

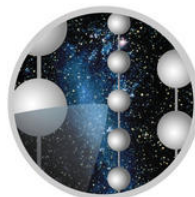
# Search for High Energy Neutrinos from Populations of Optical Transients

ICRC 2019

Robert Stein  
For the IceCube Collaboration



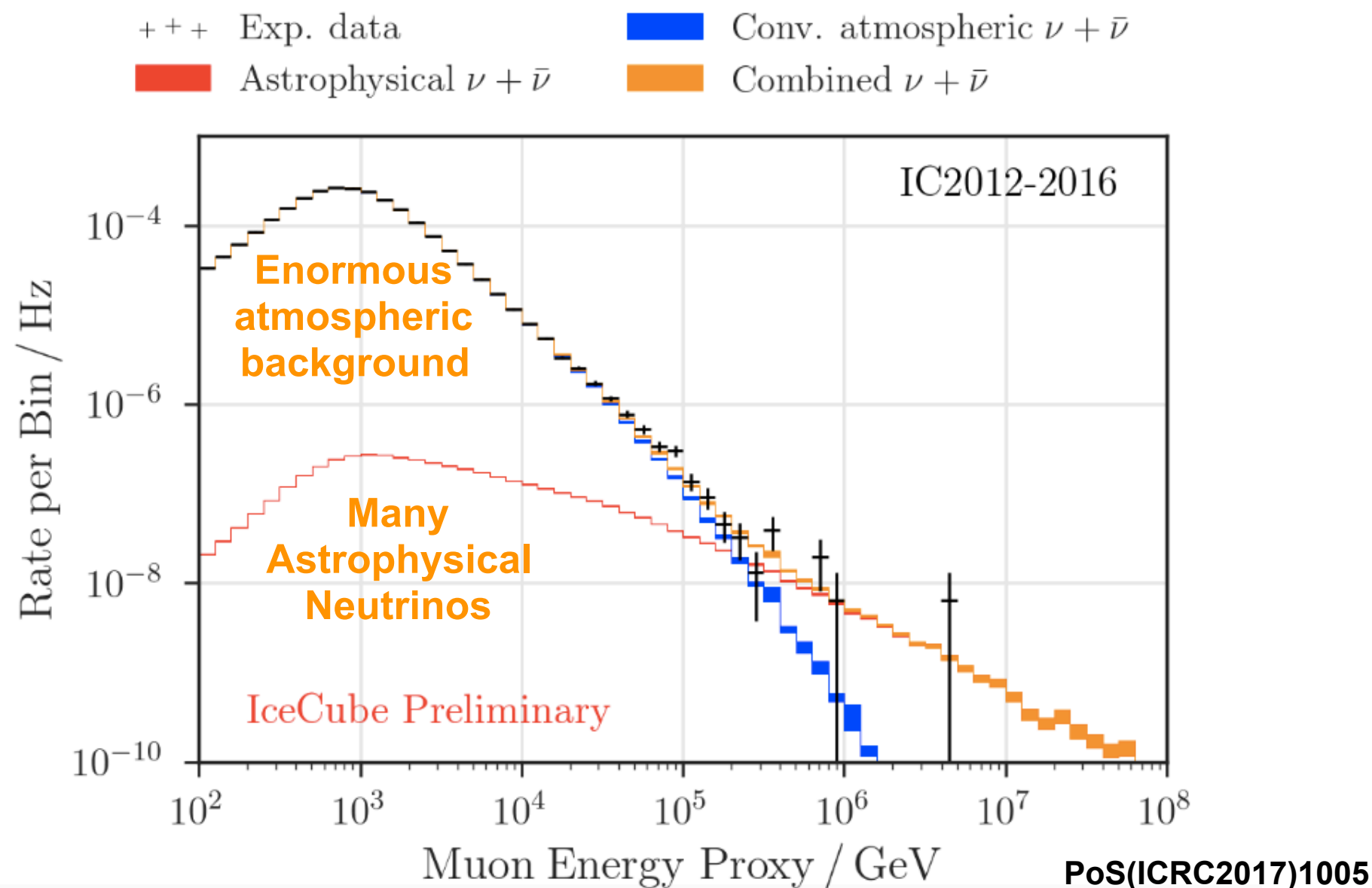
**HELMHOLTZ**  
Young Investigators



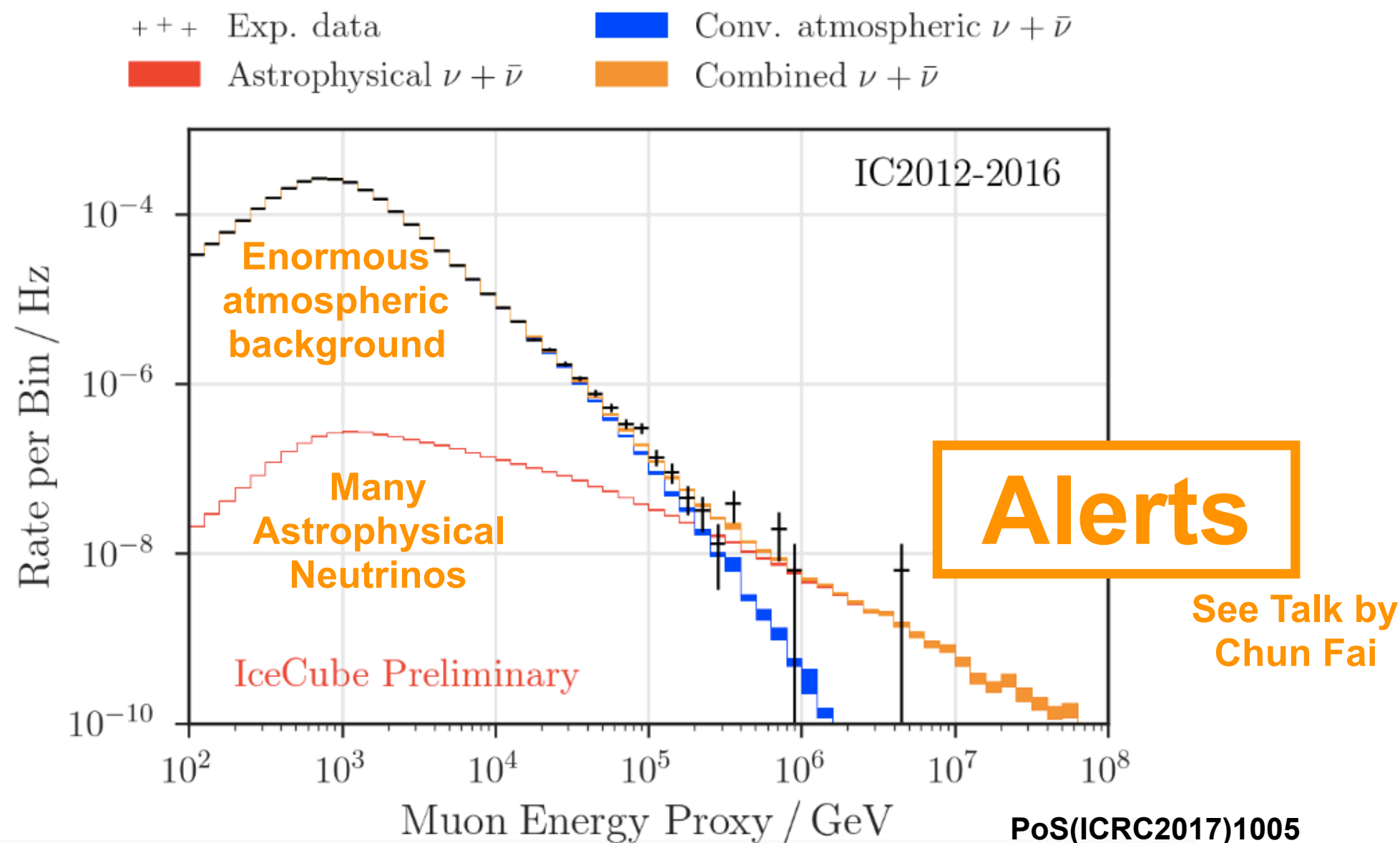
**ICECUBE**  
SOUTH POLE NEUTRINO OBSERVATORY



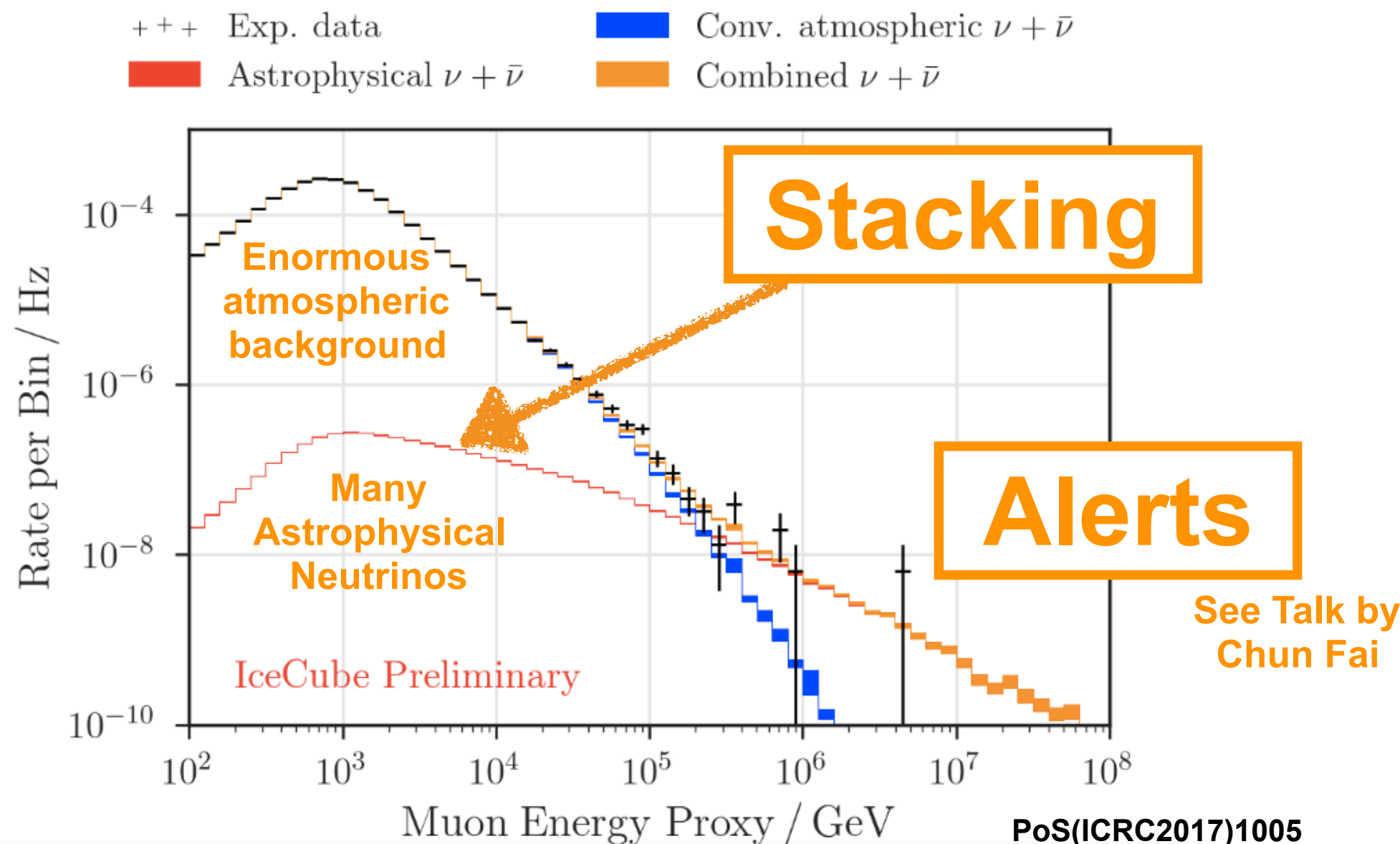
# Neutrino Astronomy



# Neutrino Astronomy



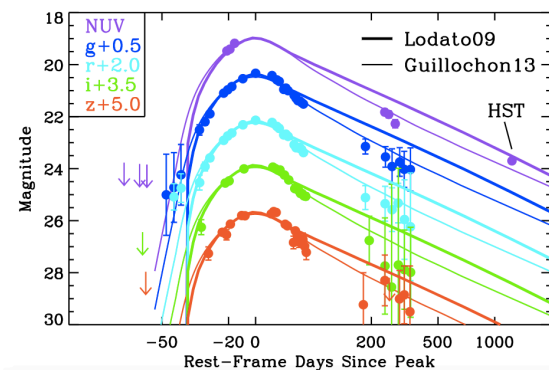
# Neutrino Astronomy





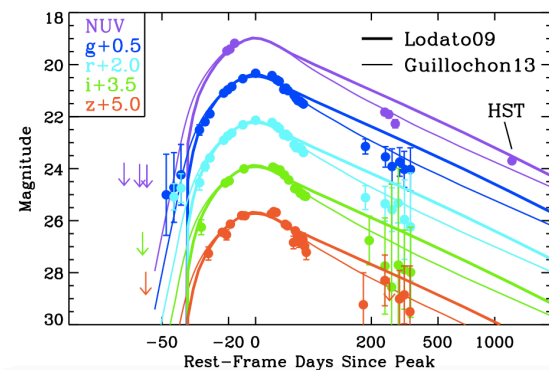
# Leveraging the lower-energy neutrinos

- Central problem in neutrino astronomy is “too much background”. Knowing where and when to look can help us!



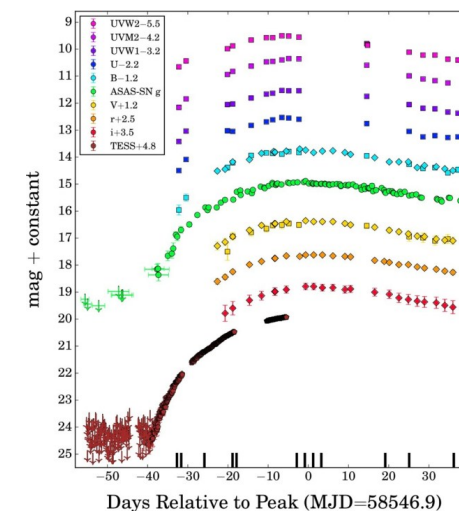
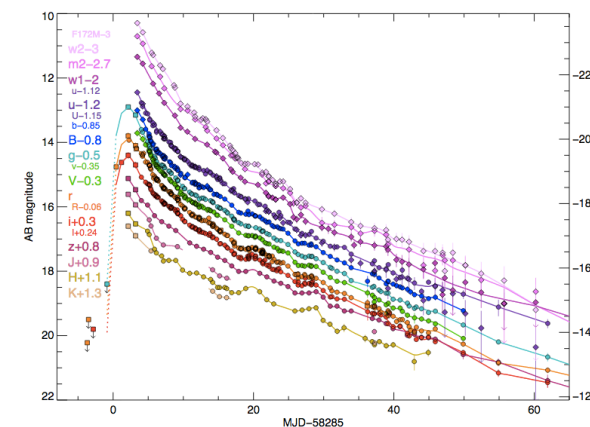
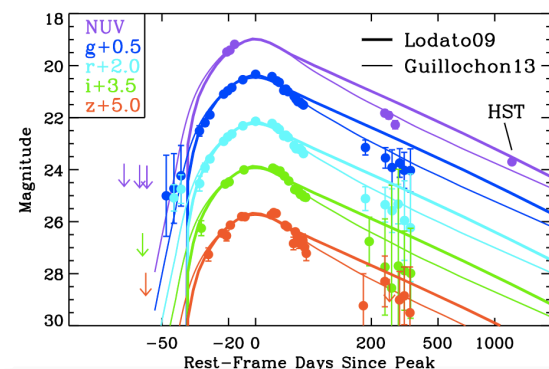
# Leveraging the lower-energy neutrinos

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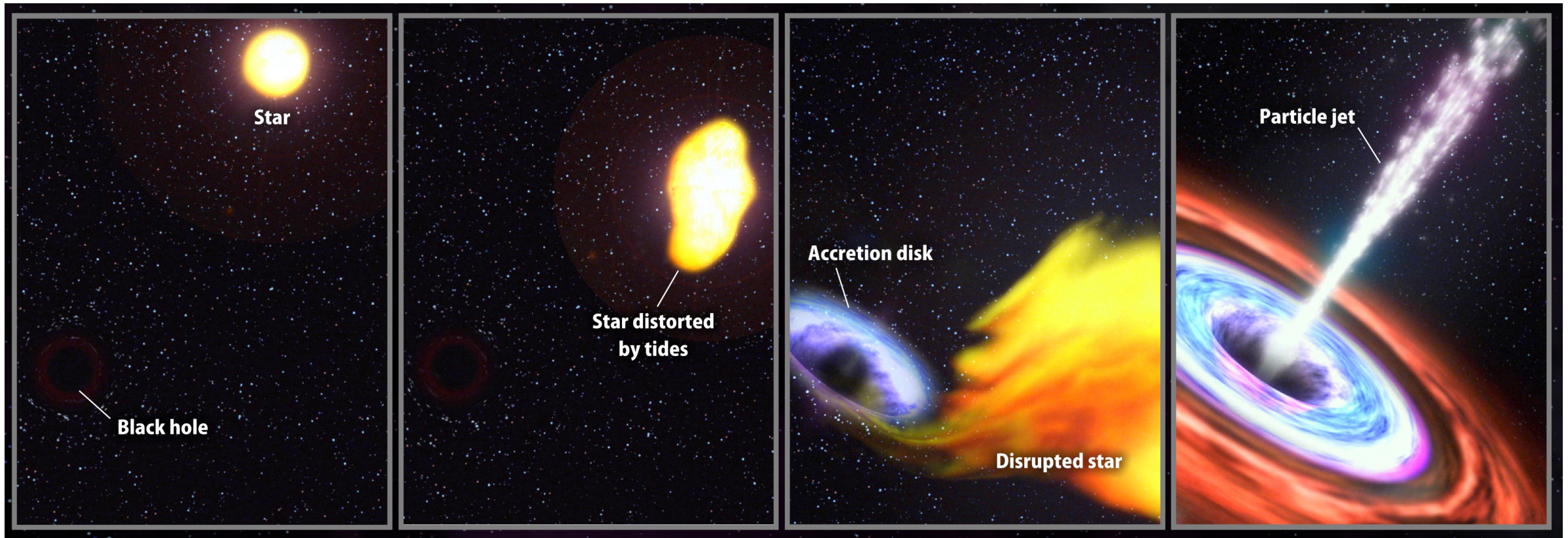
# Leveraging the lower-energy neutrinos

- Central problem in neutrino astronomy is “too much background”. Knowing where and when to look can help us!
- “Stacking analyses” combines neutrino emission from many sources. We use lower-energy neutrinos to make statistically-significant statements on populations.





# What are Tidal Disruption Events?



1

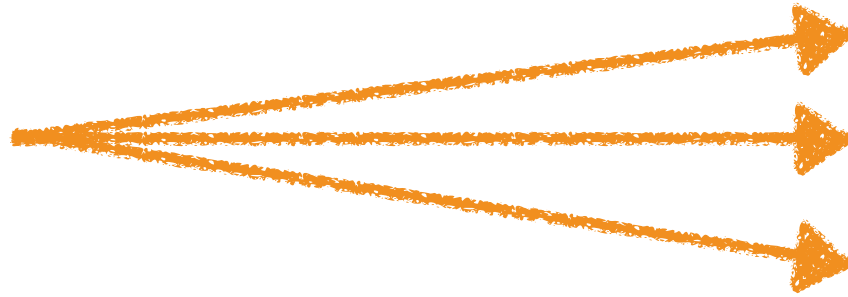
2

3

4

## But what is a TDE? And what is not?

**Nuclear  
Transients**

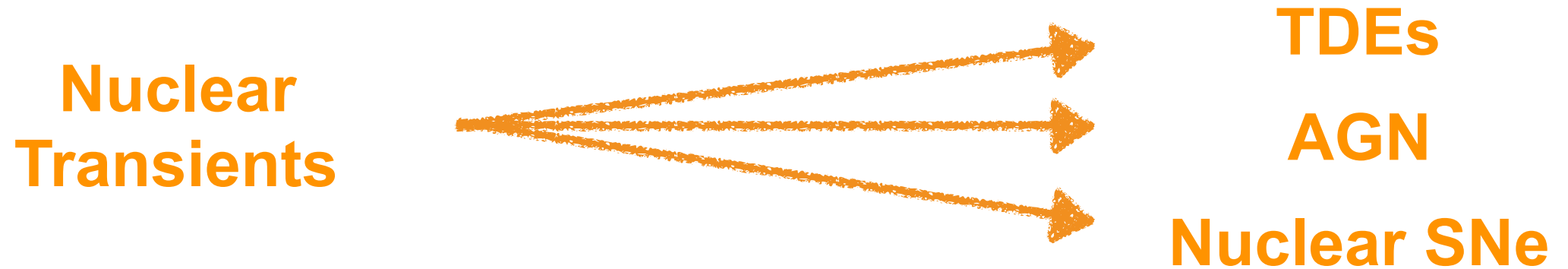


**TDEs**

**AGN**

**Nuclear SNe**

## But what is a TDE? And what is not?



**Need pure TDE sample for neutrino analysis**

**This requires extensive photometry + spectroscopy**

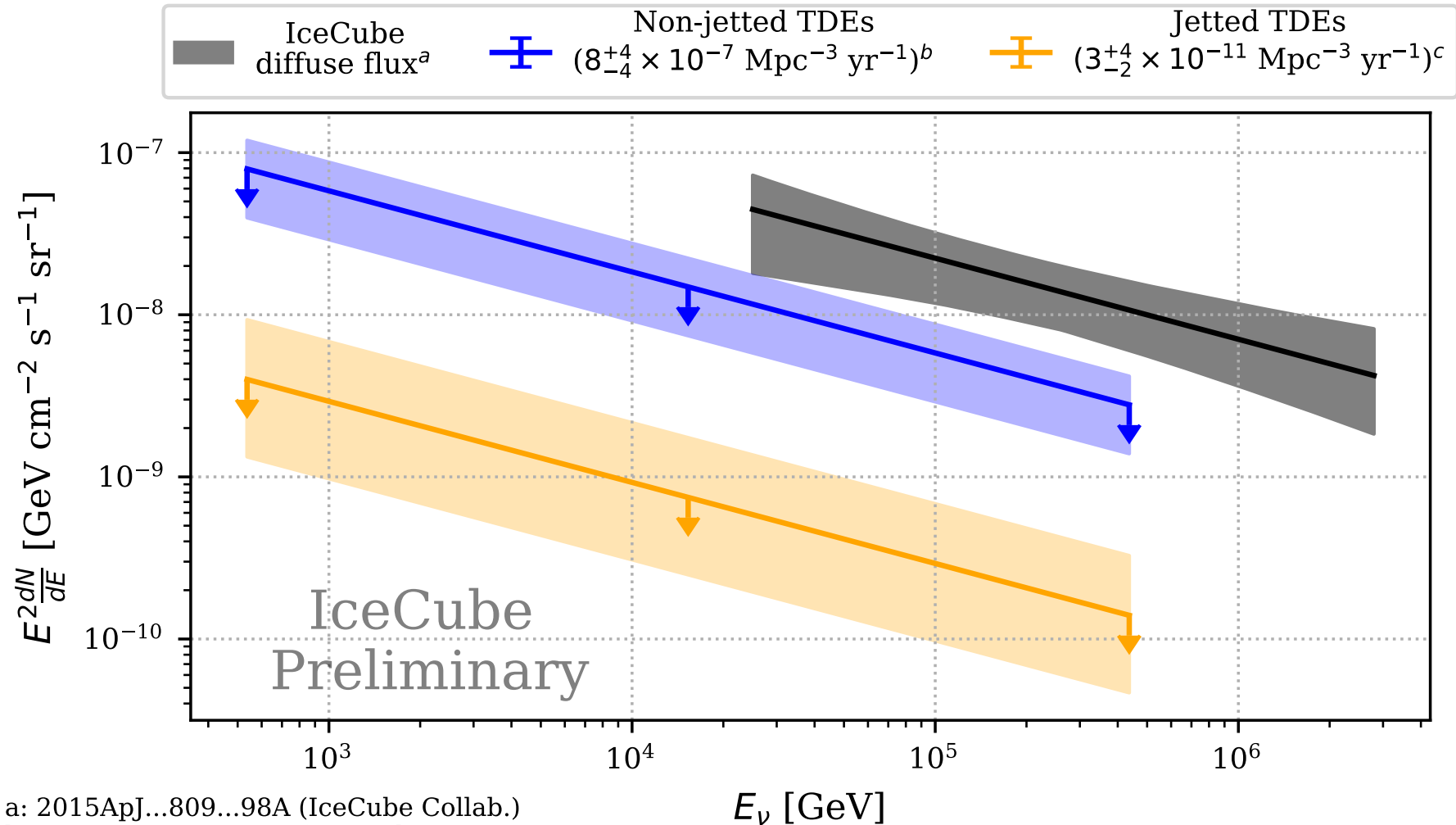
**Of literature candidates: 12/60 “convincing” Non-Jetted TDEs, 3/60 Jetted TDEs**

**Stacking analysis performed on these TDEs using IceCube data from 2008 to 2017**

# IceCube constraints on TDE neutrino emission

(Hypothesis: TDEs are Neutrino Standard Candles)

**NEW RESULT!**



**Large uncertainties in constraints are driven by poor rate estimation from “traditional astronomy”.**

a: 2015ApJ...809...98A (IceCube Collab.)

b: 2018ApJ...852...72V (van Velzen)

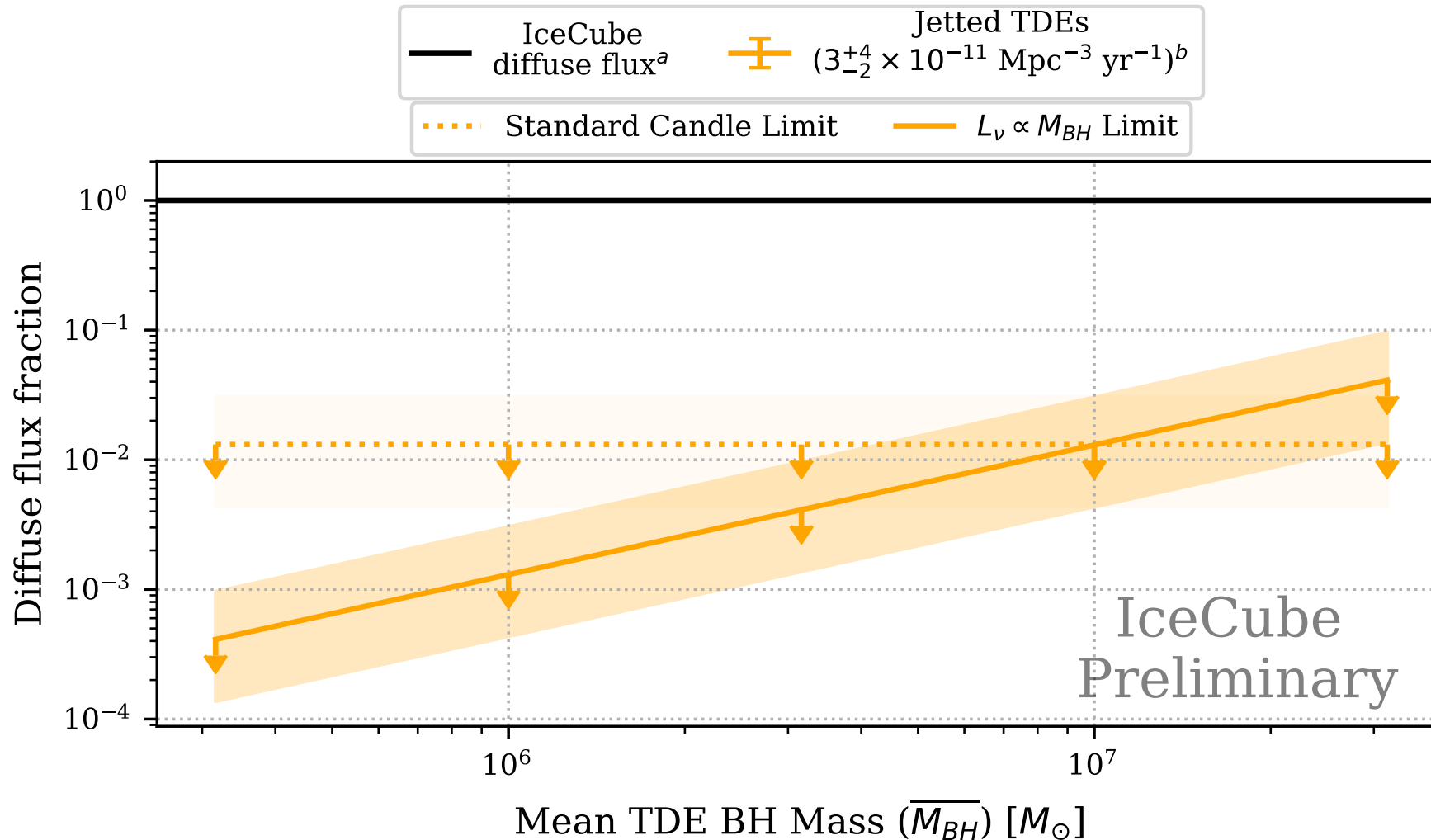
c: 2015ApJ...812...33S (Sun et al.)

With evolution from Sun et al.<sup>c</sup>

# IceCube constraints on TDE neutrino emission

(Hypothesis: Neutrino Luminosity proportional to  $M_{BH}$ )

**NEW RESULT!**



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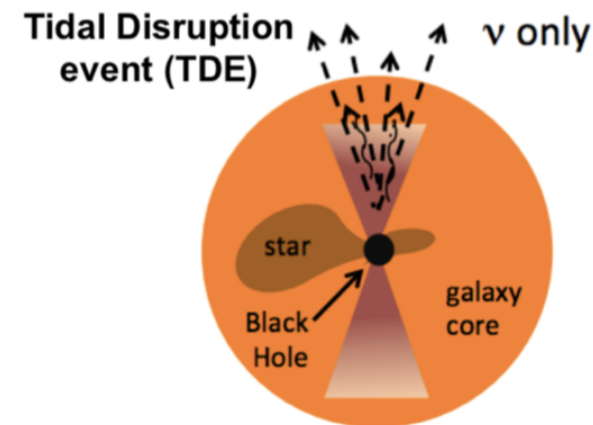
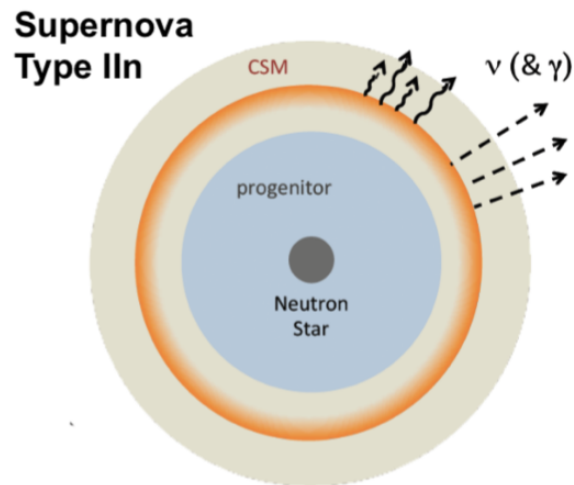
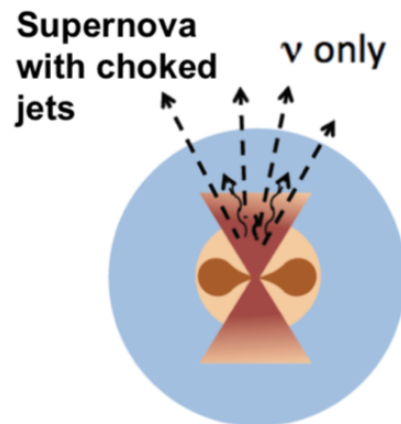
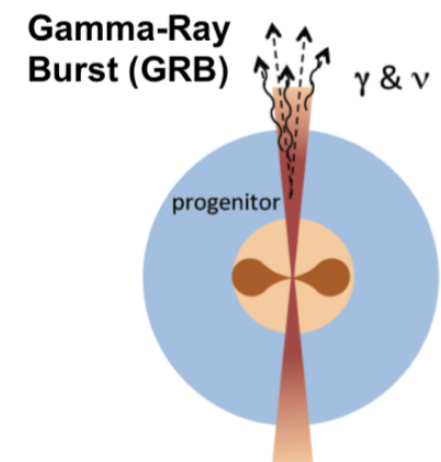
b: 2015ApJ...812...33S (Sun et al.)

With evolution from Sun et al.<sup>b</sup>



# Previous Analyses

# This Analysis



**<1%**

**<13%**

**<28%**

**<26%**

**<1.3%**

<https://arxiv.org/abs/1601.06484>

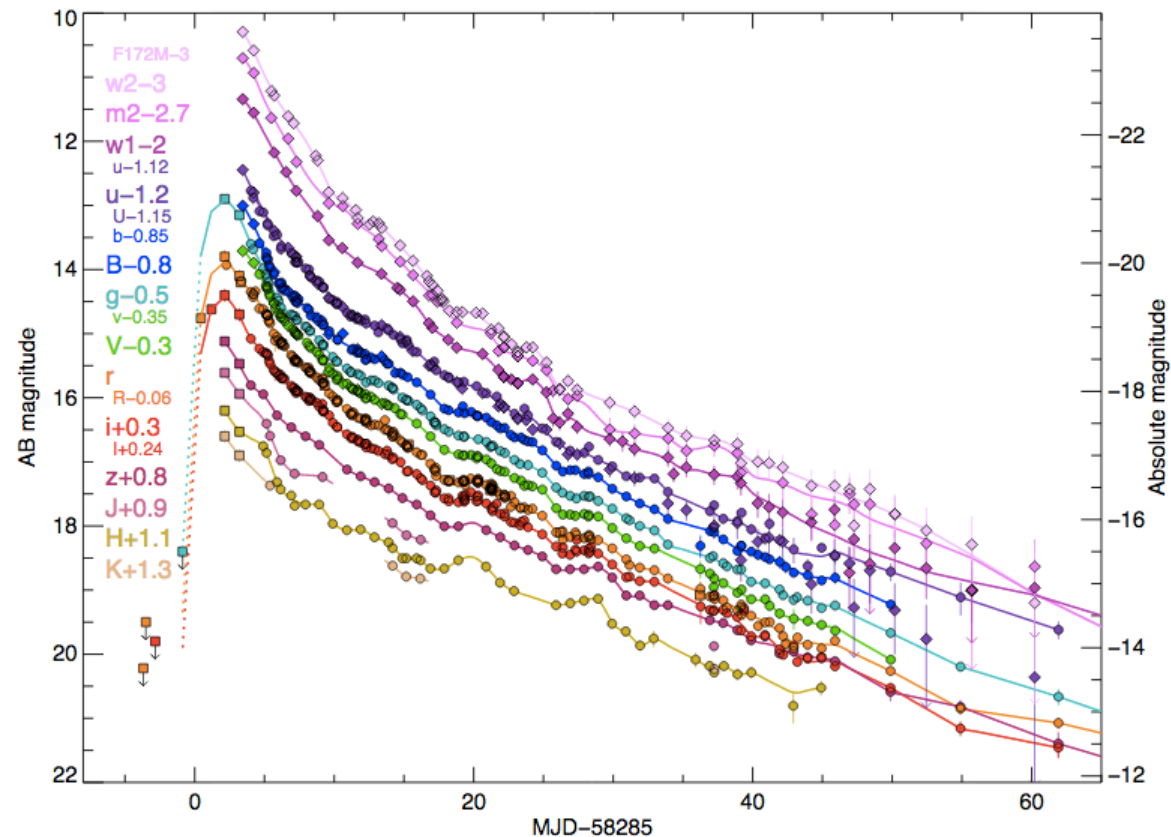
Preliminary (Publication in prep)

**Non-jetted**

**Jetted**

# The universe has surprises in store for us!

## AT2018cow



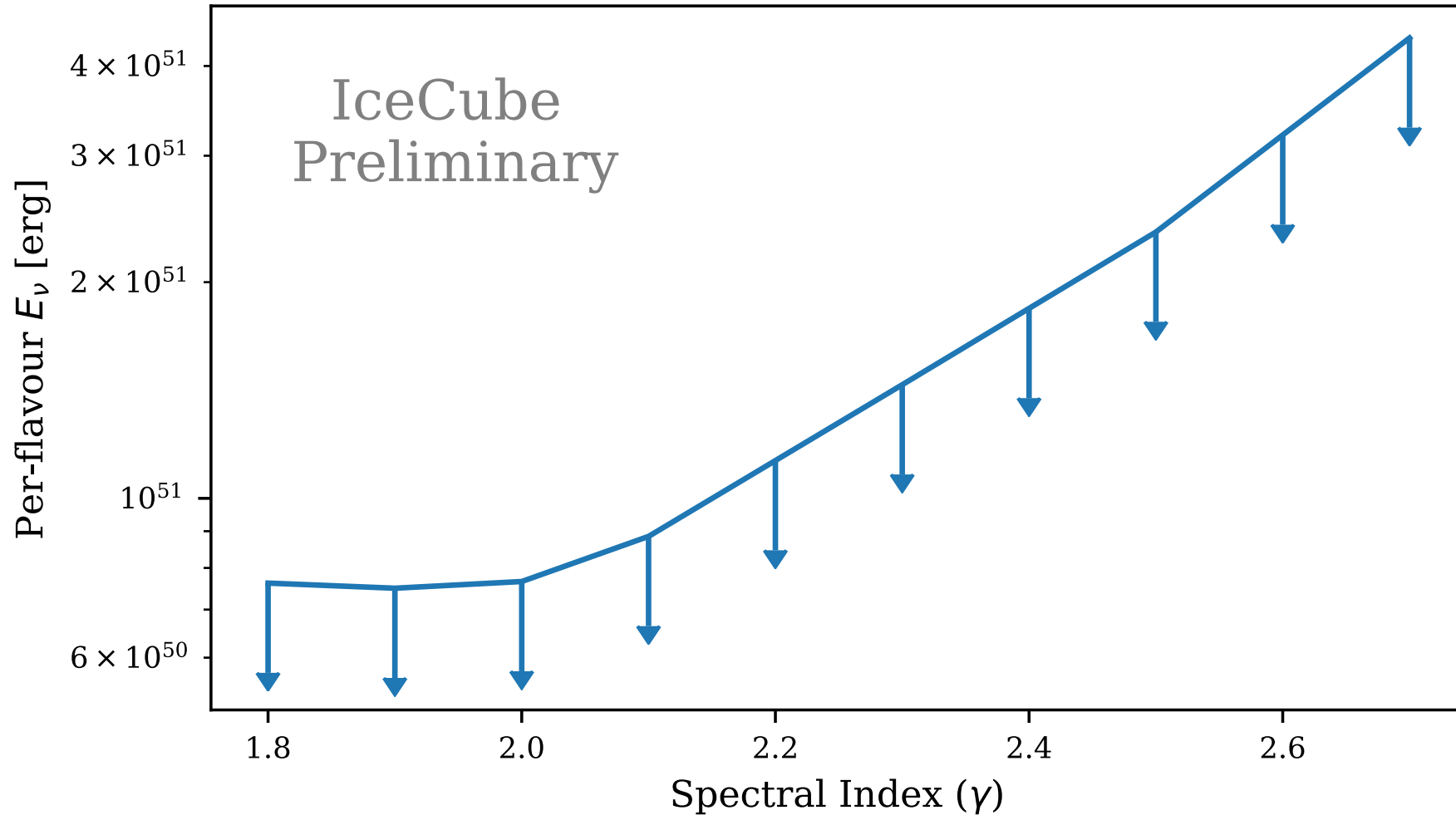
60 ATELS  
>10 papers!

Extraordinary transient  
Candidate TDE? Nearby “Fast Blue Optical Transient” (FBOT)?

# Latest IceCube results...

**NEW RESULT!**

AT2018cow neutrino emission limit (100GeV - 10PeV)



(Time-integrated emission in 130-day window)

# Summary

- Transients provide an opportunity for searches with much-reduced background.
- No significant neutrino emission found from TDEs. Previous studies limited CCSNe contribution.
- No significant emission from AT2018cow, whatever it was.
- New surveys such as ZTF, and upcoming surveys such as LSST, mean multi-messenger datasets available will improve dramatically in the near future.
- Search continues for an identified neutrino source population

