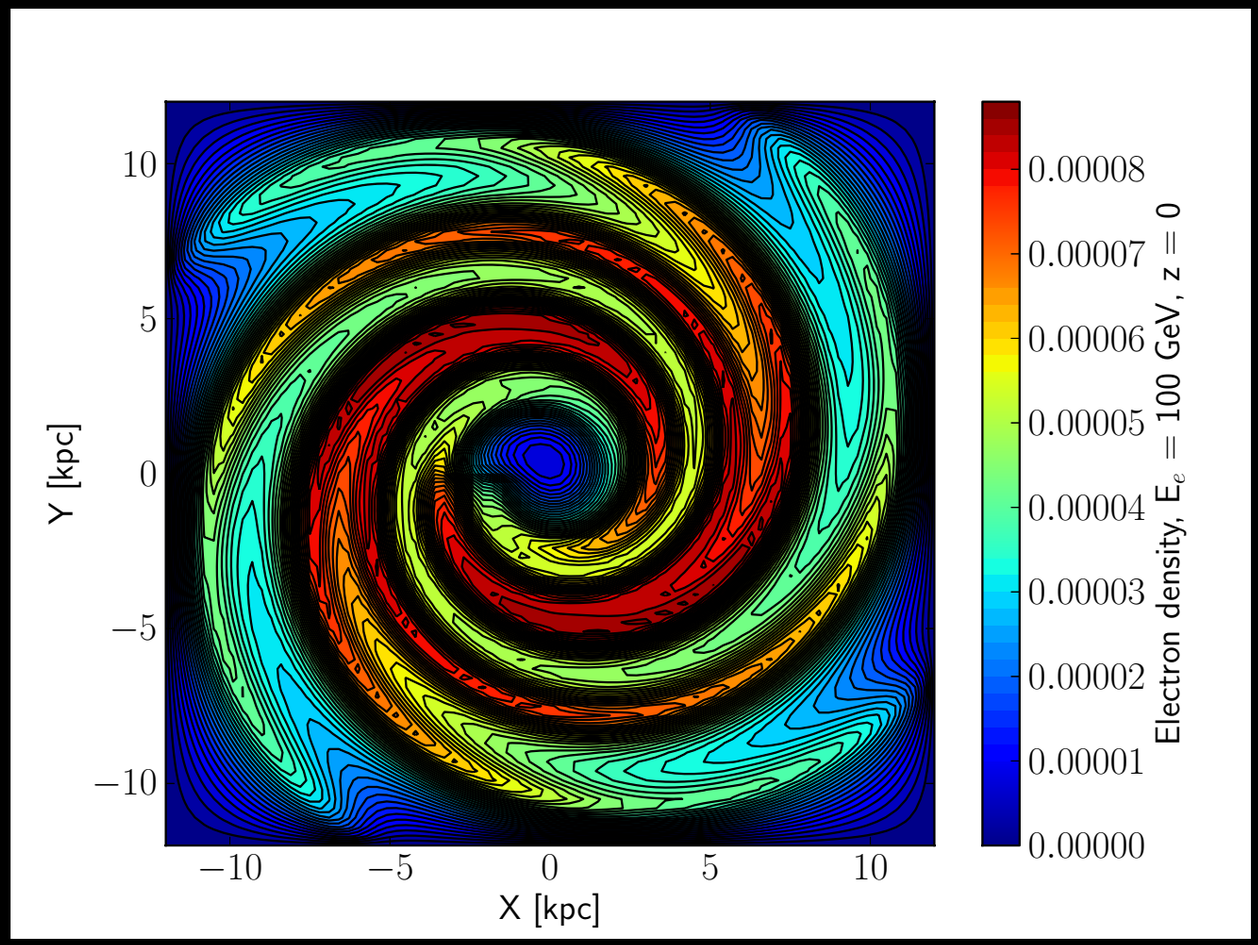
@ 100 GeV





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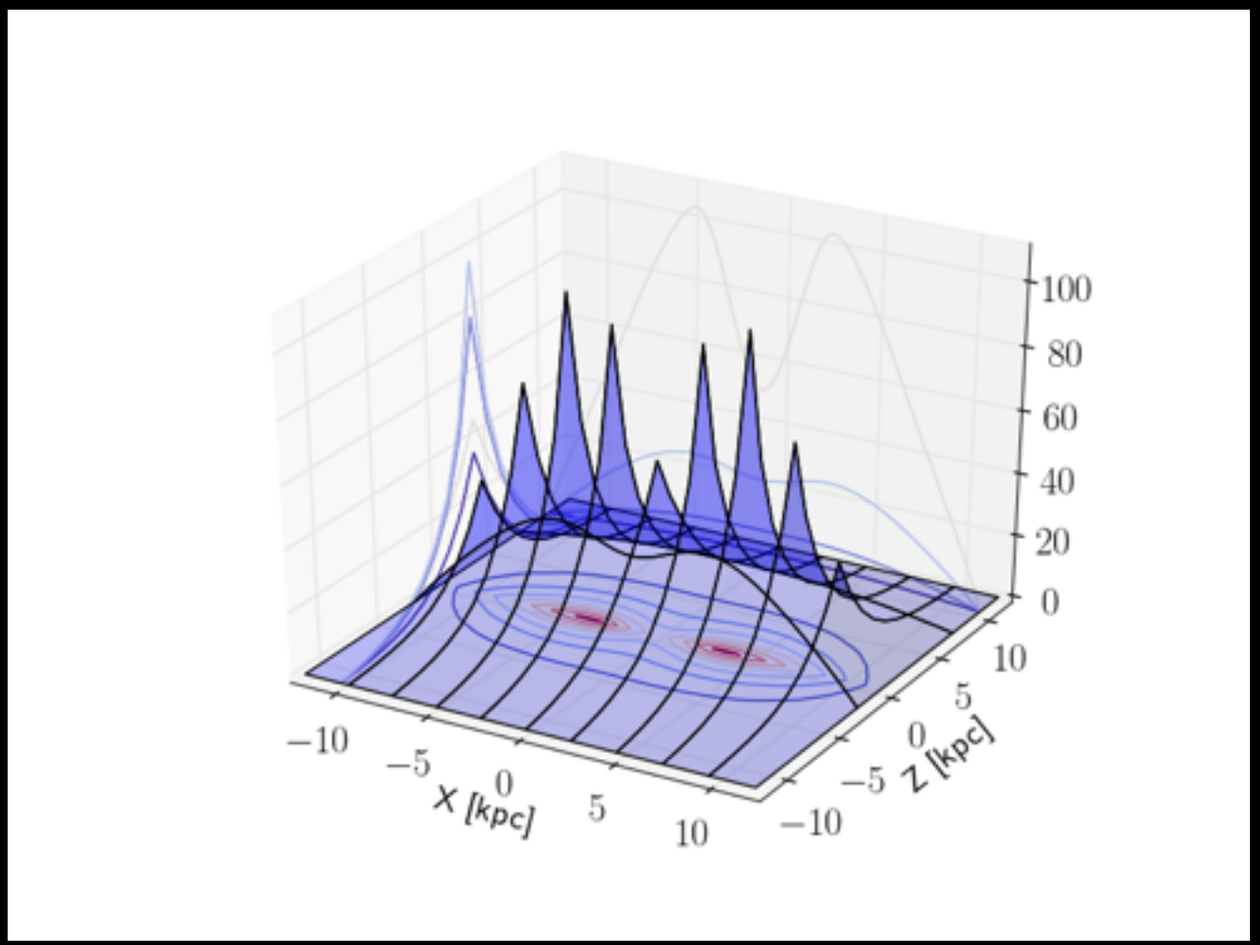

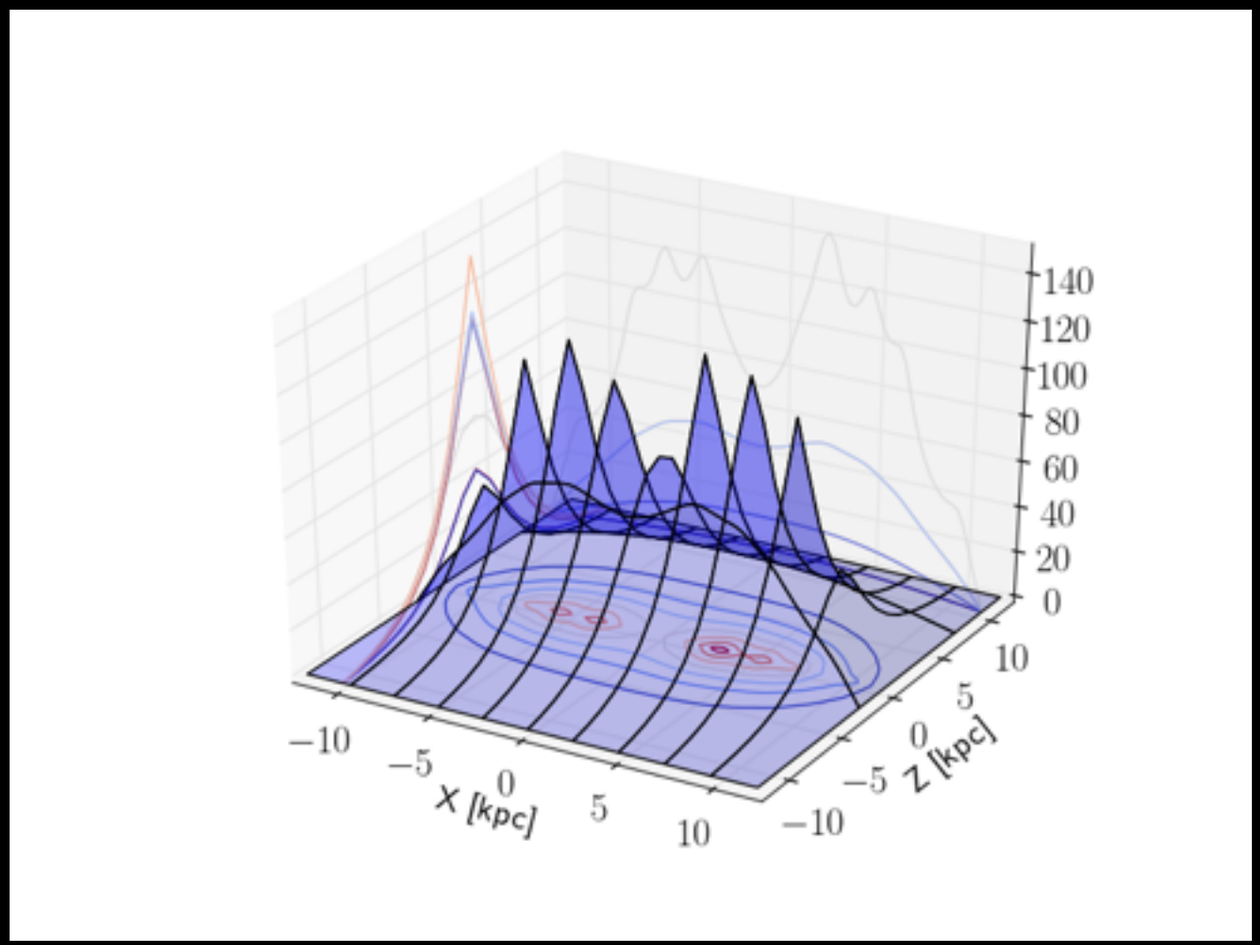

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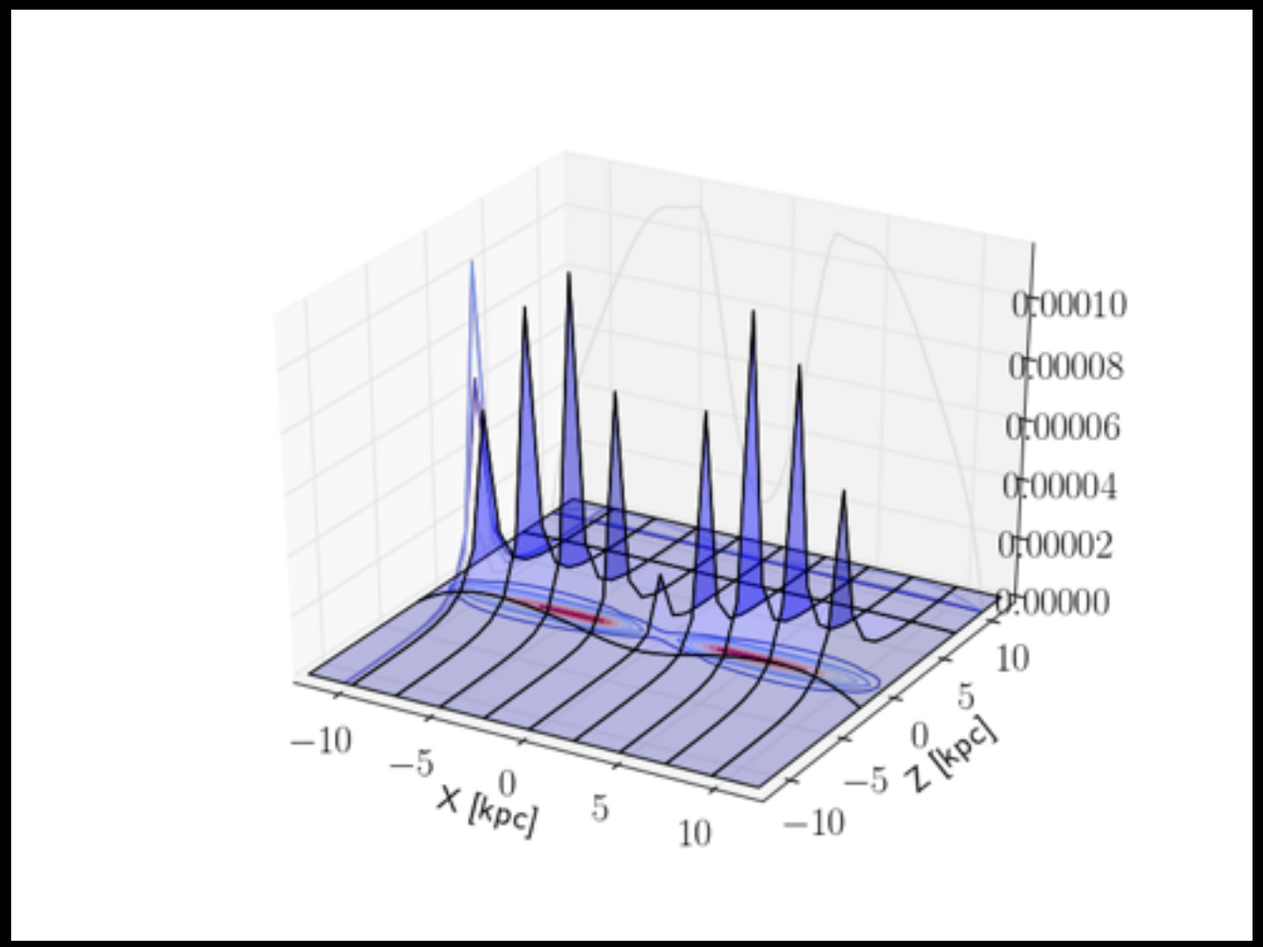
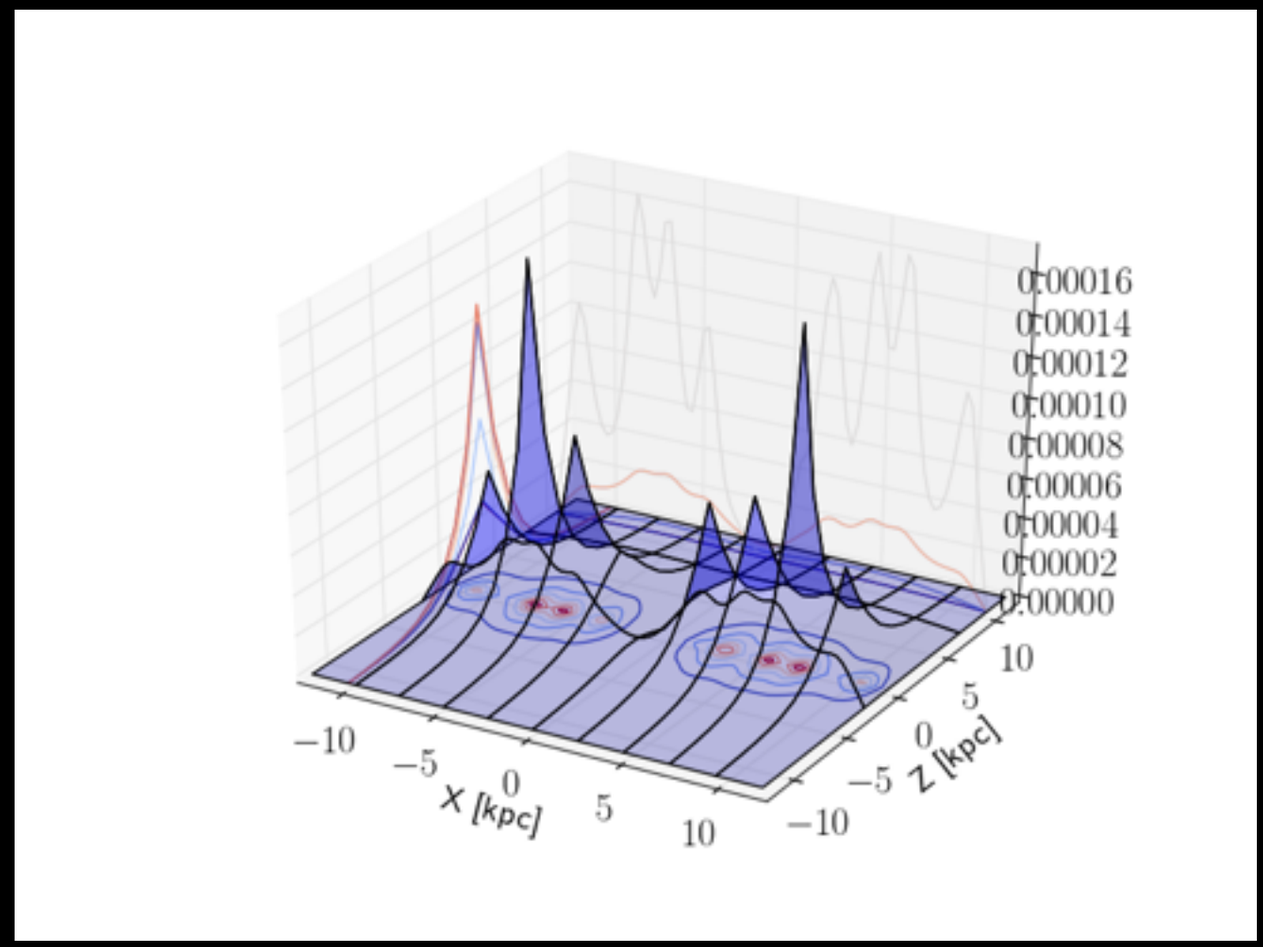




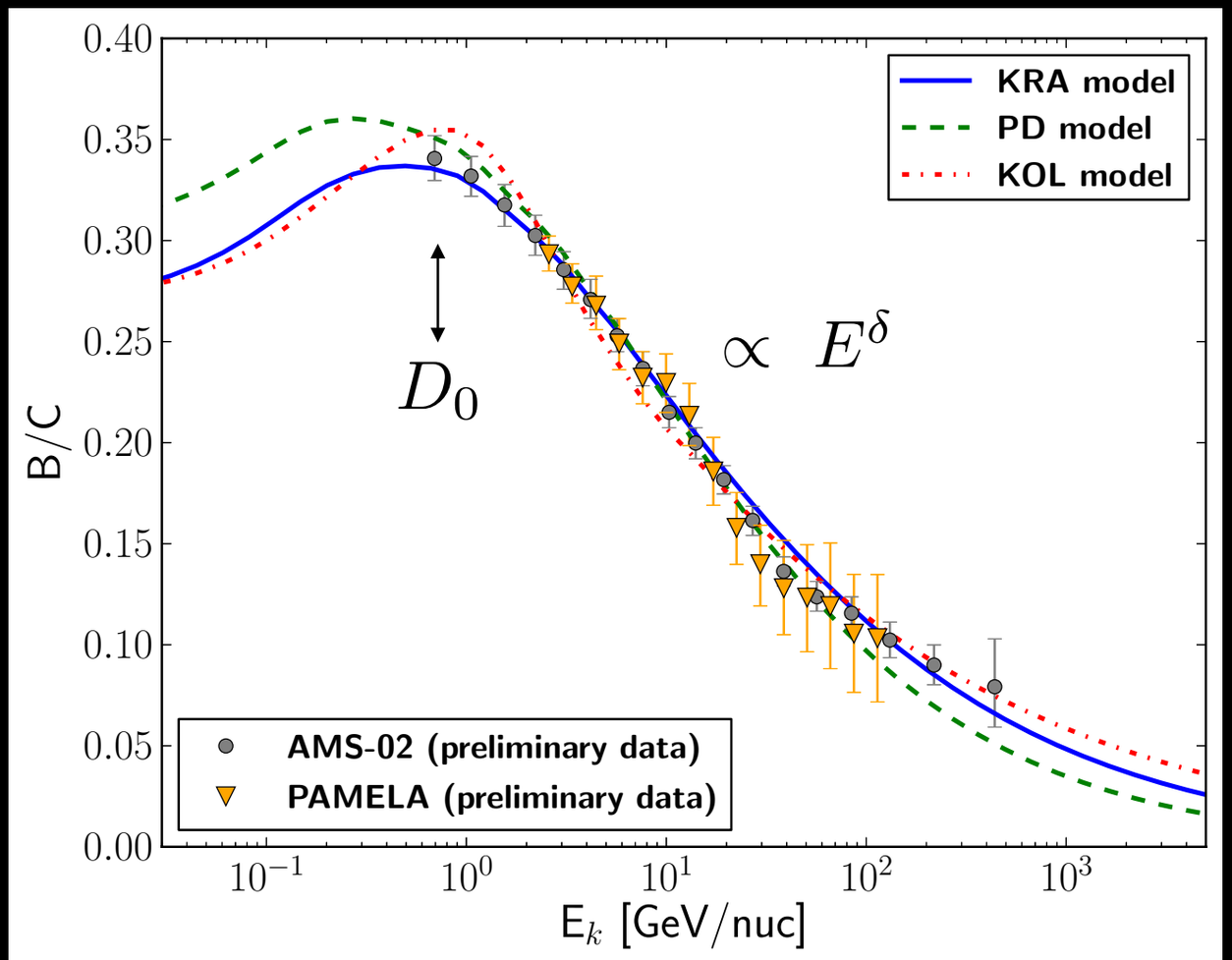
RELEVANT ISSUES

2.GALACTIC SYNCHROTRON EMISSION WITH 3D CRE PROPAGATION MODELS

THE NUCLEAR COSMIC RAYS

B/C AND THE PROTON SPECTRUM: THE MOST SUITABLE "LOCAL" OBSERVABLES TO TUNE FREE PARAMETERS

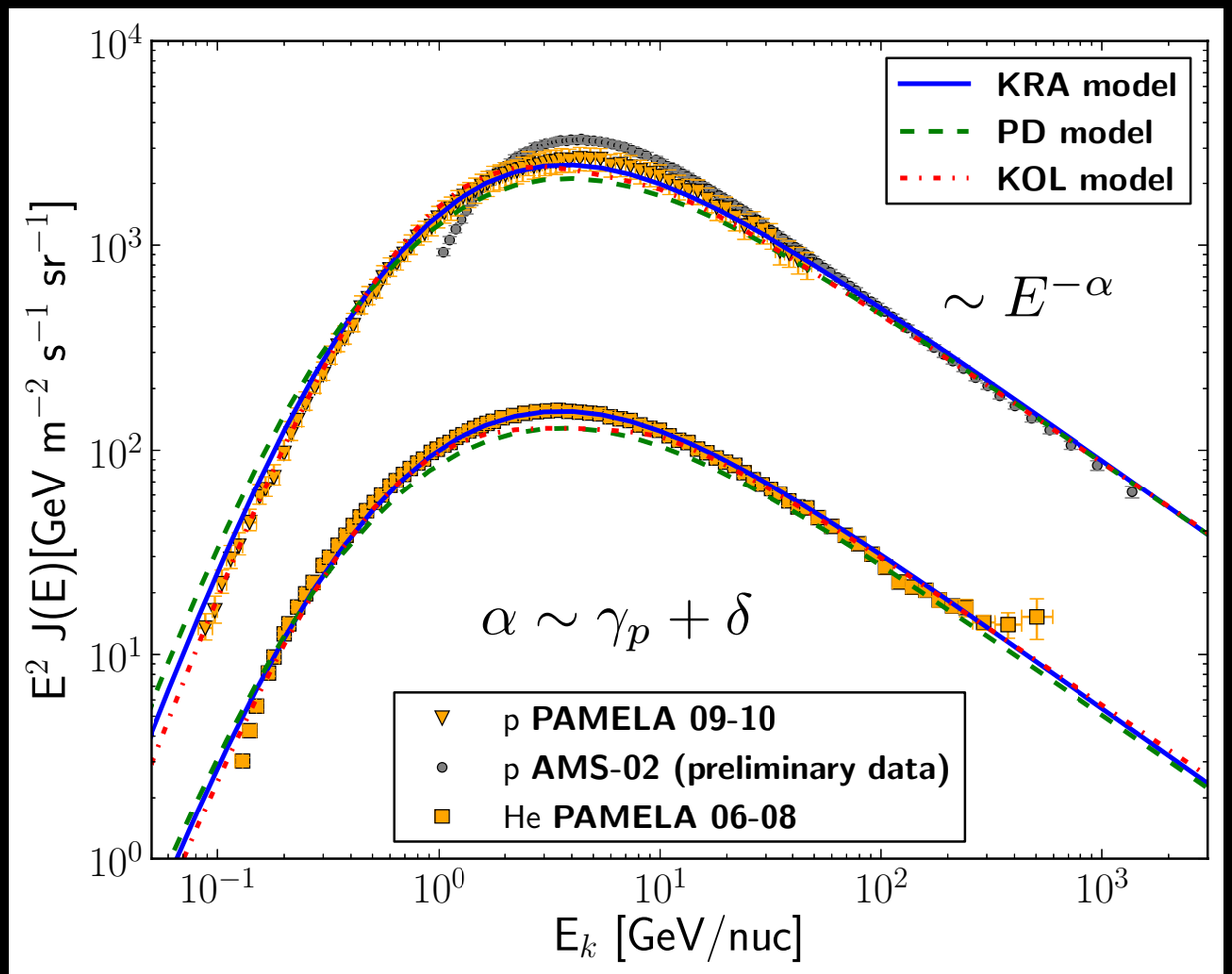
Different choices of δ, v_A ...



Waiting for the AMS-02 data!

(see C.Evoli's talk)

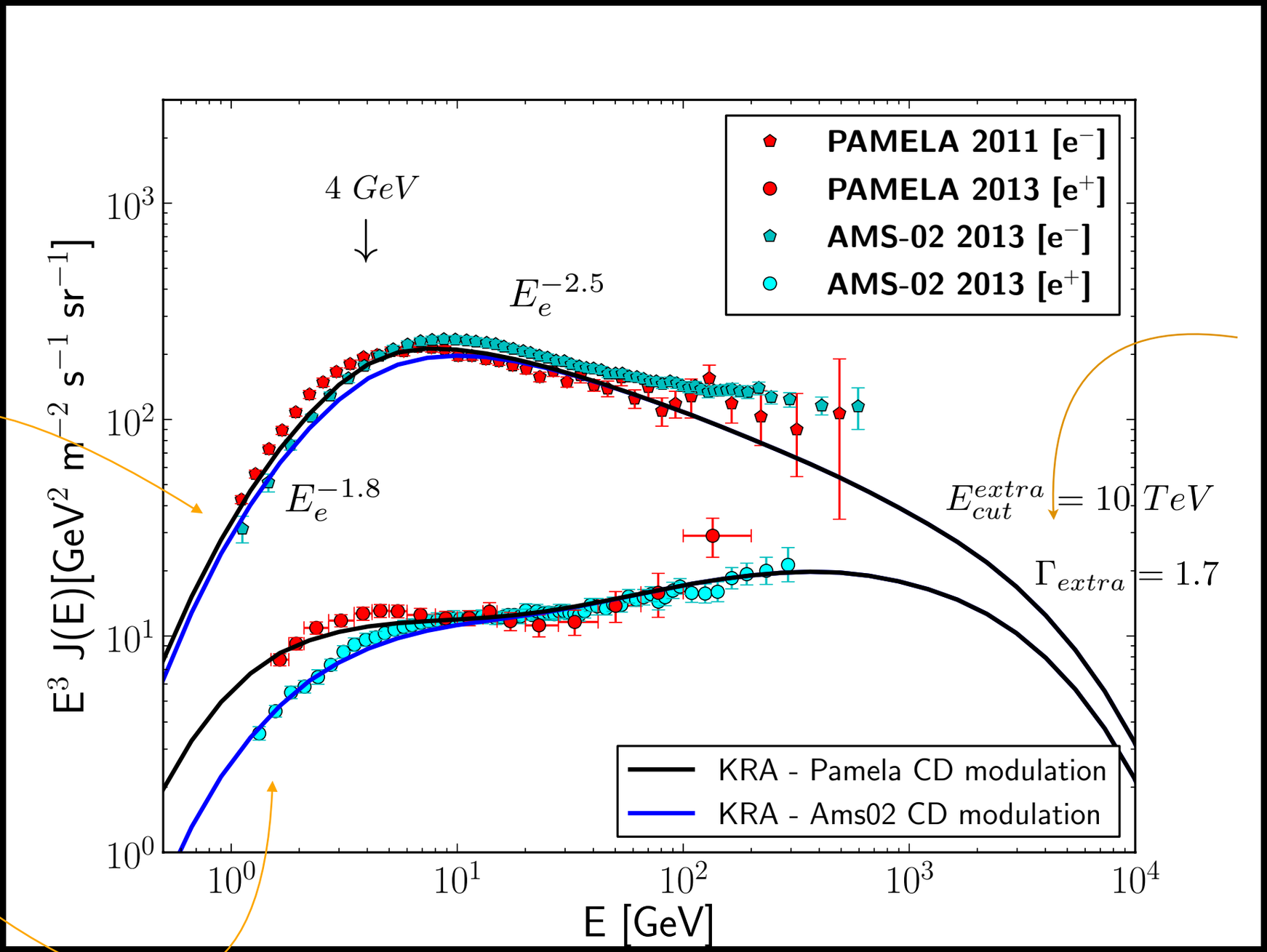
$z_t \in [1 \div 16]$ kpc



D.GAGGERO, L.MACCIONE, D.GRASSO, GDB, C.EVOLI PRD, (2014)

THE ELECTRON SPECTRUM

I.KRAICHNAN MHD TURBULENCE



Charge-Dependent Solar Modulation (L.MACCIONE, PRL, 2013)

One or few nearby accelerators of electrons and positrons? Dark Matter (maybe a nearby clump)?

(please, see also D.Grasso's talk)

$$N_{extra} \propto E^{-\Gamma_{extra}} \exp(-E/E_{cut})$$

THE ELECTRON SPECTRUM

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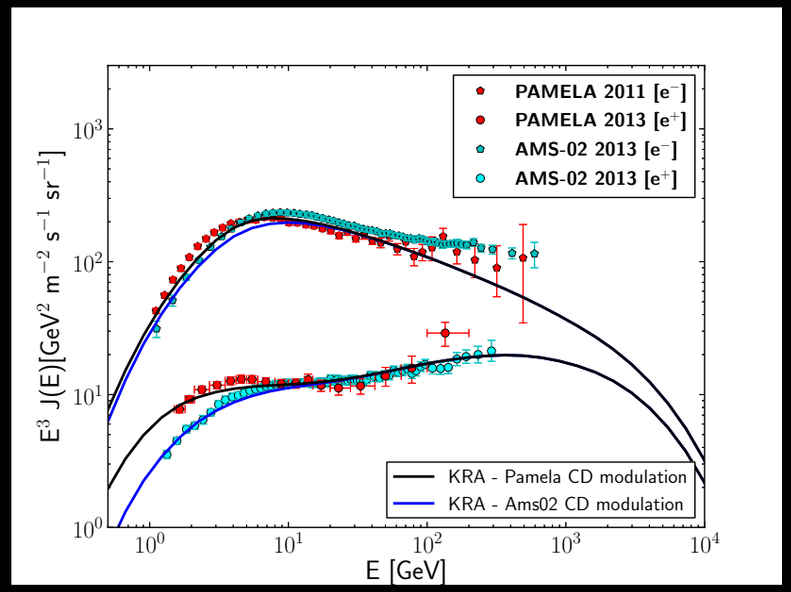
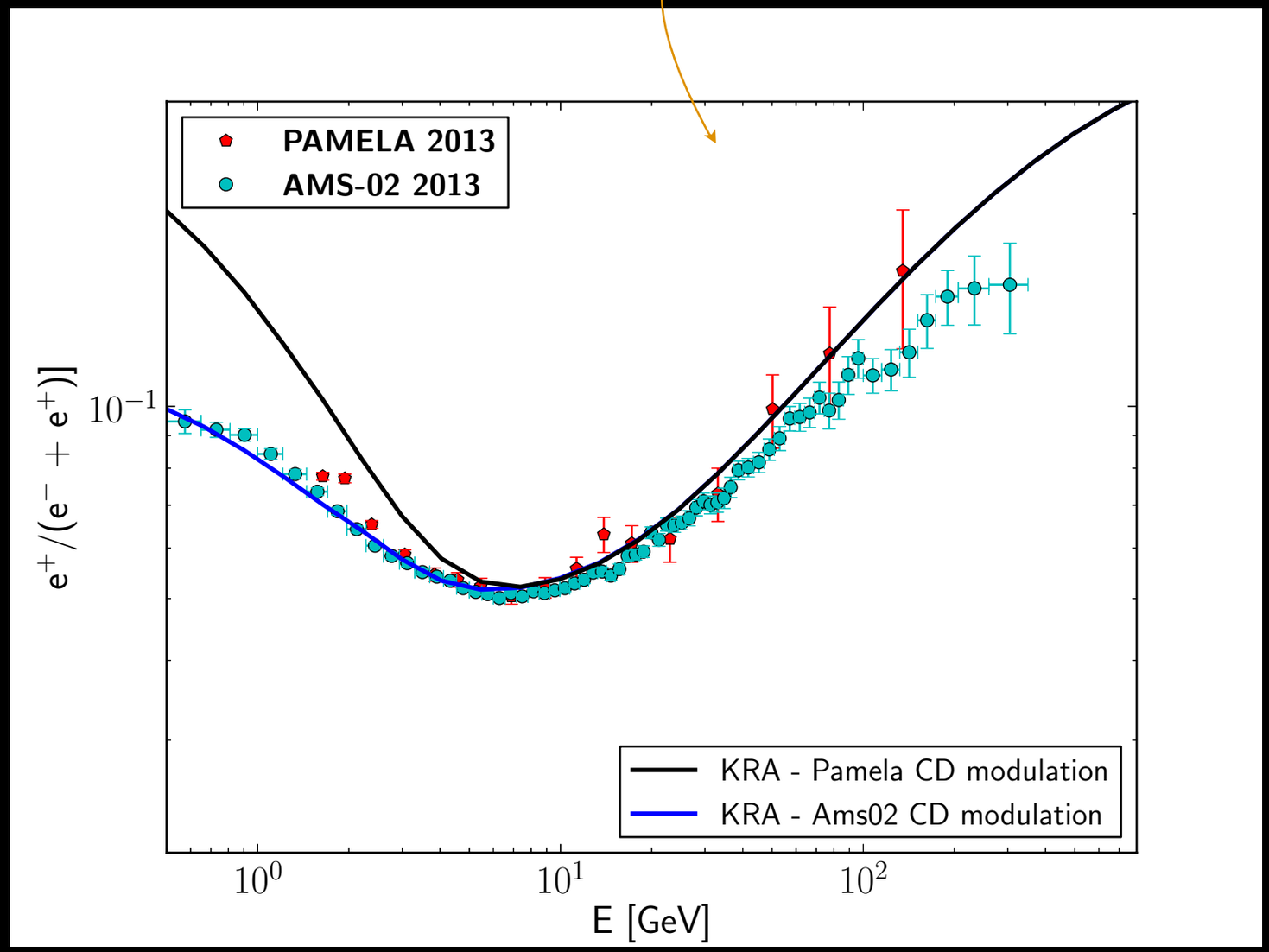
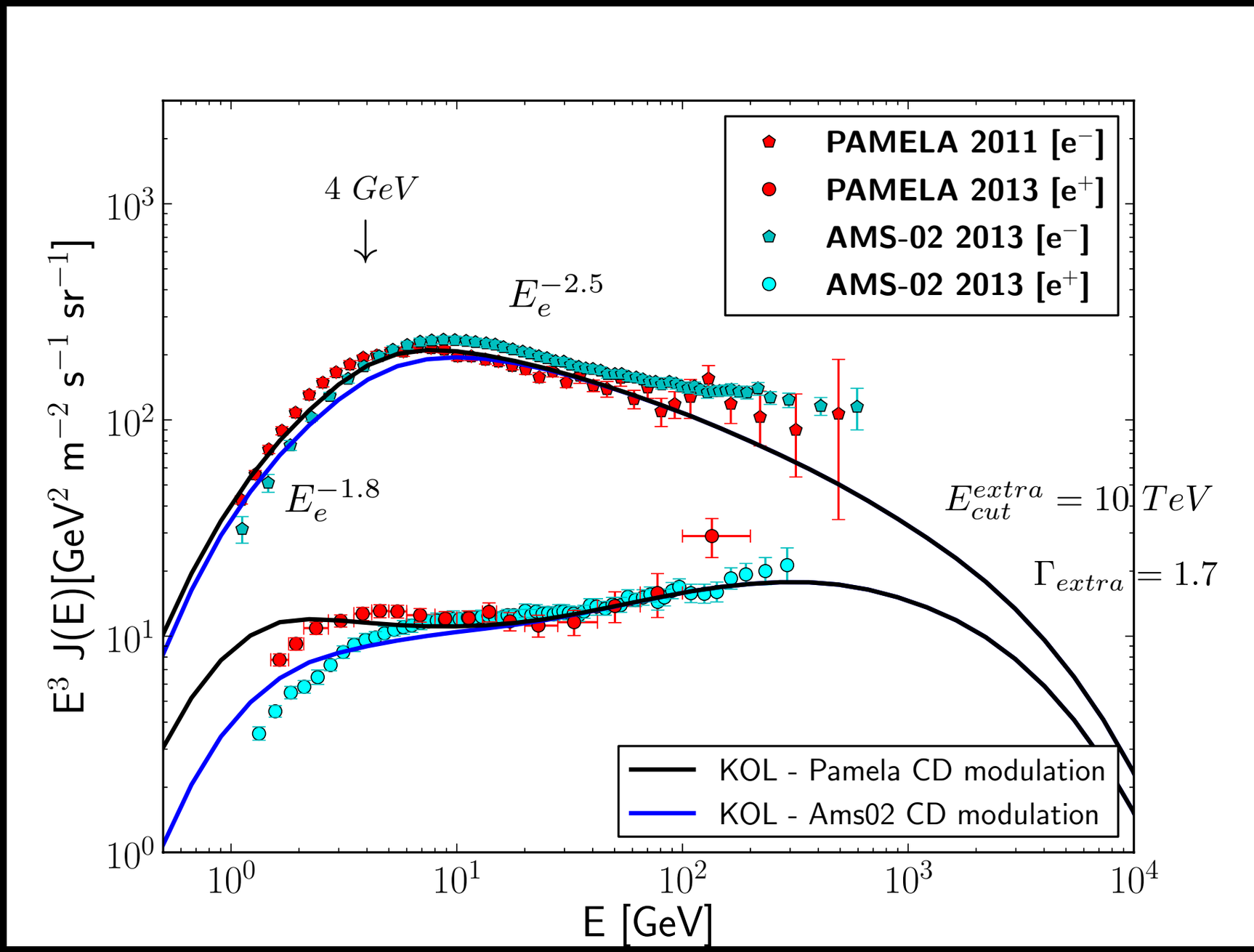




SEE ALSO E.G., GRASSO ET AL., APP 32 (2009), SERPICO, PRD, 79 (2009), HOOPER ET AL., JCAP 1 (2009): INCOMPLETE LIST OF PAPERS

THE ELECTRON SPECTRUM

II. KOLMOGOROV TURBULENCE



Models with strong reacceleration are in tension with the data

THE ELECTRON SPECTRUM

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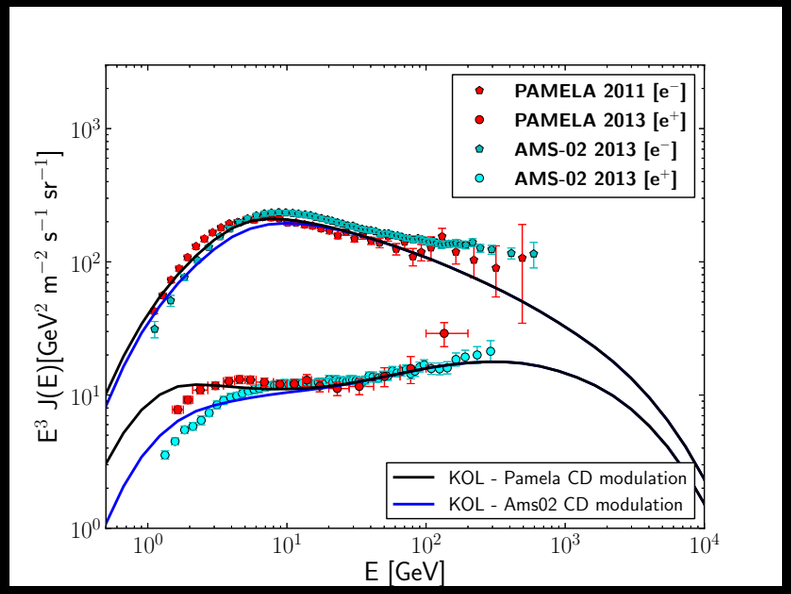

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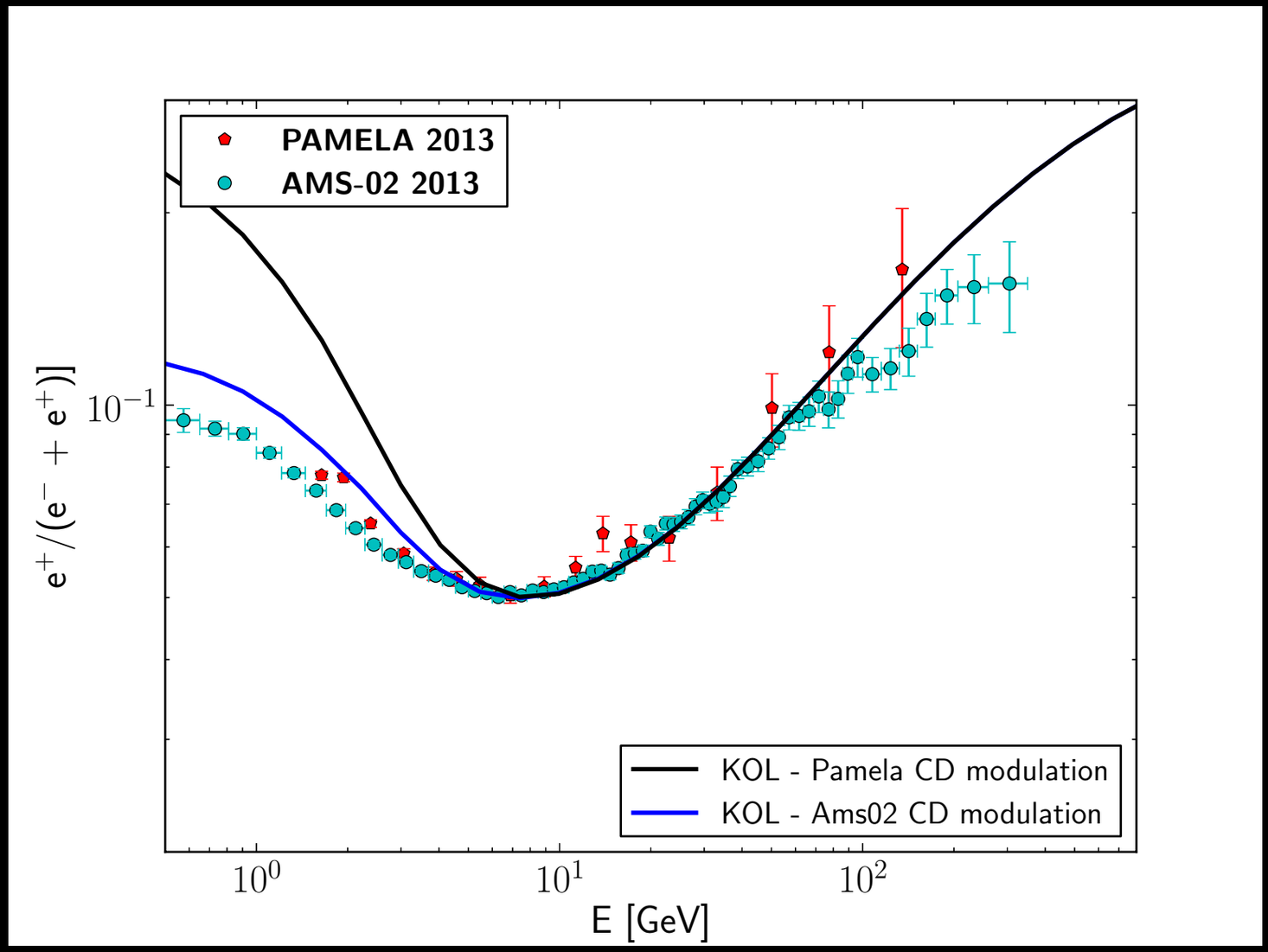
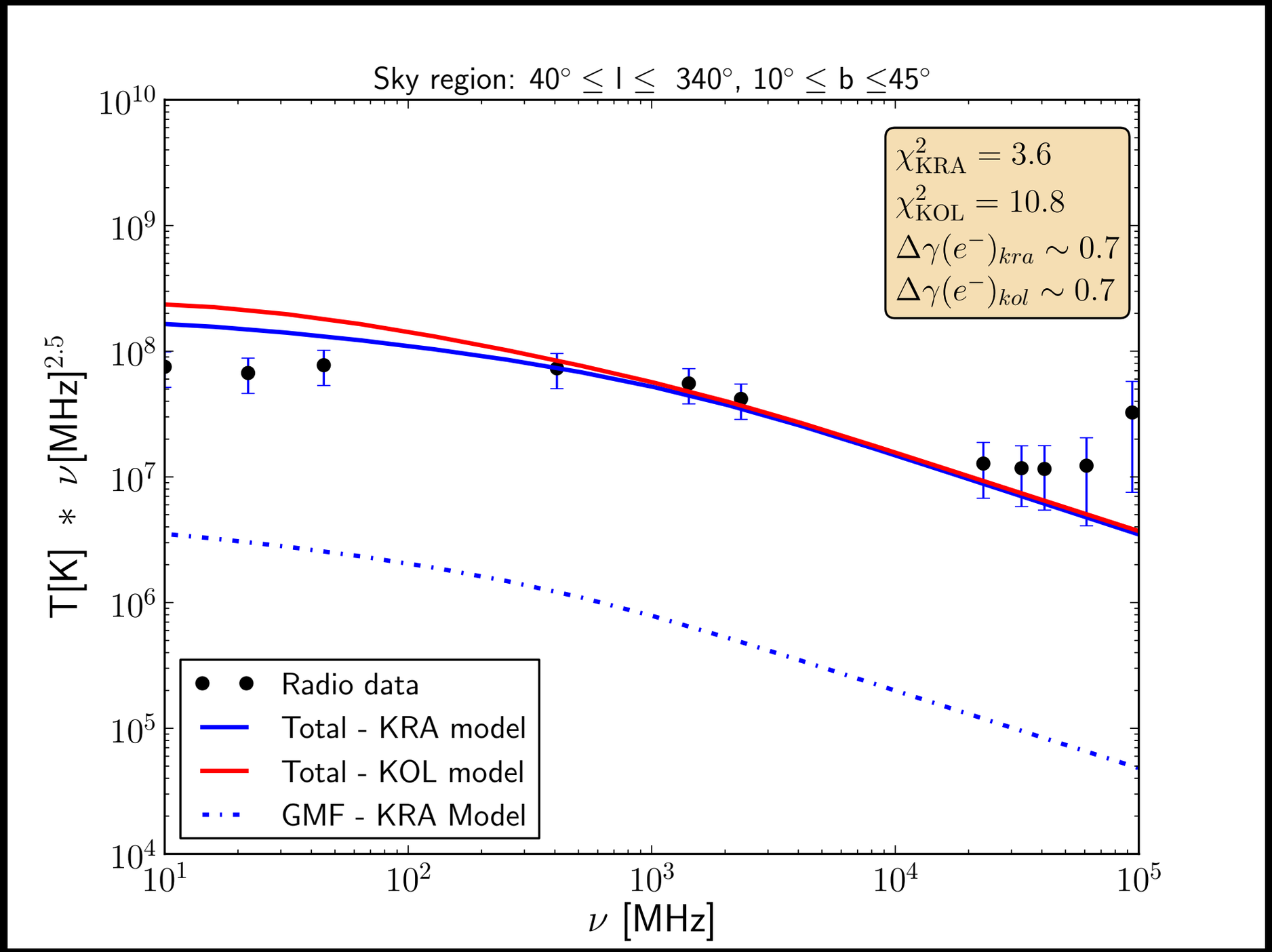


THE SYNCHROTRON SPECTRA

(PRELIMINARY RESULTS:W/O A SHARP BREAK, STILL GOOD)



SEE ALSO E.G.,JAFFE ET AL. (2011), ORLANDO&STRONG (2013), BRINGMANN ET AL (2012): INCOMPLETE LIST OF PAPERS

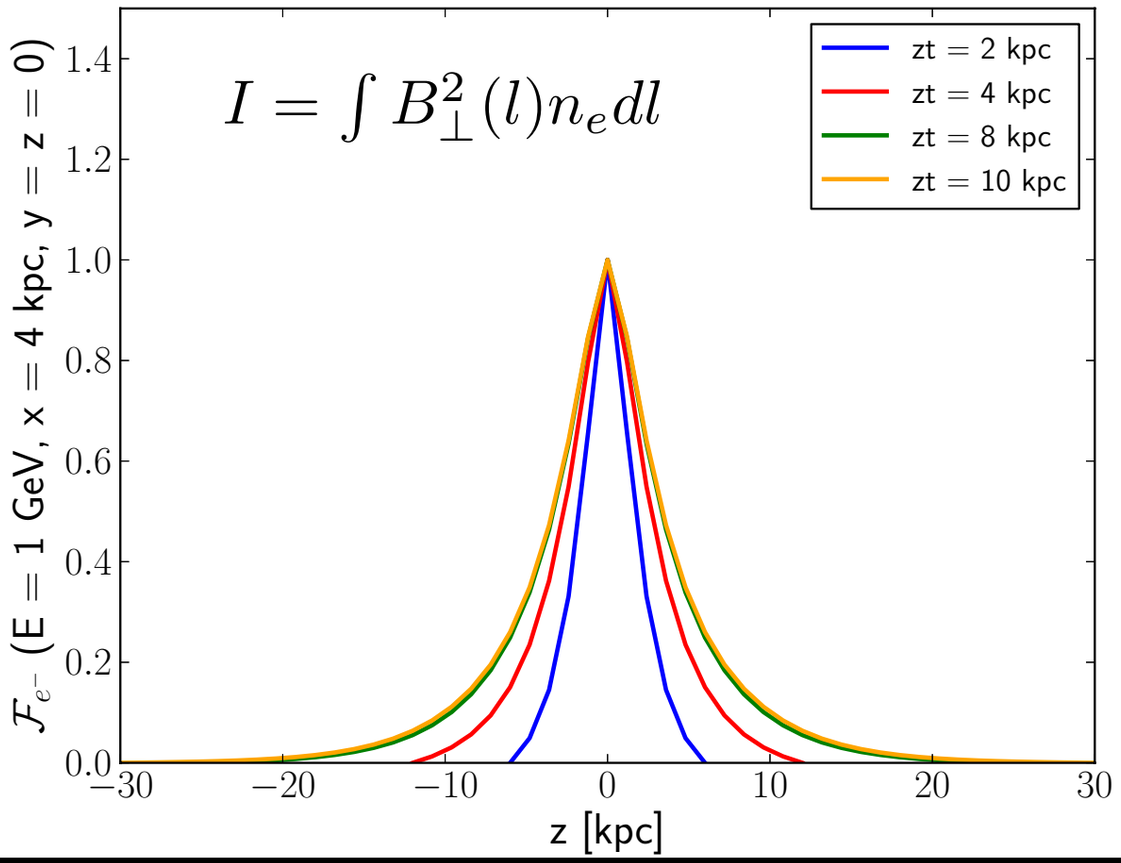
DI BERNARDO, EVOLI,GAGGERO,GRASSO,MACCIONE, JOURNAL OF COSMOLOGY AND ASTROPARTICLE, 3 (2013)

THE HALO HEIGHT

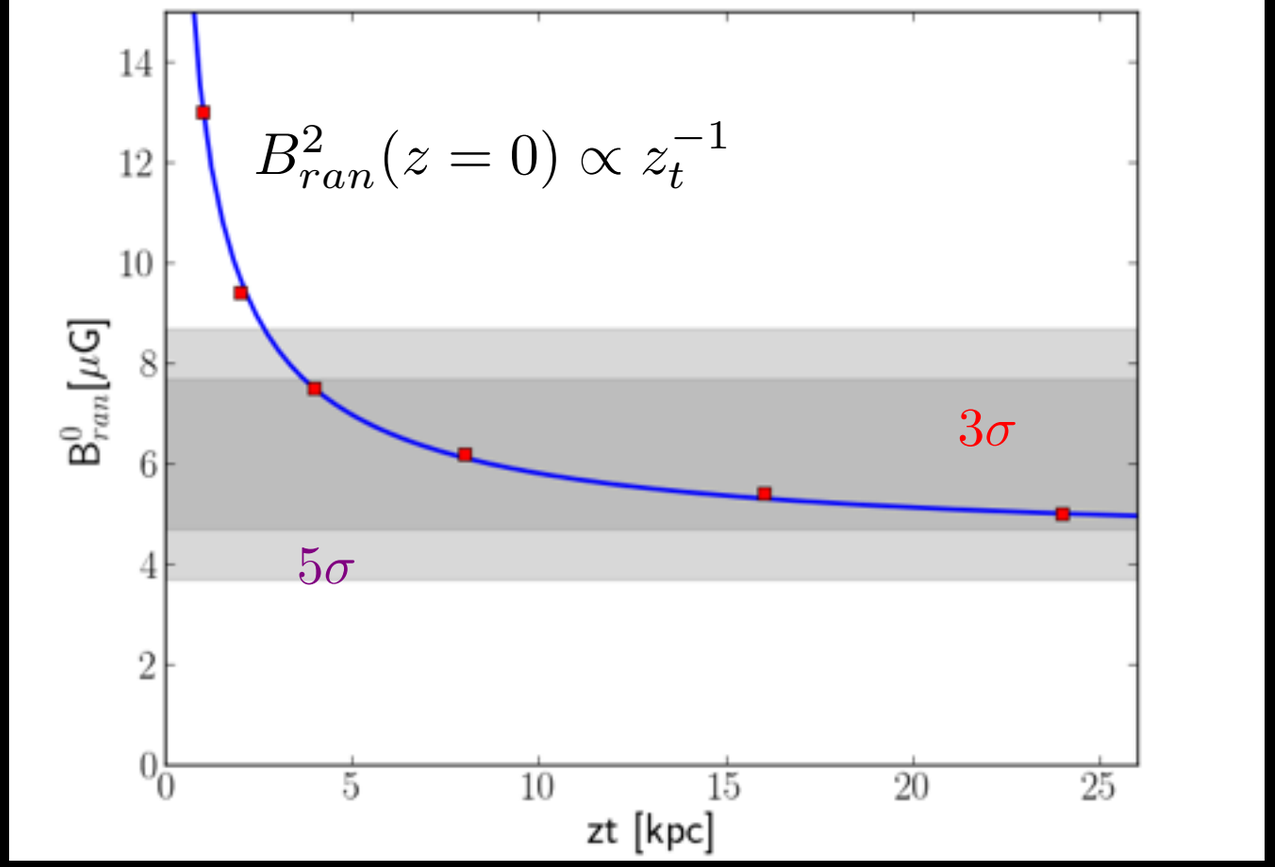
ONE OF THE MAIN GOAL IN MODERN ASTRO-PARTICLE PHYSICS;
UNCERTAINTIES ON

$^{10}Be/^{9}Be$

@ 1 GeV



@ 408 MHz



In the radio energy band the CRE are dominated by diffusion even for thick halos

The vertical extension of the CR diffusion is crucial for Dark Matter science

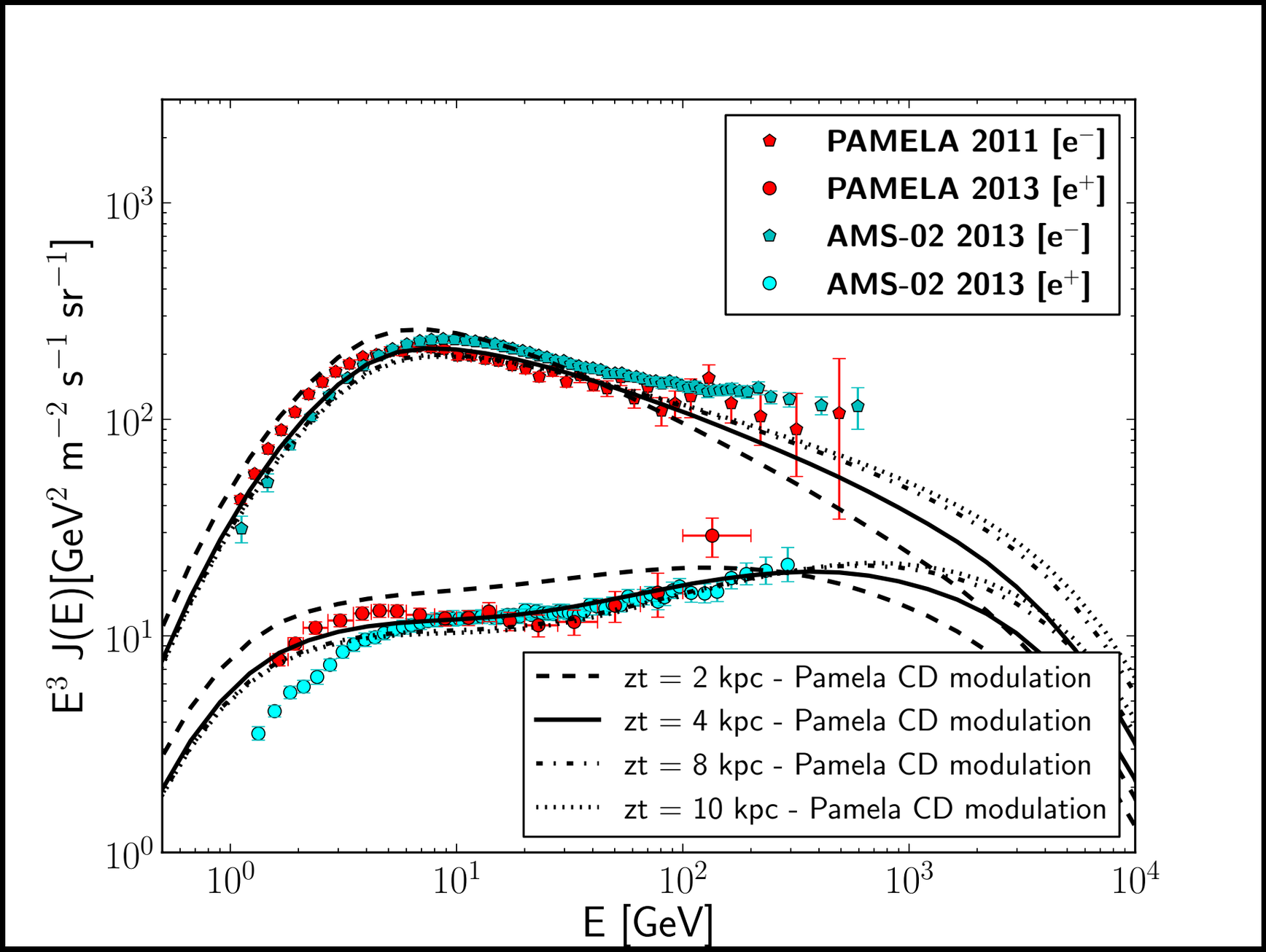
For an exponential profile of the GMF we constraint the halo height using the RM data

$3\ \sigma \rightarrow z_t > 4\ kpc$

$5\sigma \rightarrow z_t > 3kpc$

THE ELECTRON SPECTRUM

I. THE EFFECTS OF HALO SIZE:ELECTRONS

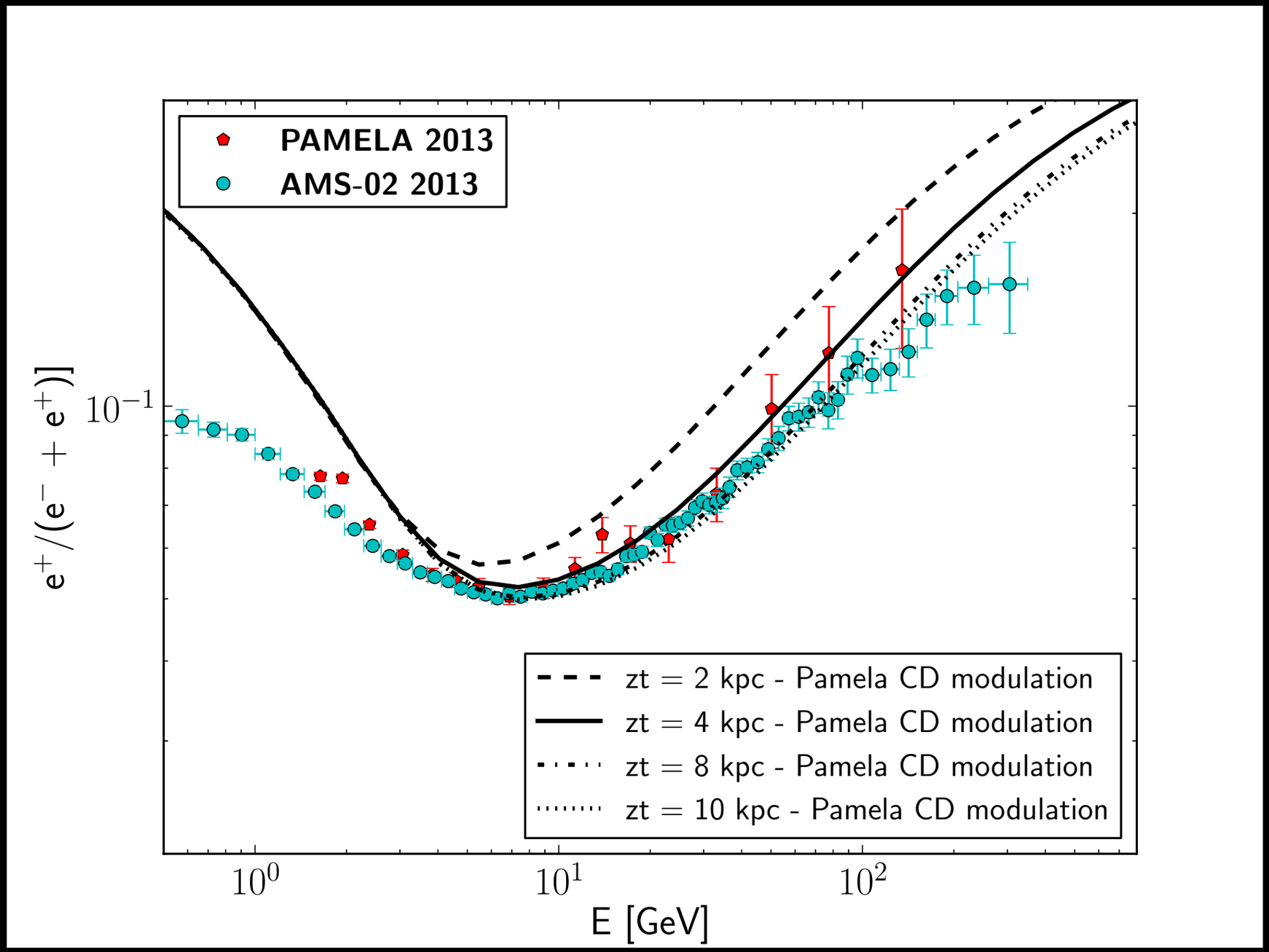


KRA test: we use $z_t \in [2 \div 10]$ kpc

Thin halos are disfavored!

THE ELECTRON SPECTRUM

II.THE EFFECTS OF HALO SIZE: POSITRON RATIO



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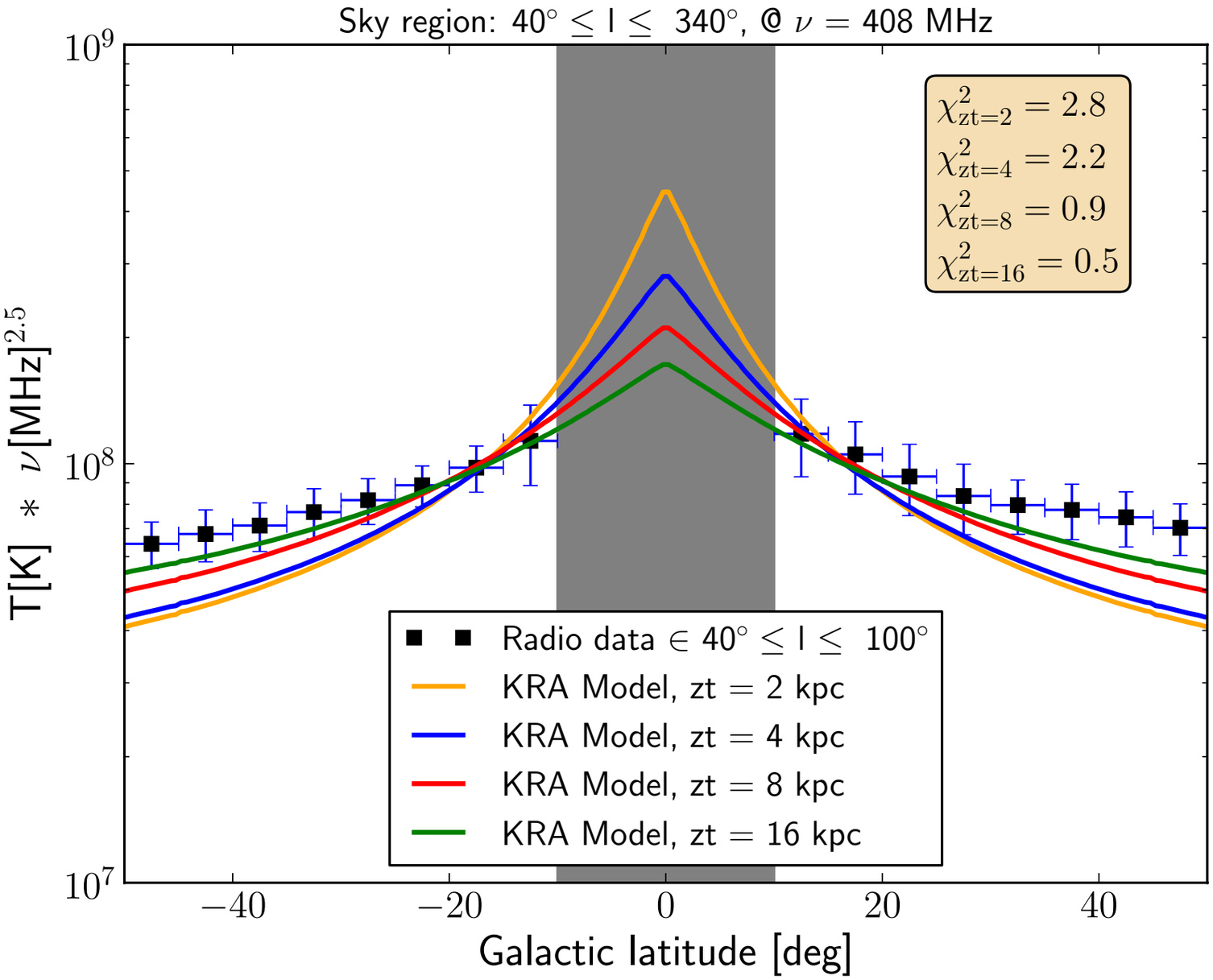
DI BERNARDO, EVOLI,GAGGERO,GRASSO,MACCIONE,
JOURNAL OF COSMOLOGY AND ASTROPARTICLE, 3 (2013)

THE LATITUDE PROFILE

THE GLOBAL ENVIRONMENT



- ✦ Complementary probe of the vertical CRE distribution
- ✦ KRA setups at different halo heights reproducing well the synchrotron spectrum
- ✦ Thick halos are favored!

$z_t < 2$ kpc are excluded at 3 σ

CONCLUSIONS

- Multichannel analysis
- Break or an exponential IR cutoff
- Only low re-acceleration in good agreement with data
- Constraints on the CR diffusive halo scale height
- Goal: Exploiting Planck, Fermi-LAT and cosmic ray data simultaneously

THANK YOU FOR YOUR ATTENTION!