Neutrals:

neutrinos, photons, neutrons as (maybe rare but) highly special messengers

trace sources

potential insights into new physics

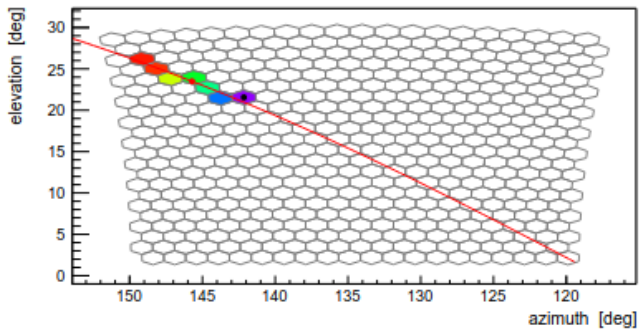
mass composition

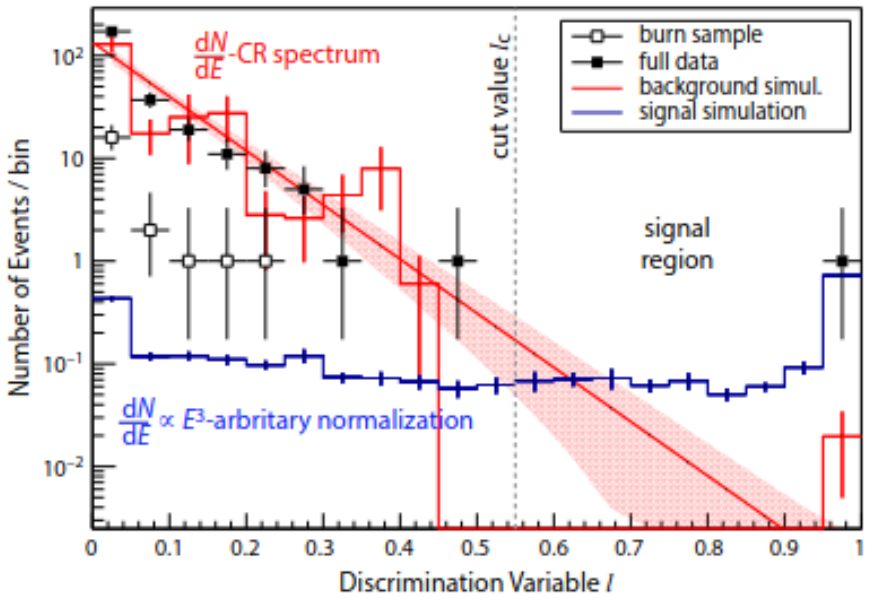
A (non exhaustive and personal) flash over the most recent activity of the MM-Neutrals tasks

If you do not hope for the inexpressible, you will not discover it, because it is closed to seeking, and no road leads to it (Eraclito)

Anita follow up using the FD detector

Search for upward-going showers with the FD above 0.1 EeV, zenith > 110° (Emanuele, LP, Francesco, Massimo, Roberto, Vladimir,...)



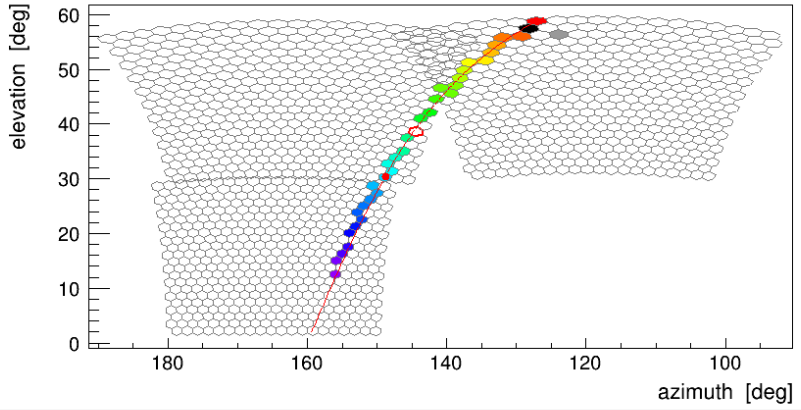


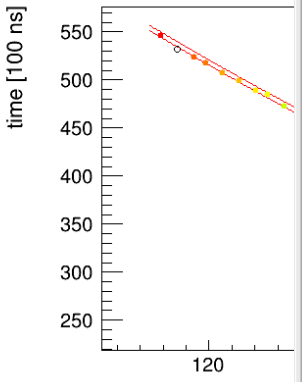
1 candidate consistent with the background (~0.3)

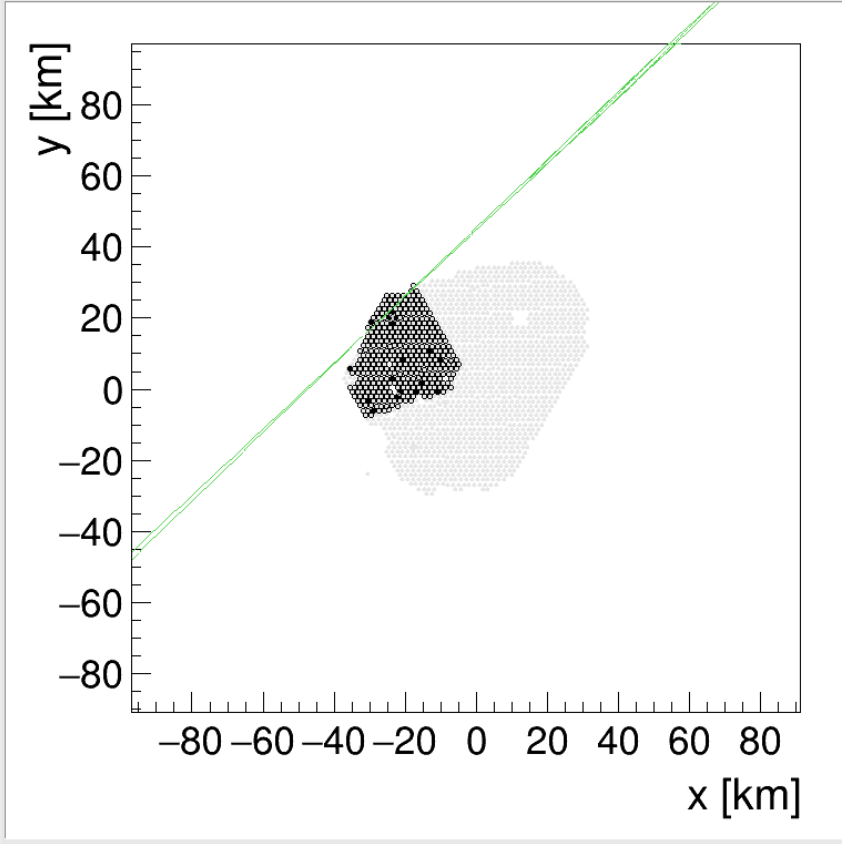
Tau scenarios and BSM (modified deep inelastic cross-sections)

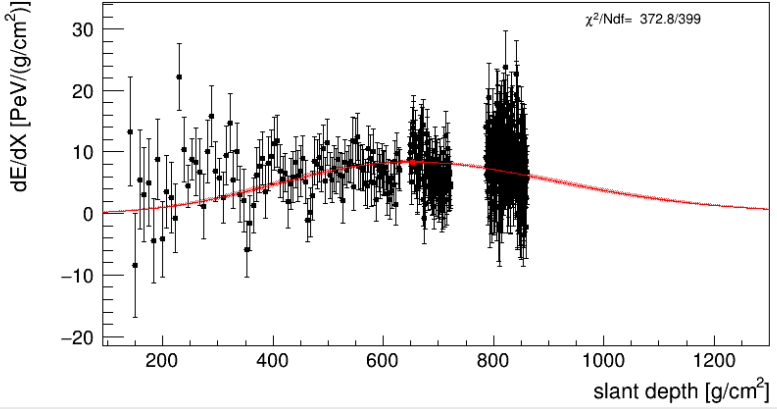
Very inclined, most likely Earth-missing event

zenith~90°, passing over Coihueco at a height of about 18km (not in current analysis)









Event Info | Pixels | PCGF

run 5929, event 5729
time stamp: 1123909401 s 40159081
Trigger: unknown, 'Shower Candidate
in MegaEye mirror 24 26 27 (in DAQ: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27)

geometry: Profile-Constrained
(θ, ϕ) = (89.2±0.4, 40.5±0.1) deg
(x, y) = (-238.44±27.67, -179.53±26.22) km
R_p = 18.14 ± 0.03 km

profile: 4-parameter Gaisser-Hillas (type: USP)
E = (6.37 ± 0.26 ± 0.39) × 10^{18} eV
X_{max} = 653 ± 20 g/cm^2
$(dE/dX)_{max}$ = 8.39 ± 0.20 PeV/(g/cm^2)
(λ, X_0, L) = (49, -642, 252±7) g/cm^2, R = 0.19±0.05
Cherenkov-fraction = 1%, mva=7 deg.

databases:
Mie attenuation: measured (h<16.3 km, VAOD at 3km: 0.00)
LIDAR: no data ; CloudCam: max(ζ)=(0/0)% (elev>5.5^°); CloudMap: max=0%
molecular profile: GDAS; time correction: good

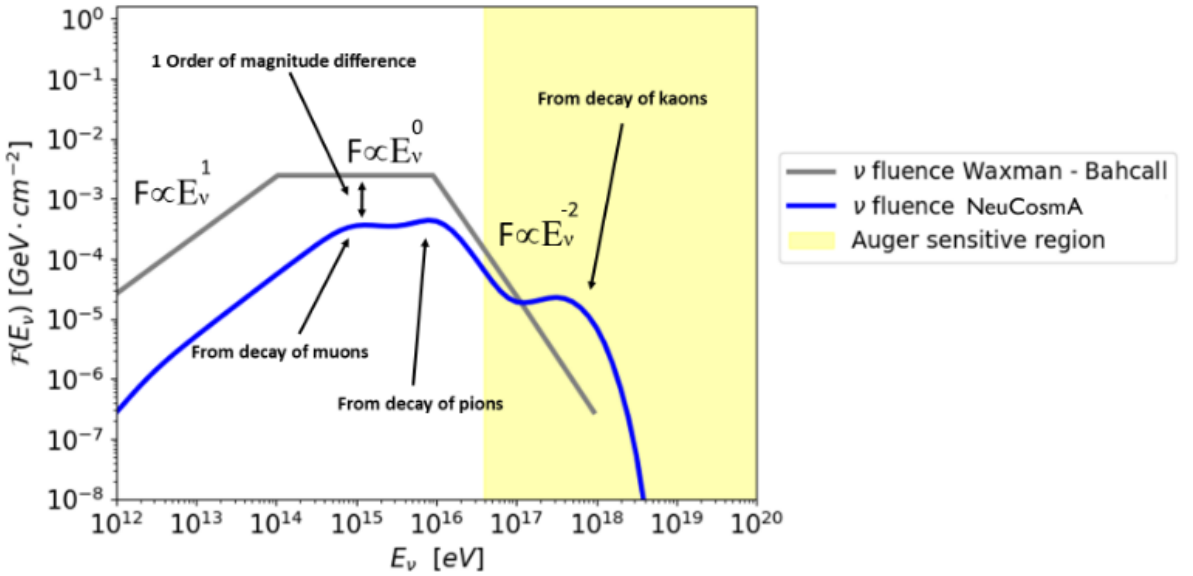
Transient: GRBs

ICRC 2025

Neutrinos from GRBs
→ new fluences calculations (Yago)

427 GRB in DGH (75°-90°)
140 GRB in ES (90°-95°)

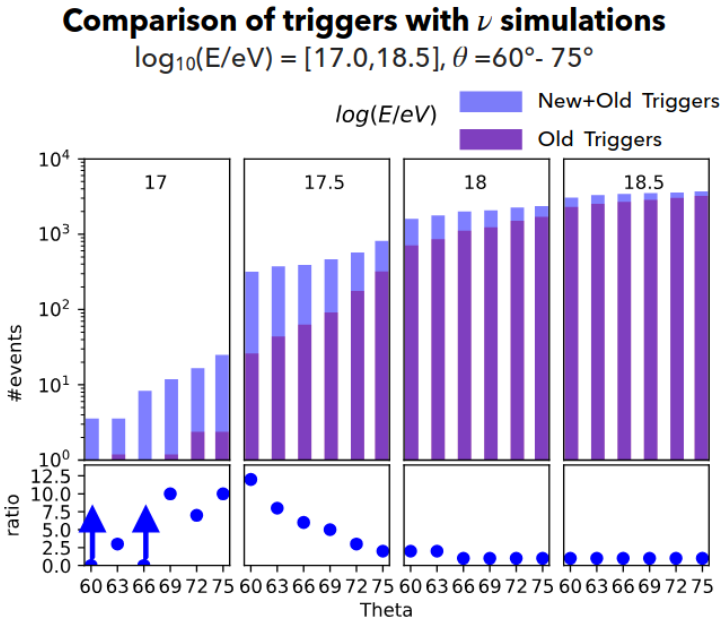
Fluence upper limits

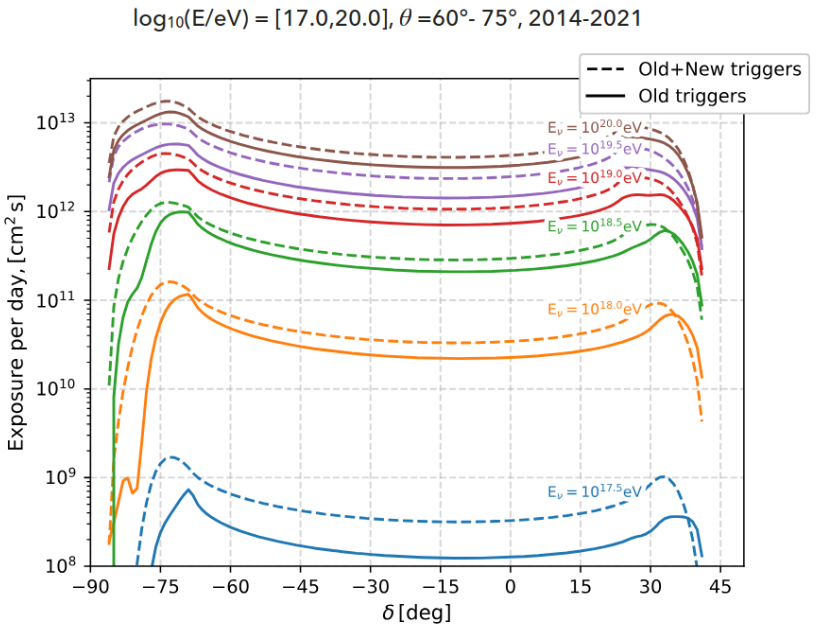


Revisiting the fluence limits for GRB170817A (in coincidence with GW170817)
→ using different emission models and spectral shapes (Therese)

New Triggers: improvement at low energies

Impact of new triggers (ToTd and MoPS) in the search for neutrinos with SD (Srijan).





Gain at low energies.

Papers status and perspectives

PRL with Anita follow up : last iteration with referee is finished!

APJ on BBH (GW follow up with neutrinos): discussion with referee and request of substantial change

APJ on photon search as follow up of Ligo/VIRGO GW sources

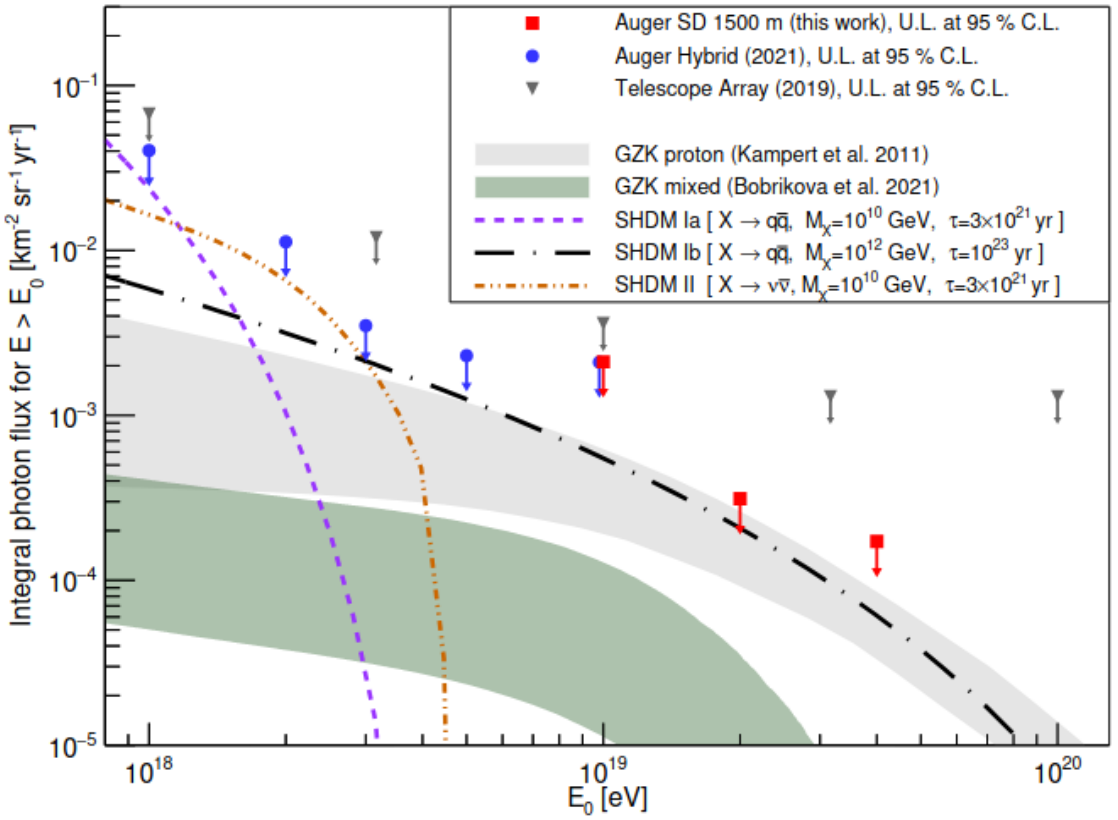
BSM, paper(s) in preparation

Keep the MM network active (the ACME project can help)

Extend the FD analysis towards more inclined/horizontal
- adapting the simulation and the reconstruction scheme
- involve neural network
- using the Cherenkov channel and lower the threshold

Search for photons with SD above 10 EeV

JCAP05(2023)021

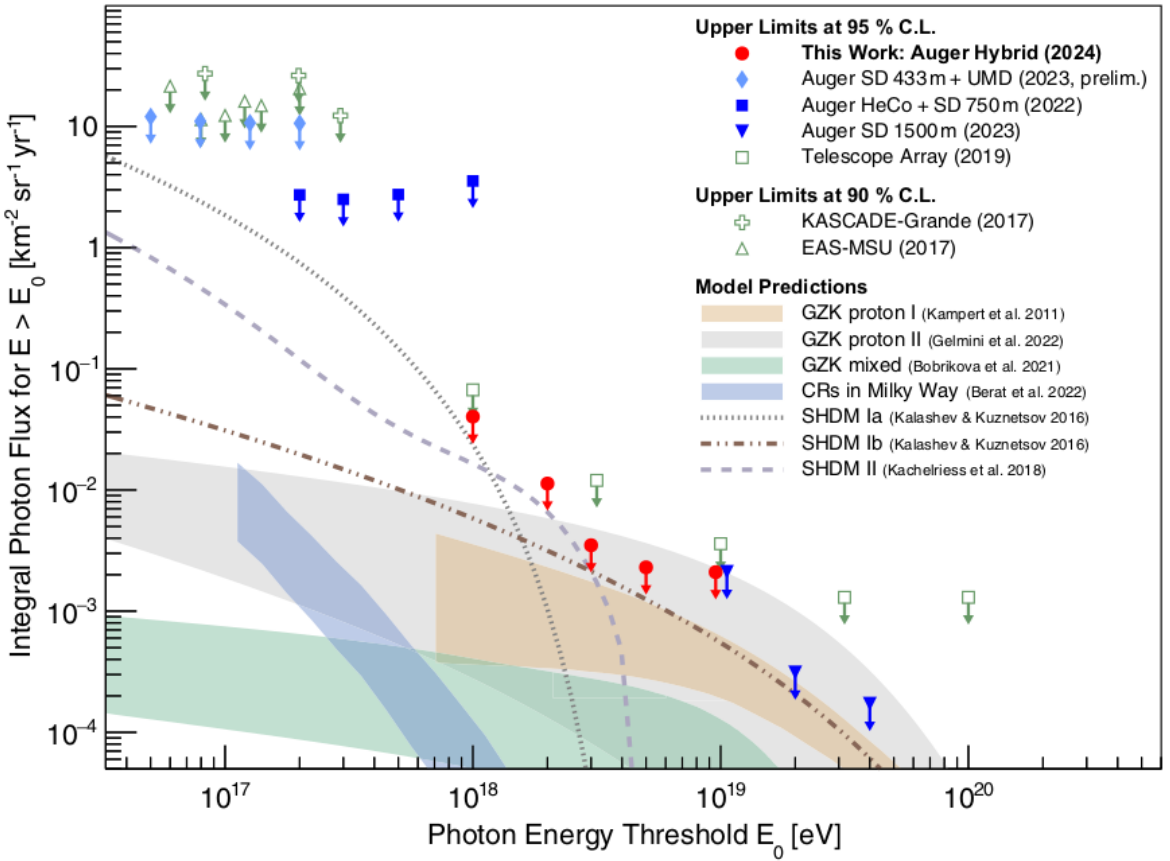


Signal risetime
steepness of the LDF

16(1) candidates above
10(20) EeV

Search for photons with hybrids

PHYS. REV. D 110, 062005 (2024)



E > 10^{18} eV

Hybrid reconstruction to feed the universality model and derive a proxy of the muon content for individual stations

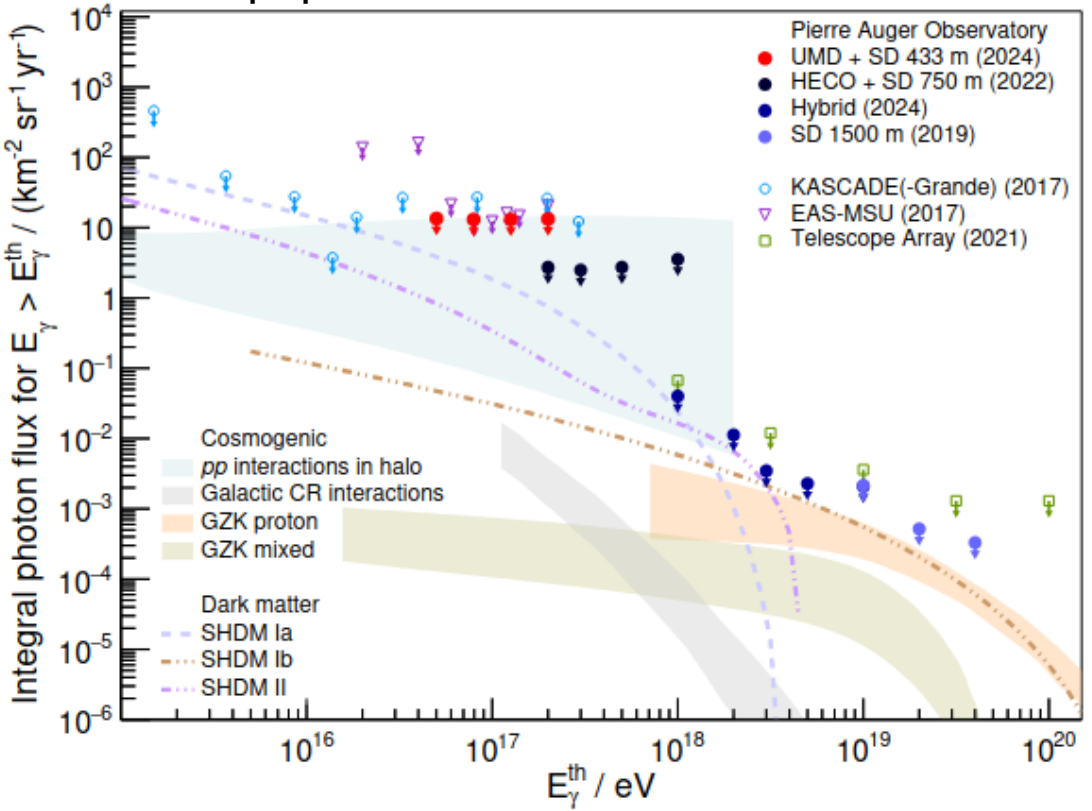
22(2) candidates above 1(2) EeV consistent with the background (subtracted)

E> 2 10^{17} eV APJ 933 (2022)

HEAT data used,
MVA, boost decision tree
No candidates

Search for photons with SD and UMD above 50 PeV

paper near to submission



Direct measurement of the muonic component (UMD+SD433)

No candidates

Target not further than GC

Papers status

JCAP SD analysis > 10 EeV (data up to mid 2020)

PRD hybrid search with universality > 1 EeV (data up to 2017)

APJ hybrid with HEAT > 0.2 EeV (data up to 2015)

To be submitted to JCAP > 50 PeV

Task proposal: have a paper with analysis updated with phase1 data

Perspectives

Hybrid with universality (see Pierpaolo contribution)
- extend the data sample
- energy dependent background calculation
- new upper limit calculation

Hybrid at low energy: investigate the possibility of using the universality also below 1 EeV (to be verified)

SD photon analysis with DNN (Fiona), candidates significantly reduced (~4)
Integrating background will not improve the UL...room for background free searches?
Using SSD could improve on discrimination (Matteo).
In this case, even a shorter time scale may help improving on UL.

Discovery a photon is the most attractive alternative