All-sky and Galactic Ridge diffuse astrophysical neutrino flux search with KM3NeT/ARCA6-8-19-21 data

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KM3NeT detectors

- Network of Cherenkov detectors [1]:
  - ➡ **KM3NeT/ARCA** optimized for high-energy (TeV-PeV) astrophysical neutrinos;
  - ➡ **KM3NeT/ORCA** optimized for few-GeV atmospheric neutrinos;
- 31 x 3" PMTs hosted in pressure resistant glass sphere: Digital Optical Module (DOM);
- 18 DOMs anchored at the seafloor with buoyancy at the top form a detection unit (DU);
- 115 DUs evenly spaced form a building block.

|	ARCA	ORCA
Location	Italy	France
N. building building blocks	2	1
DU distance	90 m	23 m
DOM spacing	36 m	9 m
DU height	~ 800 m	~ 200 m
Instrumented mass (Mton)	2*650	7
Depth	3500 m	2500 m

The KM3NeT DOM
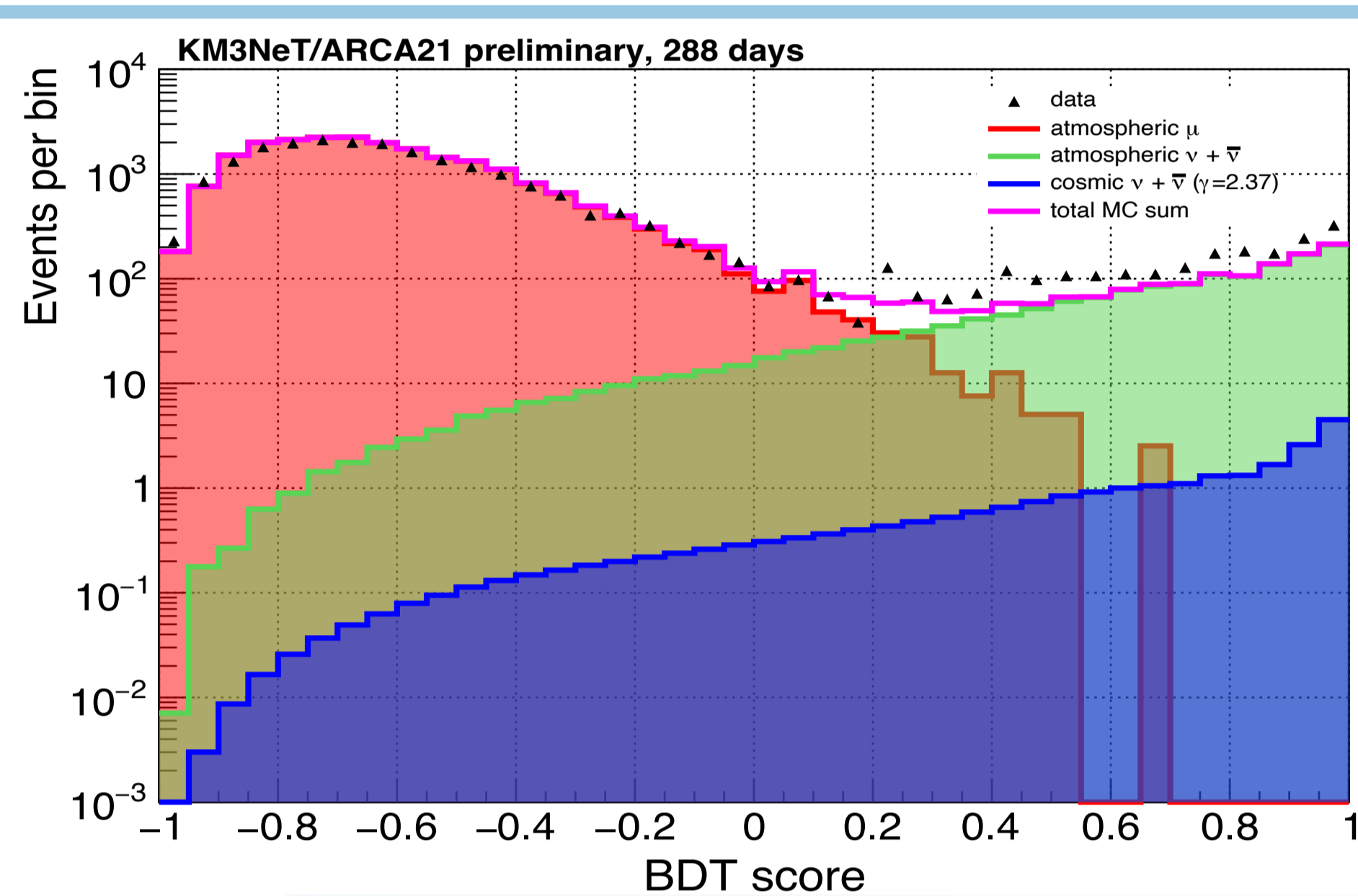
Event selection & BDT

Events reconstructed as up-going tracks are selected based on trigger level information and on variables indicating the quality of the track reconstruction.

A Boosted Decision Tree (BDT) classifier, using ROOT TMVA[2] was applied to suppress the atmospheric muon background. Separate BDT trainings have been performed for the ARCA6/8 and ARCA19/21 geometries.

Cut optimization based on MRF minimization [3].

All-sky

An all-flavor cosmic neutrino search (both CC+NC) is performed.
In this work the flux is parameterized with an unbroken power-law.
As a baseline IceCube's reported values [4] ϕ_0 = 1.44 and γ = 2.37 are used.
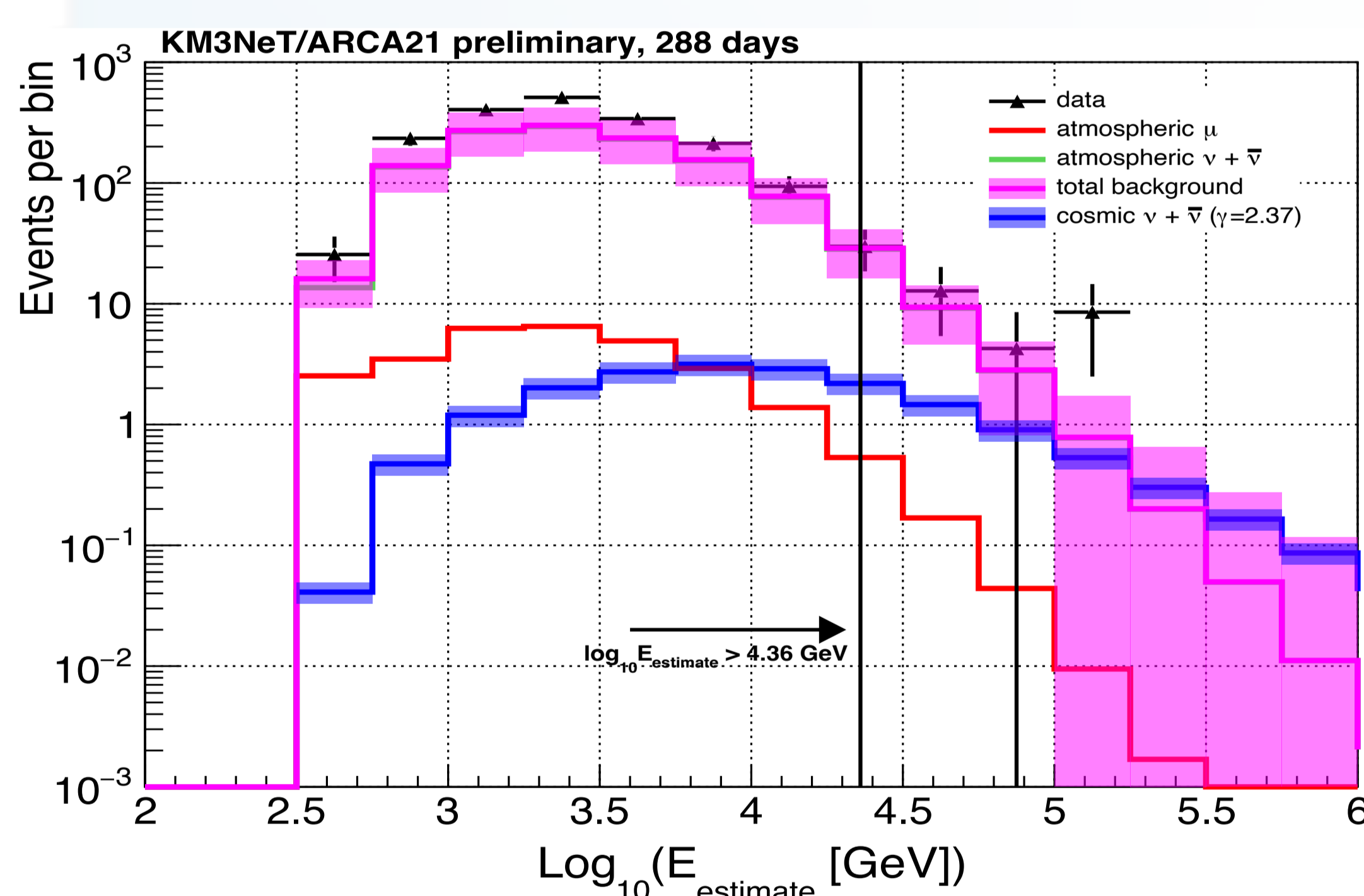

Galactic ridge

Searching for a possible excess of events coming from an extended region, with Galactic coordinates $|l|$ < 30° and $|b|$ < 2°, namely the Galactic Ridge (ON zone).

Data-driven background extracted from OFF zone region: same sky coverage but shifted in right ascension. Signal modeled assuming an unbroken power-law. More detail on the analysis procedure in [5].
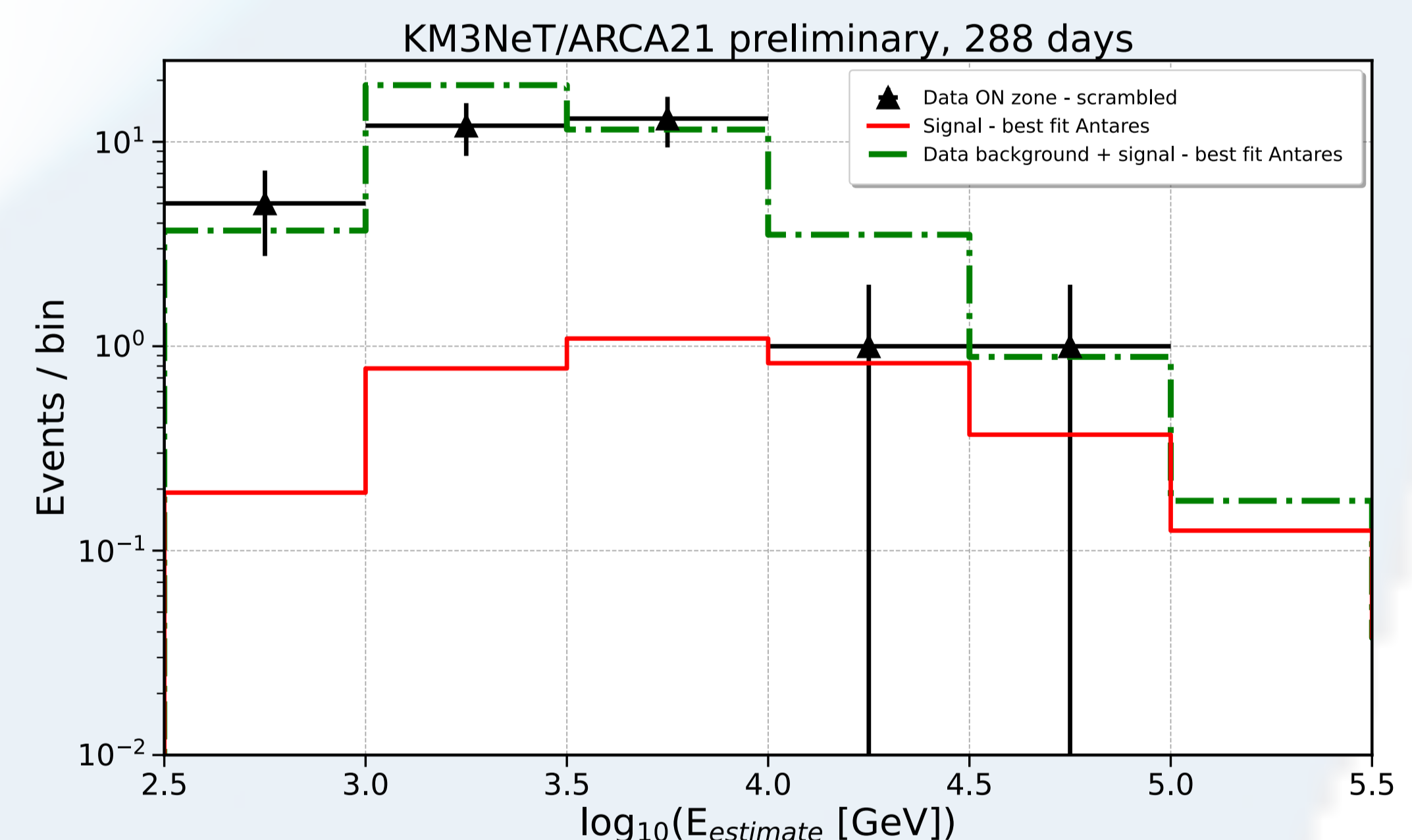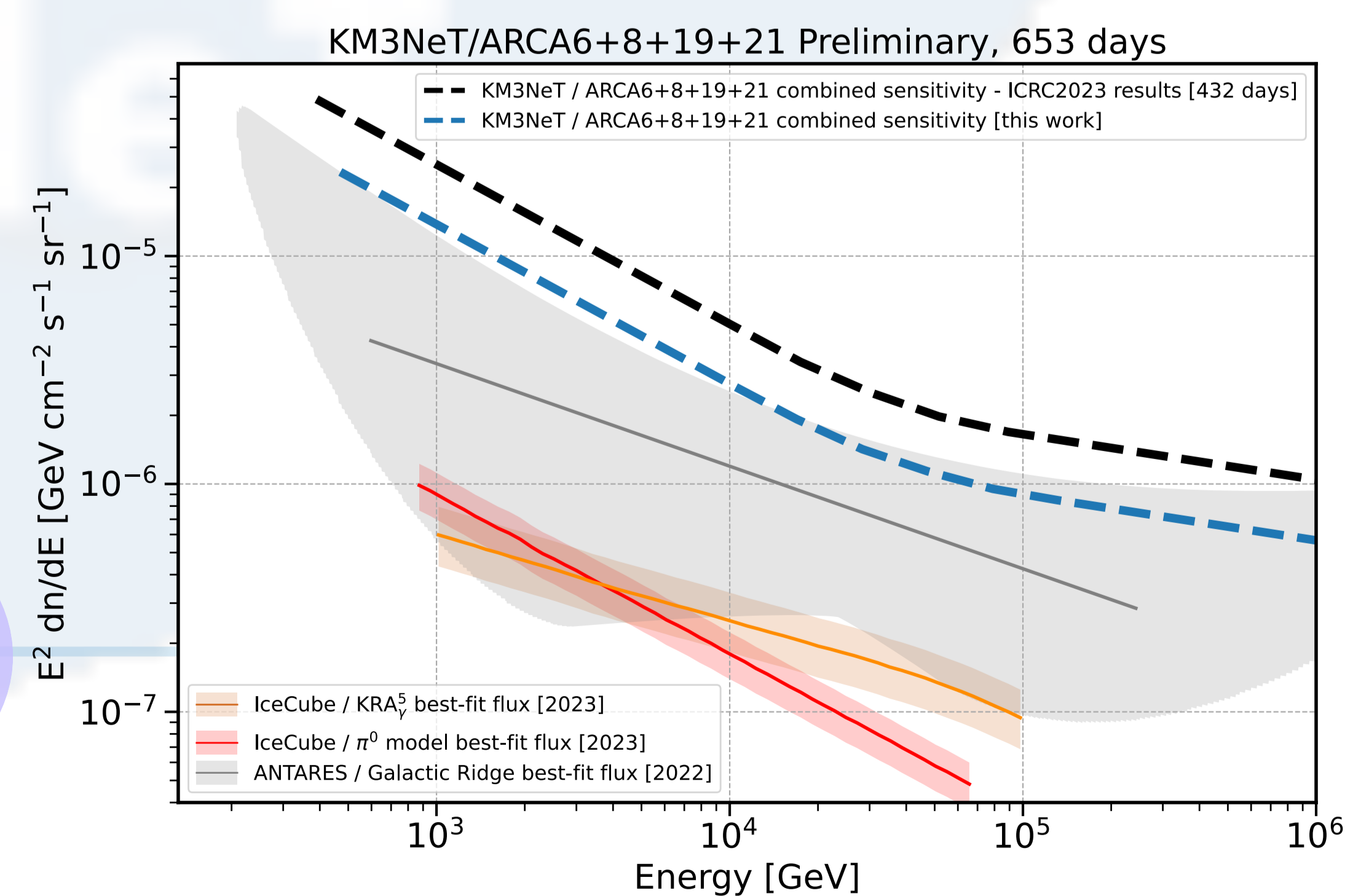

Sensitivity

A Bayesian approach, described in [5] is used to extract sensitivities and upper limits for different spectral indices. The convolution of sensitivities at 90% C.I. for ARCA6+8+19+21, as a function of energy, for a subset of selected spectral indices is shown. The improvement in sensitivity reported in this contribution with respect to ICRC23, is due to an increase of the livetime analyzed: from 67 days to the whole ARCA21 data taking period, accounting in total 288 days.
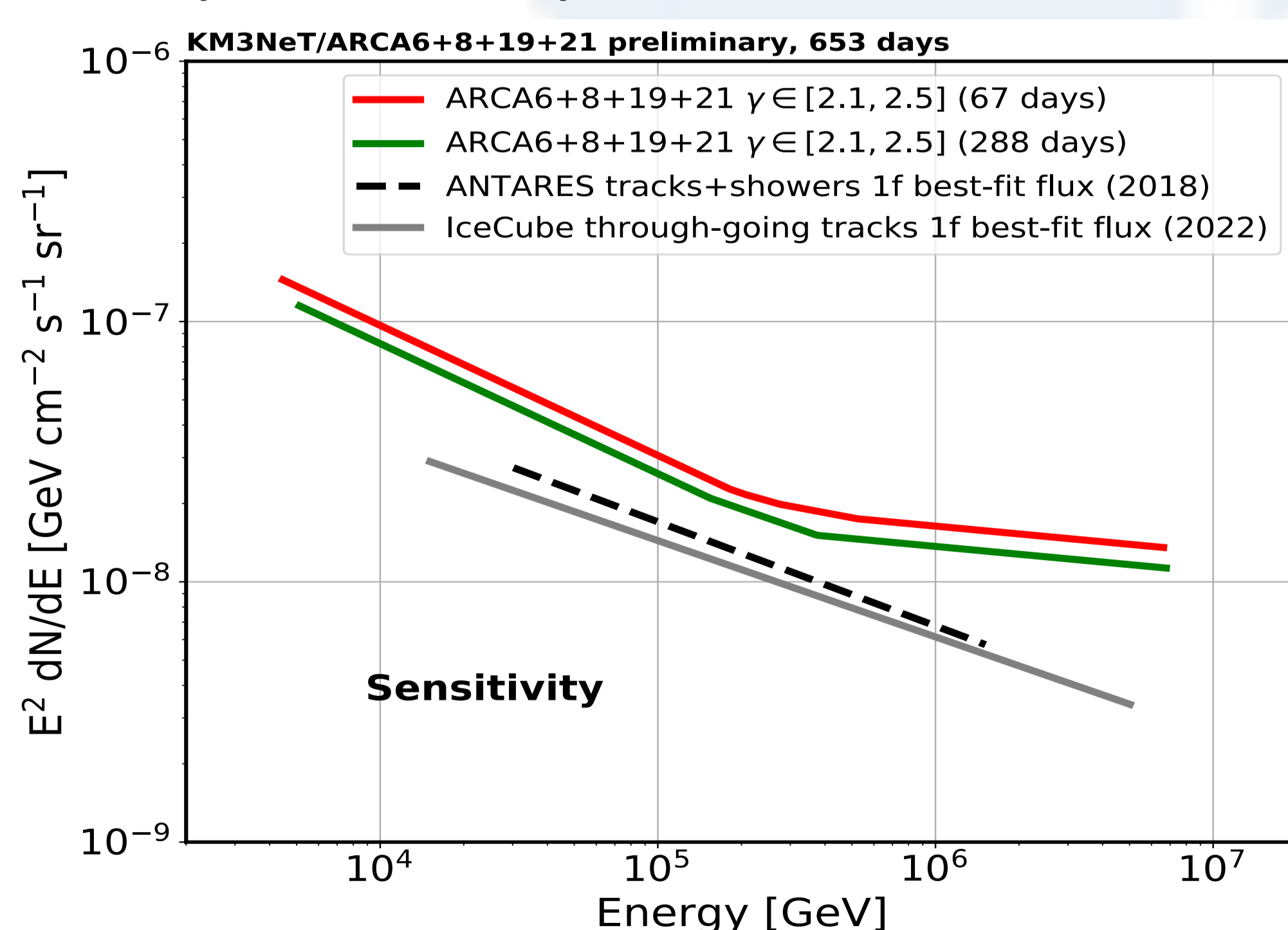
KM3NeT/ARCA is rapidly evolving approaching ANTARES and IceCube fitted fluxes

In the plot above, the KM3NeT/ARCA sensitivity, for the two searches, is compared to the ANTARES and IceCube best fits.
KM3NeT detectors are collecting more and more data and the instrumented volume is growing. KM3NeT/ARCA is currently taking data with 28 DUs.

References:
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