WORKSHOP SUMMARY

Markus Ahlers
NBI, Copenhagen

image credit: DESY

9 TALKS / 32 ATTENDEES

ACKERMANN, Markus	DESY	Zeuthen
AHLERS, Markus	Niels Bohr Institute	Copenhagen
BERNARDINI, Elisa	DESY	Zeuthen
BHATTACHARYYA, Wrijupan	DESY	Zeuthen
BIEHL, Daniel	DESY Zeuthen	Zeuthen
BOETTCHER, Markus	North-West University	Potchefstroom
BOSNJAK, Zeljka	University of Zagreb	Zagreb
BUSON, Sara	NASA-GSFC	Greenbelt
DZHATDOEV, Timur	Moscow State University	Moscow
FEDYNITCH, Anatoli	DESY	Zeuthen
FINLEY, Chad	Stockholm University / OKC	Stockholm
FRANCKOWIAK, Anna	DESY	Zeuthen
GAO, Shan	DESY	Zeuthen
GARRAPPA, Simone	DESY	Zeuthen
GLAUCH, Theo	TU Munich	Munich
GLIWNY, Pawel	DESY	Zeuthen
HUBER, Matthias	TU Munich	Garching
KAPLAN, David	UW-Milwaukee	Milwaukee
KINTSCHER, Thomas	DESY	Zeuthen
KOPPER, Claudio	University of Alberta	Edmonton, Alberta
KOUCHNER, Antoine	APC	Paris
KOWALSKI, Marek	DESY	Zeuthen
KRAUSS, Felicia	GRAPPA/API, University of Amsterdam	Amsterdam
LIU, Ruoyu	DESY	Zeuthen
MURASE, Kohta	Penn State University	University Park
OHM, Stefan	DESY, Zeuthen	Zeuthen
PALLADINO, Andrea	DESY	Zeuthen
RAAB, Christoph	Universite Libre de Bruxelles	Elsene
REIMER, Anita	University of Innsbruck	Innsbruck
SATALECKA, Konstancja	DESY	Zeuthen
TAVECCHIO, Fabrizio	INAF-OAB	Merate
WINTER, Walter	DESY	Zeuthen

TXS 0506+056

OBSERVATION

NEUTRINOS & TXS 0506+056

Multimessenger observations of a flaring blazar coincident with high-energy neutrino IceCube-170922A

The IceCube Collaboration, *Fermi*-LAT, MAGIC, *AGILE*, ASAS-SN, HAWC, H.E.S.S., *INTEGRAL*, Kanata, Kiso, Kapteyn, Liverpool Telescope, Subaru, *Swift/NuSTAR*, VERITAS, and VLA/17B-403 teams*†

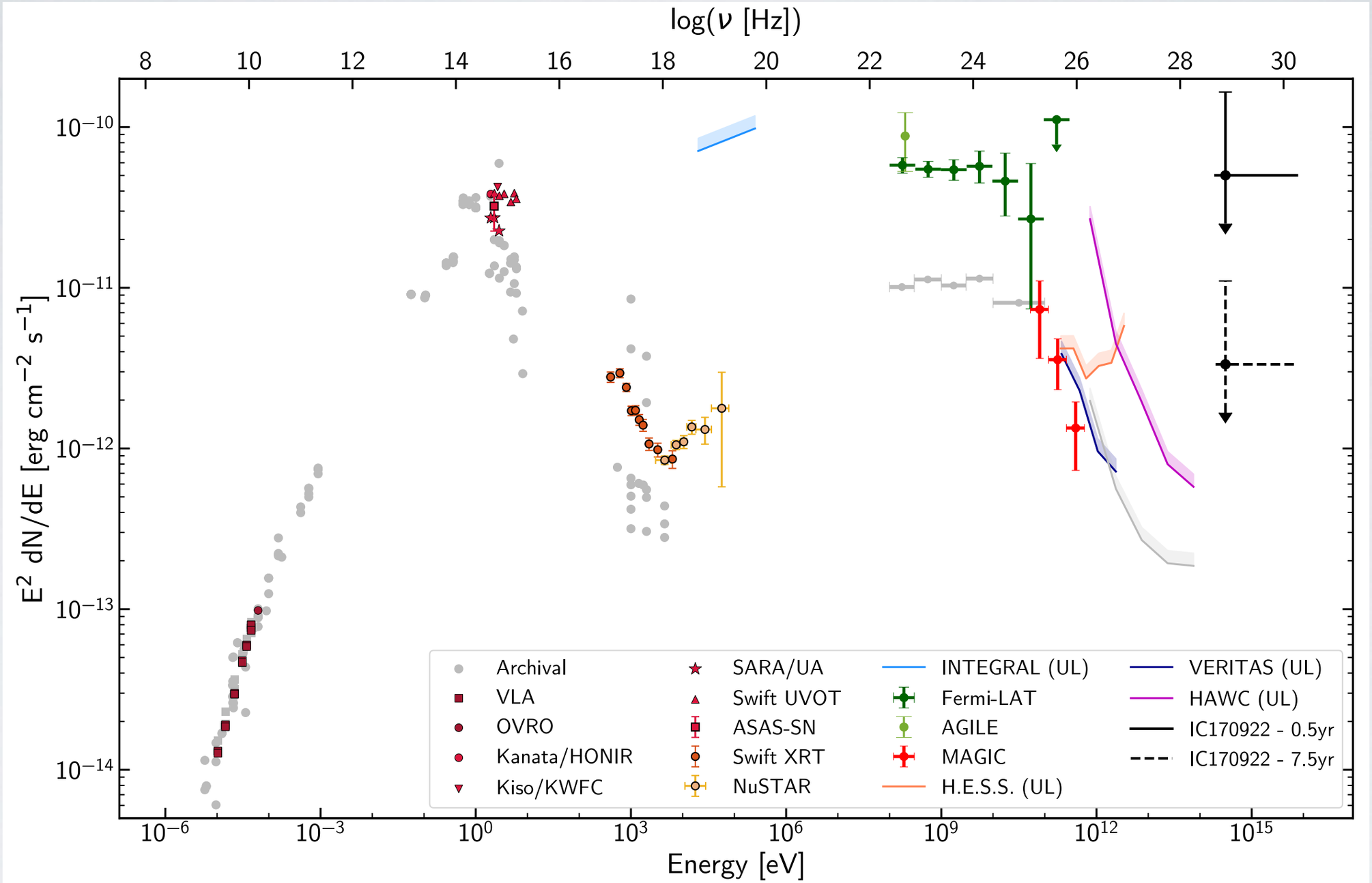
Science 361 (2018) no. 6398, eaat1378

Neutrino emission from the direction of the blazar TXS 0506+056 prior to the IceCube-170922A alert

IceCube Collaboration*†

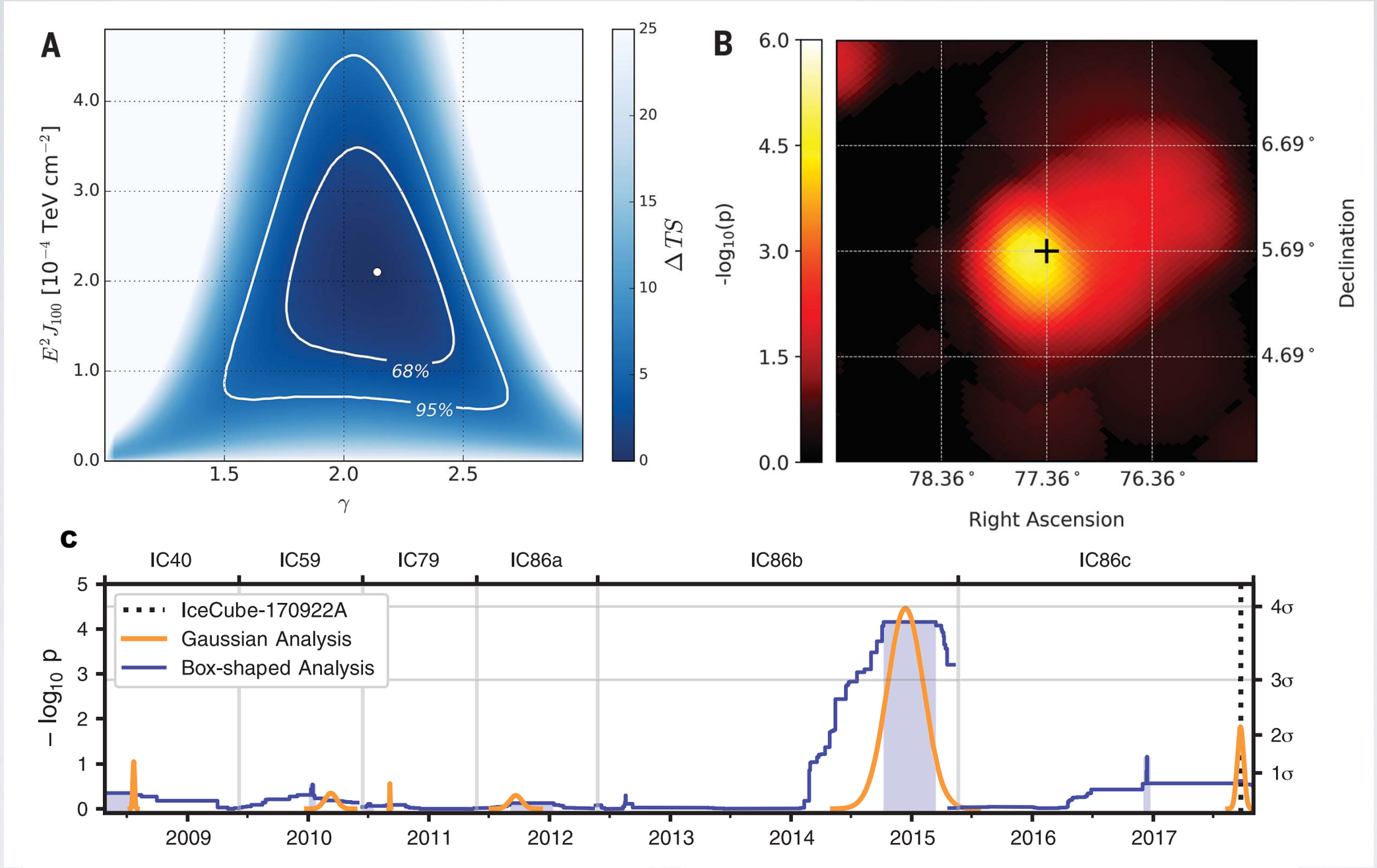
Science 361 (2018) no. 6398, 147-151

MULTI-MESSENGER FOLLOW-UP



- chance correlation can be rejected at **3sigma level**
- TXS 0506+056 is among the 3% brightest AGNs in 3LAC
- one of the most luminous BL Lacs **talk by Elisa Bernardini**

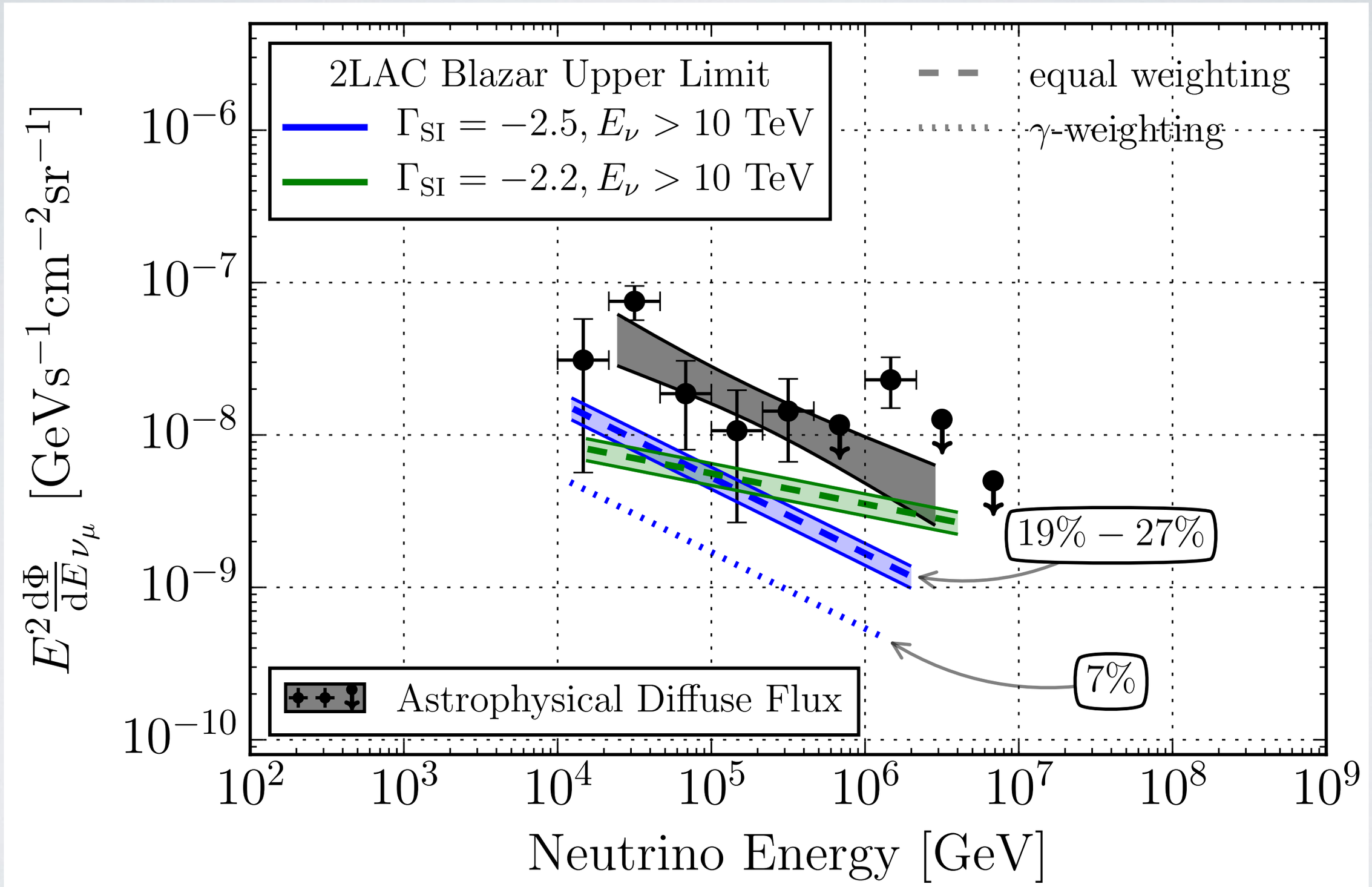
2014/15 NEUTRINO FLARE



- previous **3.5sigma** neutrino flare (13 +/- 5 events)
- observed between September 2014 and March 2015
- implies neutrino luminosity of 10^{47} erg/s over 158 days

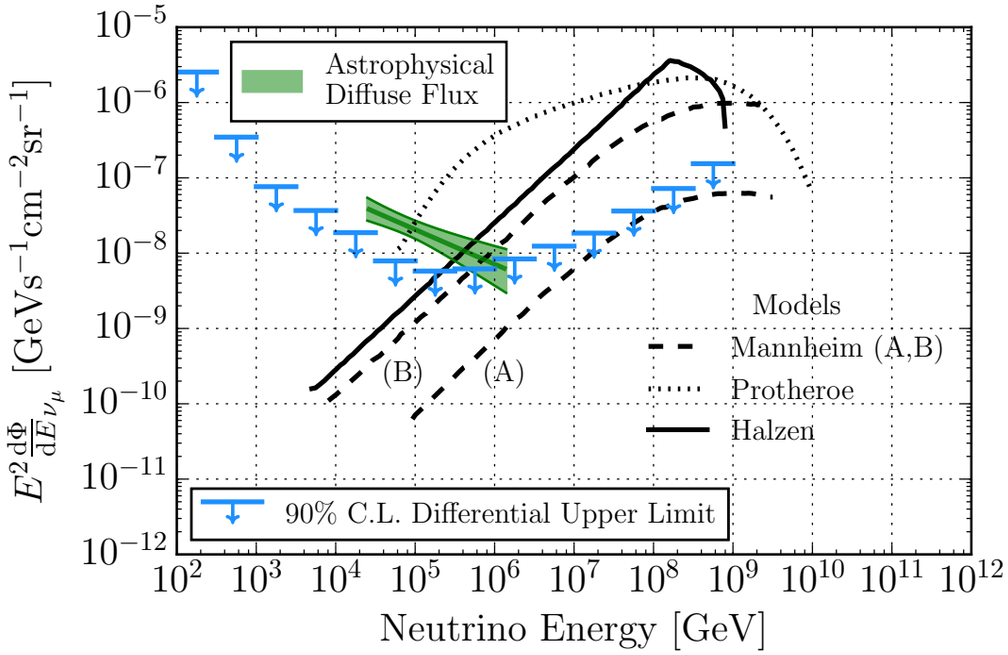
talk by Chad Finley

BLAZAR LIMITS

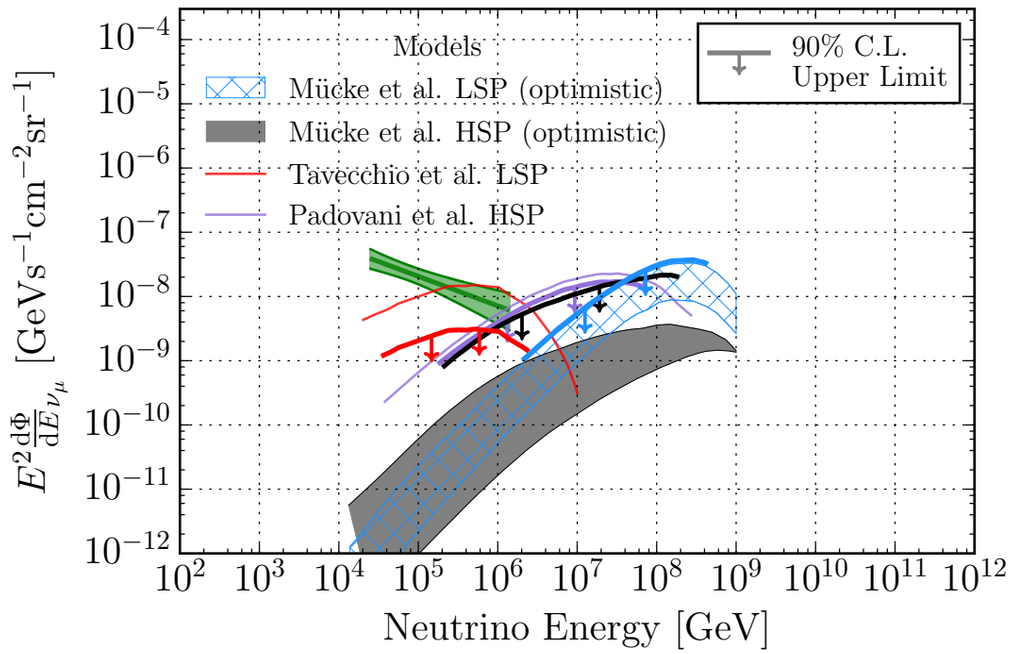


talks by Chad Finley & Kohta Murase

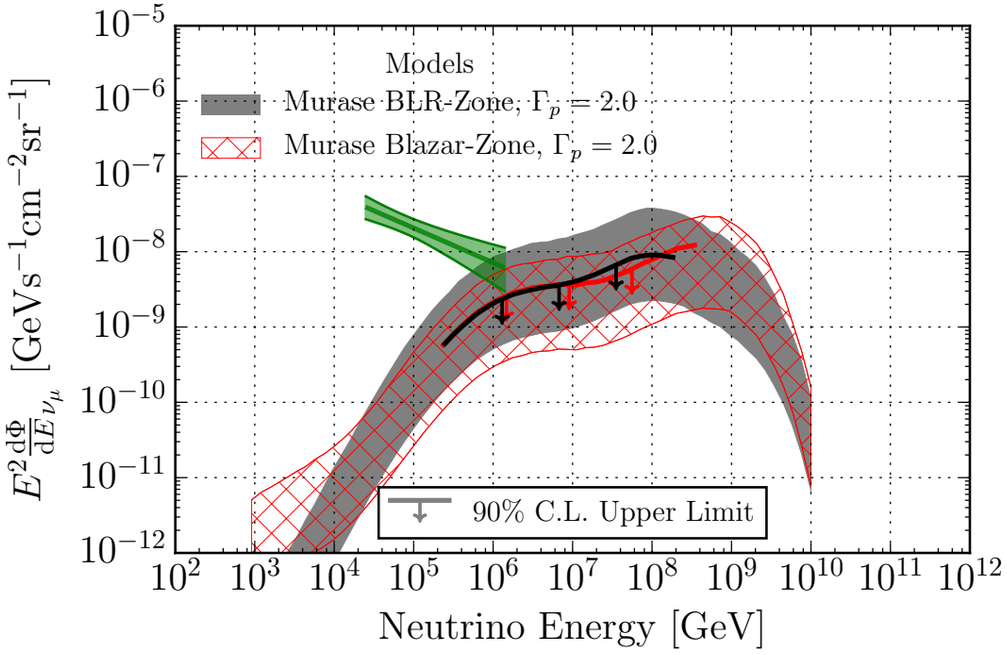
BLAZAR LIMITS



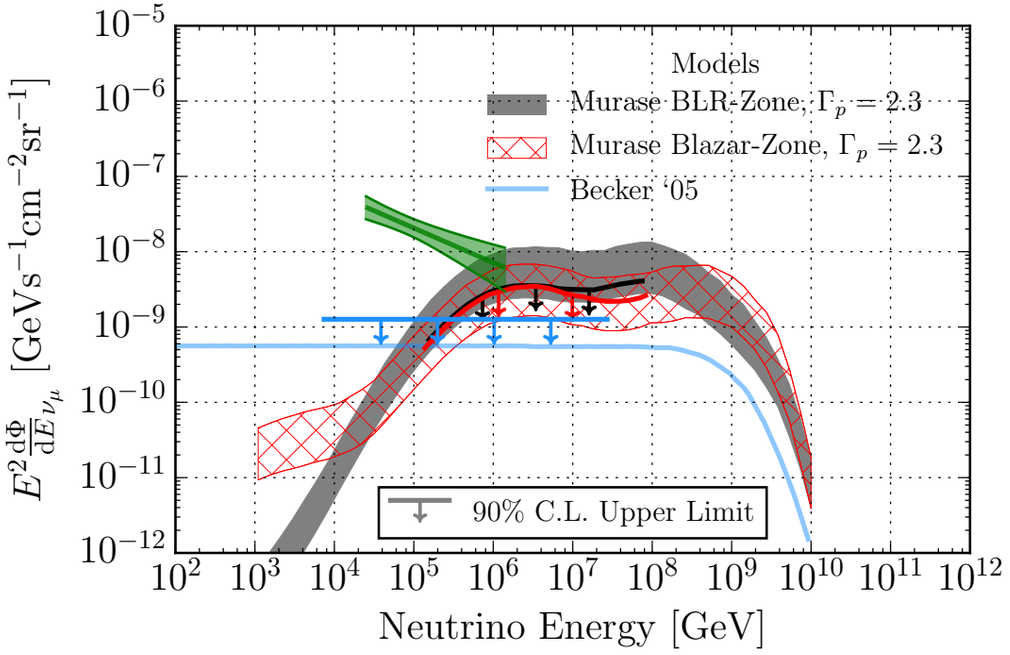
(a) generic blazars



(b) BL Lacs



(c) FSRQs - 1



(d) FSRQs - 2

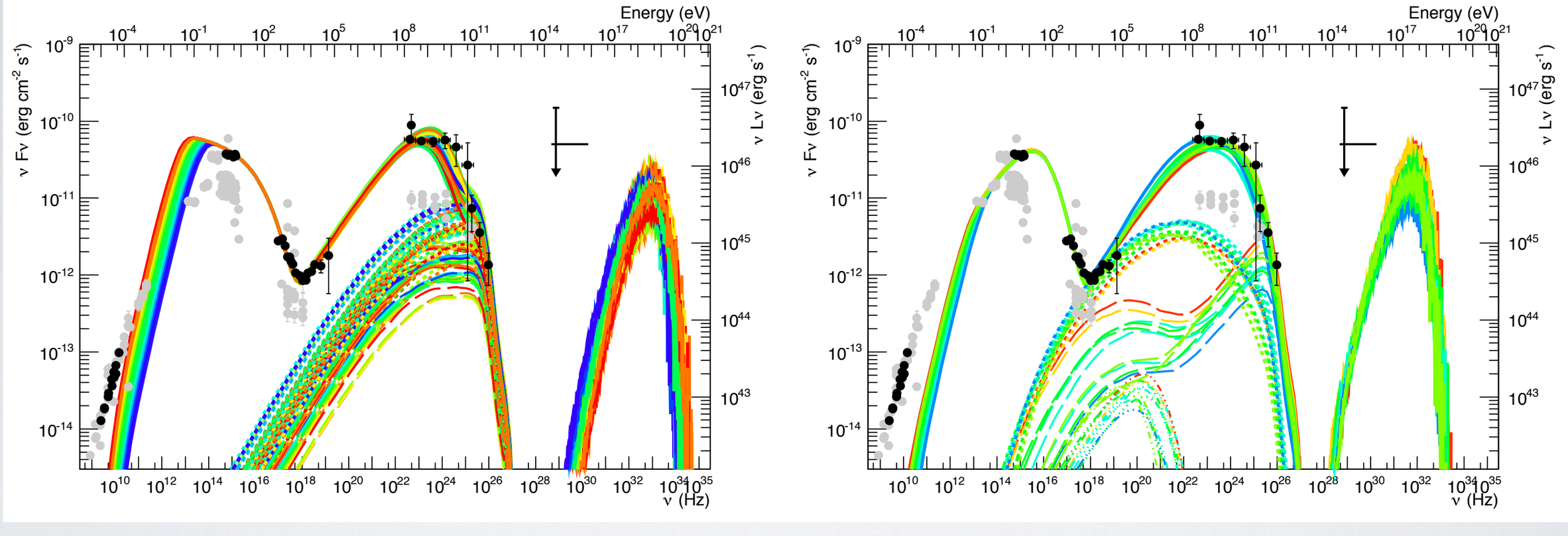
IceCube, Astrophys.J. 835 (2017) no. 1, 45

see also talk by Andrea Palladino

TXS 0506+056

MODELLING

LEPTO-HADRONIC MODELS



(a) Proton synchrotron modeling of TXS 0506+056 (b) Lepto-hadronic modeling of TXS 0506+056

Cerruti, Zech, Boisson, Emery, Inoue & Lenain; 1807.04335

Gao, Fedynitch, Winter & Pohl; 1807.04275

Keivani, Murase, Petropoulou, Fox, Cenko, Chaty, Coleiro, DeLaunay, Dimitrakoudis, Evans, Kenna, Marshall, Mastichiadis, Osborne, Santander, Tohuvavohu & Turley; 1807.04537

Zhang, Fang & Li; 1807.11069

Gokus, Richter, Spanier, Kreter, Kadler, Mannheim & Wilms; 1808.05540

Sahakyan; 1807.05651

talk by Markus Boettcher

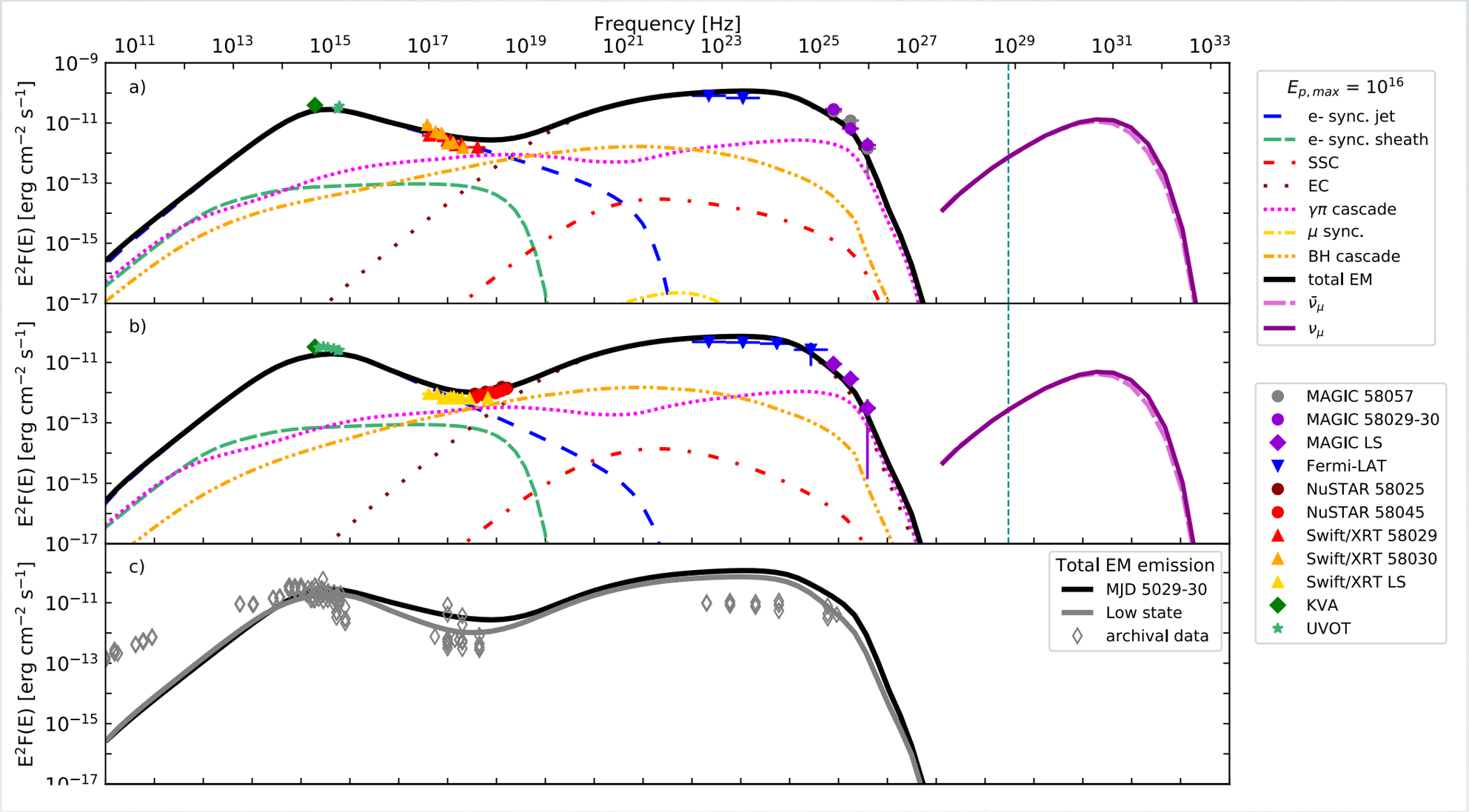
LEPTO-HADRONIC MODELS

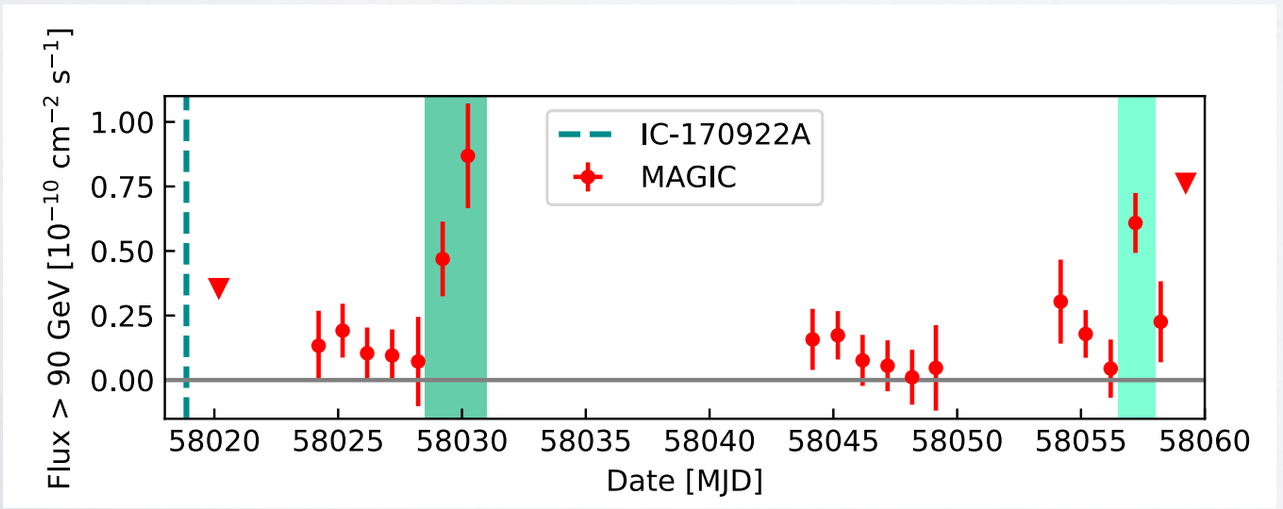
- Lepto-hadronic and proton-synchrotron models can successfully explain the EM SED during the quiescent and flaring state.

- Neutrino production efficiency in one-zone proton-gamma models is typically low; requires large proton luminosities.

- Interaction with external radiation fields?

SPINE-SHEATH INTERACTION ?

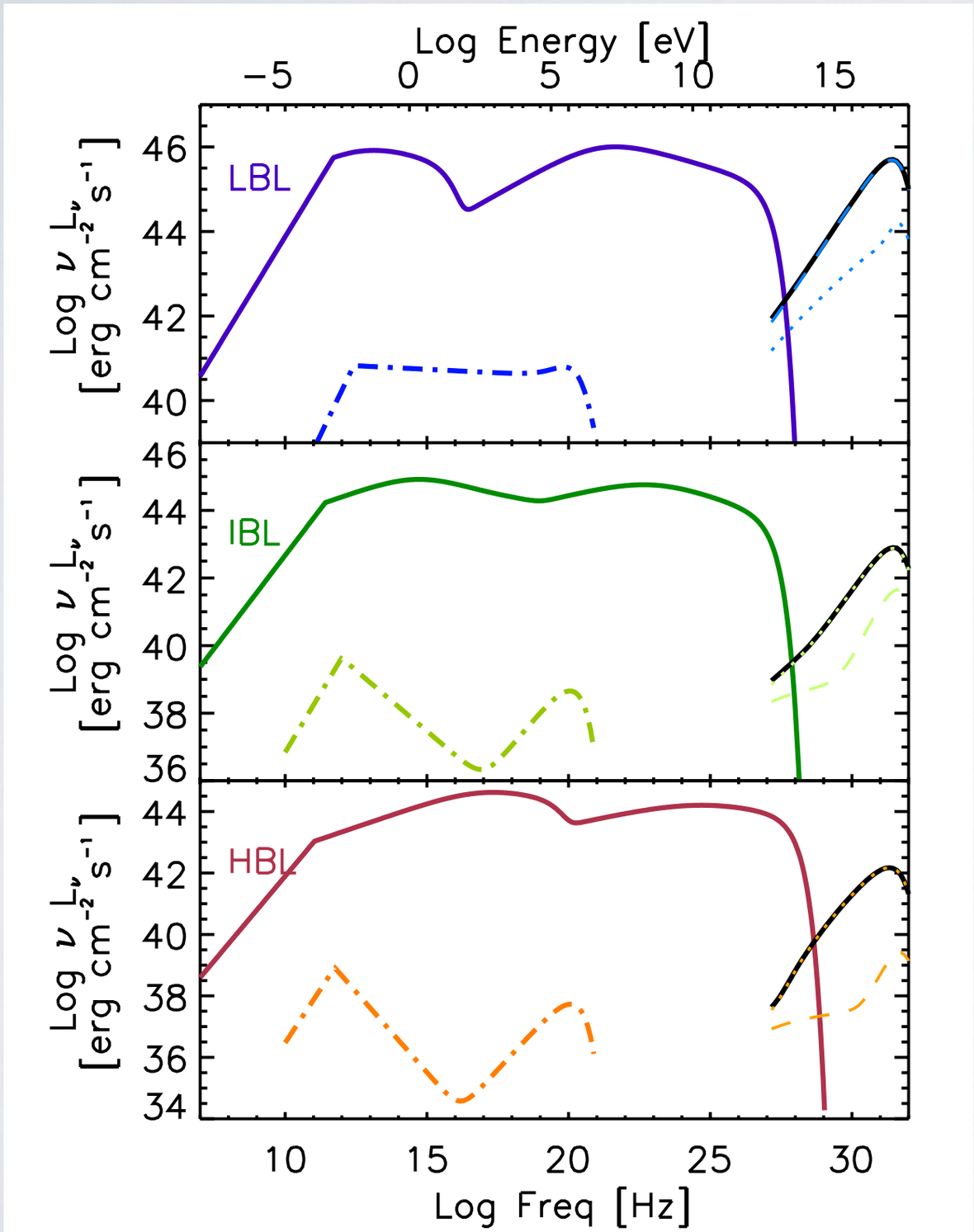




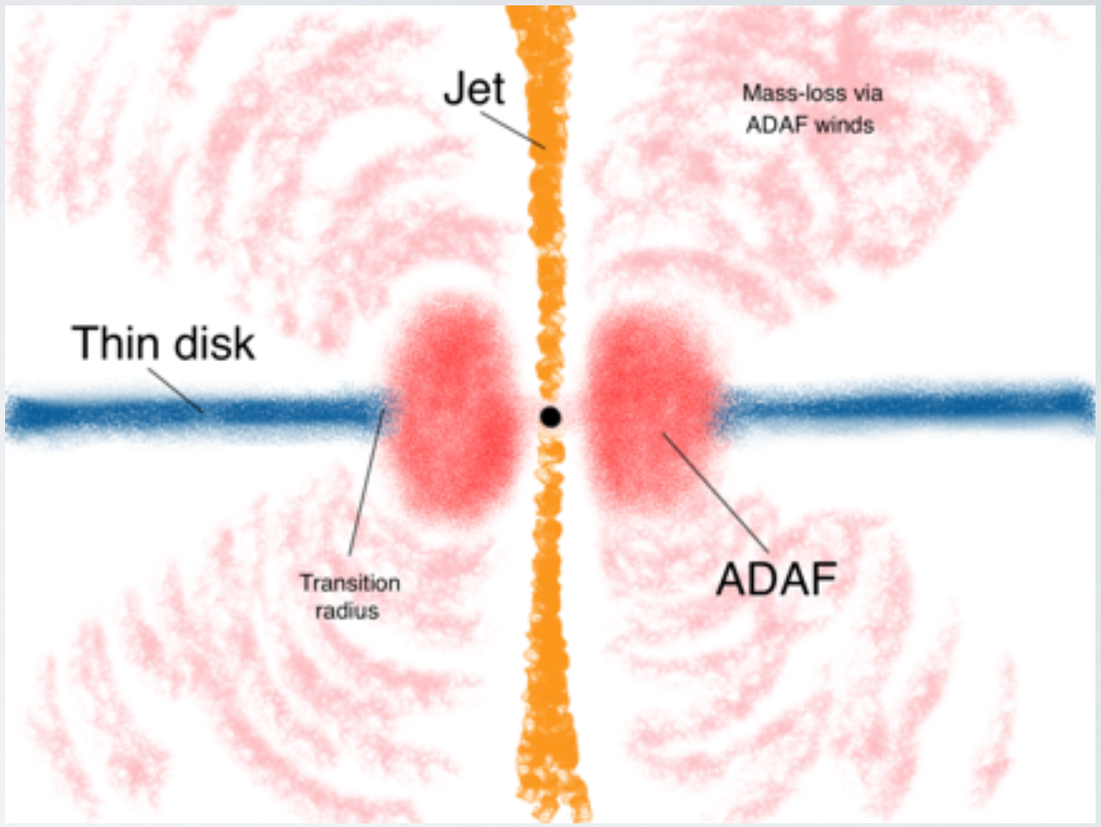
MAGIC Collaboration
1807.04300

talk by
Fabrizio Tavecchio

ADVECTION-DOMINATED ACCRETION FLOWS ?



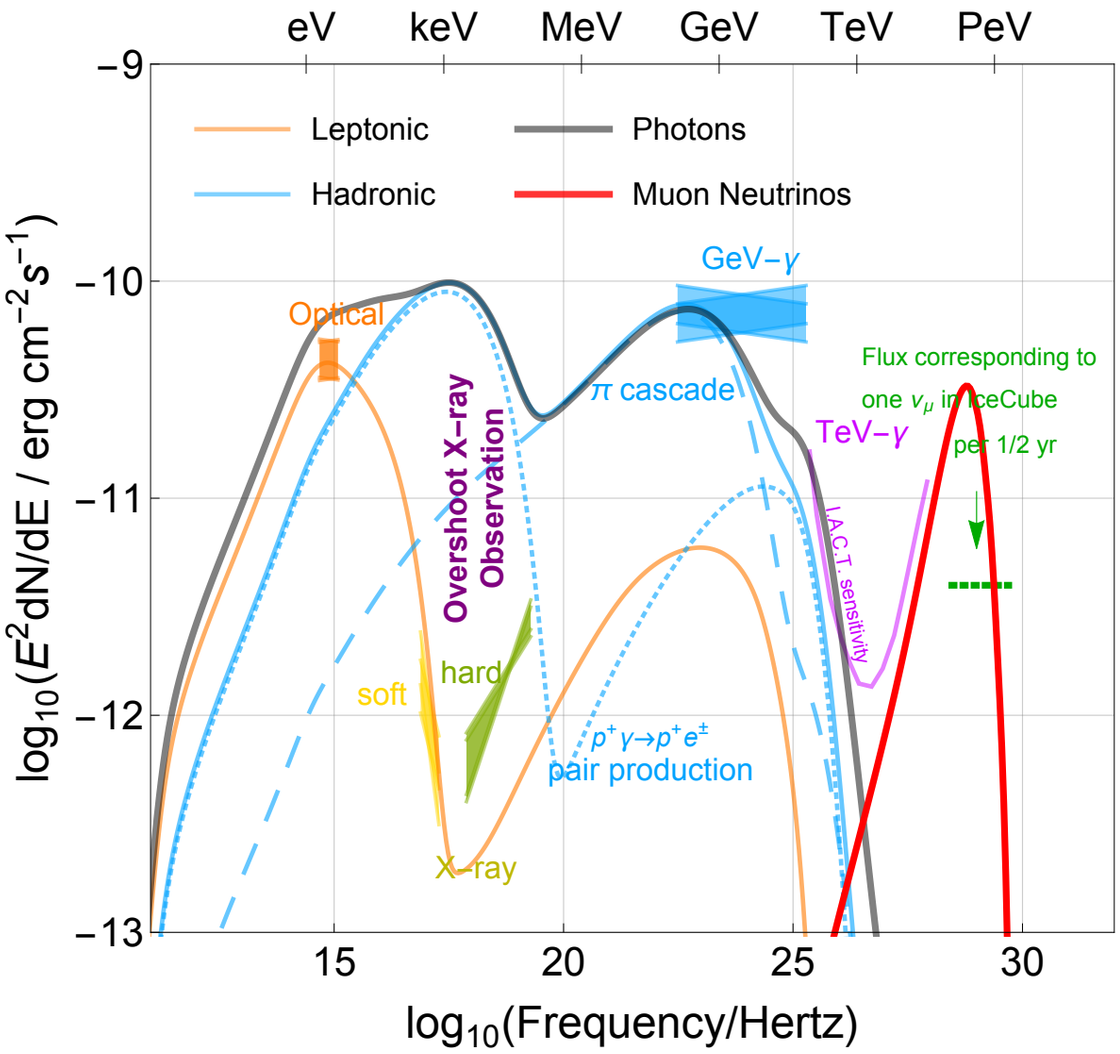
Righi, Tavecchio & Inoue; 1807.11069

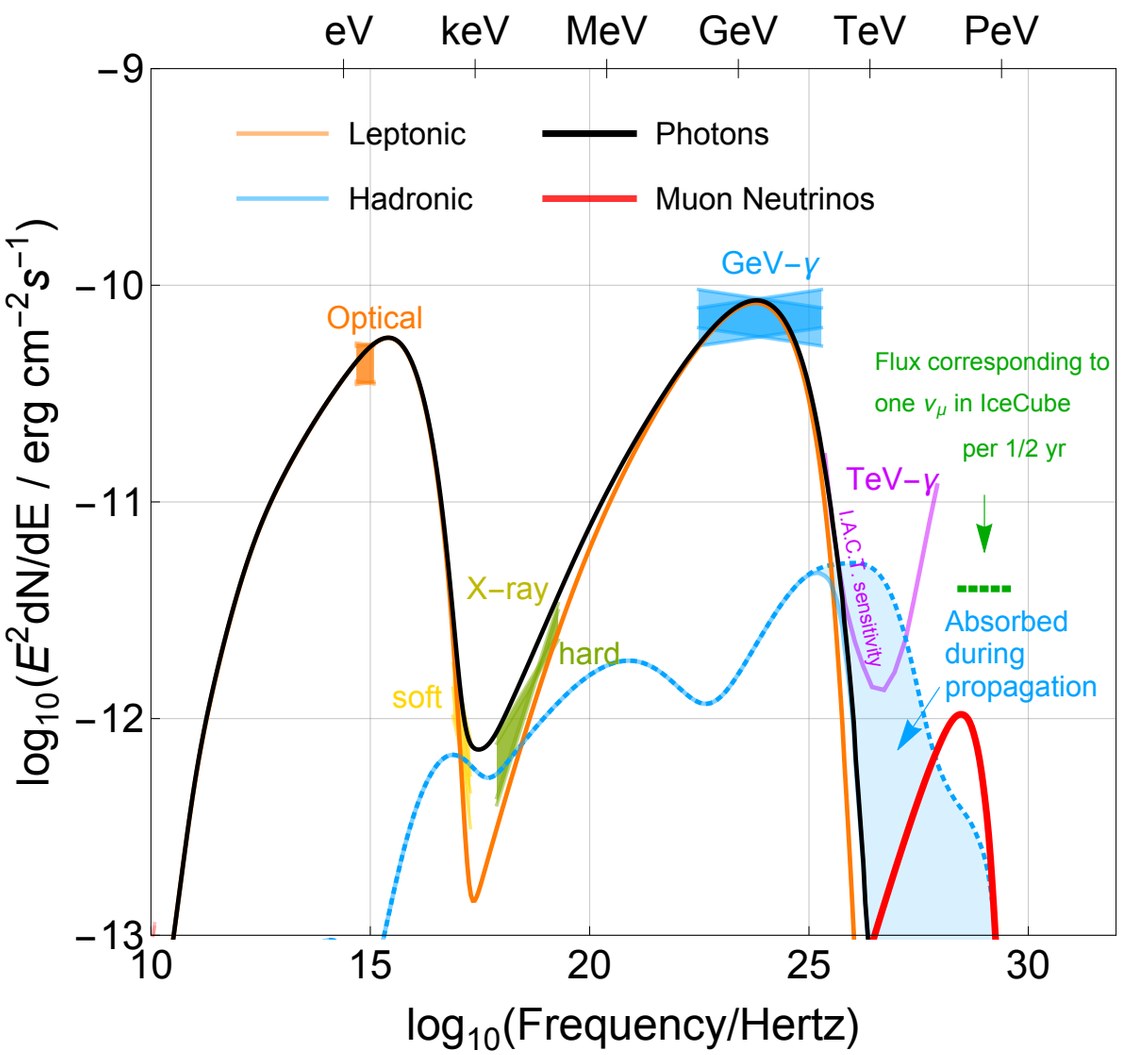


efficient neutrino production
by external RIAF SED;
reduces proton luminosity

talks by Fabrizio Tavecchio

X-RAY CONSTRAINTS

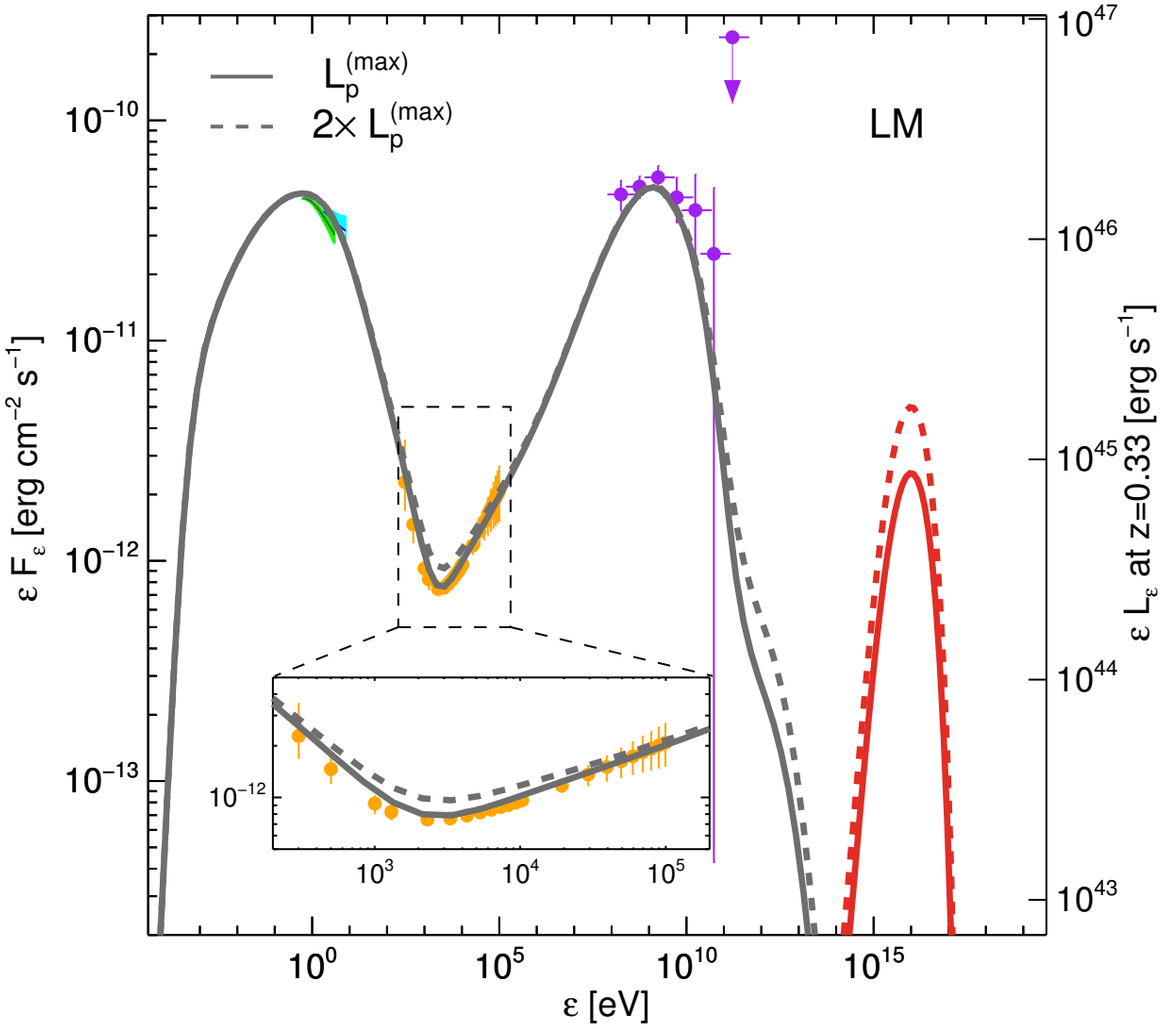


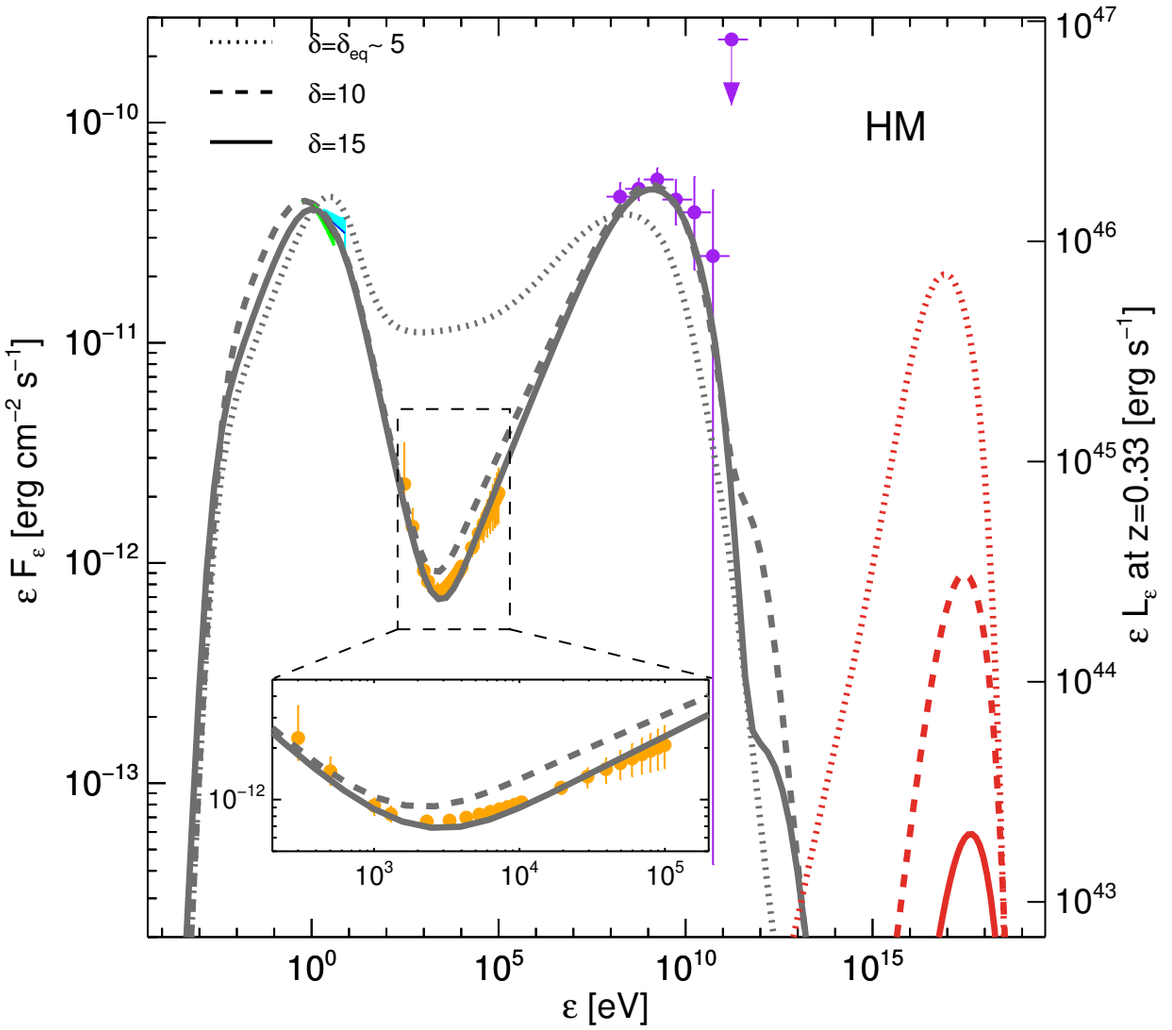


Gao, Fedynitch, Winter & Pohl; 1807.04275

talks by Markus Boettcher, Kohta Murase, Anita Reimer & Anatoli Fedynitch

X-RAY CONSTRAINTS

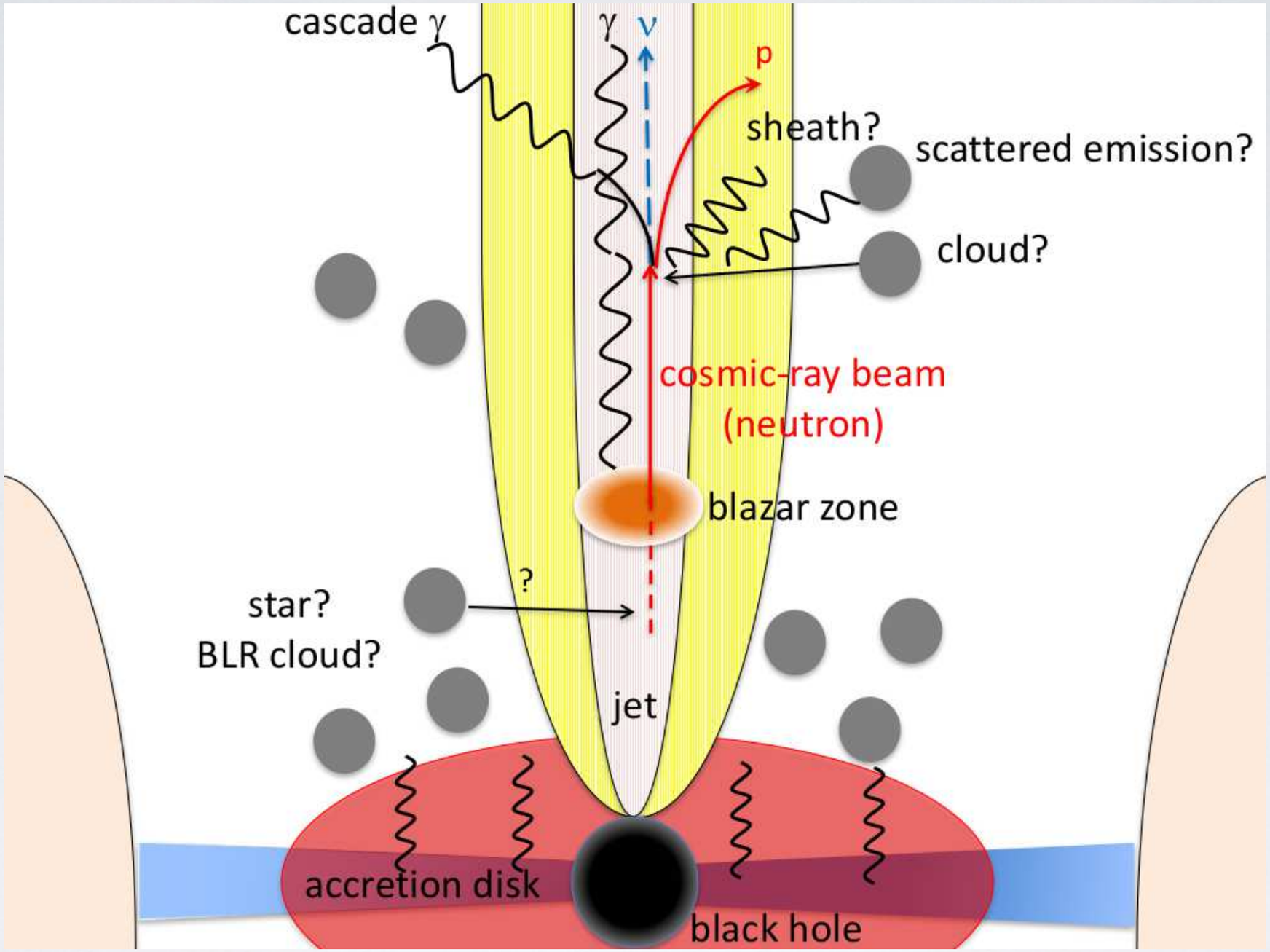




Keivani, Murase, Petropoulou, Fox, Cenko, Chaty, Coleiro, DeLaunay, Dimitrakoudis, Evans, Kenna, Marshall, Mastichiadis, Osborne, Santander, Tohuvavohu & Turley; 1807.04537

talks by Markus Boettcher, Kohta Murase, Anita Reimer & Anatoli Fedynitch

MULTI-ZONE MODELS ?



Murase, Oikonomou & Petropoulou; 1807.04748

see also Liu, Wang, Xue, Taylor, Wang, Li & Yang; 1807.05113

talk by Kohta Murase

MODELLING OF 2014/15 FLARE

- No Fermi-LAT flare observed in coincidence with 2014/15 neutrino flare.

- Neutrino luminosity is 5 times larger than the gamma-ray luminosity.

- Are these two intrinsically different flares?

- Is there necessarily a connection between Fermi-LAT and IceCube energy range?

- Is there evidence of a spectral hardening, indicating VHE flares?

talks by Anita Reimer & Simone Garrappa

MORE NEUTRINO FLARES!

- We need more observations like TXS to identify the emission process and to establish blazars as neutrino emitters.

- Maybe we have already witnessed these sources:
  - PKS B1424-418 and "Big Bird" (Kader et al. 2016)
  - AGL J1418+0008 and IC-160731 (Lucarelli et al. 2017)
  - GB6 J1040+0617 and IC-141209A

talks by Simone Garrappa & Matthias Kadler

Thank you for your participation!