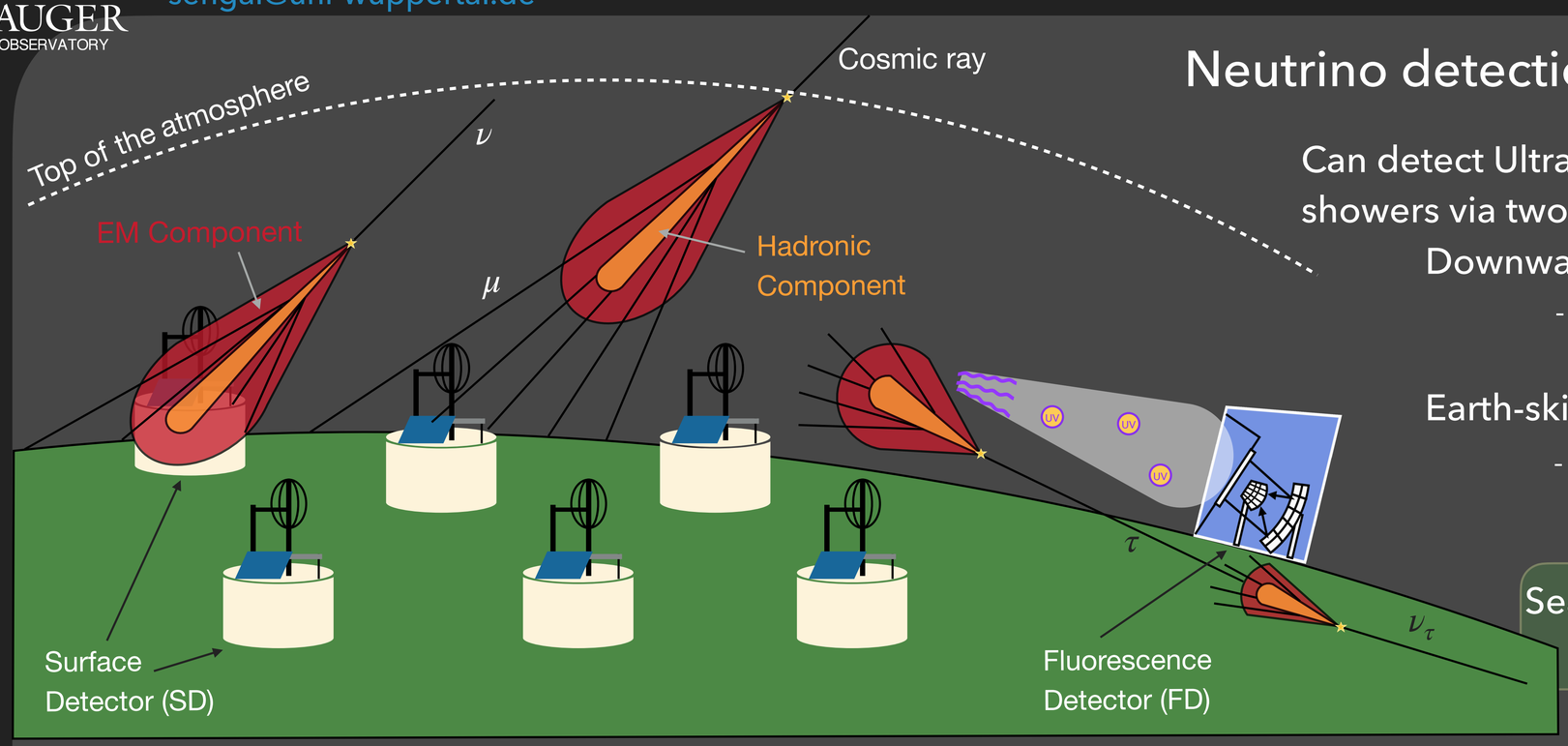
RECENT ULTRA-HIGH ENERGY NEUTRINO SEARCHES AT THE PIERRE AUGER OBSERVATORY

SRIJAN SEHGAL FOR THE PIERRE AUGER COLLABORATION

sehgal@uni-wuppertal.de

BERGISCHE UNIVERSITÄT WUPPERTAL

Bundesministerium für Bildung und Forschung



Neutrino detection at the Pierre Auger Observatory

Can detect Ultra-high energy ($E > 10^{17}$ eV) neutrino induced air showers via two methods:

Downward going (DG) all flavours: NC and CC interactions

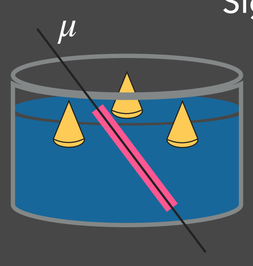
- Neutrino interacts much deeper in the atmosphere compared to main background, cosmic rays

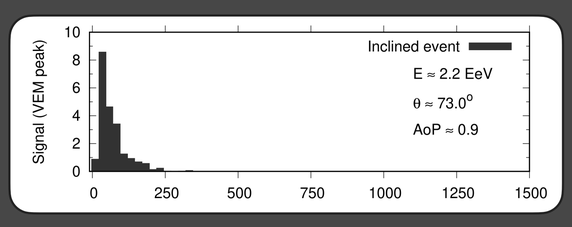
Earth-skimming(ES) ν_τ: CC interaction

- ν_τ interacts inside the earth producing a τ which induces an upward going shower

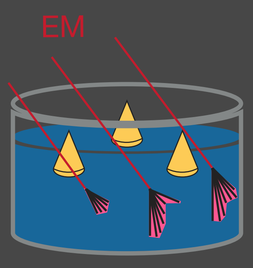
Search for **highly inclined air showers (θ > 60°)** with a **large electro-magnetic component** at ground

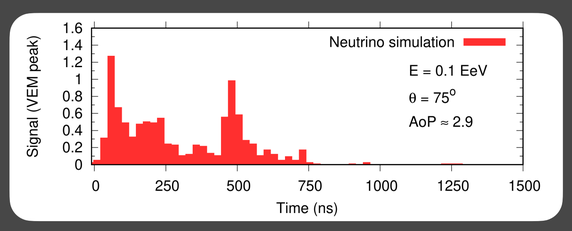
Signal Area over Peak (AoP) main discriminating variable





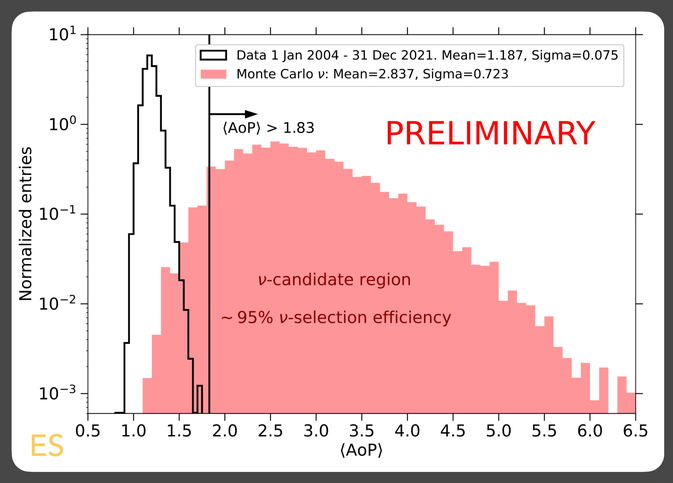
Small Area-over-Peak (due to μ-component)



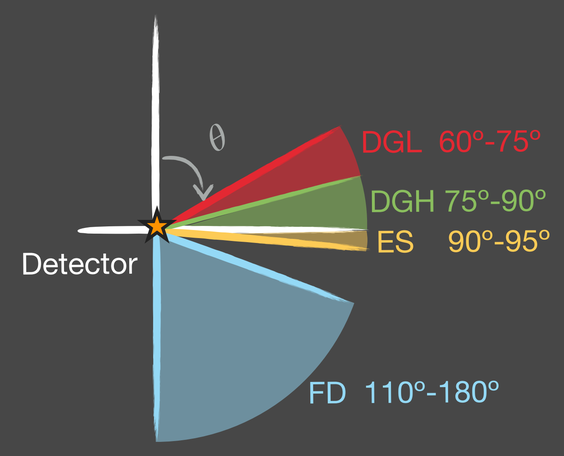


Large Area-over-Peak (due to em-component)

Expected background <1 event in 50 years



NO neutrino candidates found yet

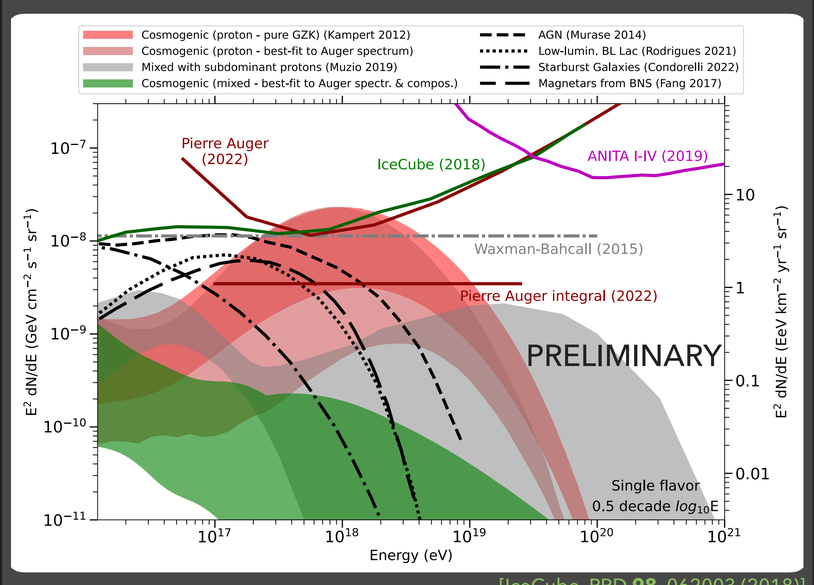


Some interesting results:

Constraints on Diffuse Neutrino Flux

Data between 01.01.2004-31.12.2021 analysed

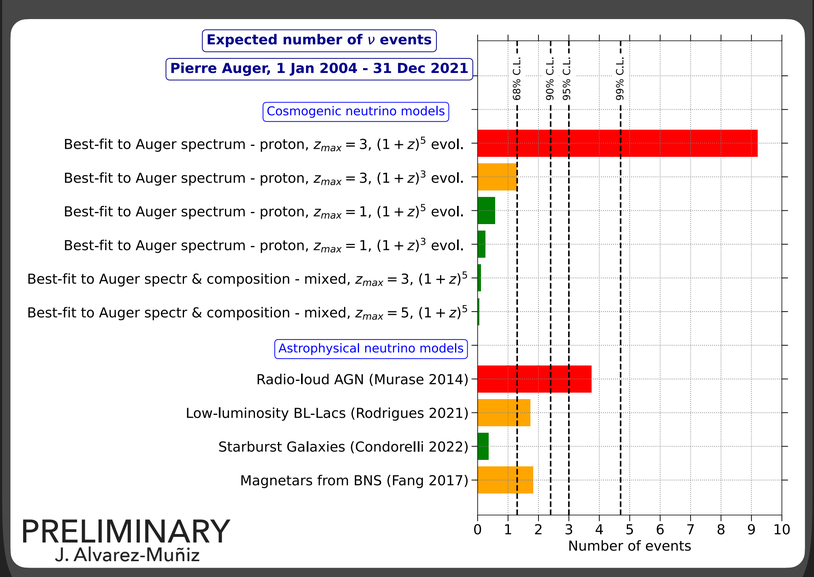
Integral limit between 10^{17} eV and 2.5×10^{19} eV: 3.5×10^{-9} GeV cm^{-2}s^{-1}sr^{-1}



[IceCube, PRD **98**, 062003 (2018)]

[ANITA, PRD **98**, 022001 (2019)]

Non-observation used to constraint astrophysical and cosmogenic neutrino models



[Pierre Auger Coll., JCAP 10 (2019) 022]

[M. Niechciol (Pierre Auger Coll.), PoS (ICRC 2023) 1488]

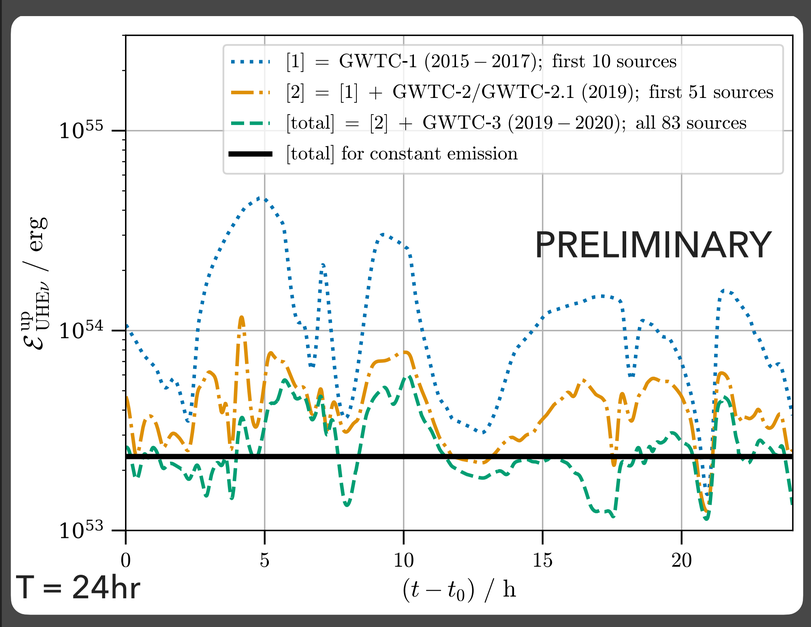
Neutrinos from BBH mergers

Stacking analysis of LIGO/VIRGO BBH mergers

Assumptions:

- Constant emission within 24 hr and 60 day windows after the merger
- Constant luminosity for all mergers with an E_ν^{-2} spectrum
- Non-observation of UHE neutrinos used to calculate UHE neutrino luminosity limit from **83 BBH events**

Limit on total energy emitted in UHE neutrinos per source (90% CL) ~ 2.3×10^{53}erg



Upper limit on ratio of energy emitted in UHE neutrinos to GWs ~ 5%

[Pierre Auger Coll., ApJ in preparation]

[M. Schimp (Pierre Auger Coll.), PoS (ICRC 2021) 968]

Search for upward-going showers with FD

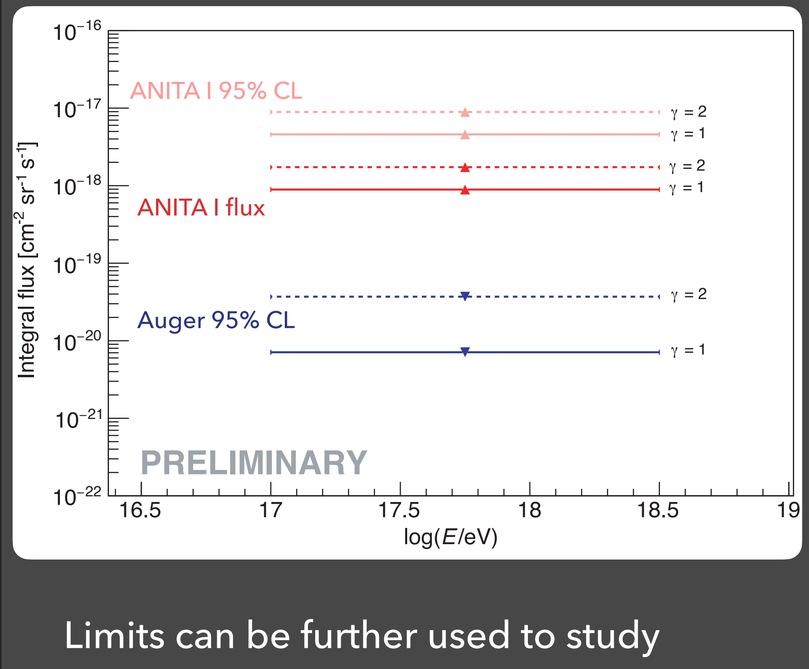
FD can also detect up-going events:

- Zenith angles: $\theta \in [110°, 180°]$
- Shower Energies: $E_{sh} \in [10^{16.5}, 10^{18.5}$ eV]
- First Interaction height: $H_1 \in [0, 9$km]

Used to follow-up anomalous ANITA events

No candidate event observed between 01.01.2004-31.12.2018

Auger limits 100(30) times lower than inferred ANITA fluxes for $E^{-1}(E^{-2})$ spectrum for both ANITA I & ANITA III



Limits can be further used to study viability of BSM scenarios …

(More in poster #241)
B.Yue

[Pierre Auger Coll., PRL in preparation]

[E. De Vito (Pierre Auger Coll.), PoS (ICRC 2023) 1099]