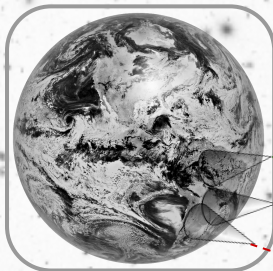


# UHECRs and by-products

## Air showers

- Particle sampling
- Fluorescence

→  $(\alpha, \delta)$ ,  $E$ ,  $X_{\max}$



$\pi^0 \rightarrow \gamma\text{-rays}$   
 $\pi^{+/-} \rightarrow \mu \nu$   
**EeV-ZeV cosmic rays**  
**EBL eV photons**

**CMB meV photons**

**electromagnetic emission**

**Long gamma-ray burst**

**Jetted Active Galactic Nucleus**

## MICRO key modeling points

- **Catalogs** tracing AGN and GRB activity, e.g.:
  - Radio catalogs of AGNs (Bochum, Wuppertal)
  - Infrared mapping of star formation rate (Orsay)
- **UHECR propagation**, including:
  - In-source propagation: jet
  - Escape, time spread: host galaxy, cluster
  - Intergalactic medium
- **Neutral secondaries**
  - TeV-PeV neutrinos (IceCube, KM3NeT)
  - GeV-TeV gamma rays (*Fermi*-LAT, CTA)

