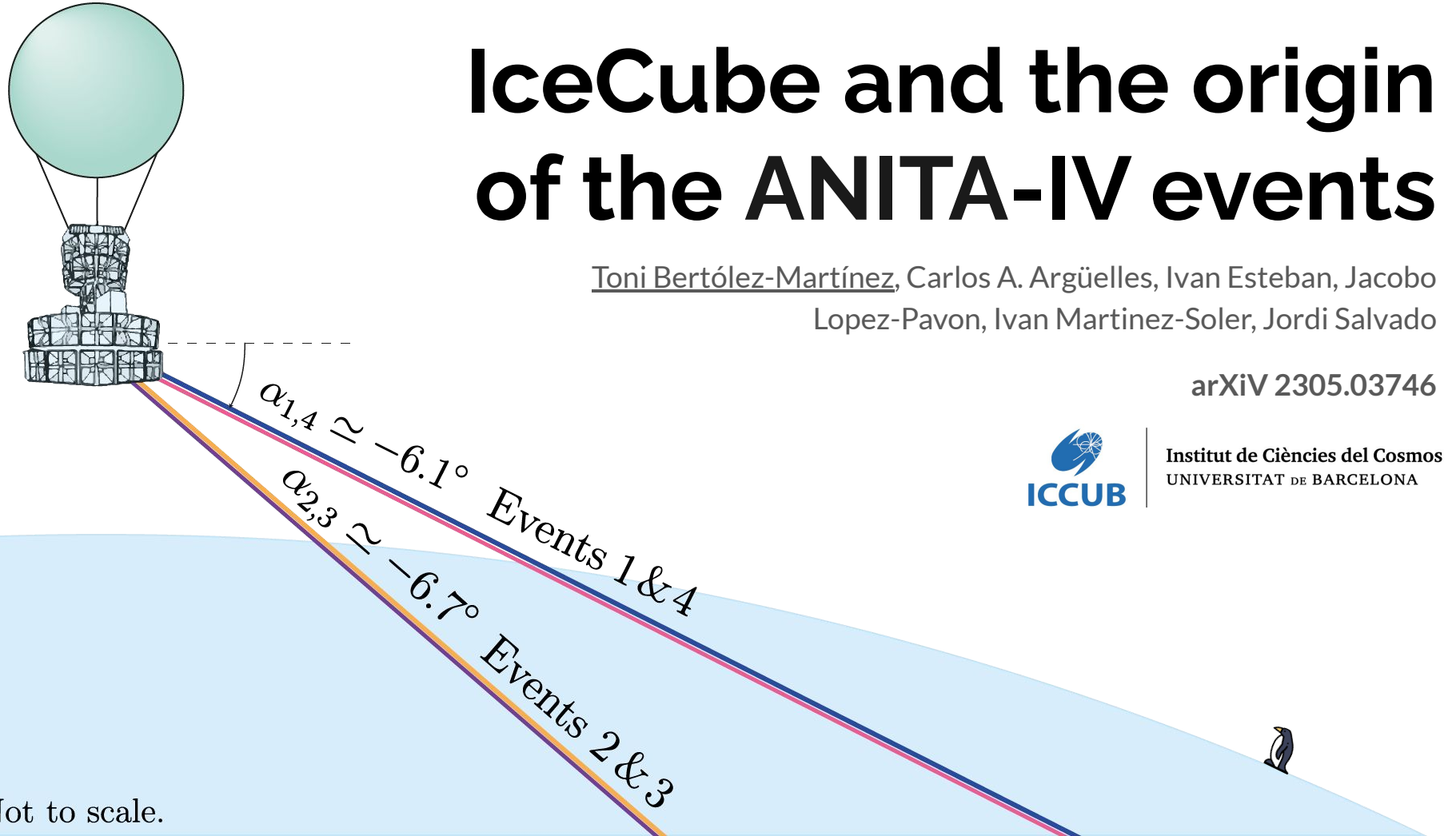
IceCube and the origin of the ANITA-IV events

Toni Bertólez-Martínez, Carlos A. Argüelles, Ivan Esteban, Jacobo Lopez-Pavon, Ivan Martinez-Soler, Jordi Salvado

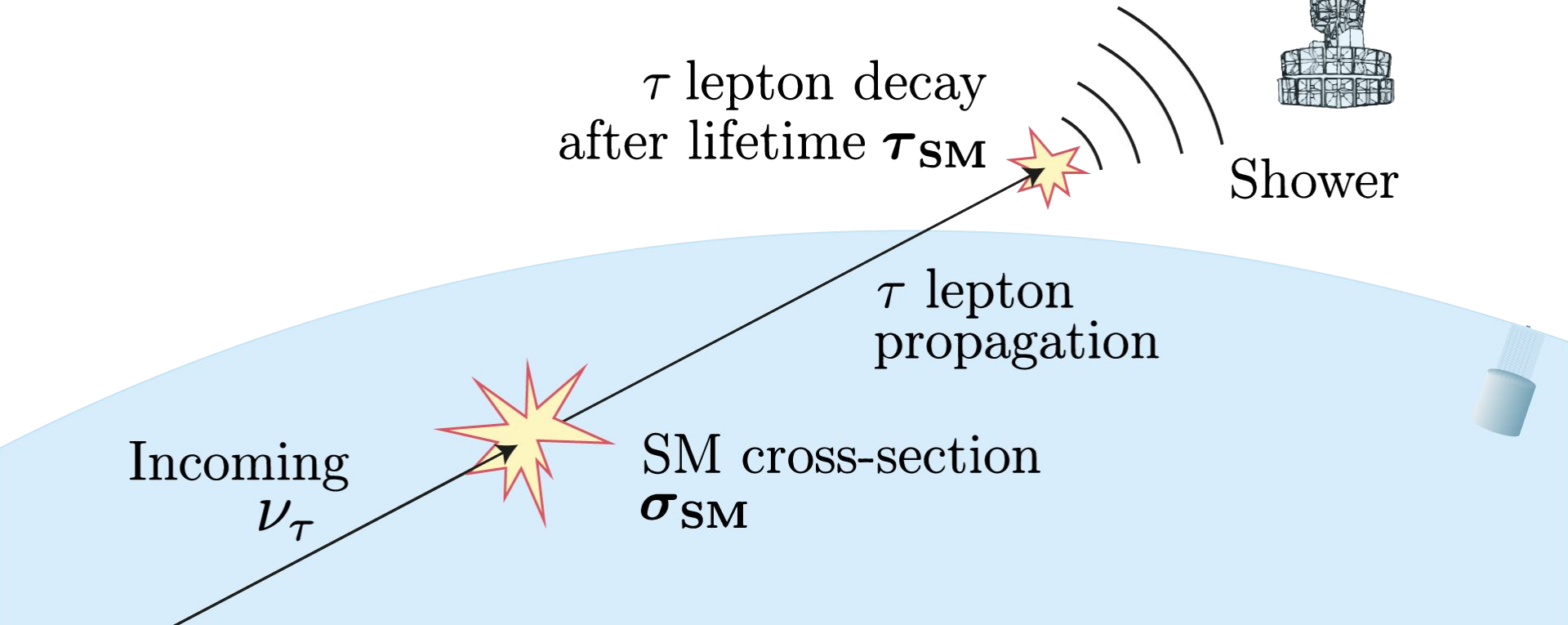
arXiV 2305.03746

ICCUB
Institut de Ciències del Cosmos
UNIVERSITAT DE BARCELONA



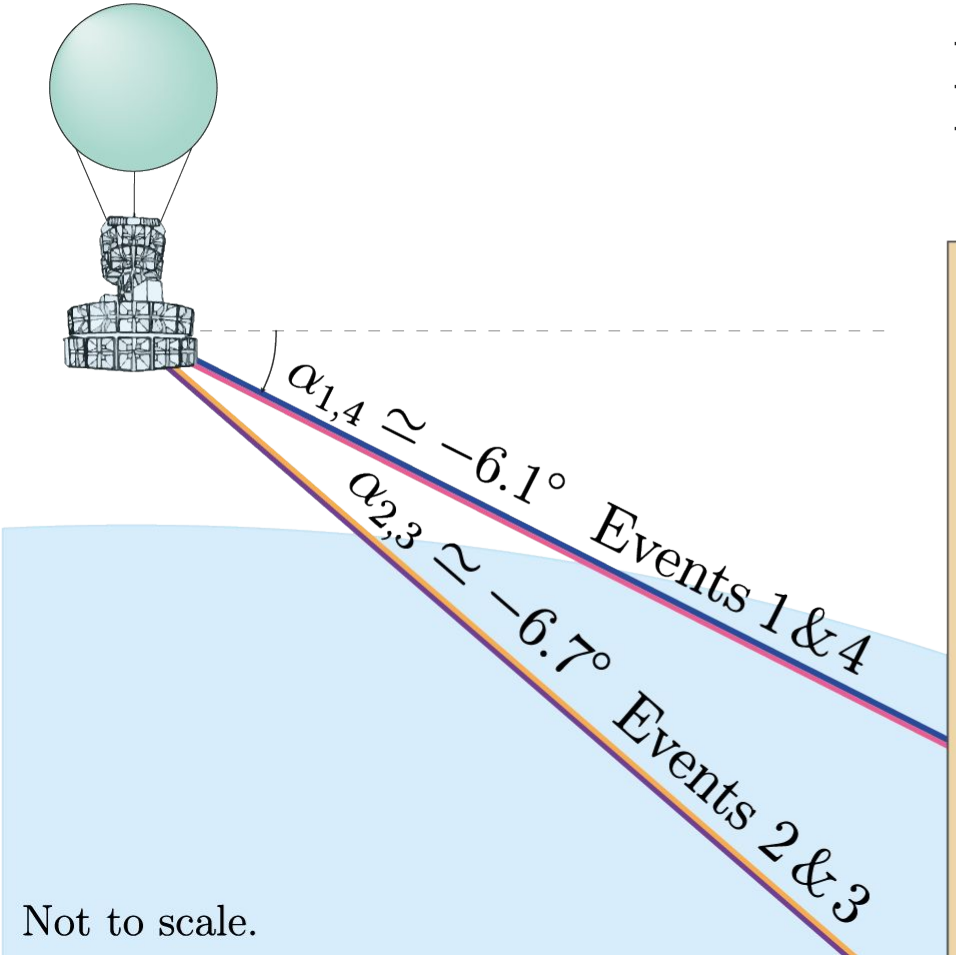
An explanation within the Standard Model

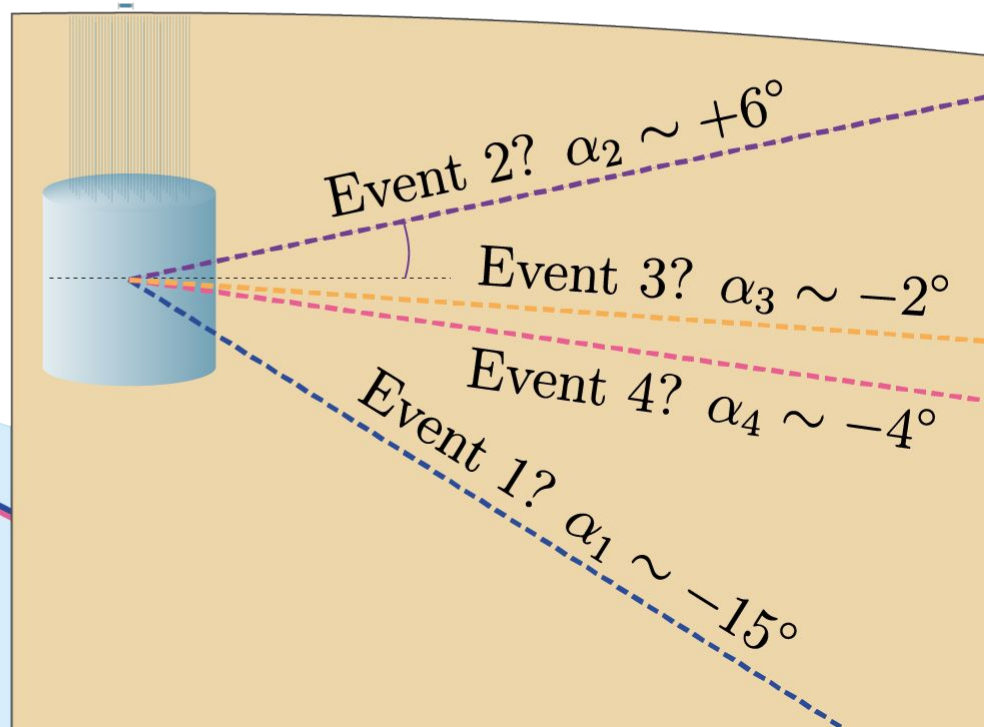
For trajectories close to the horizon, the signals can be produced from ultra-high-energy astrophysical tau neutrinos.



ANITA has seen 4 events, IceCube has seen none: tension!

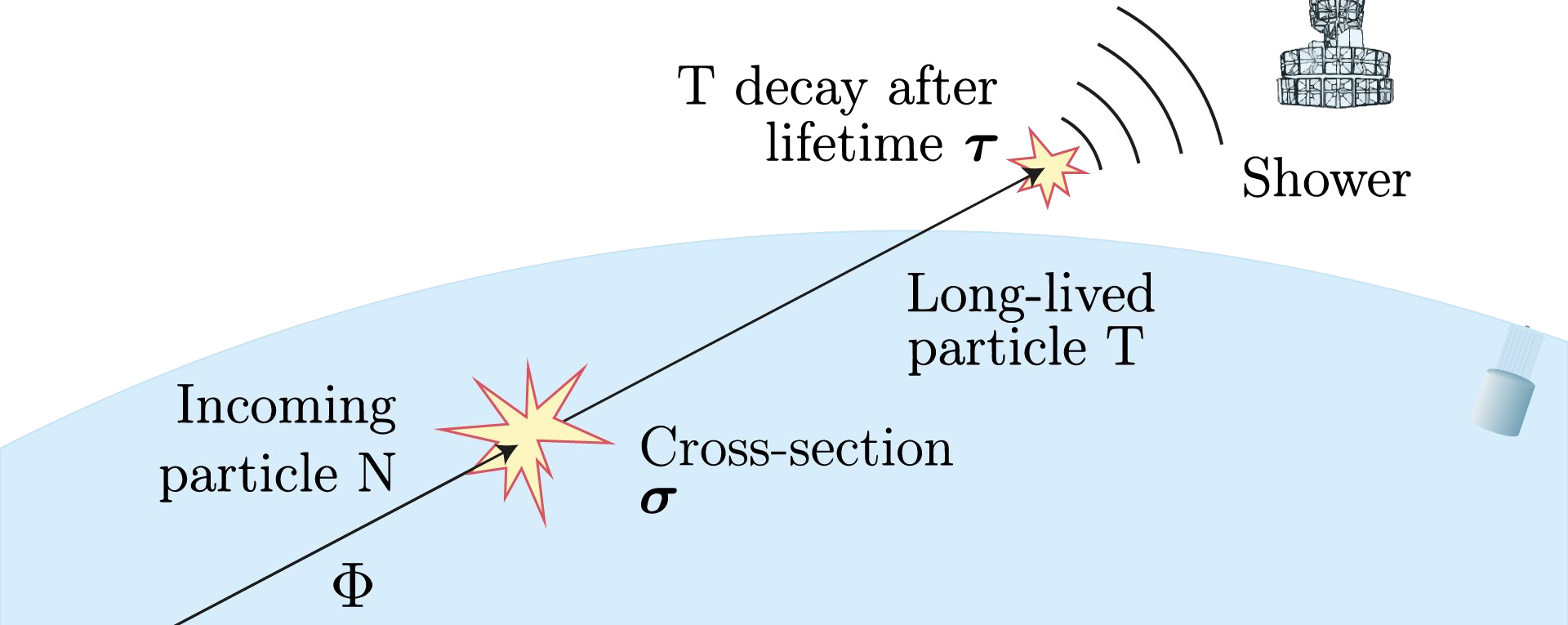
- IceCube is sensitive to less area (1 km^2 vs ~200 km^2)
- More angular aperture (full 4π vs a narrow window)
- More exposure time (9 years vs 26 days)





A class of models which may evade IceCube

Tries to mimic the SM explanation with three free parameters,
e.g., decay of EeV Dark Matter with inelastic DM models.

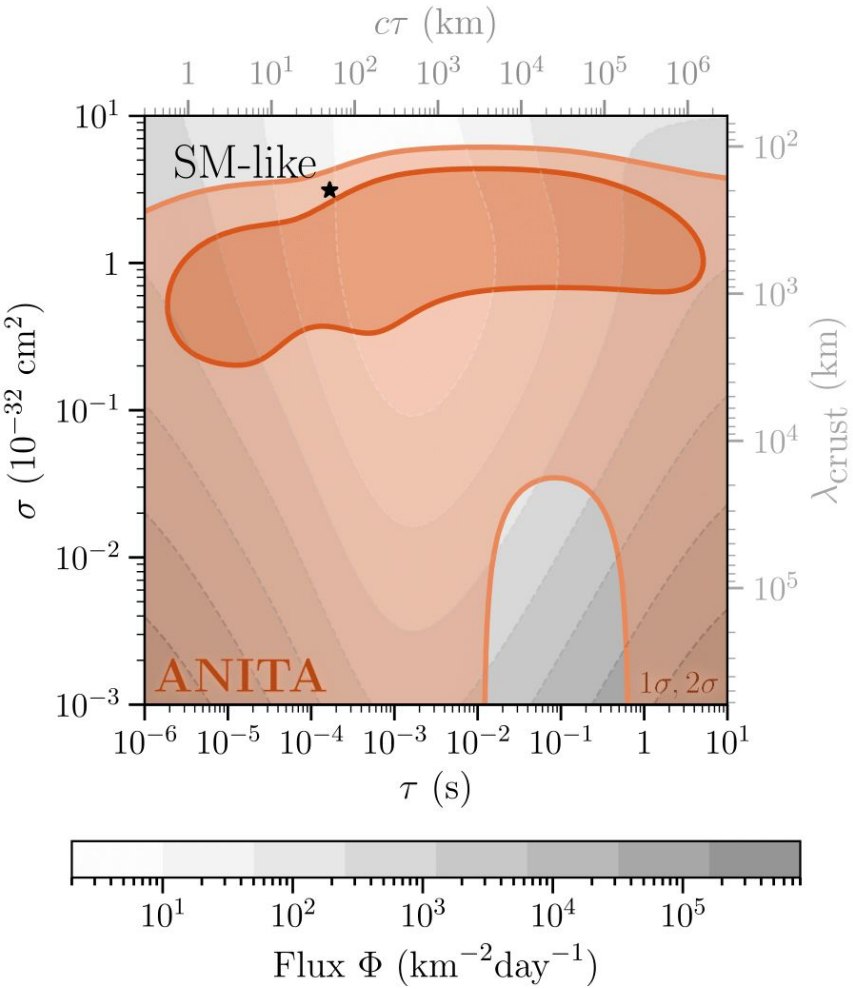


Constraints from the ANITA angular event distribution

Why are events coming from where they come?

A closed region to 1 sigma!

- σ Best-fit slightly smaller than SM.
- τ Poorly constrained, degenerate with flux normalisation.



Constraints from ANITA events and IceCube's absence of events

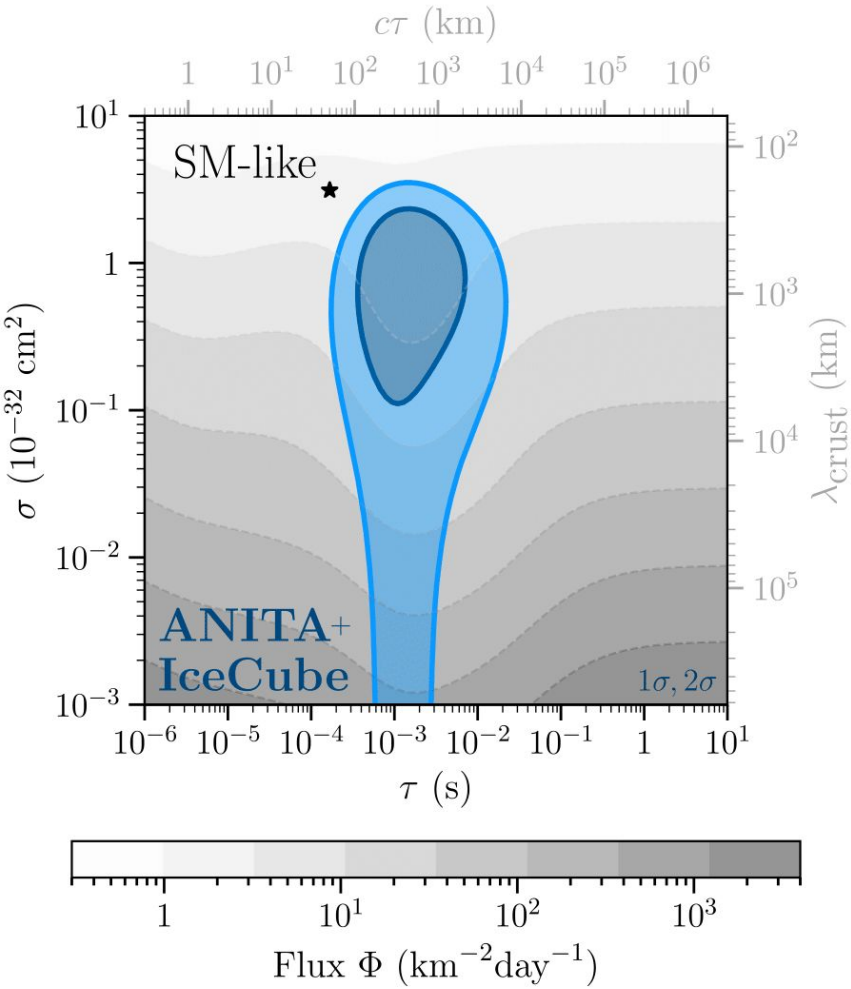
Which parameters explain *both* experiments simultaneously?

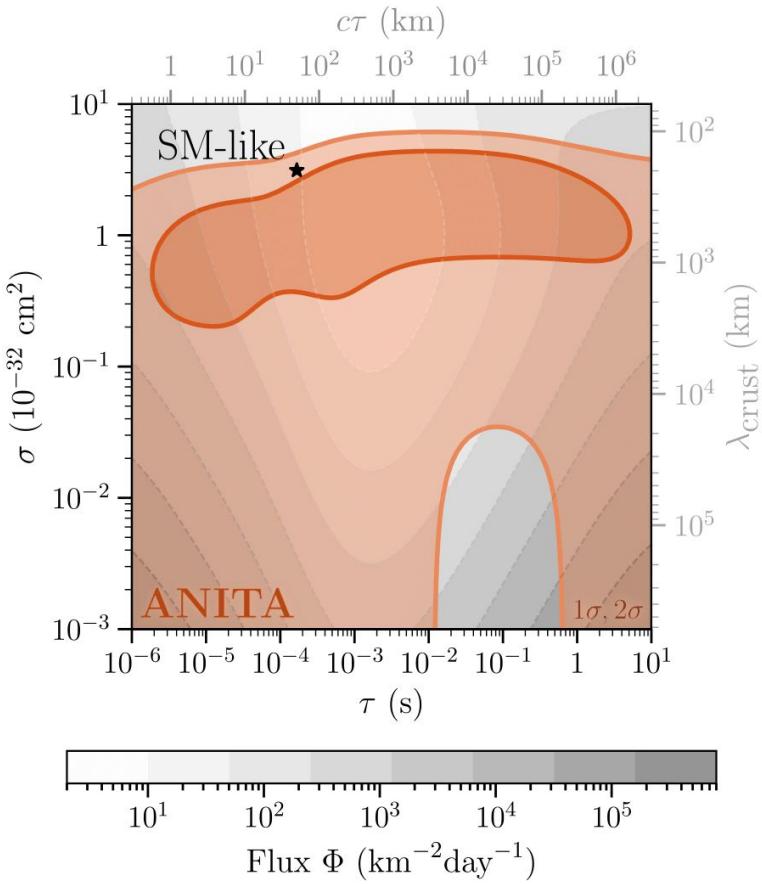
BSM relaxes the tension: best-fit predicts O(1) events for the 9 years of IceCube.

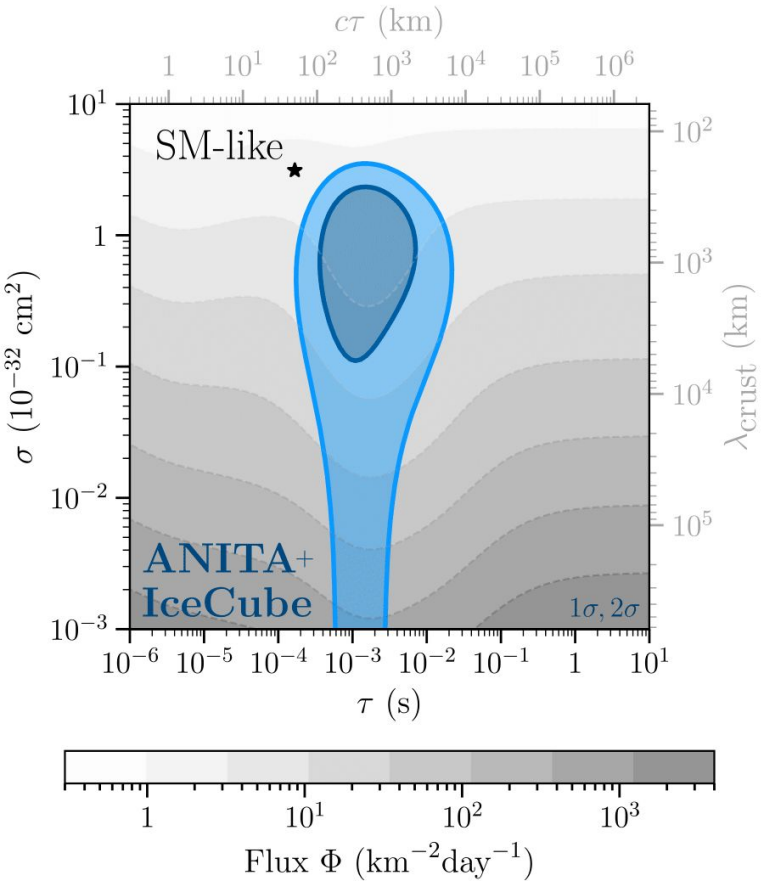
Signals would be observable in IceCube-Gen2!

$\mathcal{T}$ Degeneracy is broken, best-fit ~1 ms.

Φ Similar to CR fluxes in this energy range.







Thanks!

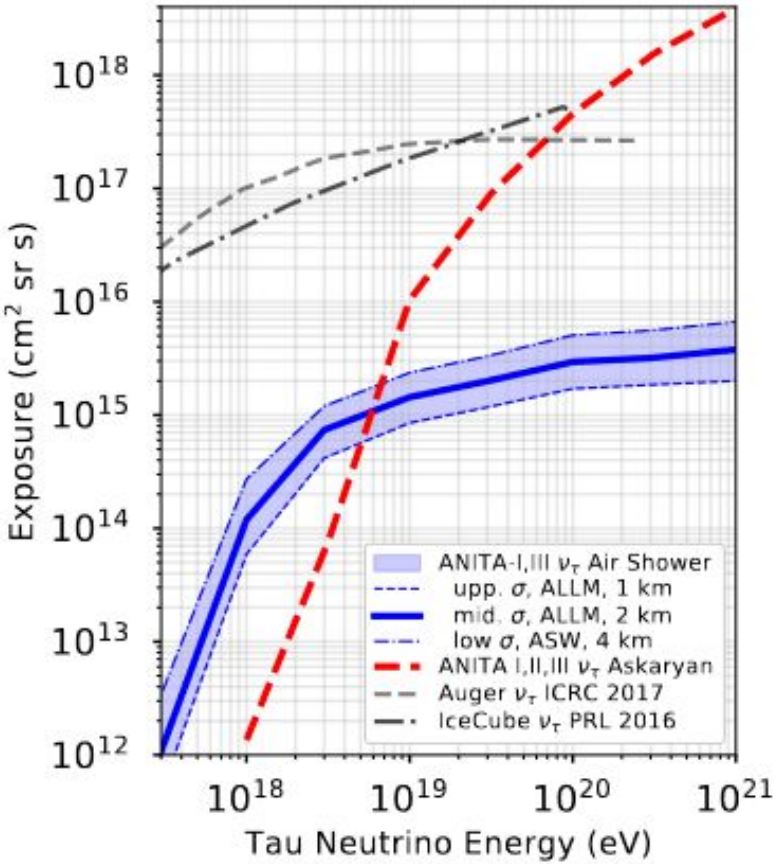
Find me around, in the poster or in the arXiV: 2305.03746

Backup slides

A tau neutrino diffuse flux origin is in strong tension with IceCube and Auger

Despite a four-transients hypothesis is not.

IceCube (and Auger) exposure is ~2 orders of magnitude larger than ANITA's for a tau neutrino diffuse flux.

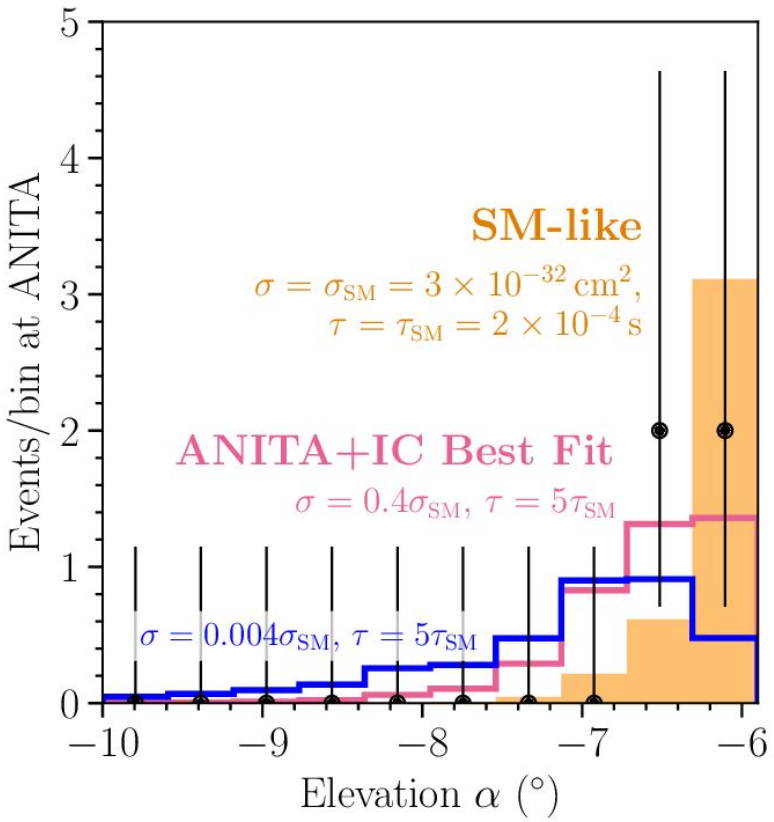


A. Romero-Wolf *et al.*, 1811.07261

Constraints from the ANITA angular event distribution

The 4 ANITA events occur near the horizon, and not anywhere else.

Even with a free flux normalization, some parameters are discarded by data!



In ANITA, σ mostly controls where the events peak, and τ mostly controls the normalization.

Constraints from the absence of events in IceCube

If ANITA has seen four events, how many events should have seen IceCube?

SM-like

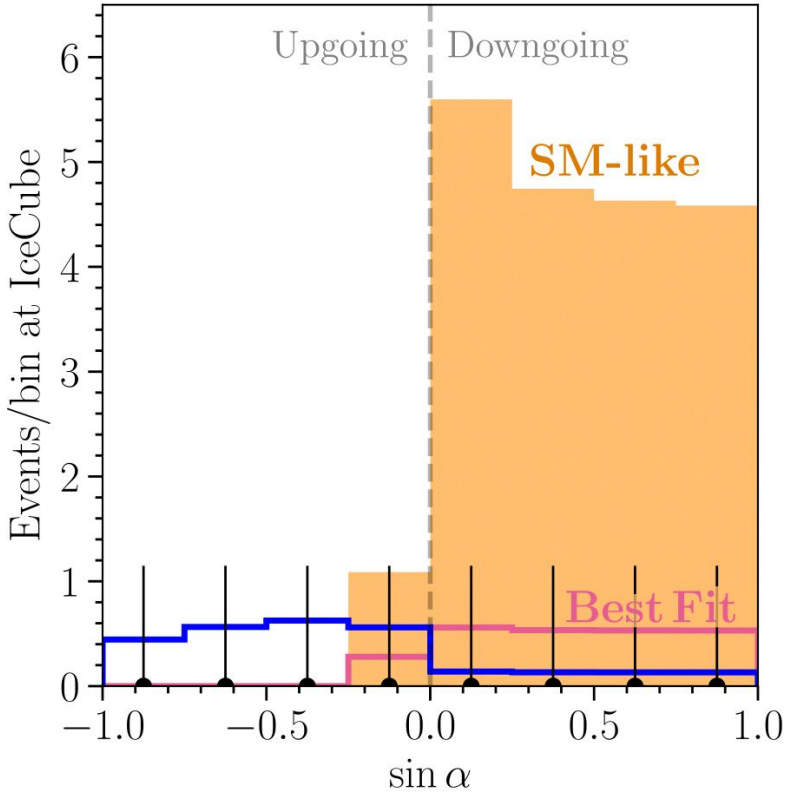
$\sigma = \sigma_{\rm SM} = 3 \times 10^{-32}\,{\rm cm}^2,$
$\tau = \tau_{\rm SM} = 2 \times 10^{-4}\,{\rm s}$

ANITA+IC Best Fit

$\sigma = 0.4\sigma_{\rm SM},\ \tau = 5\tau_{\rm SM}$

$\sigma = 0.004\sigma_{\rm SM},\ \tau = 5\tau_{\rm SM}$

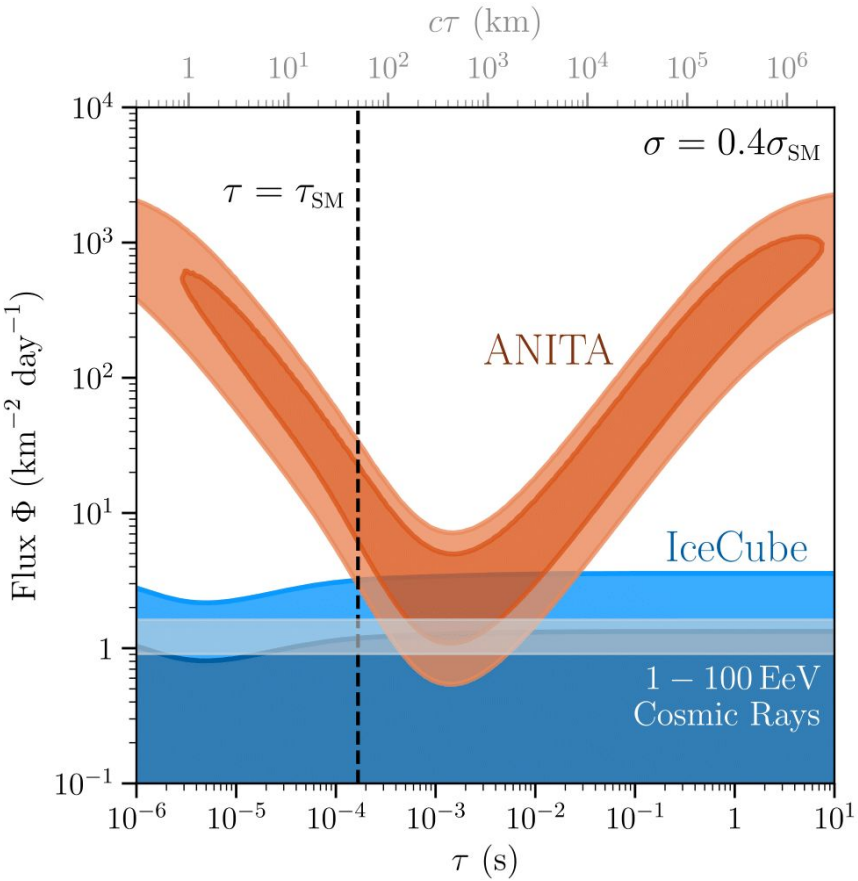
In IceCube, the flux normalization plays the most significant role.



Visualizing the tension between ANITA and IceCube

ANITA is mostly sensitive to secondary (T) particles. T particles need to decay *after* exiting the Earth but *before* reaching the antenna. Therefore, τ and Φ are strongly correlated.

IceCube is mostly sensitive to primary (N) particles, not very sensitive to τ.



The flux normalization is similar (or larger) than cosmic rays fluxes in the 1-100 EeV range.