# Sensitivity of different experiments to UHE photon component.[a]

**Grigory I. Rubtsov**

**Institute for Nuclear Research of the Russian Academy of Sciences**

Quarks'2008,

Moscow, May 27, 2008

[a] **work done with Sergey Troitsky and Oleg Kalashev**

# Ultra-high energy photon component

- Ultra high energy photon component have not been discovered.
- There exist several upper limits set in different experiments (AGASA, Yakutsk, Pierre Auger).
- Gamma limits are useful to constrain top-down models.

# Ultra-high energy photon component

- Ultra high energy photon component have not been discovered.
- There exist several upper limits set in different experiments (AGASA, Yakutsk, Pierre Auger).
- Gamma limits are useful to constrain top-down models.
- Longitudal and lateral profiles are different for photon-induced showers.
- Event reconstruction is performed in assumption of hadronic primaries.

# Ultra-high energy gamma flux limits

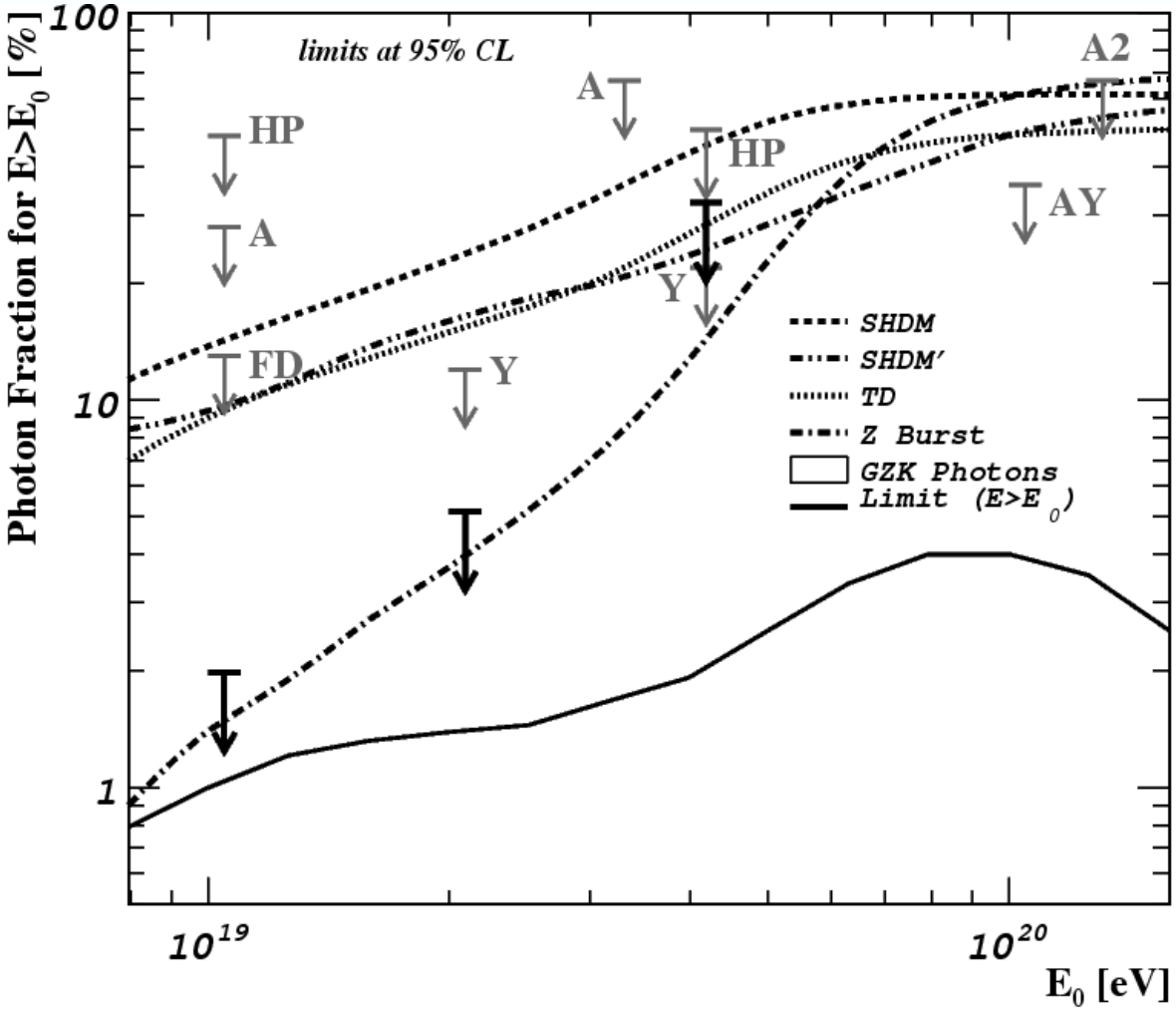


Fig. 1: Abraham et al., Astropart. Phys. 29:243-256,2008

# Energy spectra shifted to match at low end

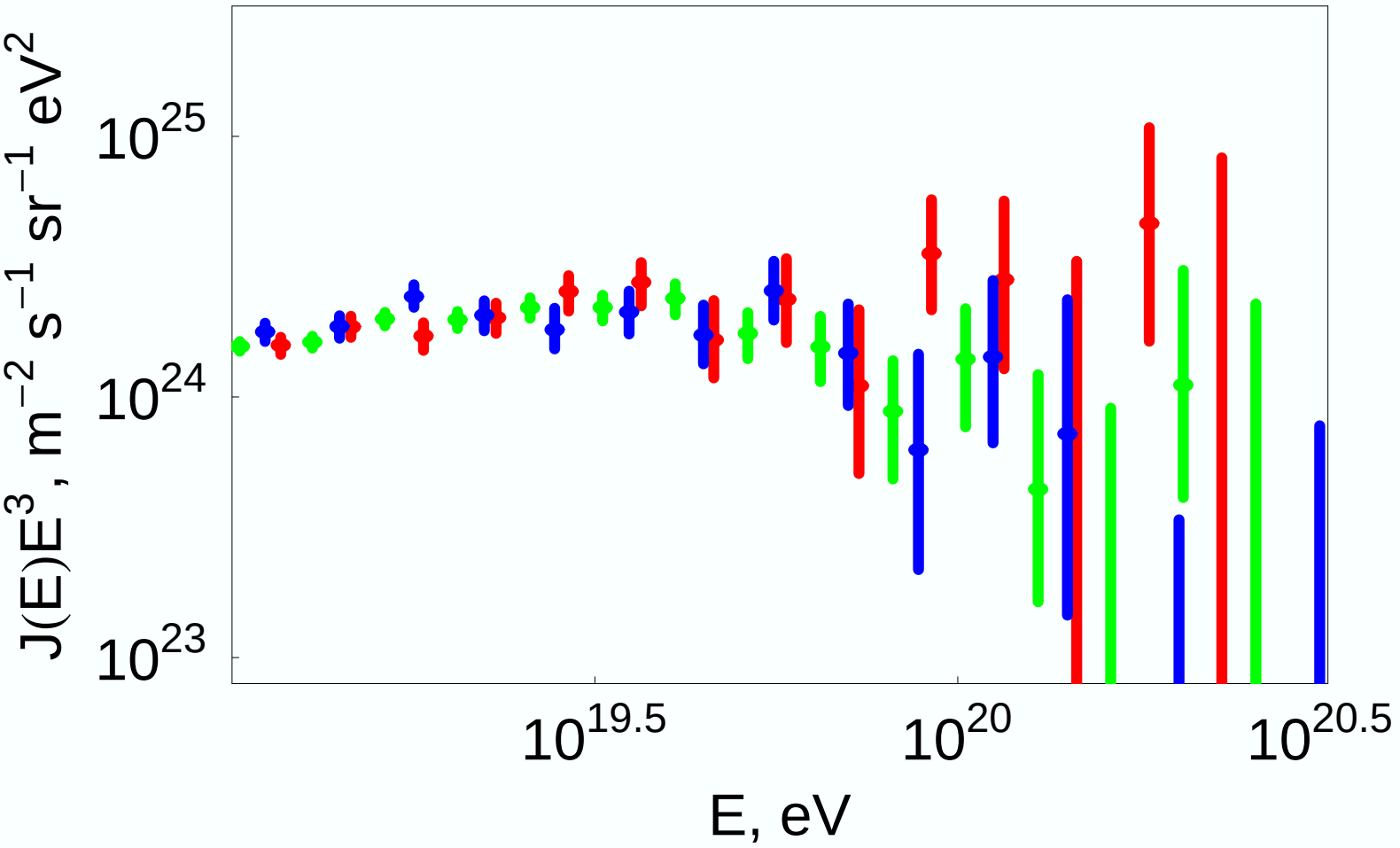


Fig. 2: AGASA, HiRes-I, Auger ground

# Energy spectra

- Energy spectra look different at the highest energies, although low statistics
- HiRes and Auger spectra fits favour zero distance to the closed source ($z_{min} = 0$) [Gelmini et al. Astropart.Phys. 28:390-396,2007; Arisaka et al. JCAP 0712:002,2007], but we don't see the source candidates nearby
- Another component may be responsible?

# Auger sesnitivity to photons

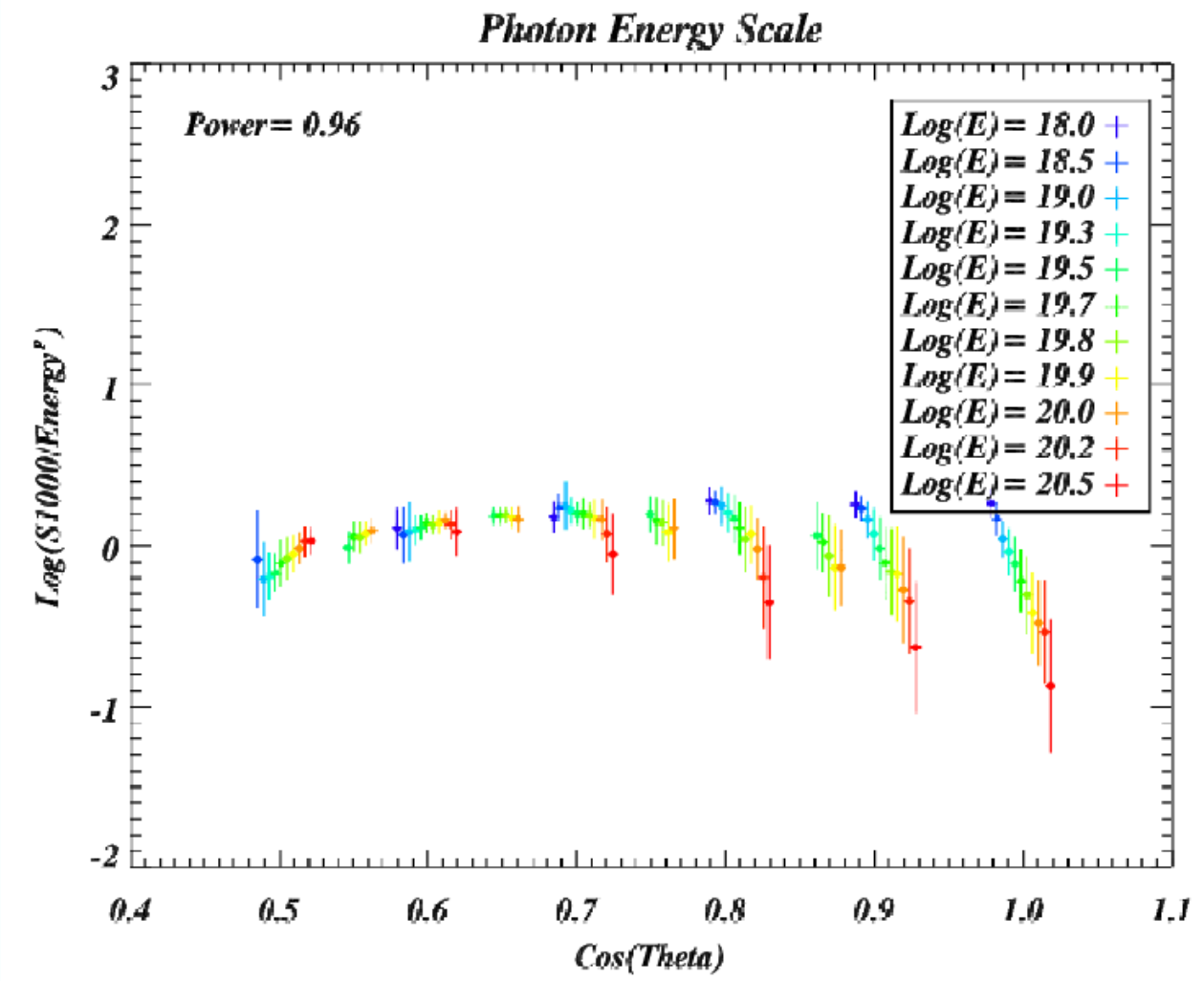


Fig. 1: [Billoir et al, astro-ph/0701583], no geomagnetic field

# Gammas @ Auger

- We simulate geomagnetic cascade for El Nuhuil location using PRESHOWER code by Pietr. Homola.
- We reconstruct the primary energy of photons using energy and S(1000) relation.
- Reconstructed energy depends on primary energy, azimuth and zenith angles.

# Gammas @ AGASA and HIRES

## AGASA

- The detector response function for AGASA is published [Sakaki et al, Proc. ICRC 2001]
- We simulate photon-induced showers using CORSIKA 6.61 with PRESHOWER code.
- We reconstruct energies using S(600) and Energy relation.

## HIRES

- HiRES-I reconstructed spectrum for gamma primaries is calculated using energy correction [T. Pierog et al., Proc.29th ICRC] and acceptance [de Souza, Medina-Tanco, Ortiz Phys.Rev.D 72,103009] for gamma rays.

# Results

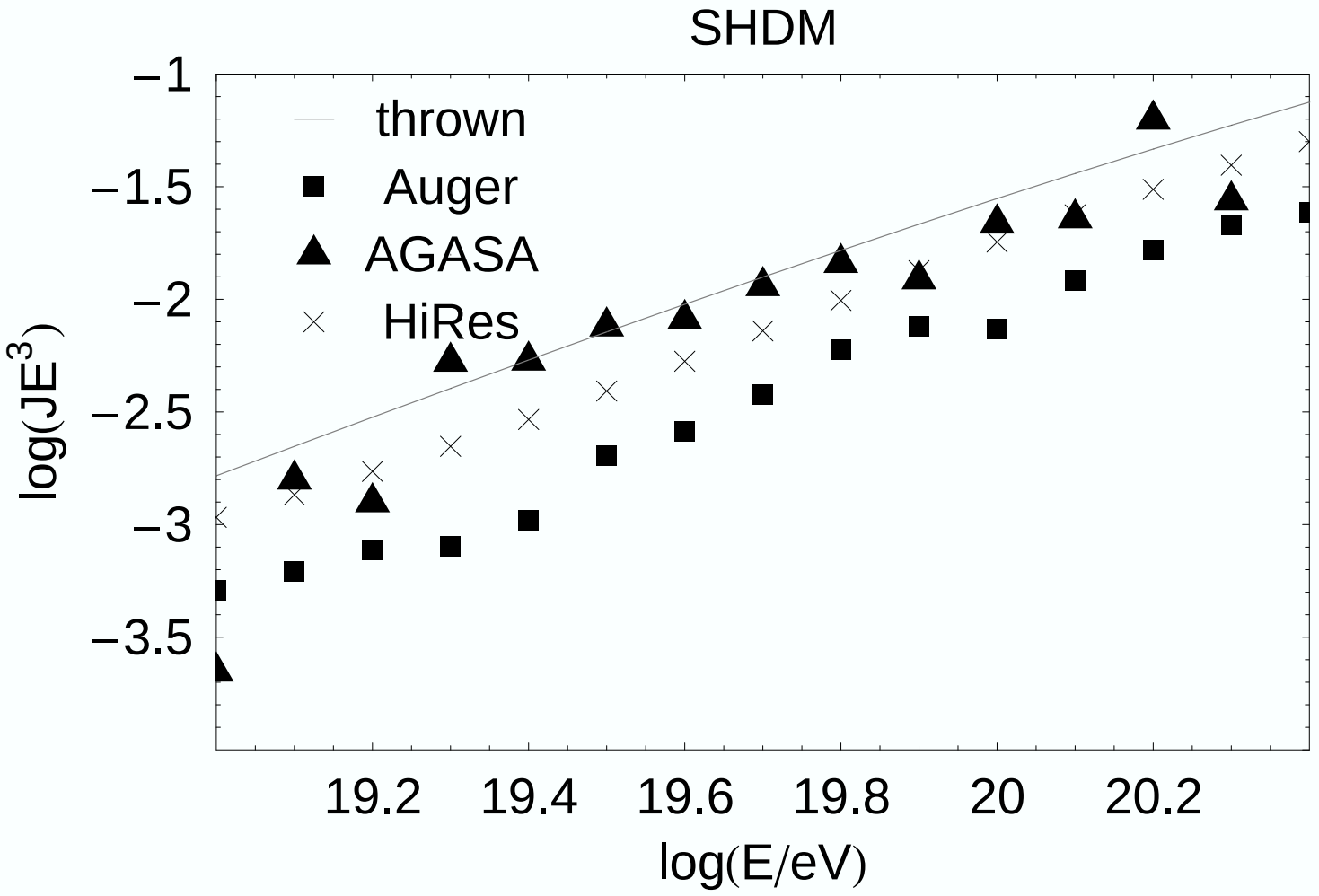


Fig. 3: SHDM gamma spectrum as observed by different experiments

# (repeated) Shifted energy spectra

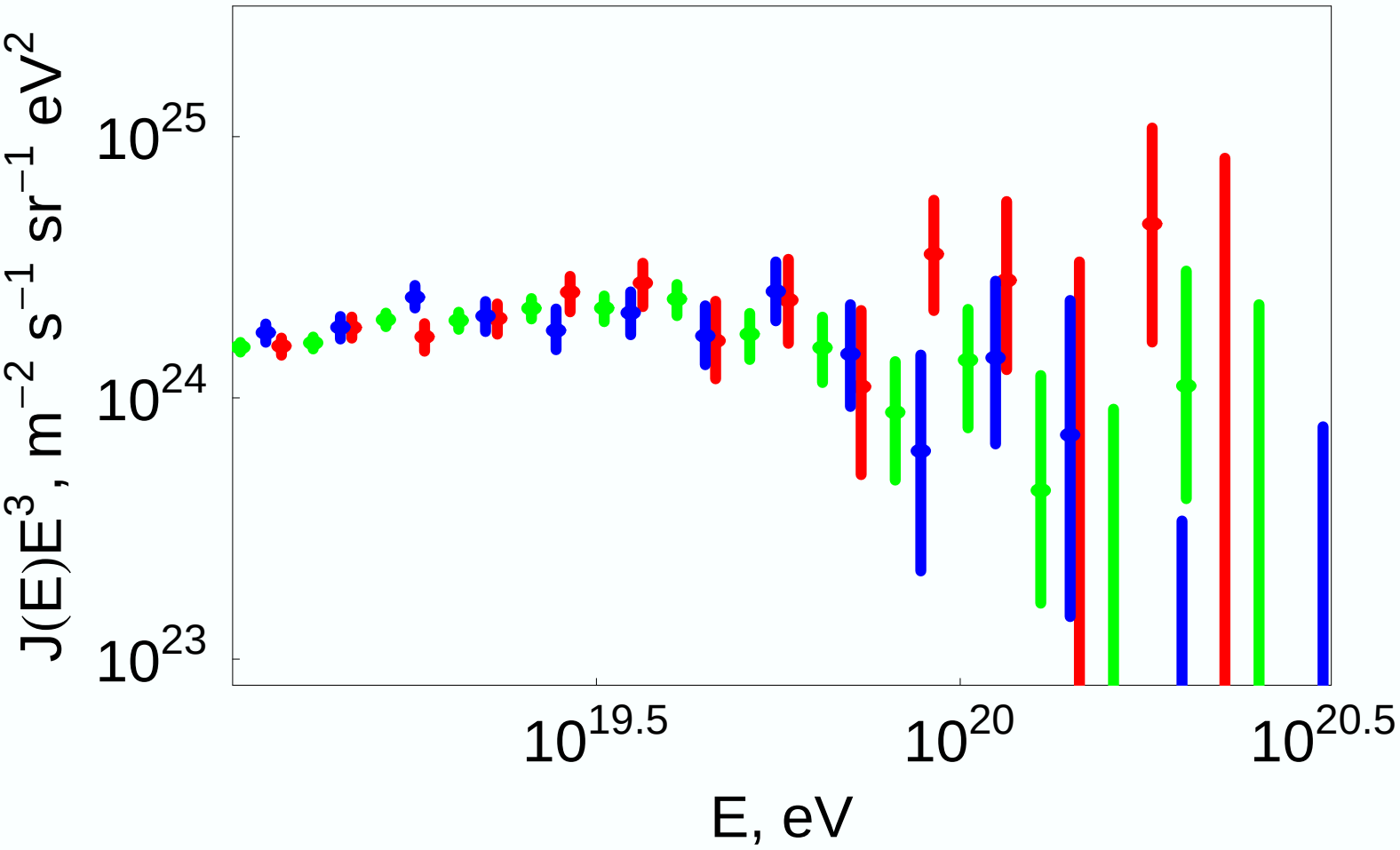


Fig. 2: **AGASA**, **HiRes-I**, **Auger ground**

# Conclusions

- Sensitivity to the primary type is important for super-GZK component.
- Photon component is one example, although the statistics is not large enough.

# Conclusions

- Sensitivity to the primary type is important for super-GZK component.
- Photon component is one example, although the statistics is not large enough.

- One should account for different reconstruction of photon-induced air showers when reproducing primary spectrum.
- Modern gamma flux upper limits use correct procedure.