Neural networks for electron identification on DAMPE

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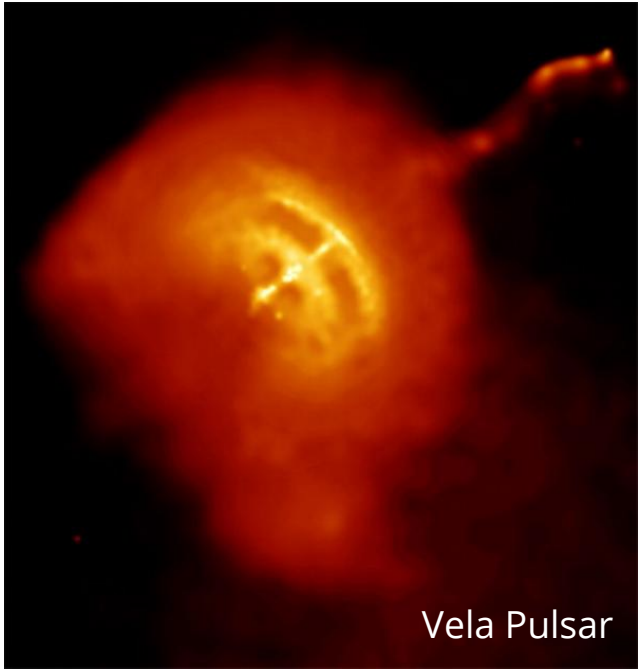
D. Droz et al., 2021, arXiv 2102.05534, accepted in JINST

Cosmic electrons (CREs)

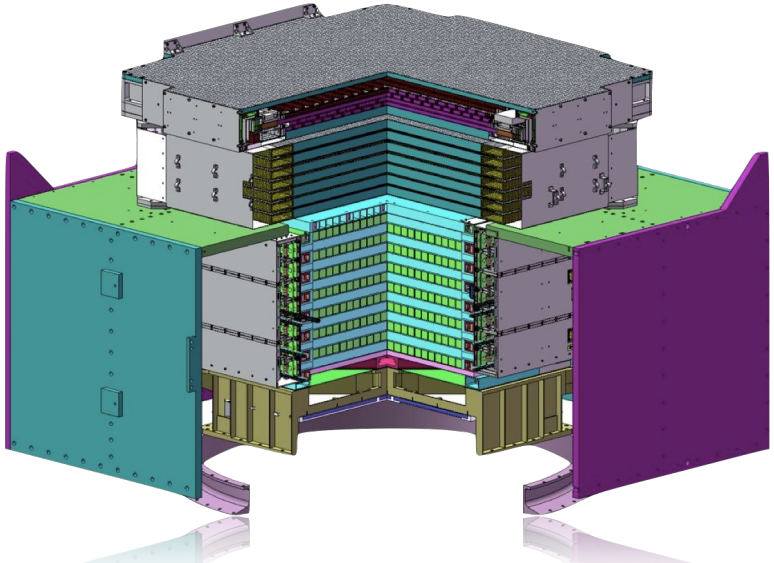
- Softer spectrum and lower flux than hadronic cosmic rays
- “Positron excess” observed
  - PAMELA, AMS, Fermi
  - Primary source of positrons?
- CRE spectral break observed a 1 TeV
  - DAMPE: Ambrosi et al., Nature 552.7683 (2017)
- Energy losses → TeV CREs must come from a nearby source
  - Pulsar Wind Nebulae (Crab, Vela)



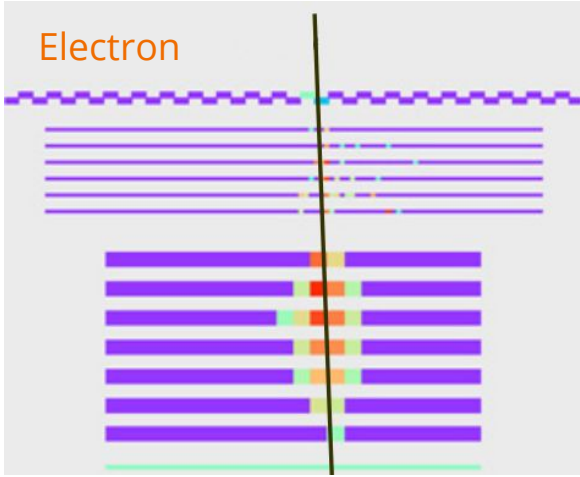
Kobayashi T et al, Astro J, 2004

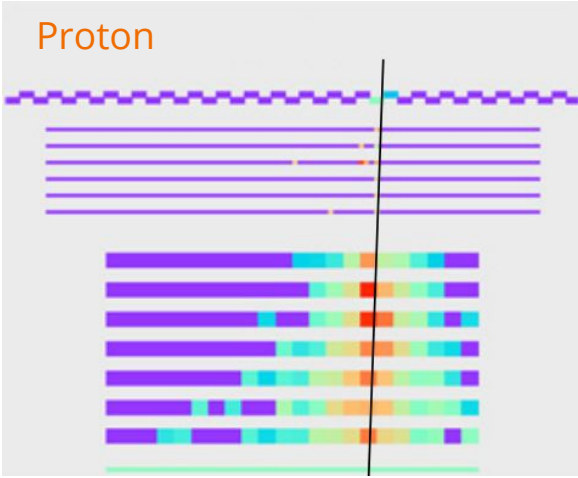
DAMPE & measurement of TeV CREs

DArk Matter Particle Explorer, in space since Dec. 2015
Particle ID based on shower topology inside calorimeter
Classical methods limited at multi-TeV energies

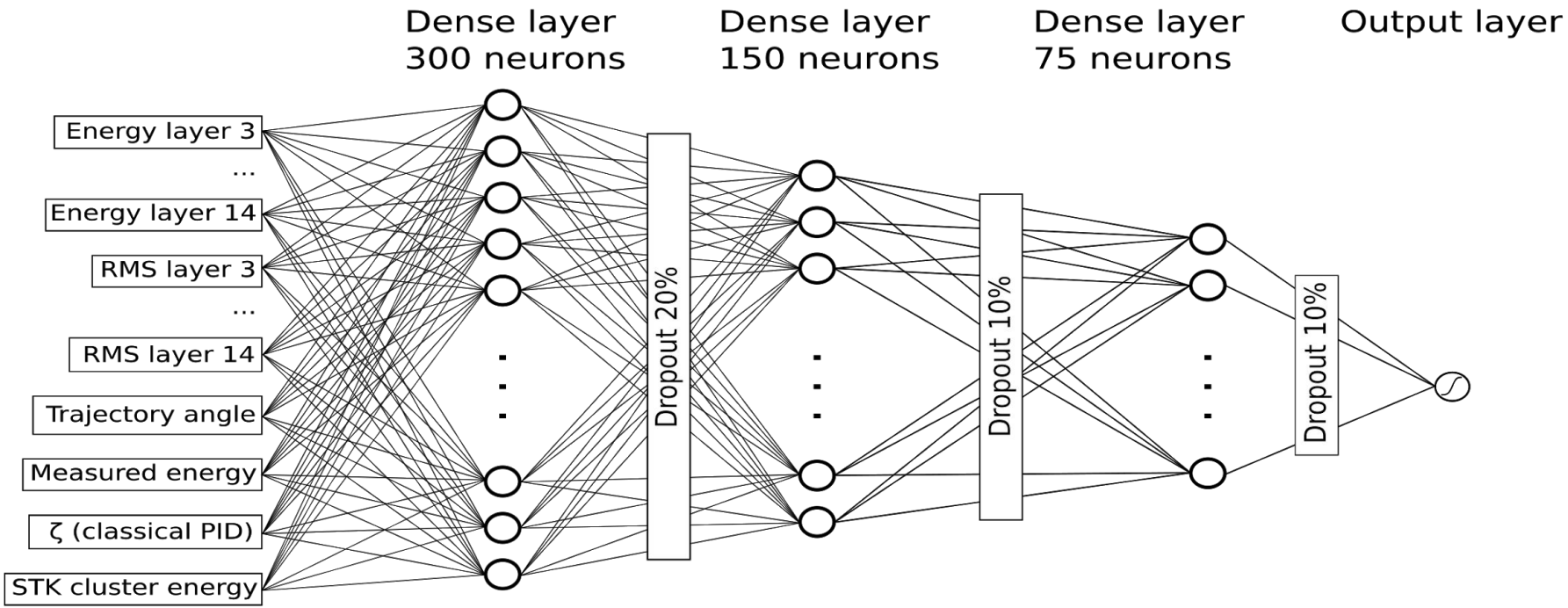


Chang J et al, ASR, 2008
Chang J et al, Astro P, 2017
Ambrosi G et al, Nature, 2017



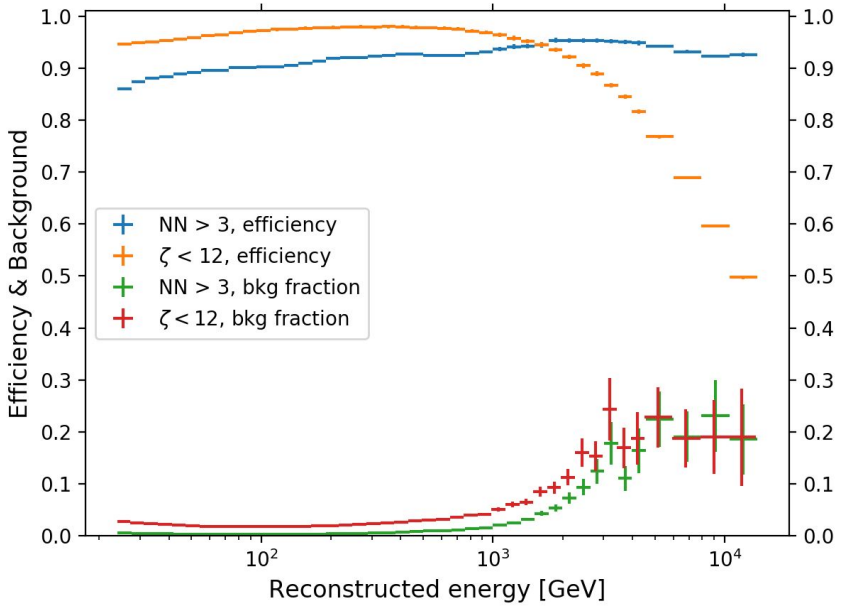


Neural network classifier

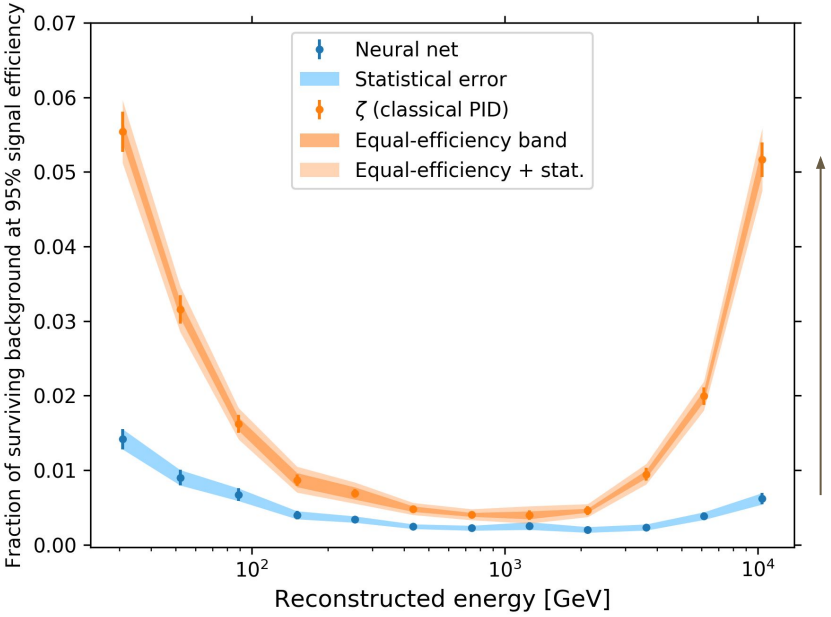


Performances against classical method

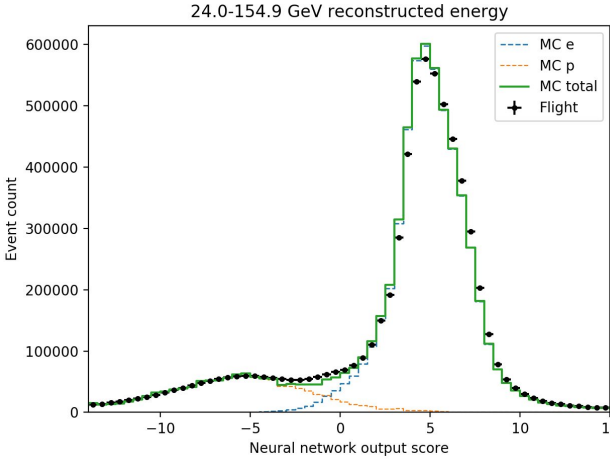
Fixed cut

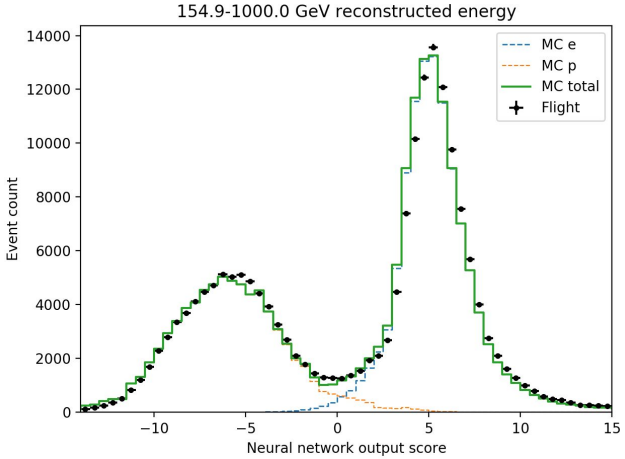


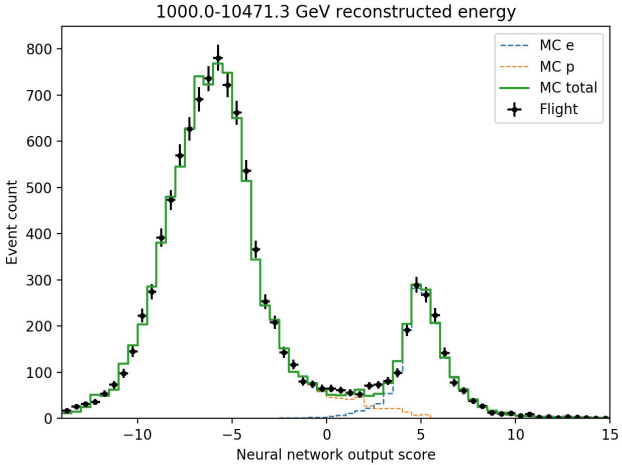
Moving cut (MC only)

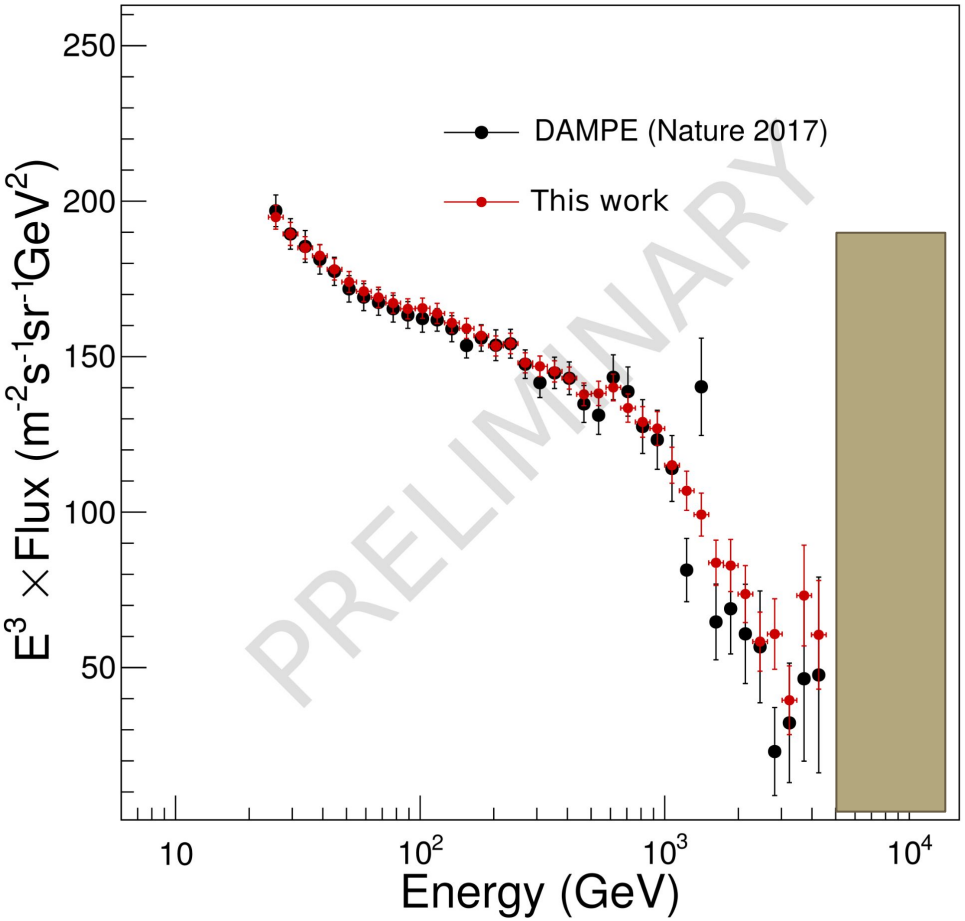


Monte Carlo Validation








DAMPE (Nature 2017)
This work
PRELIMINARY
$E^3 \times$Flux ($m^{-2}s^{-1}sr^{-1}GeV^2$)
Energy (GeV)
250
200
150
100
50
10
10^2
10^3
10^4

Stay tuned!

Backup

Transformation of output

- Sigmoid in output layer squashes distribution to [0;1]
  - Non-monotonous behaviour
  - Complicates interpolation methods
  - Irreducible background
- Replace the sigmoid activation by the identity function
  - Must be done after training so that cross-entropy can still be used
  - Identical classification performances