



MAX-PLANCK-GESELLSCHAFT



MAGIC

Measurement of the cosmic $e^- + e^+$ spectrum with the MAGIC telescopes



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(On behalf of the MAGIC Collaboration)

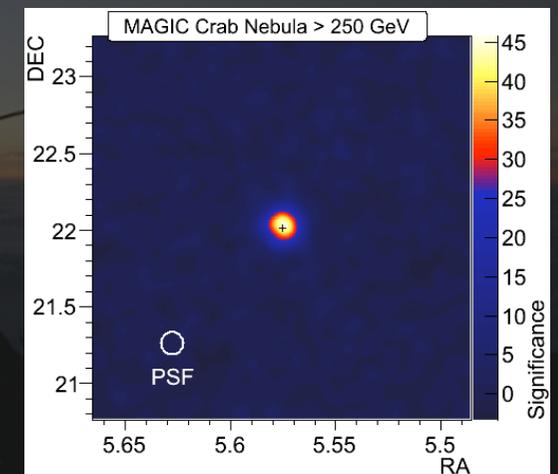
32nd International Cosmic Ray Conference
Beijing, August 11-18, 2011

Stereoscopic system of two IACT telescopes
located at Roque de los Muchachos (La Palma,
Canaries islands), 2200 m a.s.l.
Reflector dish: 17 m diameter

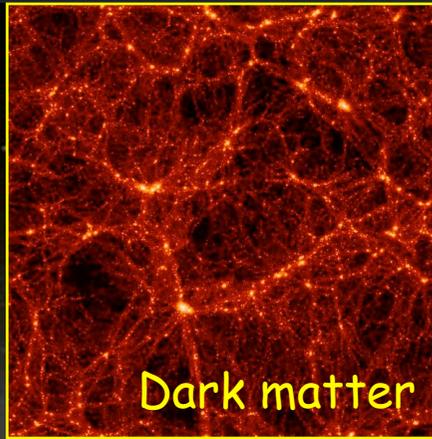
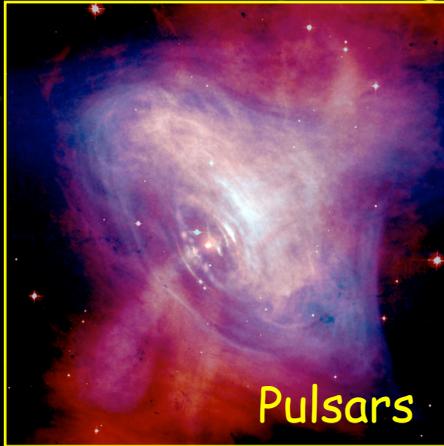
Designed for VHE γ -rays

- Energy threshold: 50 GeV
- @ Energy > 300 GeV:

Sensitivity < 1% Crab (50h)
Energy resolution $\sim 17\%$
Angular resolution $\sim 0.07^\circ$



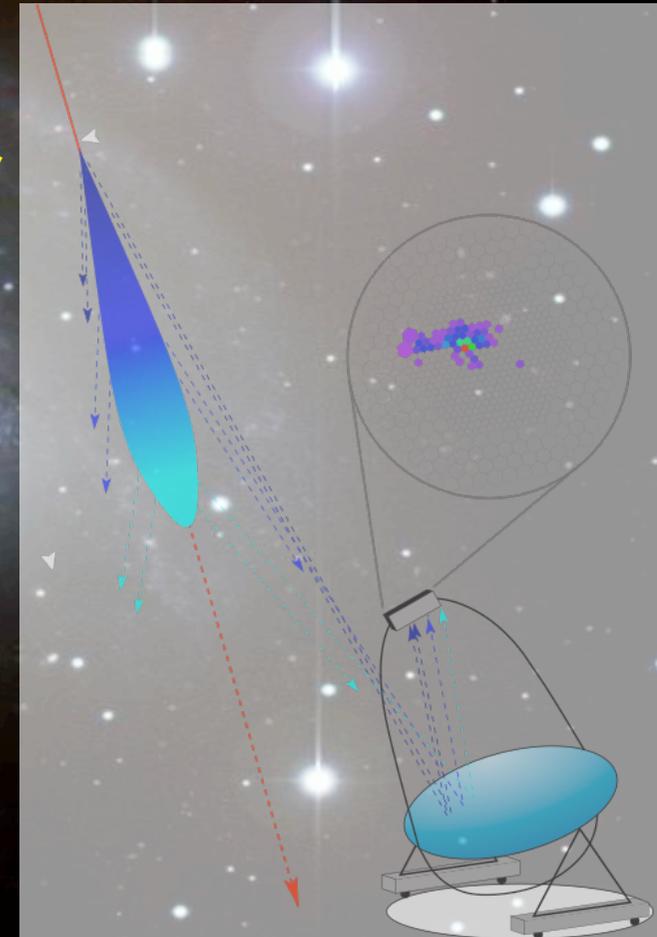
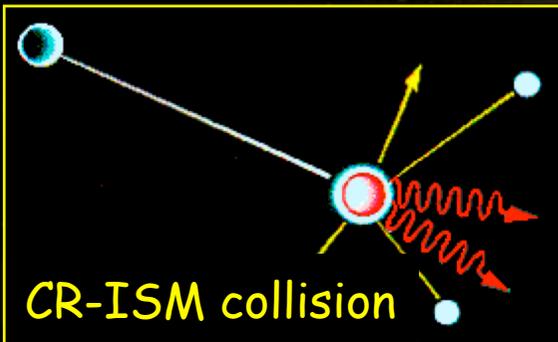
Origin of cosmic electrons



No angular direction info



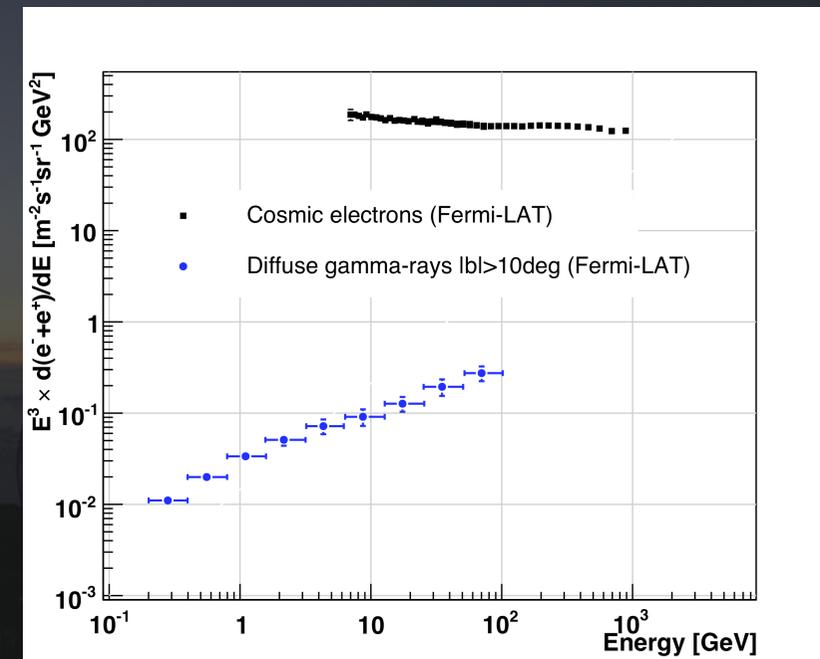
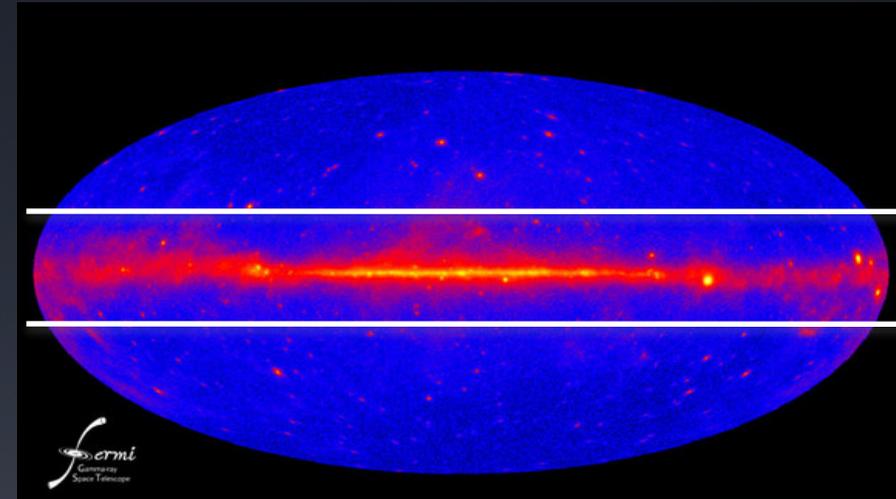
Diffusion & Propagation:
Inverse Compton
Synchrotron
Bremsstrahlung



Observations carried in December 2009, June 2010, October and November 2010

Total effective time: ~ 14 hours, Zenith angle $< 30^\circ$

- Data from galactic plane and γ -ray point sources are excluded, $|\text{galactic latitude}| > 10^\circ$.
- extragalactic diffuse γ -rays:
@ TeV $\text{flux}_\gamma < 1\% \text{flux}_{e^\pm}$ (also due to extragalactic absorption)



Abdo et al. *Phys. Rev. Lett.*, 2010
August 11-18, 2011

- Background estimated with MC:
model dependent \rightarrow large systematics

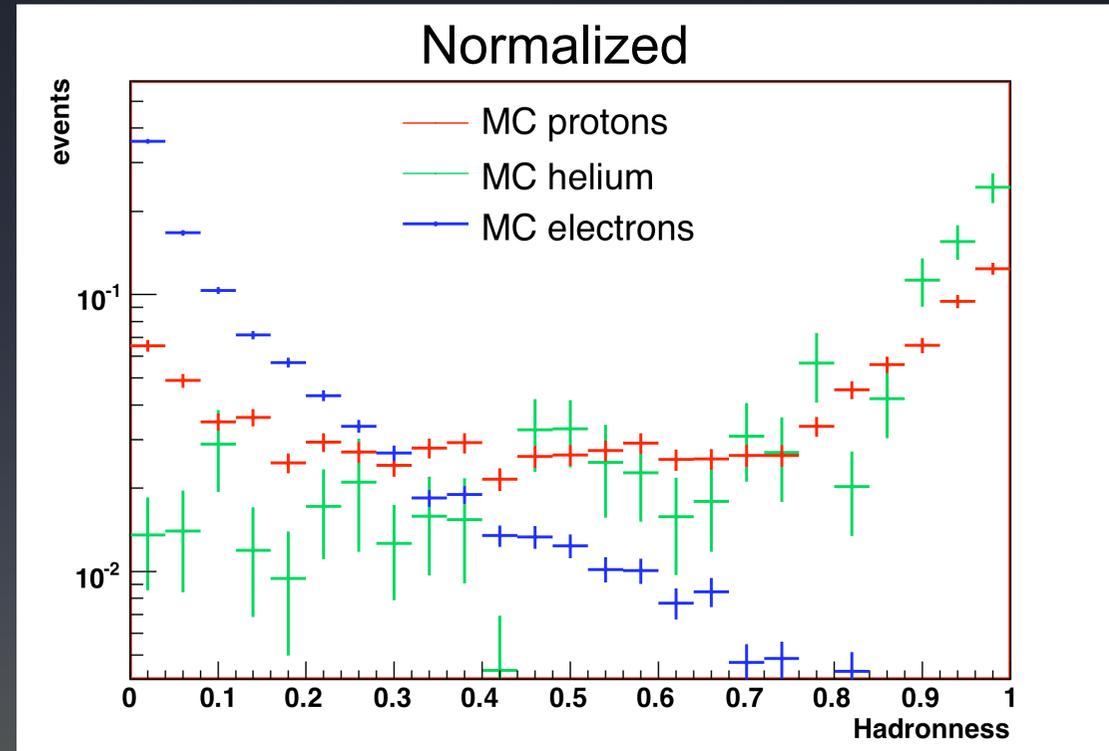
- electron-hadron separation:
Random Forest \rightarrow degree of hadron
classification:

Hadronness=0 \rightarrow electron

Hadronness=1 \rightarrow background

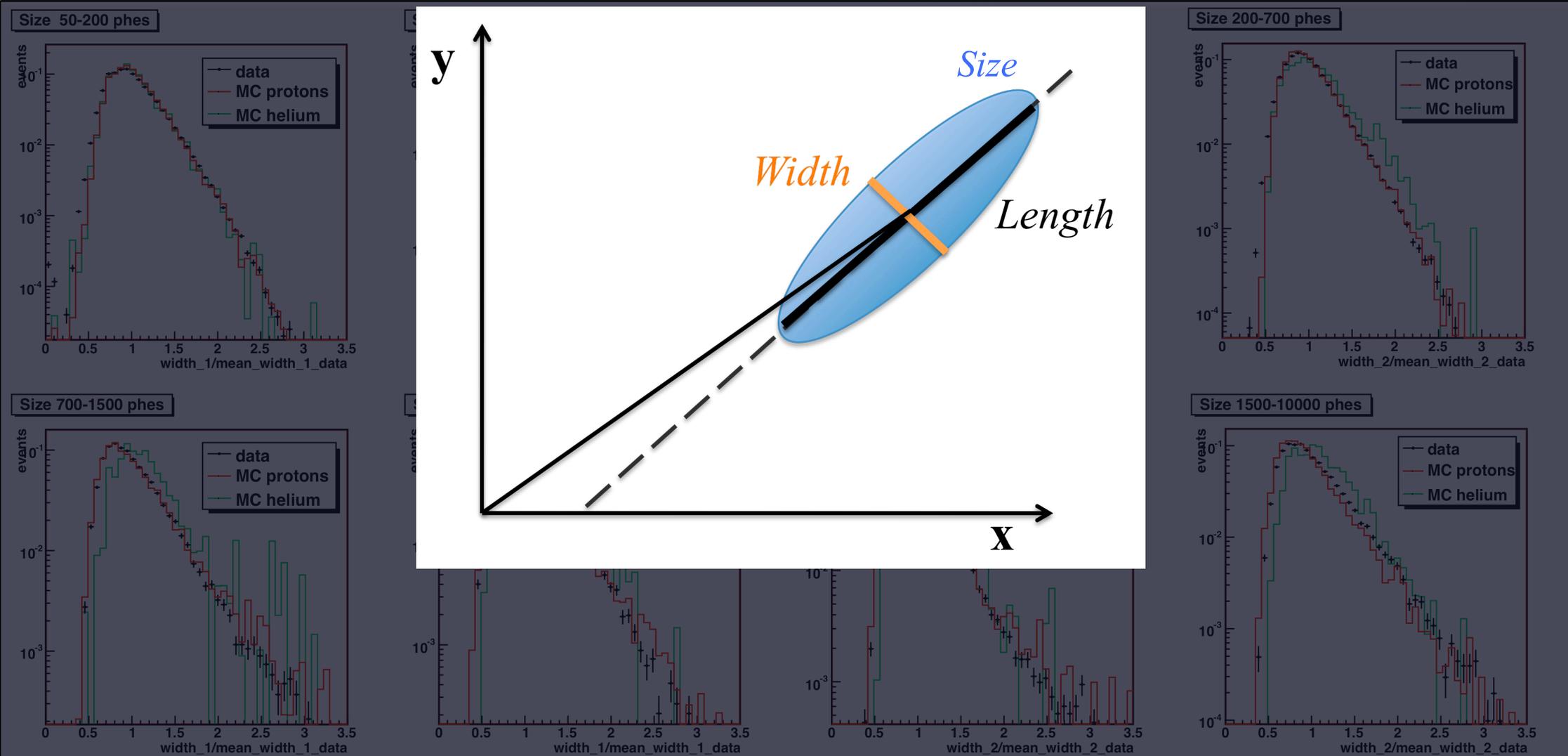
Main contribution from protons,
while heavier elements suppressed by the
cuts.

Contribution from helium < 10% protons
and cut more by the trigger.



Importance of reproducing the correct background with MC simulations

Example: comparison of the width of the shower image between real data and hadron MC

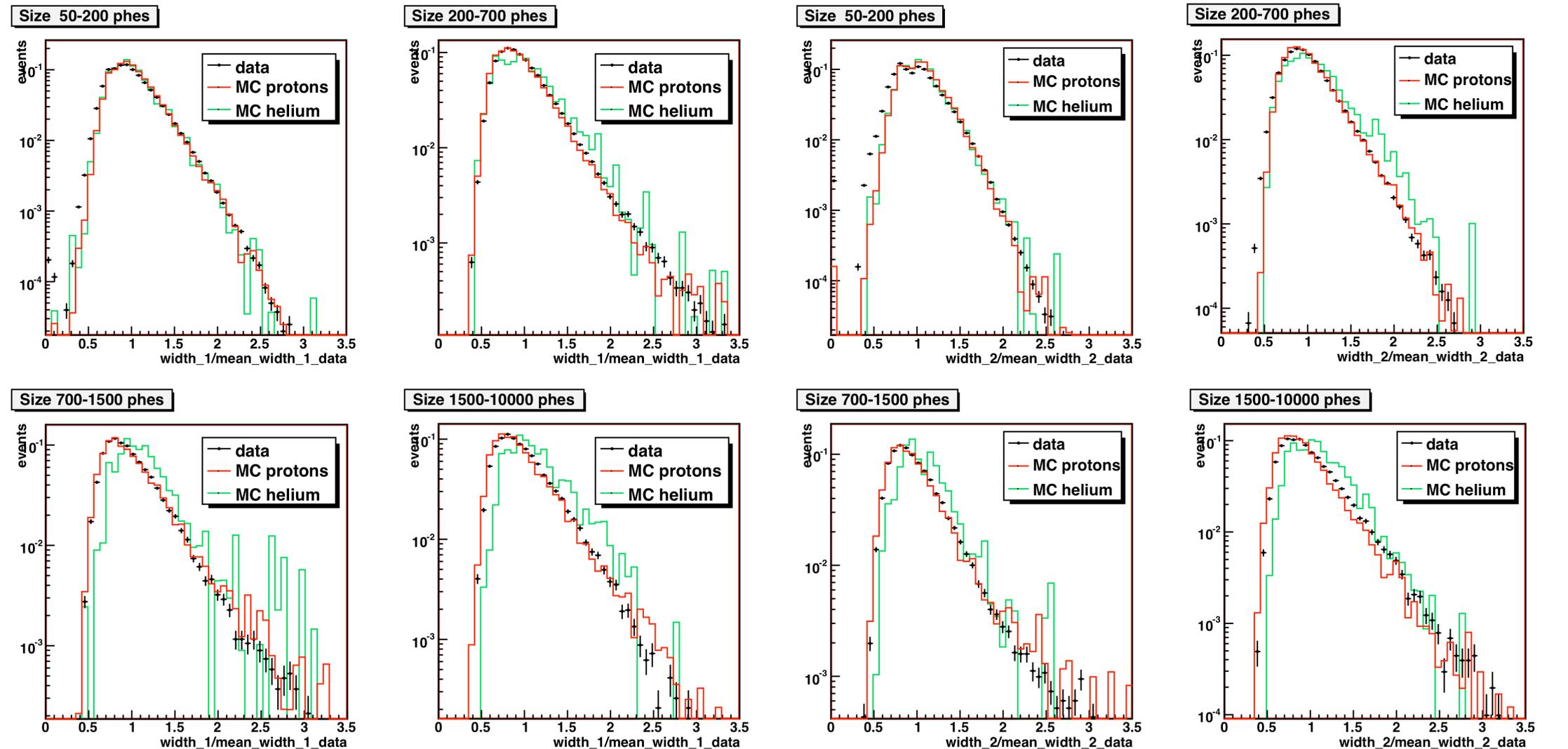


Importance of reproducing the correct background with MC simulations

Example: comparison of the width of the shower image between real data and hadron MC

MAGIC-I width (normalized)

MAGIC-II width (normalized)

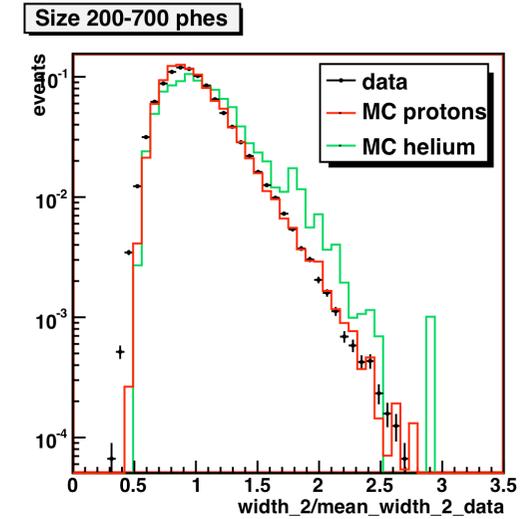
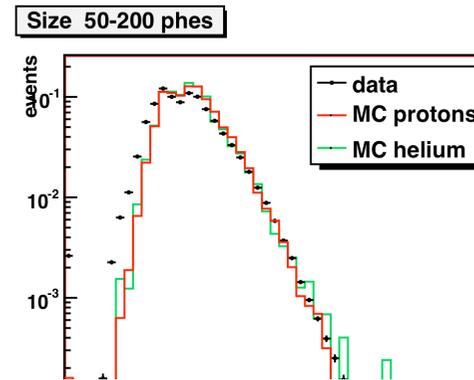
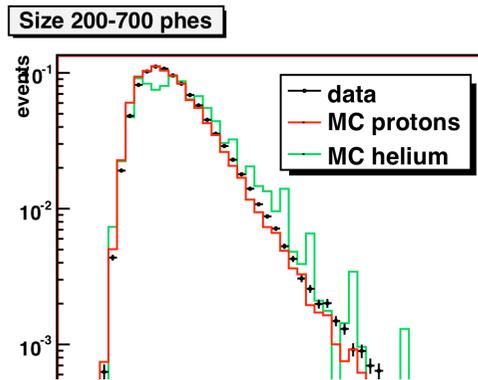
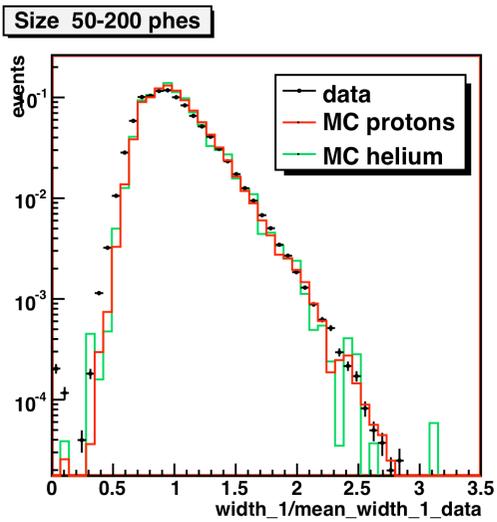


Importance of reproducing the correct background with MC simulations

Example: comparison of the width of the shower image between real data and hadron MC

MAGIC-I width (normalized)

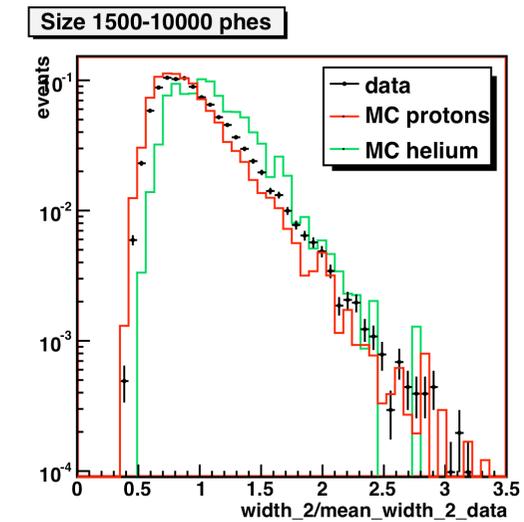
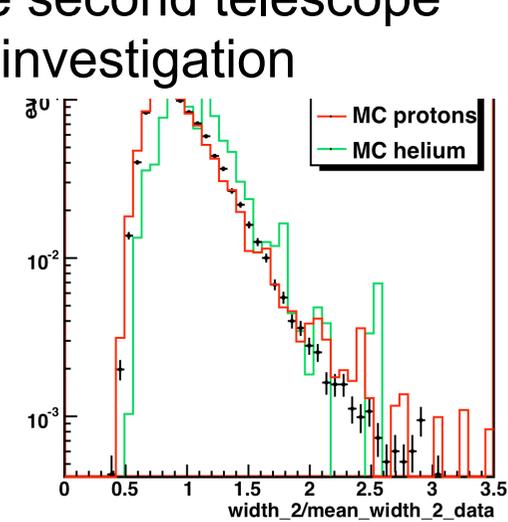
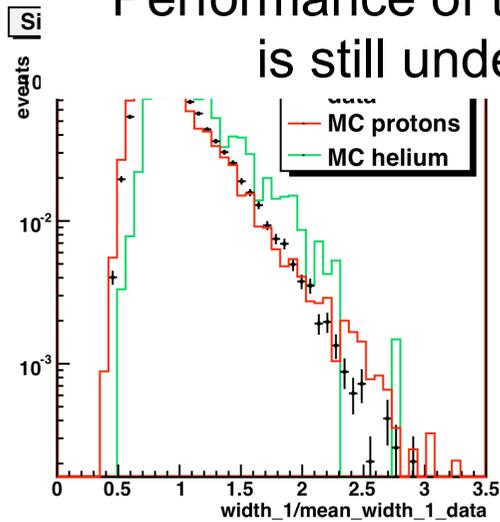
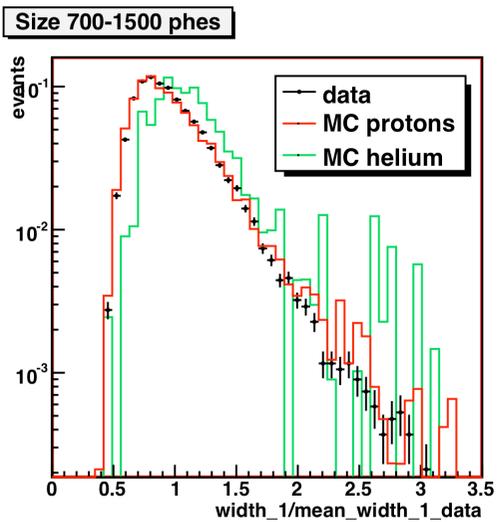
MAGIC-II width (normalized)



Due to a small mismatch at low sizes,
different cuts applied on the 2 telescopes.

Performance of the second telescope

is still under investigation



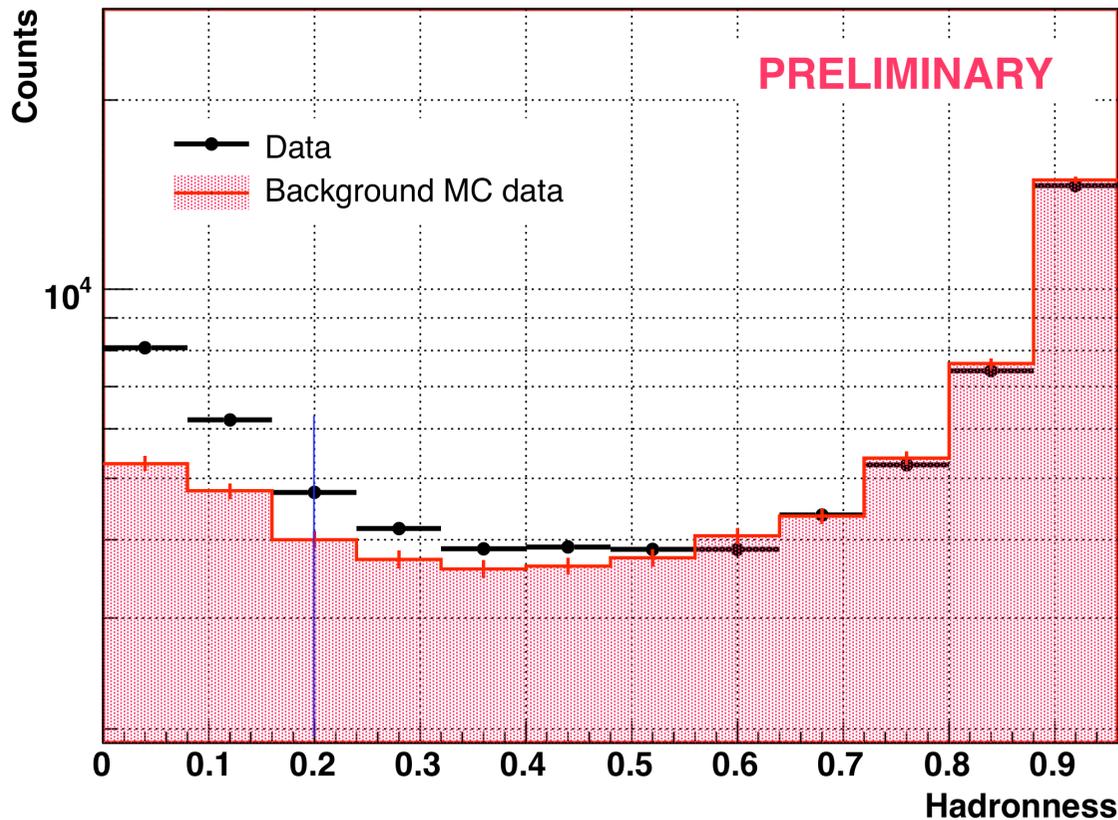
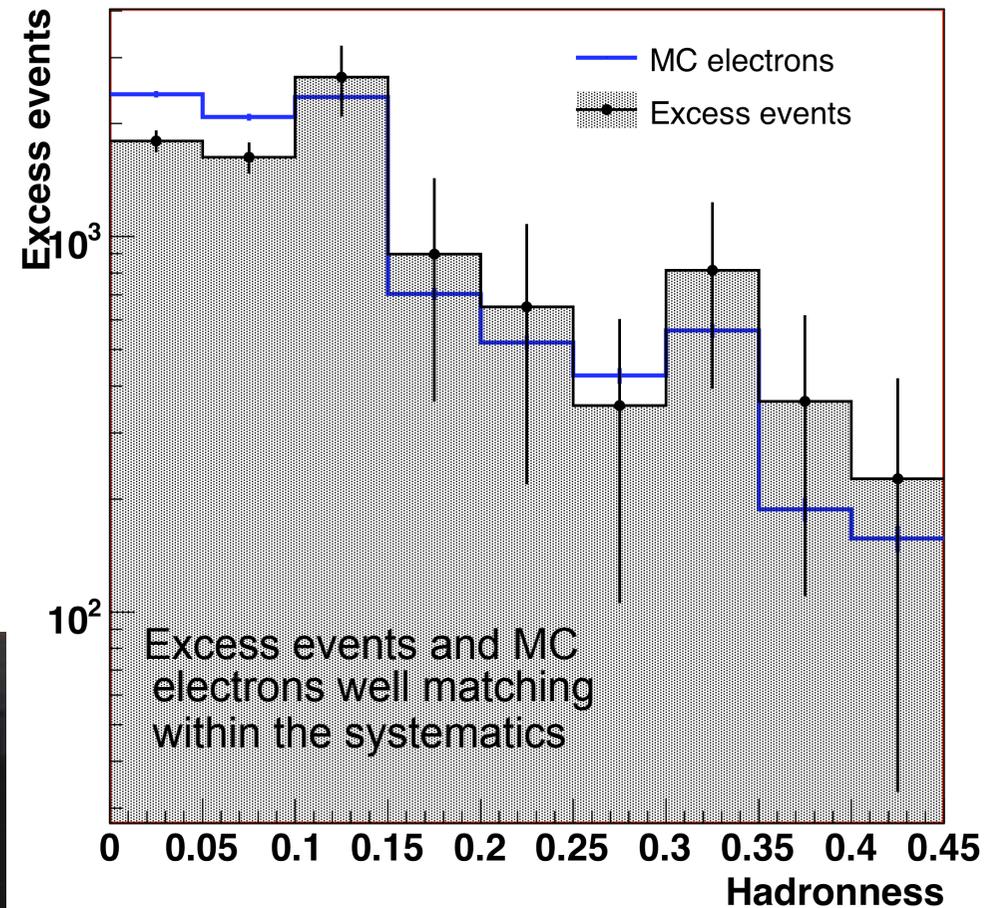
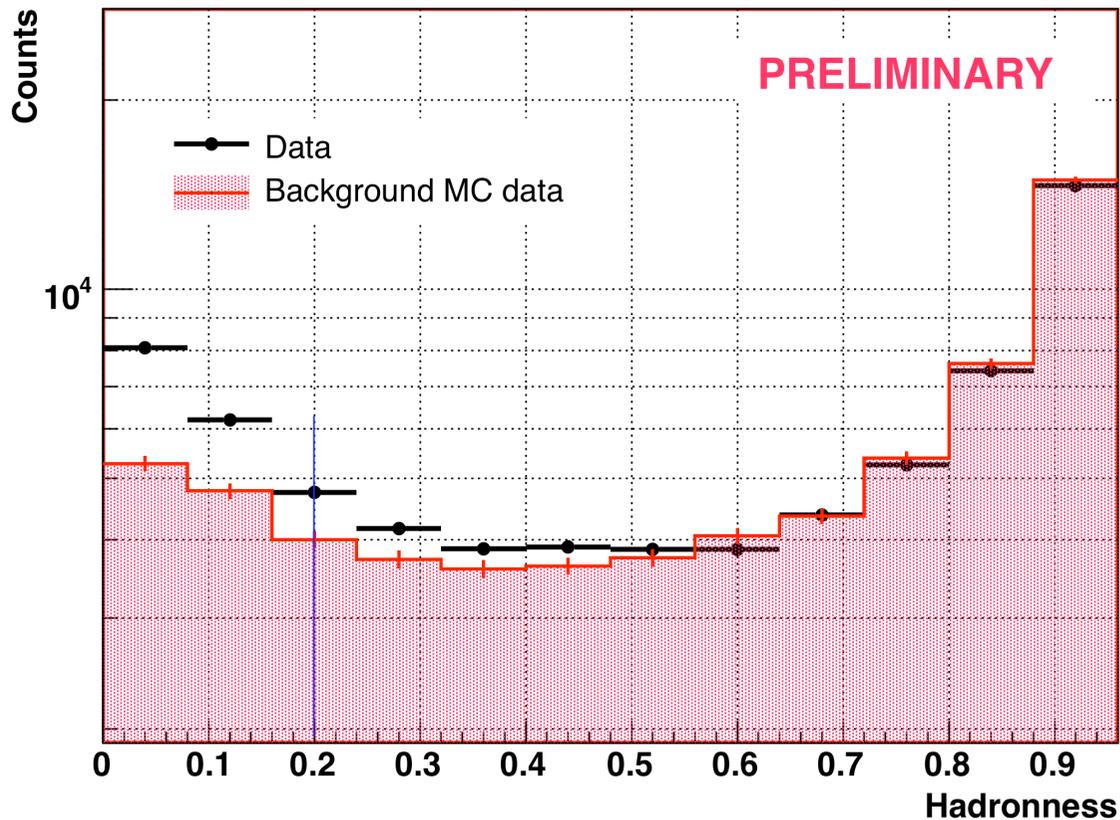


Image Size Tel_1 > 100 phe
Image Size Tel_2 > 200 phe
10m < Impact < 300m

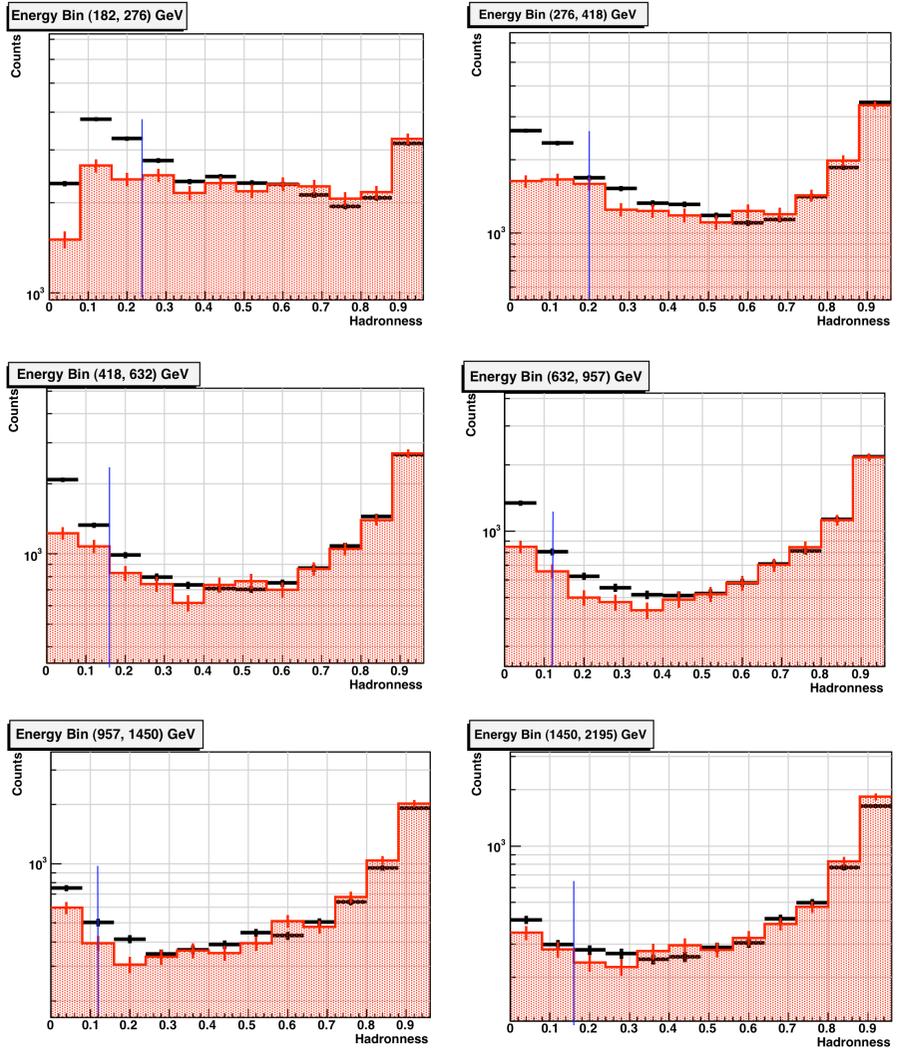
Hadronness cut to keep 60% of electron events

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Image Size Tel_2 > 200 phe
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Hadronness cut to keep 60% of electron events

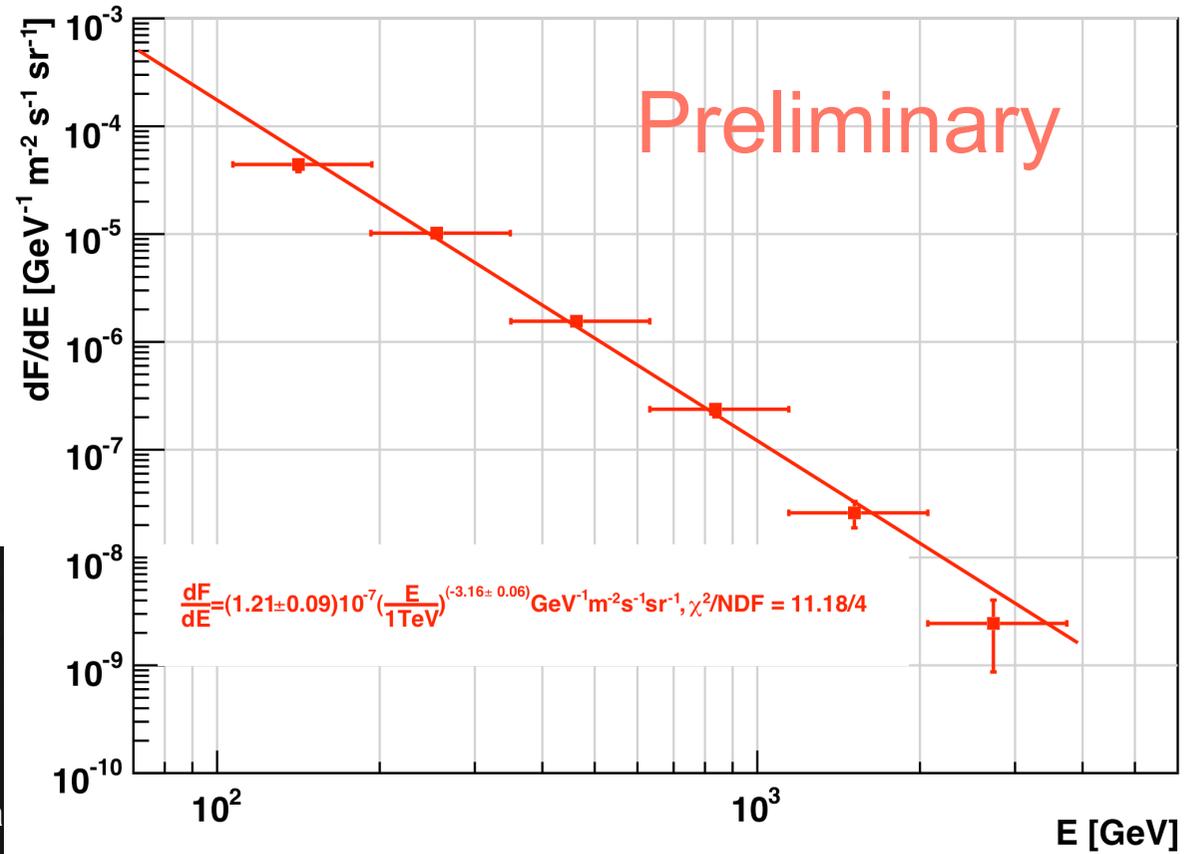
Spectrum determination

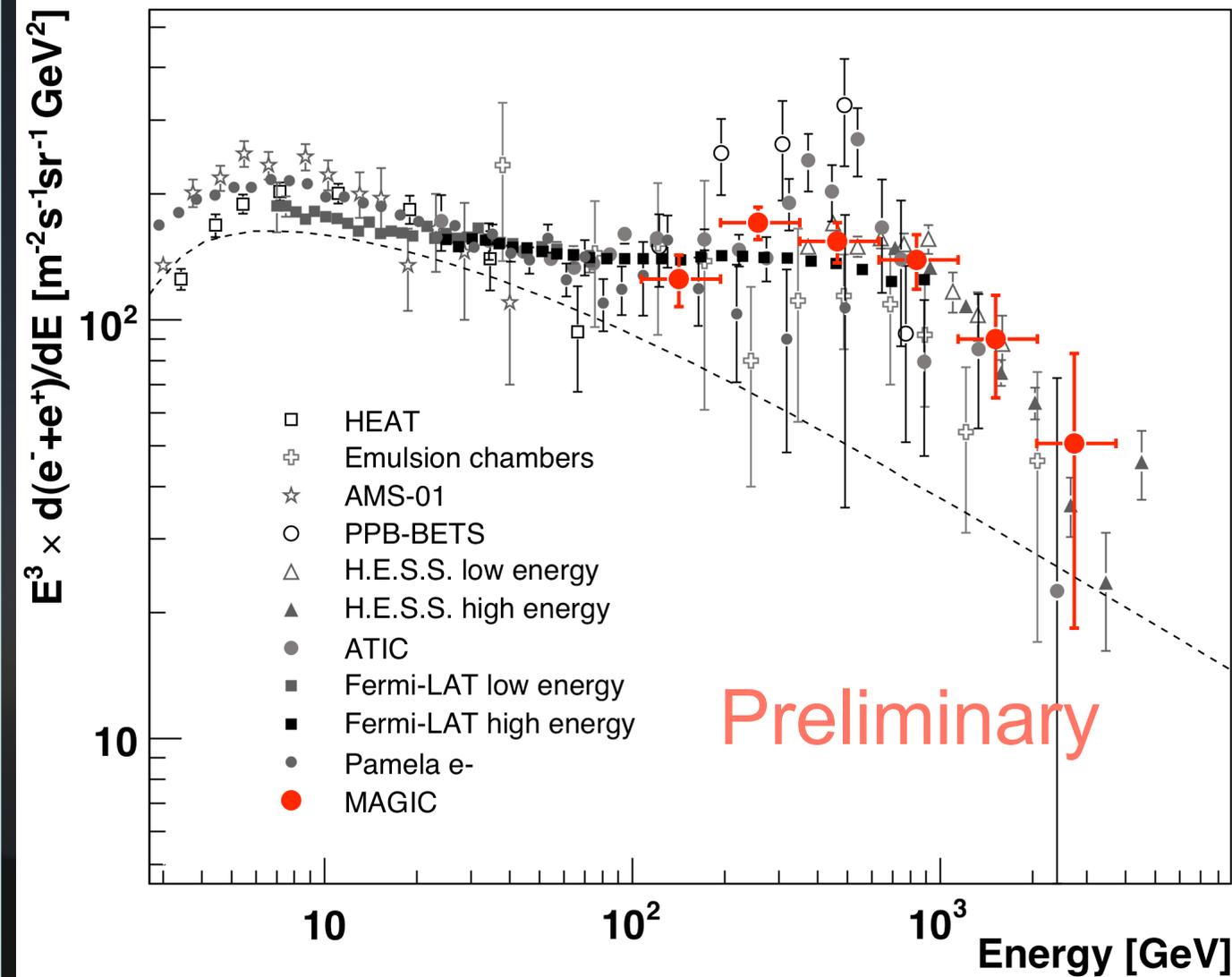


Simple power law fit:

- Flux @ 1 TeV = $(1.21 \pm 0.09) \cdot 10^{-7} \text{ GeV}^{-1} \text{ m}^{-2} \text{ s}^{-1} \text{ sr}^{-1}$
- Slope: $\Gamma = -3.16 \pm 0.06_{\text{stat}}$

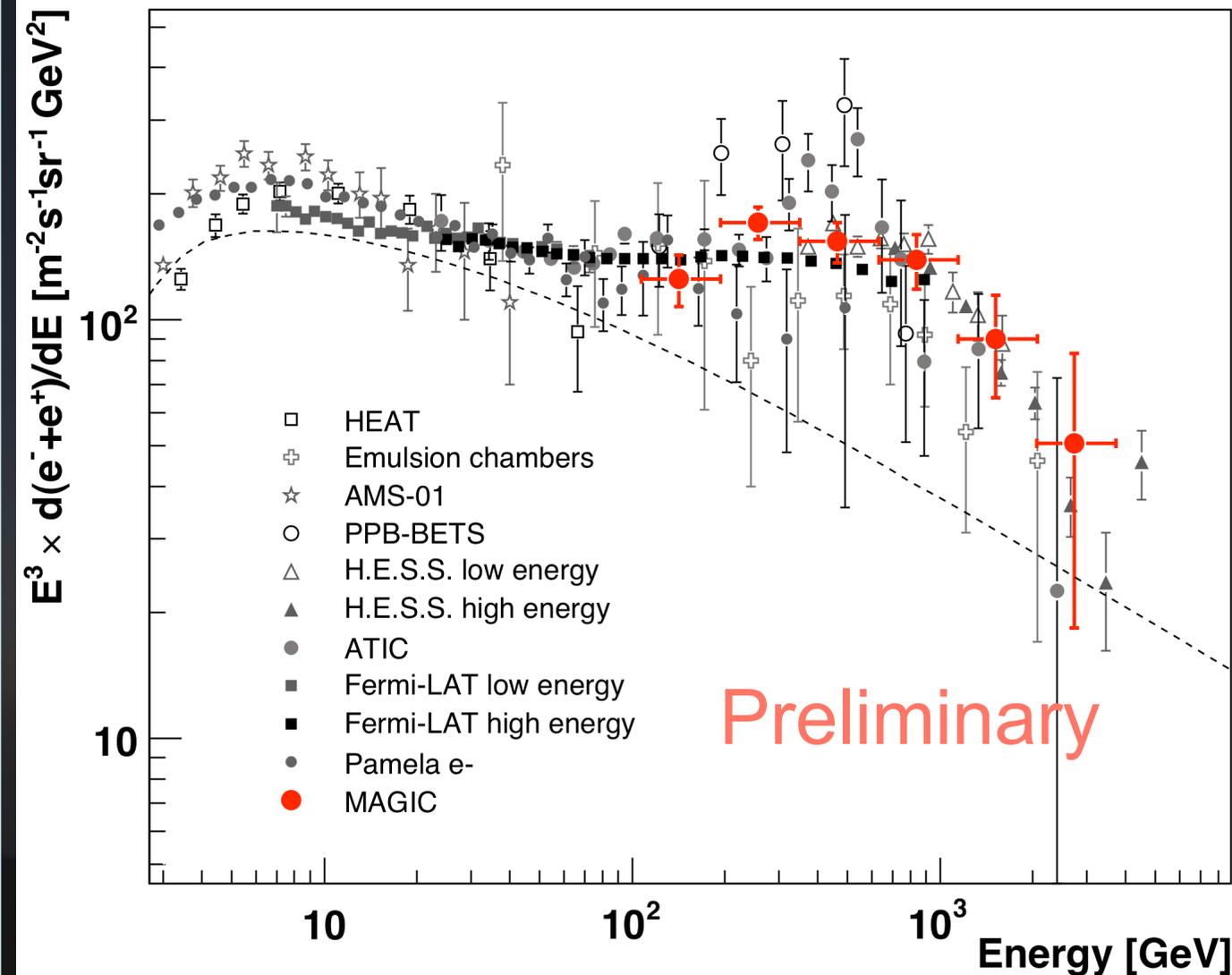
Systematic Errors: 30% flux, >0.15 spectral slope
 - atmospheric variation / detector / hadronic models (QGSJET)





- Spectrum consistent with previous measurements.
- Deviation from the diffuse background model.

Preliminary



- Spectrum consistent with previous measurements.
- Deviation from the diffuse background model.

Possible contributions to HE electrons flux:

- Secondary electrons generated in CR interactions with ISM
- SuperNova remnants
- Pulsars/PWN
- Dark matter



Conclusions



- MAGIC has measured the e^\pm spectrum in the energy range between **100 GeV and 3 TeV**. Preliminary results can be well fitted by a power-law with index $\Gamma = -3.16 \pm 0.06_{\text{stat}} \pm (>0.15)_{\text{sys}}$.
- The spectrum is in good agreement with previous measurements (still the bump observed by ATIC can not be excluded nor confirmed).
- MAGIC with its wide energy range can well overlap with Fermi at low energies and H.E.S.S. at high energies. With better statistics, a good cross calibration with these two experiments can be made.

THANK YOU FOR YOUR ATTENTION