Institute of Cosmos Sciences

EXCELENCIA MARÍA DE MAEZTU

MAGIC

Major Atmospheric Gamma Imaging Cerenkov Telescopes

2018/2019 campaign on TXS 0506+056

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for the ***MAGIC*** Collaboration

ICRC 2019

July 30, 2019

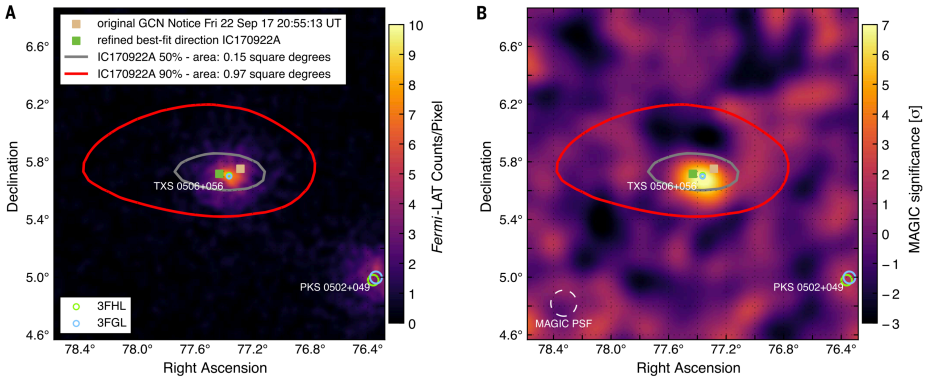
Madison, WI

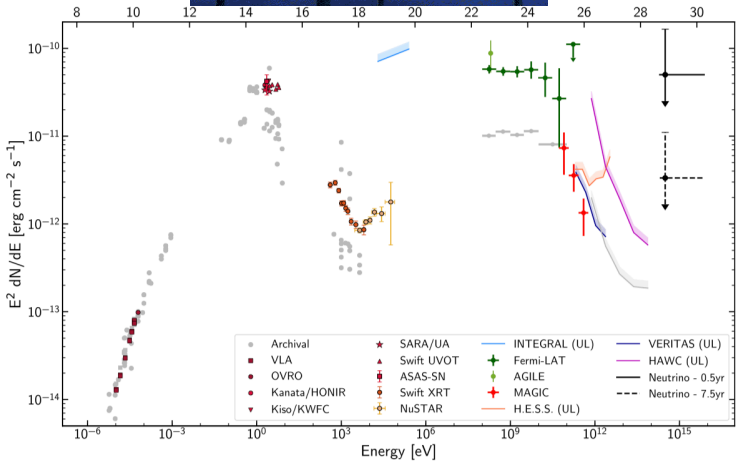
UNIVERSITAT DE BARCELONA

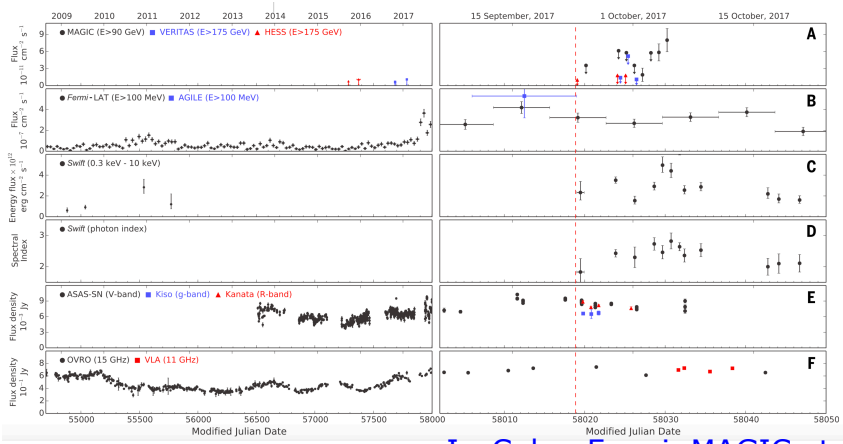
"la Caixa" Foundation

IceCube-170922A / TXS 0506+056

Most significant association (3σ)
of a high-energy (290 TeV) neutrino with an astrophysical source



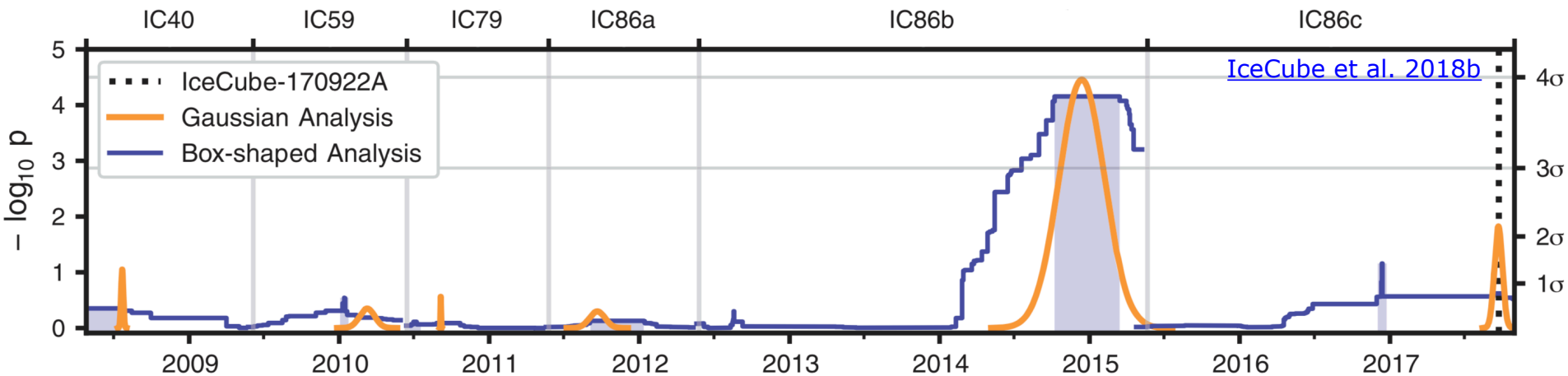




IceCube, Fermi, MAGIC et al. 2018

IceCube-170922A / TXS 0506+056

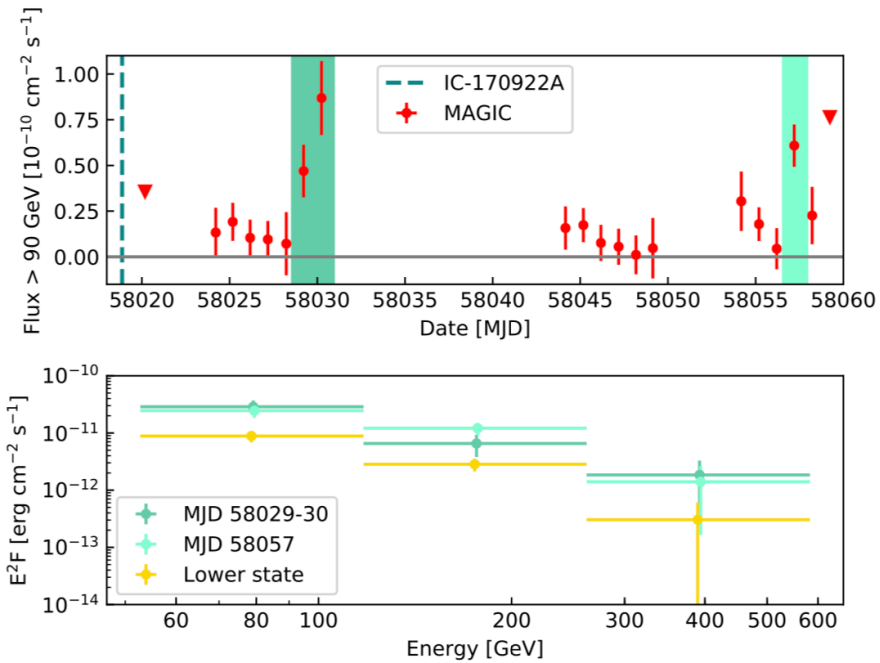
Detection of a neutrino flare (at TeV energies) in 2014-2015 (without a gamma-ray counterpart)

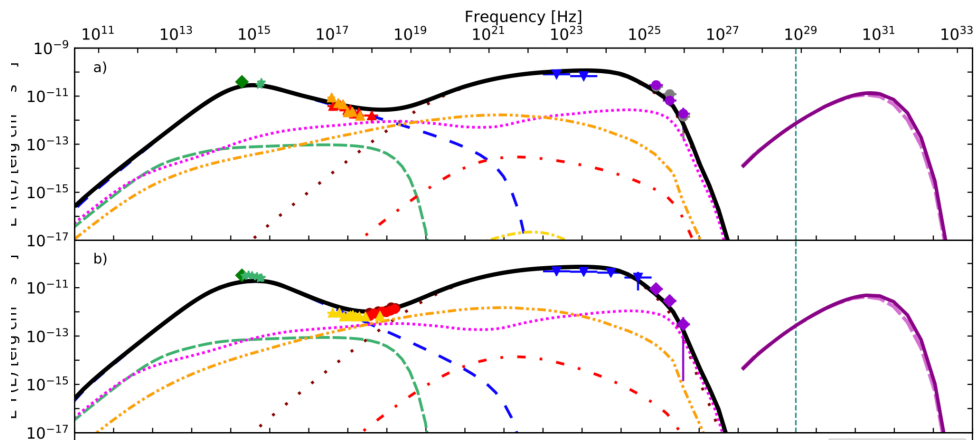


3.5σ evidence for neutrino emission in 2014-2015 independent from the 2017 event

IceCube-170922A / TXS 0506+056

The MAGIC Collaboration reported a more extensive characterization of the VHE emission, and SED modeling

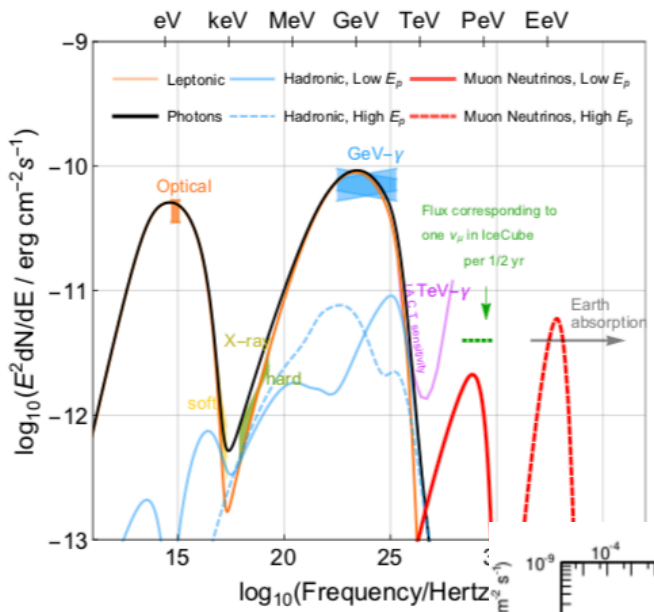




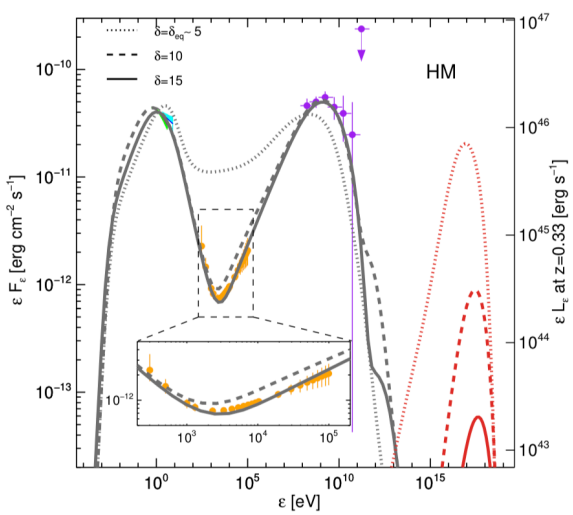
MAGIC Collaboration et al. 2018

IceCube-170922A / TXS 0506+056

Several independent modeling efforts

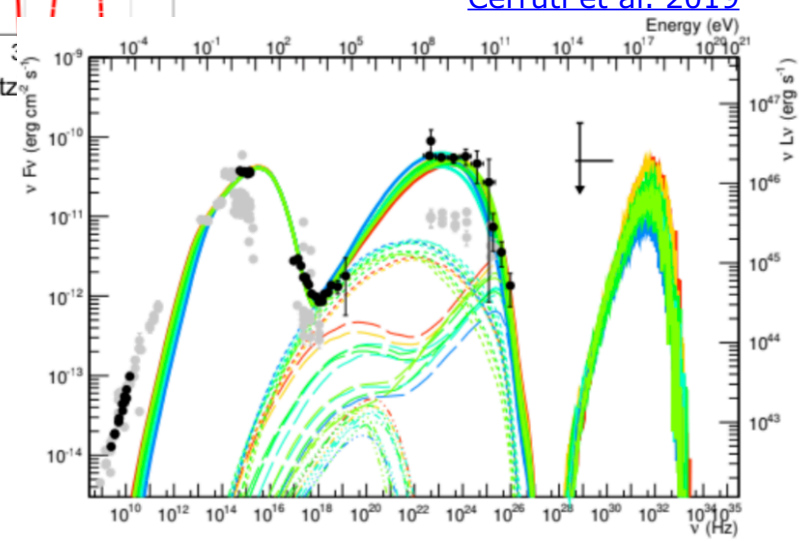


Keivani et al. 2018



Gao et al. 2019

Cerruti et al. 2019



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IceCube-170922A / TXS 0506+056

Several independent modeling efforts

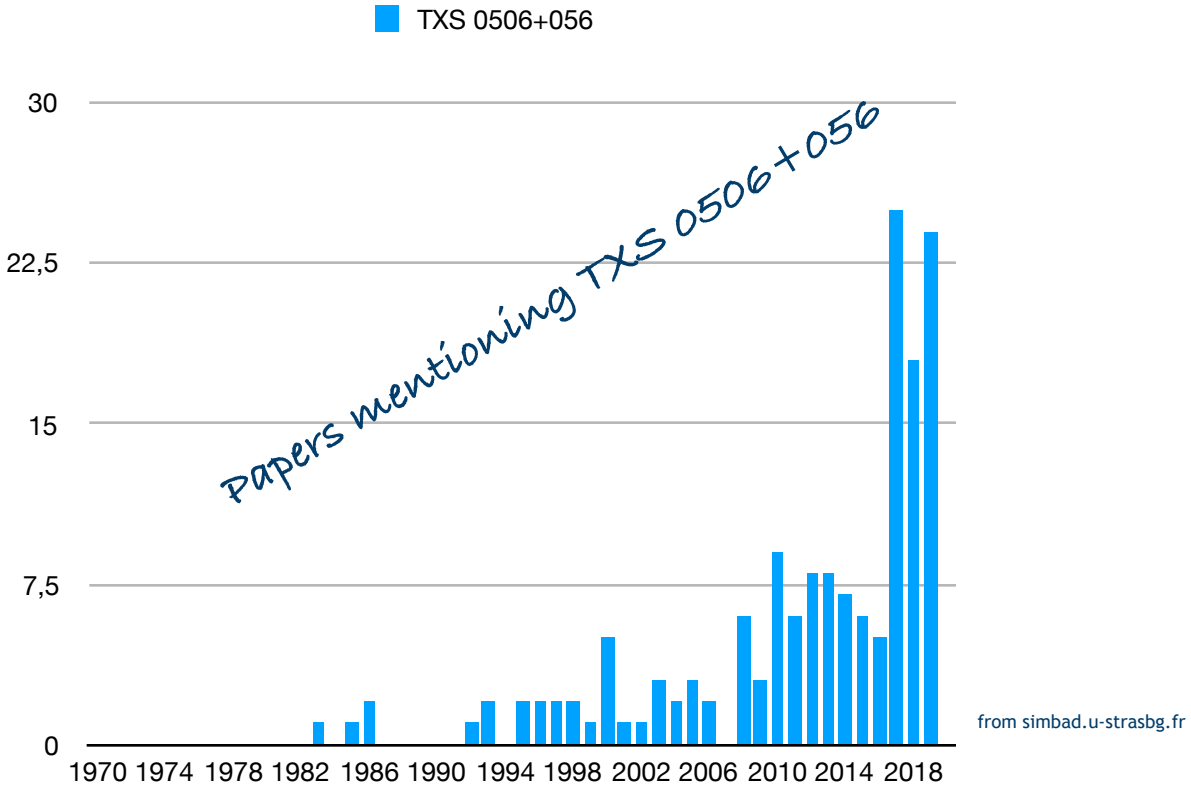
Take home message:

- pure hadronic models are disfavored
- leptonic-dominated SED with subdominant hadronic component can work
- if p-γ on external field, it can work even better (also OK for energetics)

TXS 0506+056

Why a new MWL campaign?

TXS 0506+056 was a vanilla blazar before the neutrino event with VERY limited bibliography



from simbad.u-strasbg.fr

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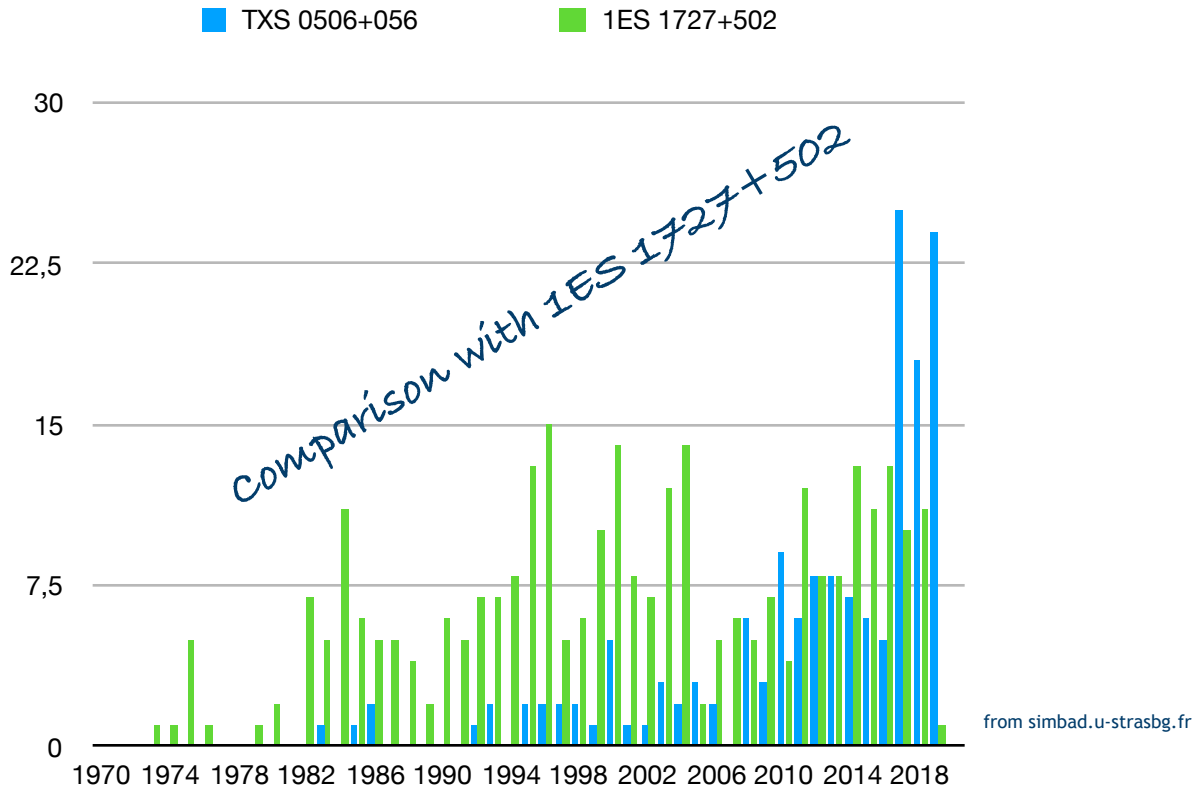

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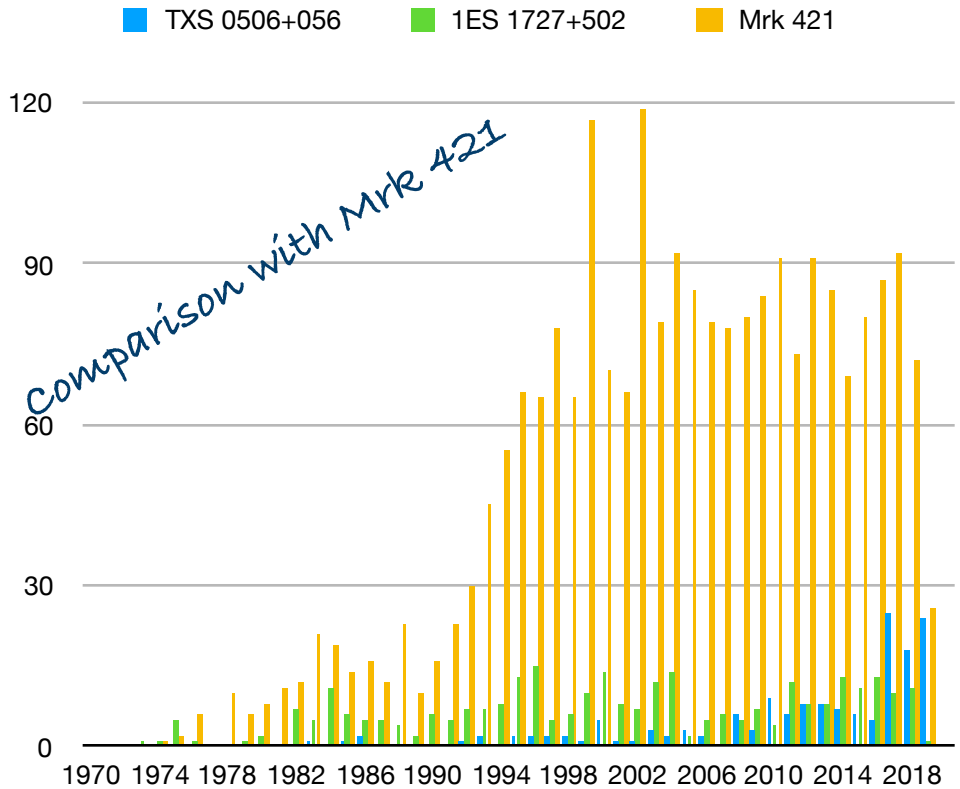
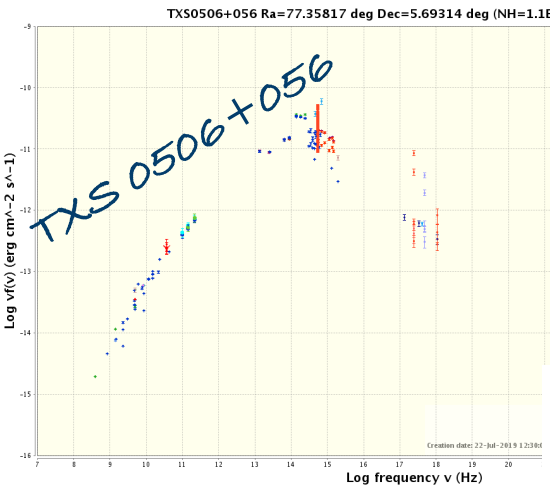


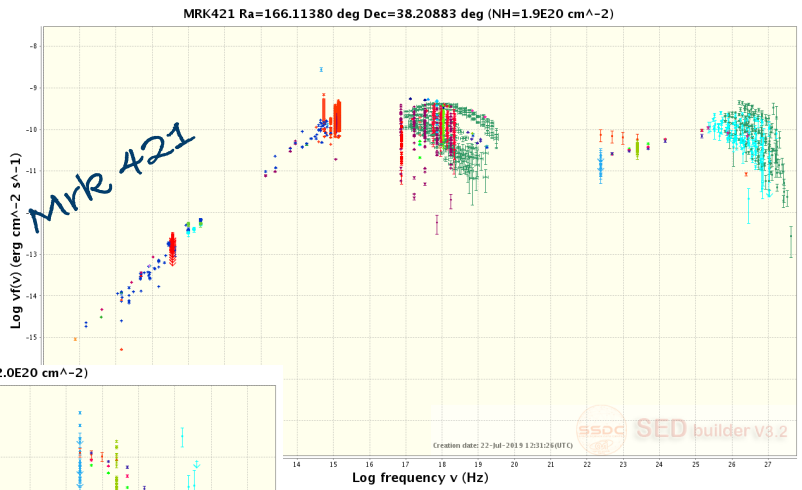
from simbad.u-strasbg.fr

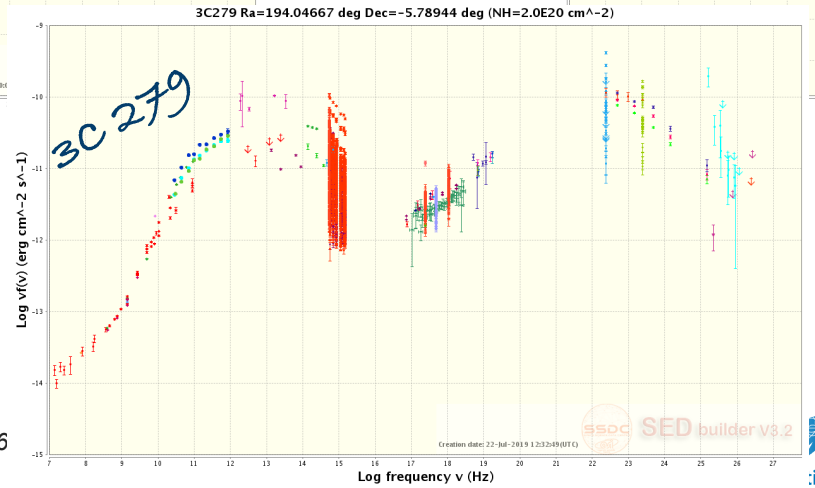
TXS 0506+056

Why a new MWL campaign?

The 2017 MWL campaign following the neutrino event was the first and only MWL study on the source







from SSDC SED Builder

2018/2019 campaign on TXS 0506

ICCUB Institute of Cosmos Sciences · EXCELENCIA MARÍA DE MAEZTU · "la Caixa" Foundation · MAGIC

2018/2019 campaign on TXS 0506+056

MAGIC data

Data from 11-2017 to 02-2019
Exposure after quality cuts is 79 hours

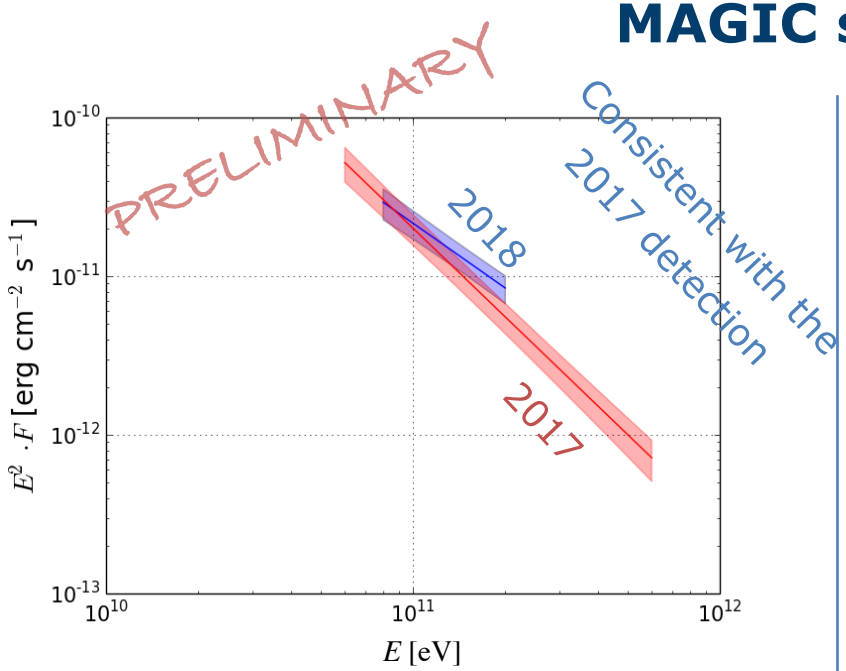
Enhanced activity observed in two nights:
5.4 σ detection on Dec 3, 2018
3.8 σ detection on Dec 1, 2018

Low state detection at 4 σ

see Satalecka et al. poster ID 784

2018/2019 campaign on TXS 0506+056

MAGIC spectra



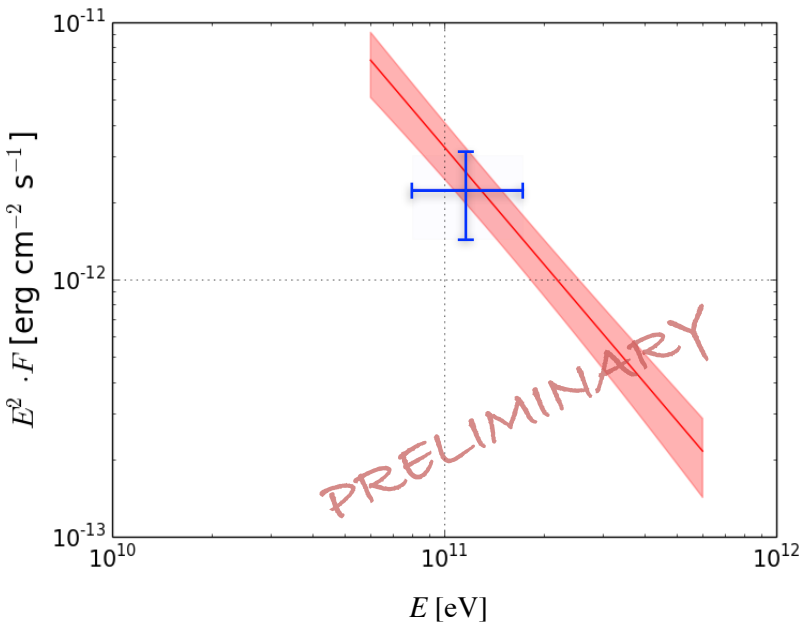
High-state

Gamma ~ 3.4

Integral flux > 80 GeV:
(8.6±1.8)10^{-11} ph/cm2/s

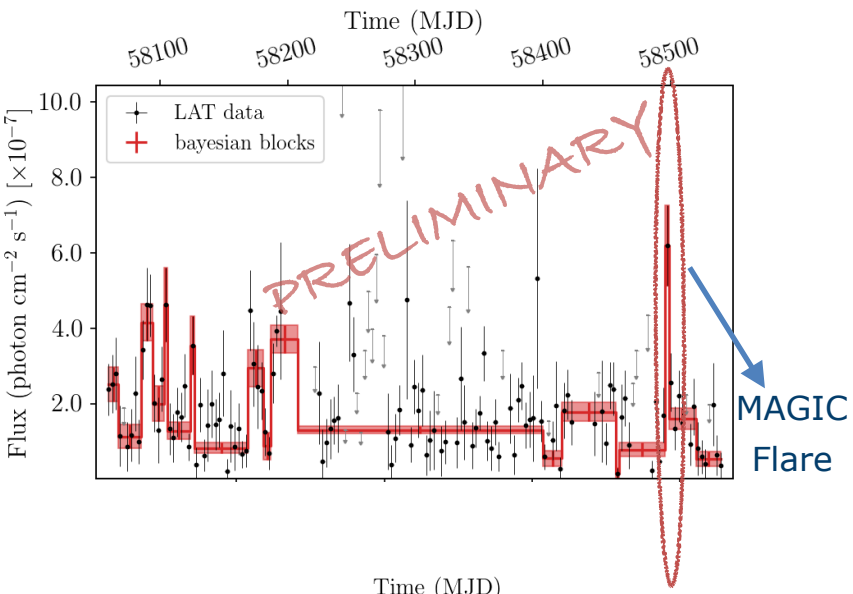
Low state

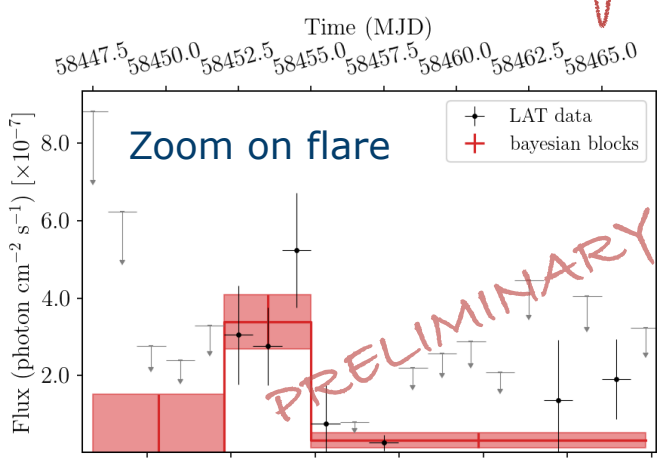
Integral flux > 80 GeV:
(7.6±4.1)10^{-12} ph/cm2/s

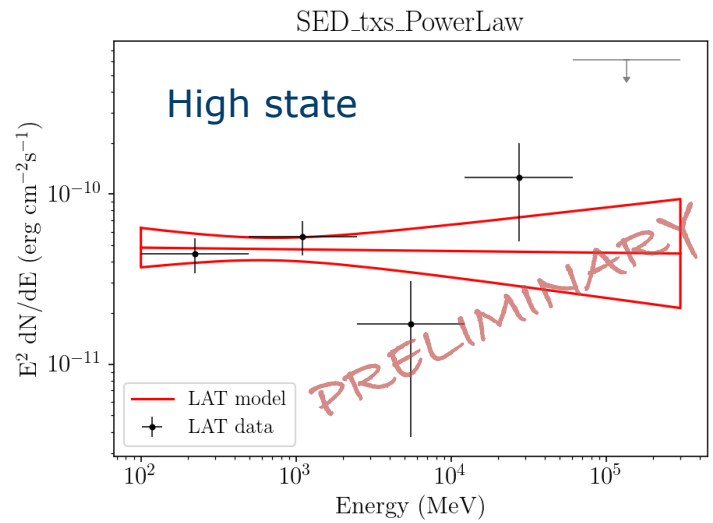


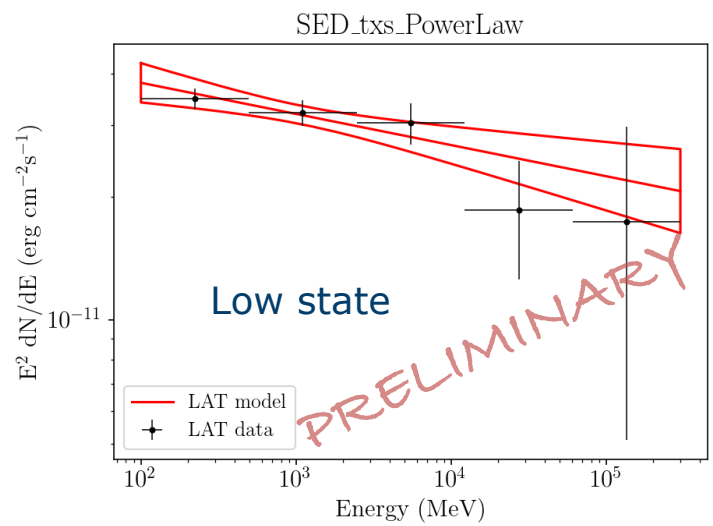
2018/2019 campaign on TXS 0506+056

Fermi data









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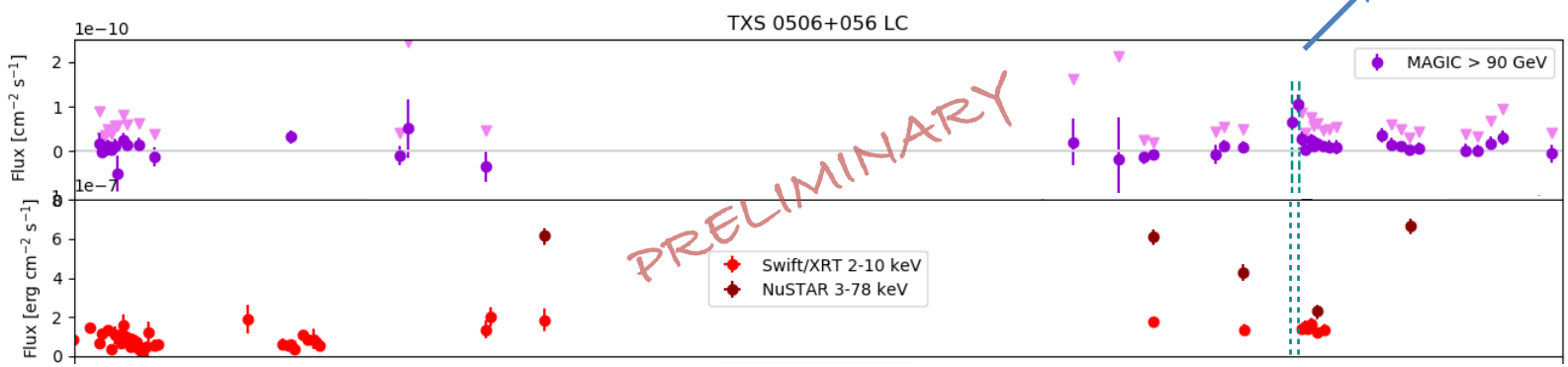
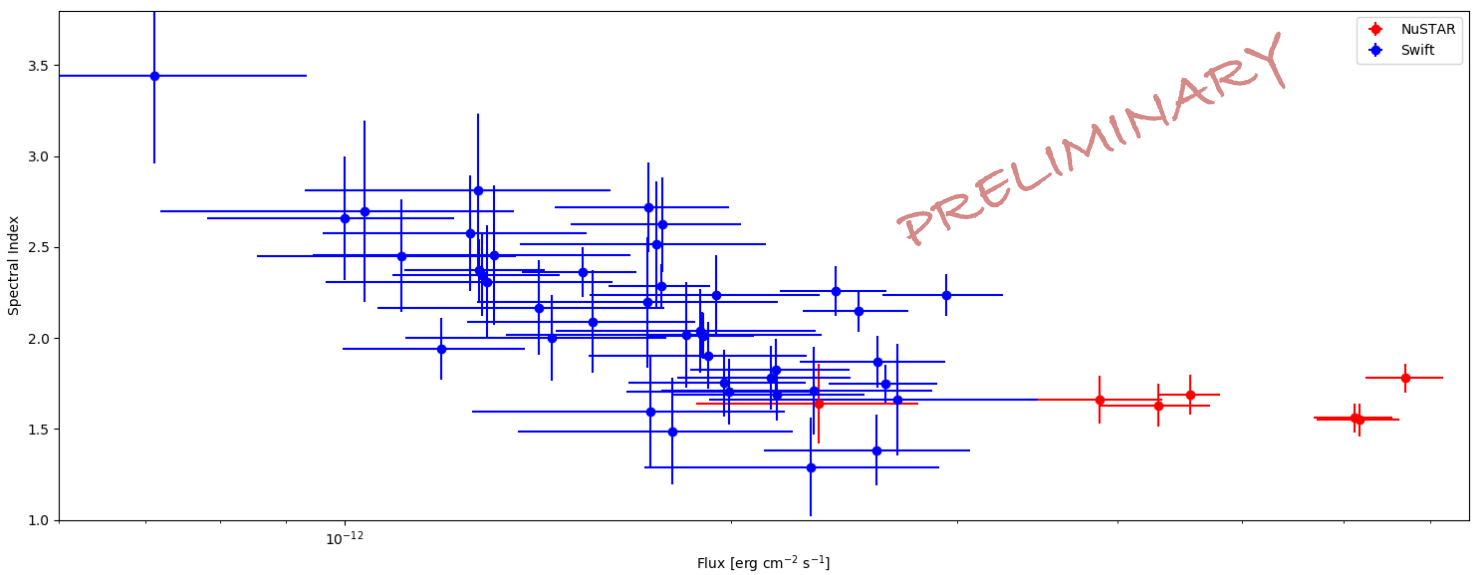
2018/2019 campaign on TXS 0506+056

VHE & X-ray data

No simultaneous
X-ray data for high-state





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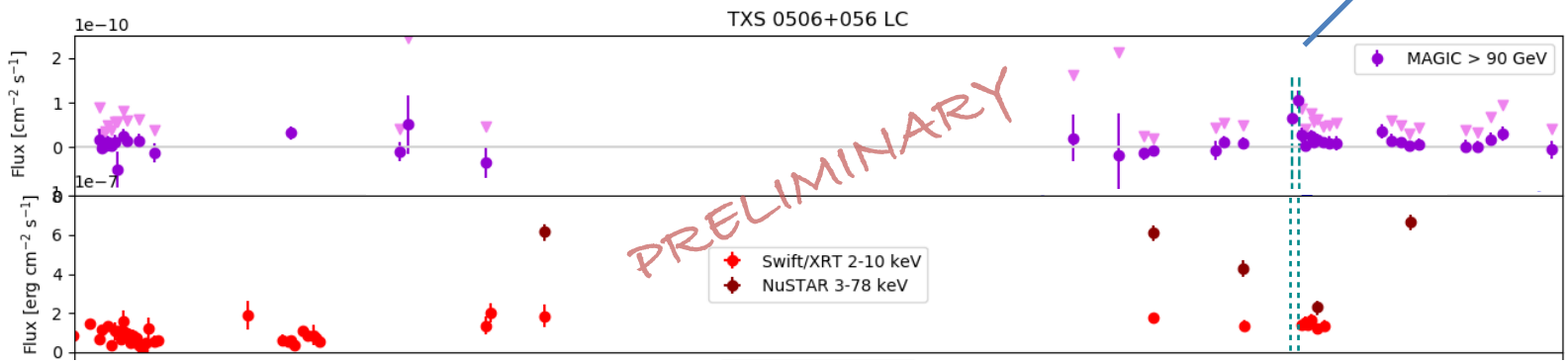

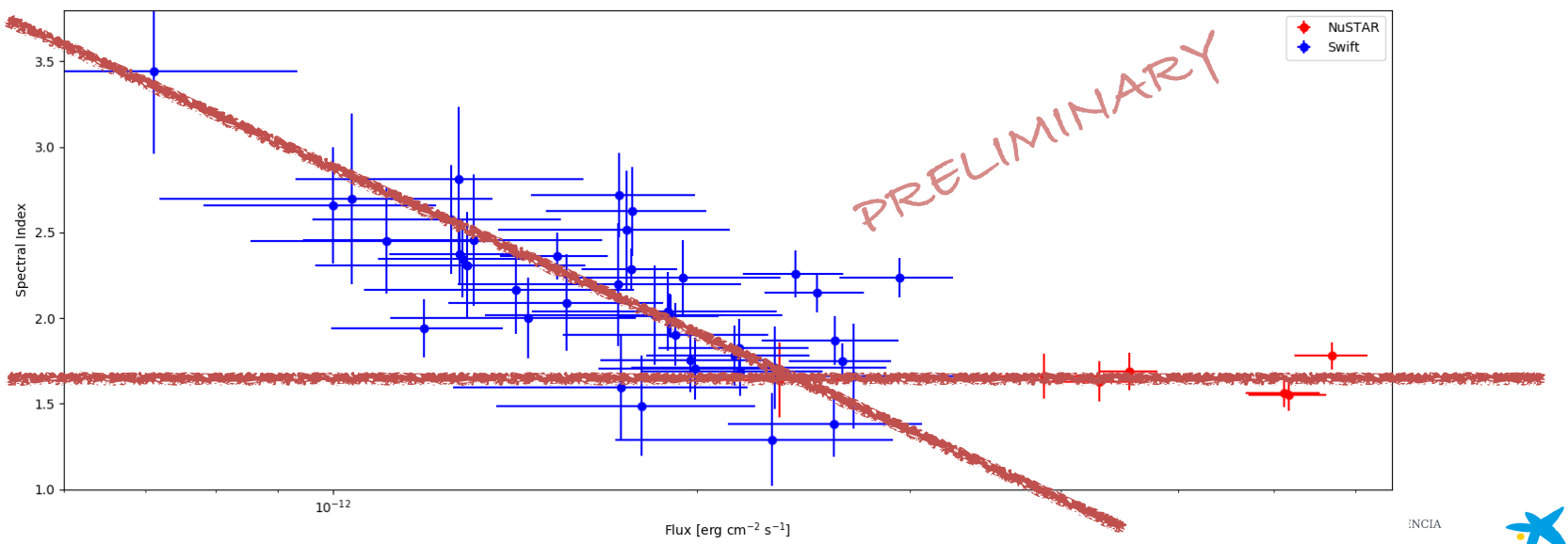

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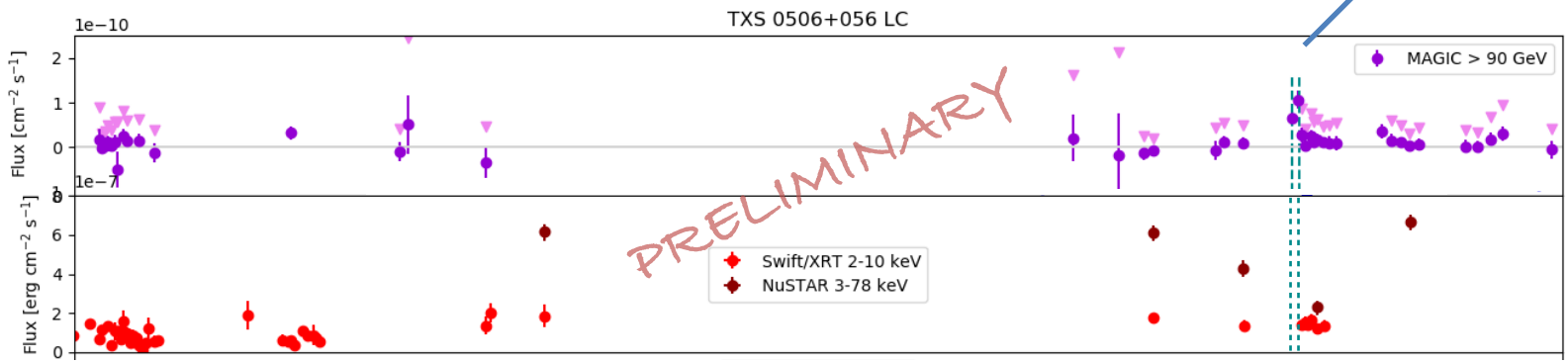

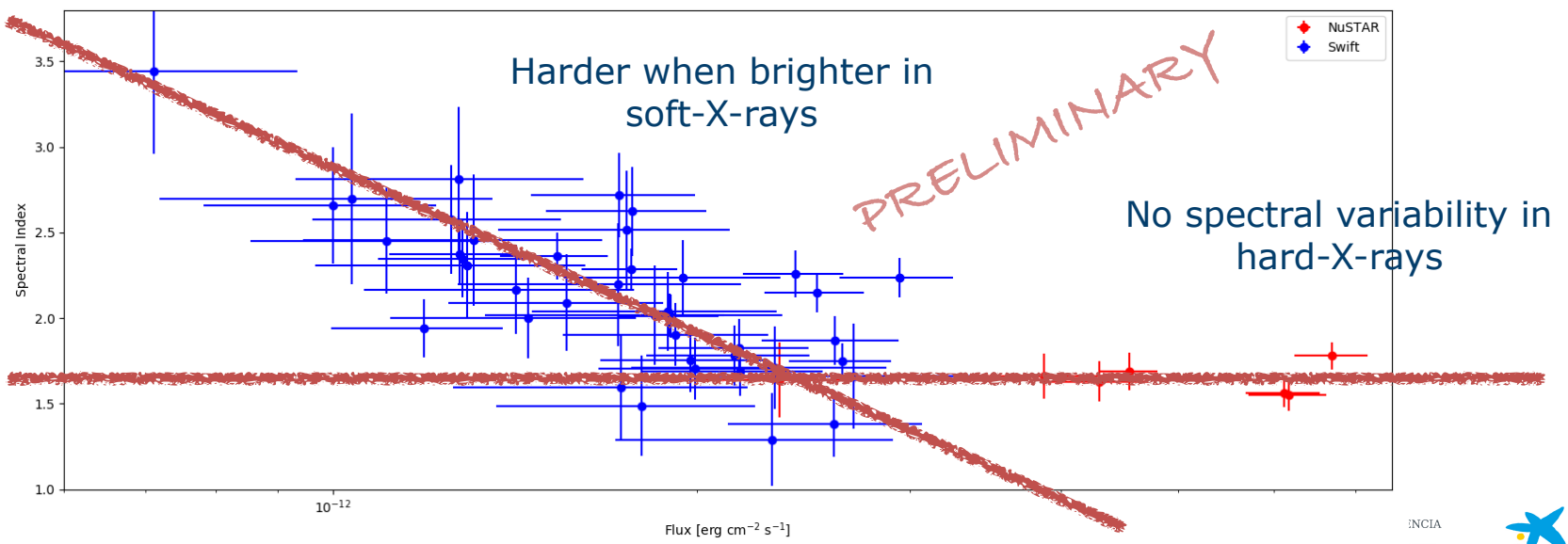

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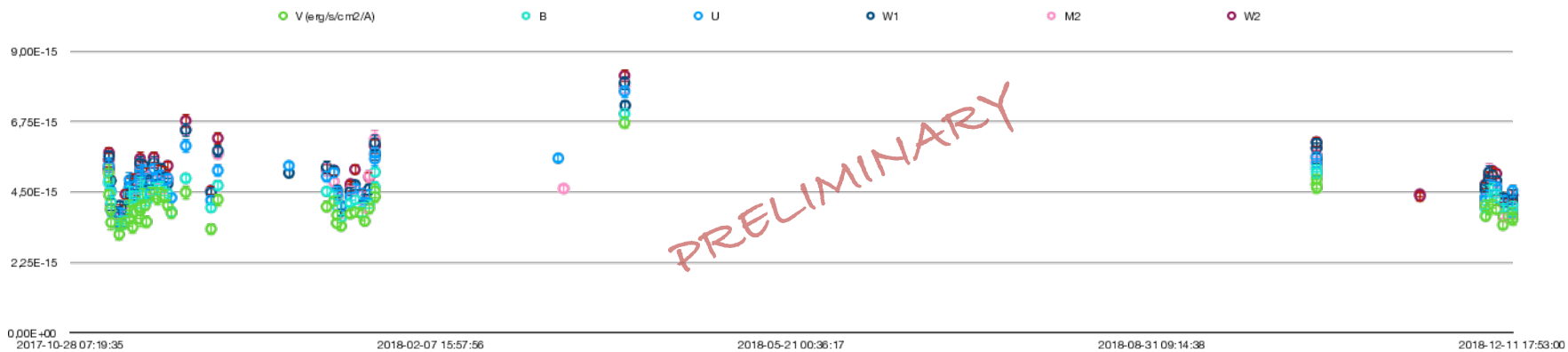
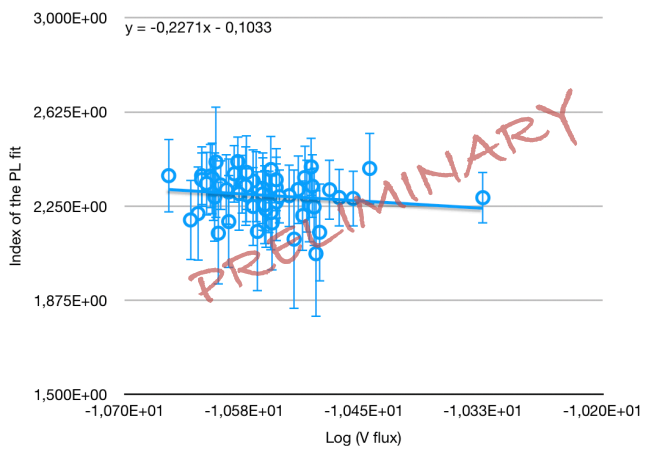
UVOT data

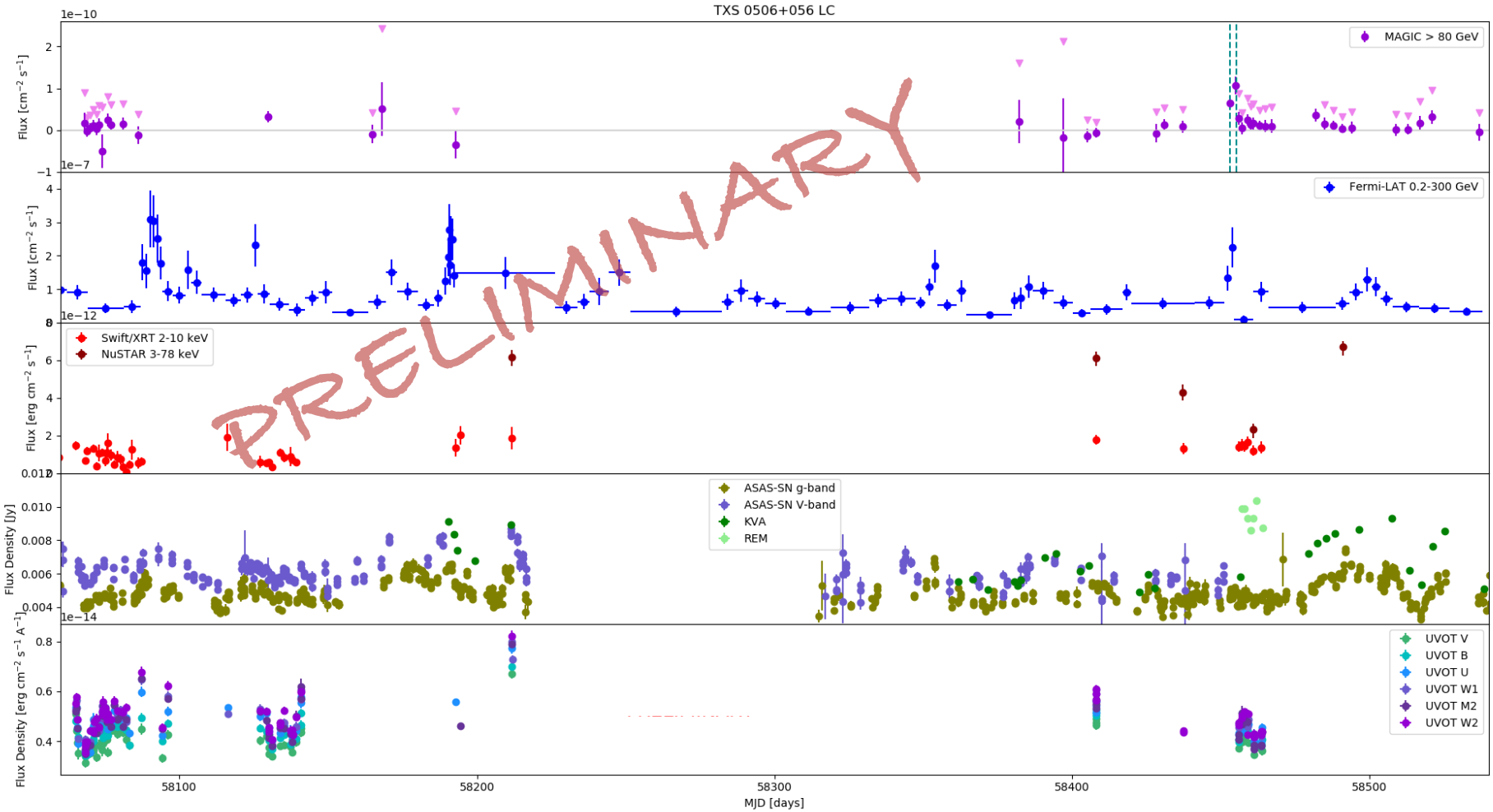




No spectral variability in optical/UV

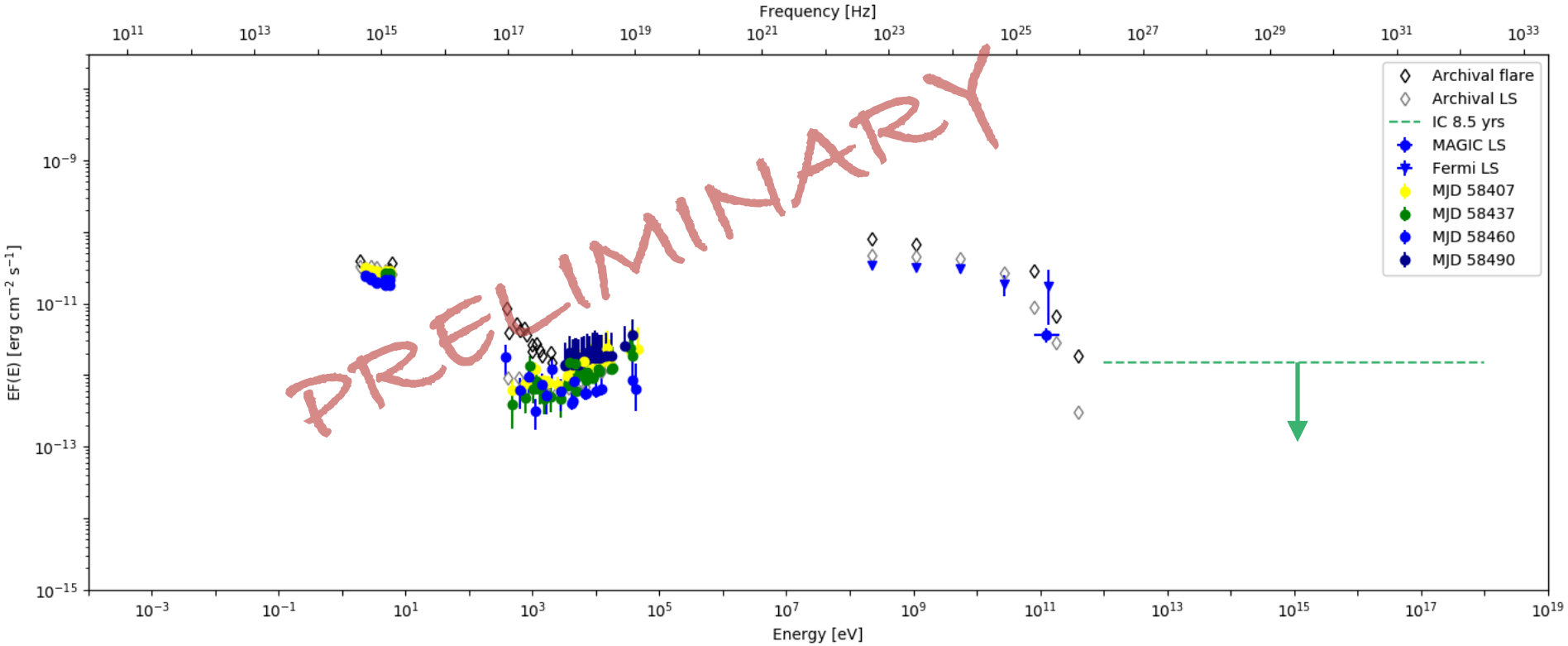
2018/2019 campaign on TXS 0506+056

MWL light-curve



2018/2019 campaign on TXS 0506+056

Low-state SED



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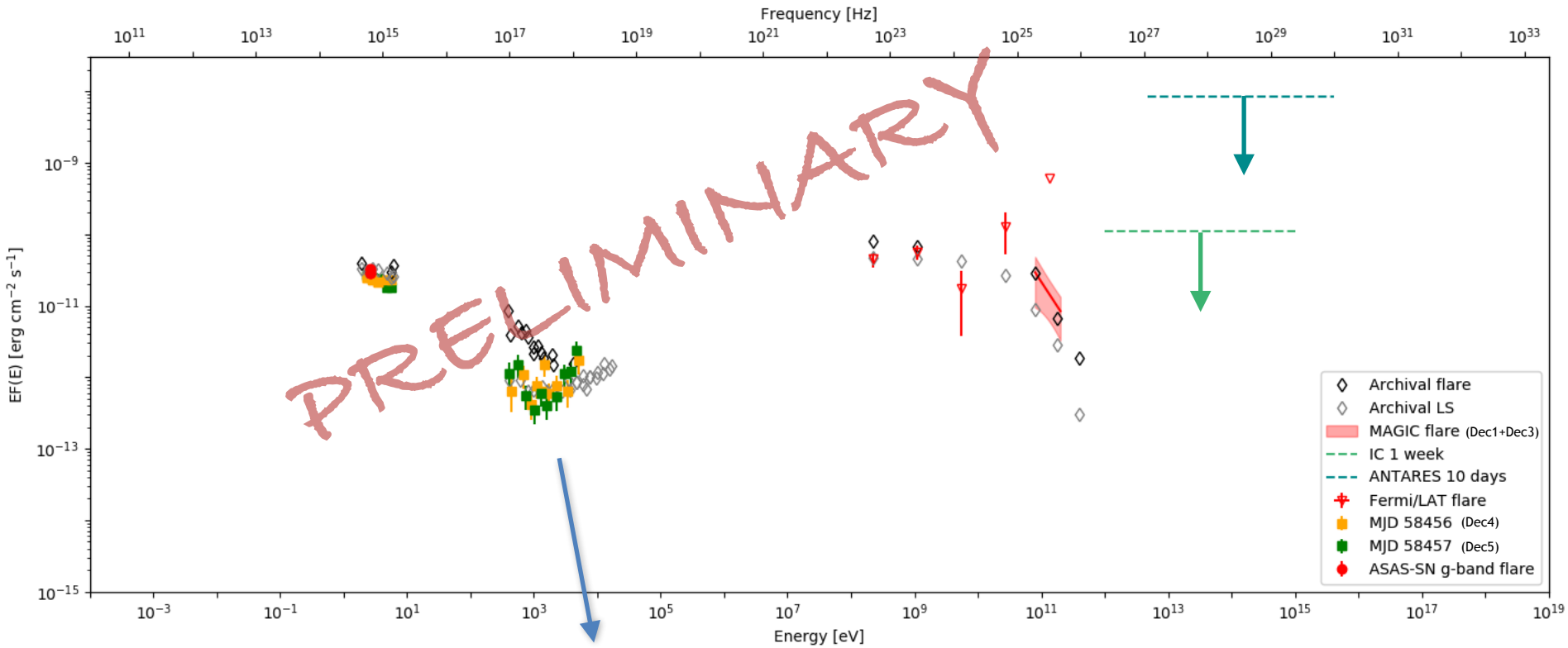


Non simultaneous!

Post flare data

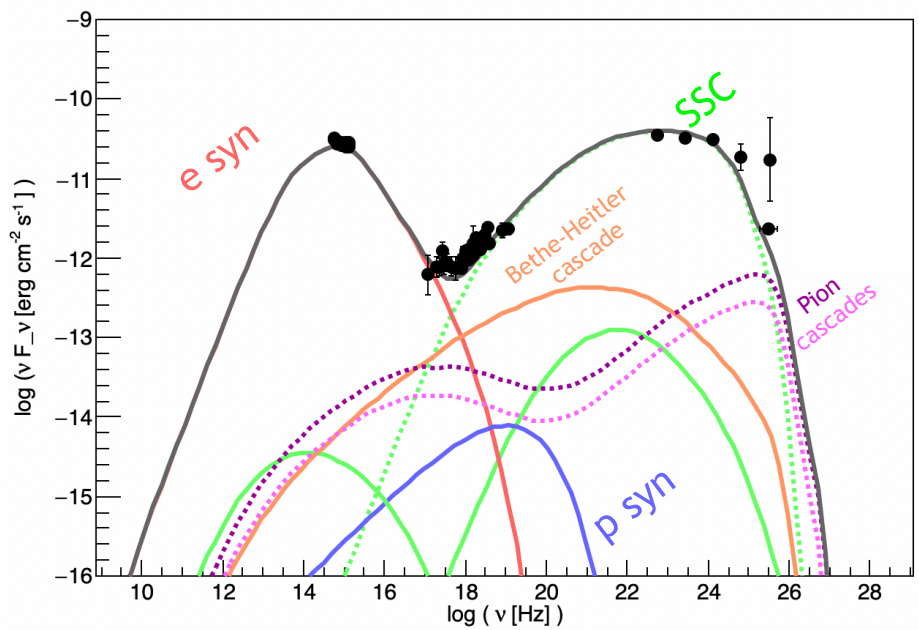
SED modeling

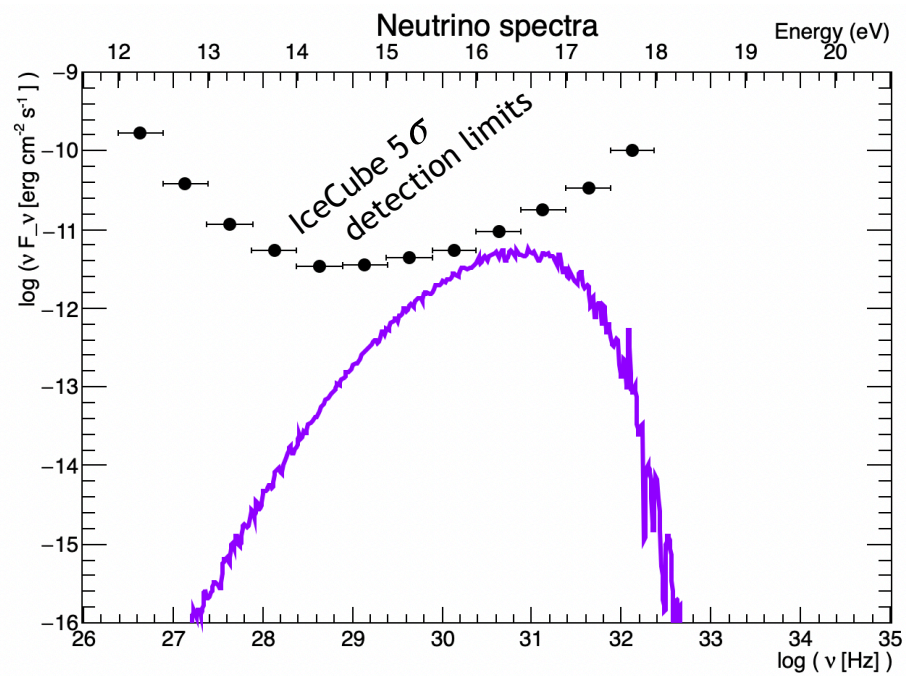
Low state SED

Shear-jet scenario: $\delta = 40$, B = 1G, R = $1.75 \cdot 10^{16}$ cm

$L_p = 3.6 \cdot 10^{46}$ ergs/s

ν_{rate} = 1.2 / year





SED modeling

Low state SED

Assuming that the 2017 and 2018/2019 low-state emission are representative of the 10-years low-state emission,

IceCube constrains the hadronic component

From Carver et al. 2019, IceCube sees ~12 neutrinos from TXS 0506+056 in 10 years

An hadronic component higher than the one shown would violate IceCube limits from point-source searches

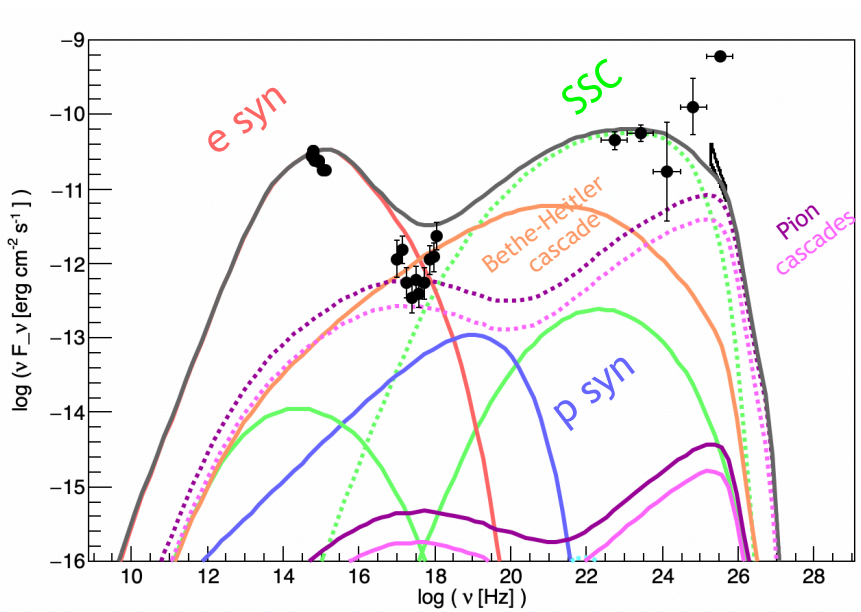
SED modeling

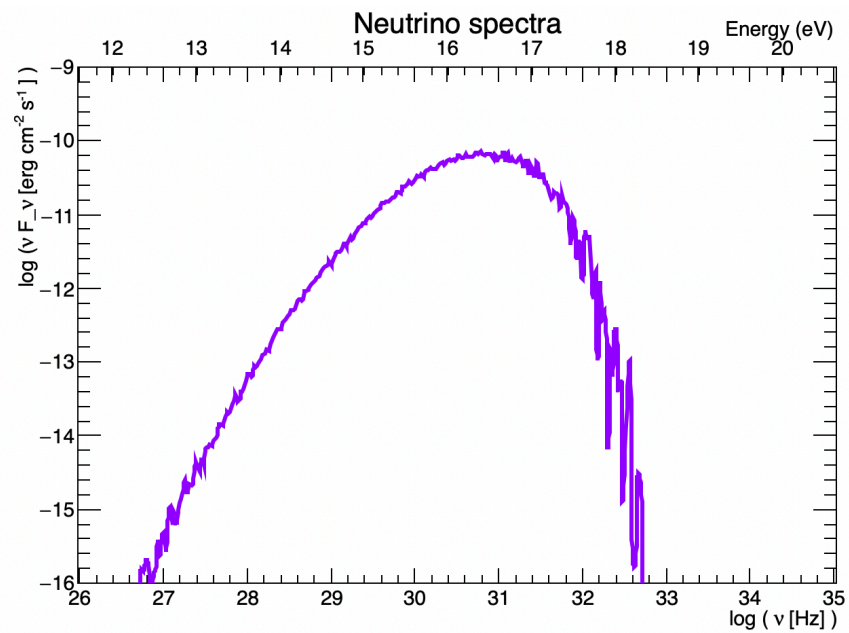
High state SED

Shear-jet scenario: δ = 40, B = 1G, R = $1.75 \cdot 10^{16}$ cm

$L_p = 5 \cdot 10^{47}$ ergs/s

$\nu_{rate,EHE}$ = 1.6 / year = $4 \cdot 10^{-3}$ / day





SED modeling

High state SED

Gamma-ray flare explained only by change in the particle injection

Fully consistent with the non-detection of additional neutrinos

(N.B. the 2017 flare was associated with a 6-months-long brightening in Fermi-LAT, here there's a day-long flare)

CONCLUSIONS

New MAGIC & MWL campaign on TXS 0506+056

New VHE flare on Dec 1-3, 2018
4σ detection of a new low-state

Low-state SED is very similar to the 2017 one:
IceCube point-source searches constrain the hadronic component

New gamma ray flare also similar to the 2017 one!
Still consistent with no additional neutrinos