

# Environmentally-induced decoherence in IceCube

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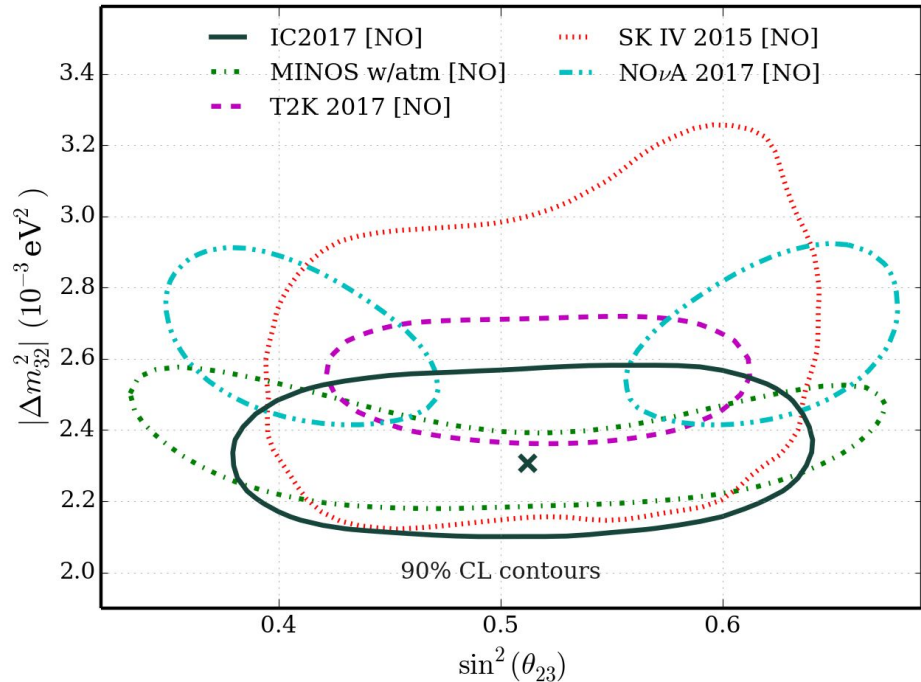
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# NOvA - T2K tension

- Different  $\theta_{23}$  measurements from NOvA and T2K.
- T2K favors maximal mixing ( $\theta_{23} = 45^\circ$ ) and NOvA favors non maximal
- Experiments have different baseline: NOvA 810 km, T2K 295 km



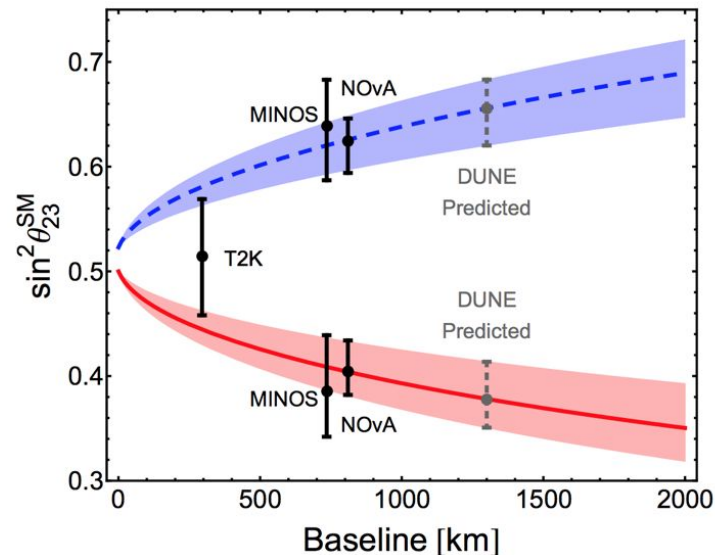
# Proposed solution: Decoherence

- Recent papers (arxiv:1702.04738) propose that  $\theta_{23}$  is maximal
  - L-dependent effect

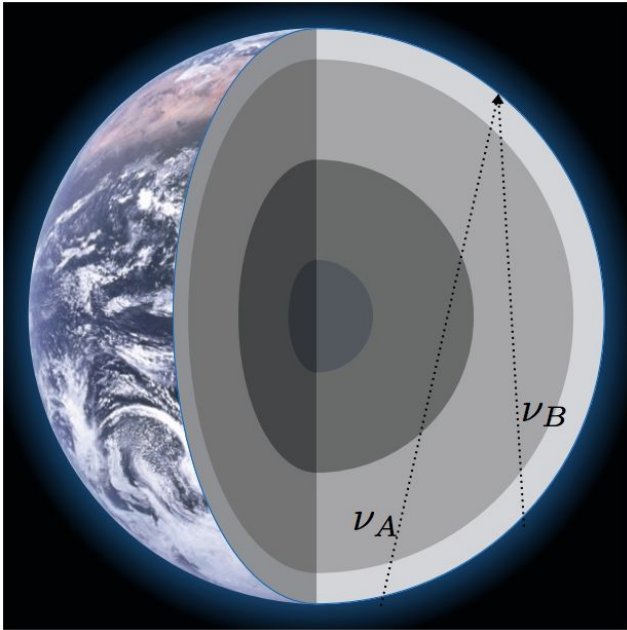
- Introduced as a damping term

$$P_{\mu\mu}^{(2\nu)} = 1 - \frac{1}{2} \sin^2 2\theta_{23} \cdot \left[ 1 - e^{-\Gamma_{32}L} \cdot \cos\left(\frac{\Delta m_{32}^2 L}{2E_\nu}\right) \right]$$

- $\Gamma_{32} = 23 \pm 11$  feV consistent with observed T2K-NOvA tension



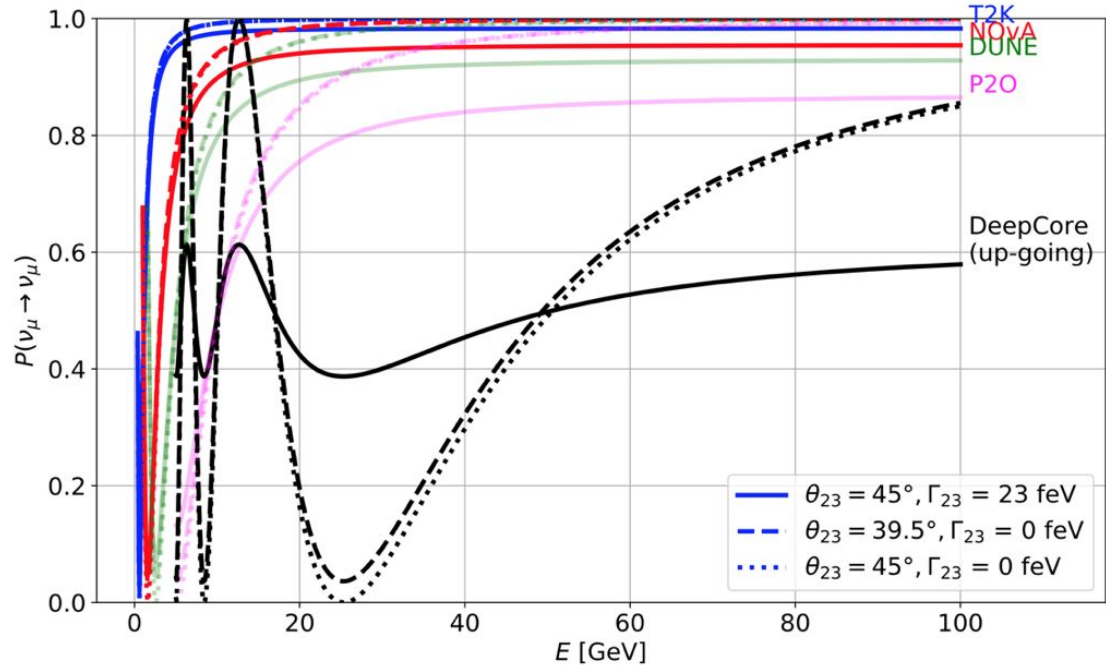
# Different baselines in IceCube



- Cosmic ray  $\rightarrow \nu_\mu$
- Different zenith angles give a range of baselines

# Potential effect in IceCube

- 2-flavor approximation
- Most upgoing case:  $L = 2 \cdot r_{\text{earth}}$



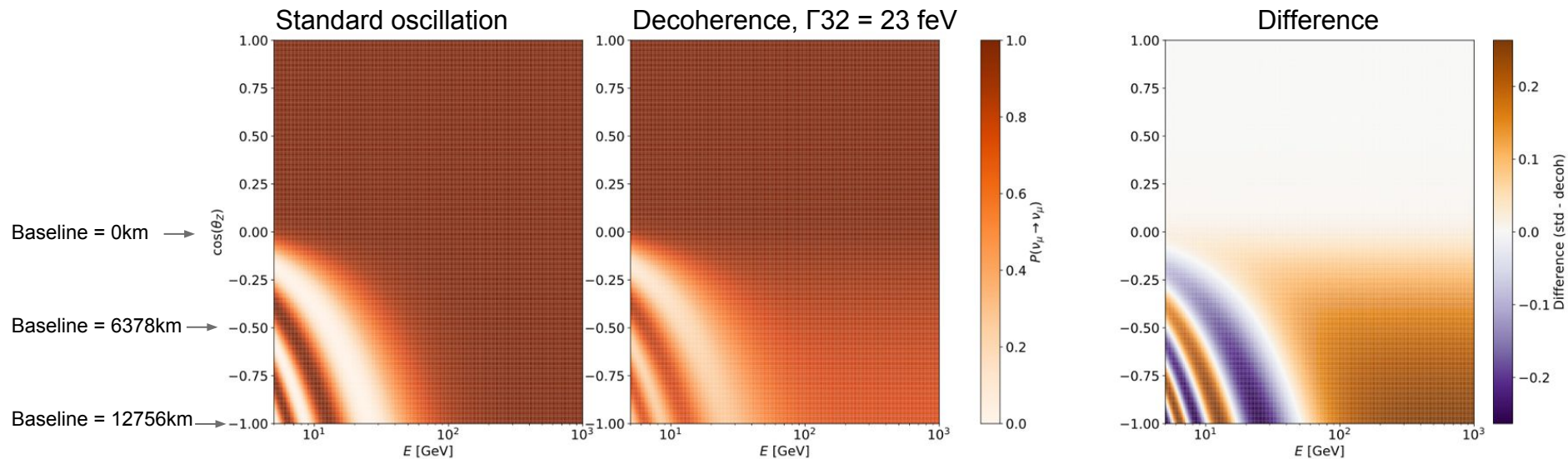
# Conclusion

- IceCube should be sensitive to a decoherence signal
  - Is able to differentiate between  $\Gamma_{32} = 0$  feV and  $\Gamma_{32} = 23$  feV
  - Can constrain the  $\Gamma_{32}$  parameter

# Backup slides

# Mapping the oscillation probability

$\nu_\mu$  survival probability





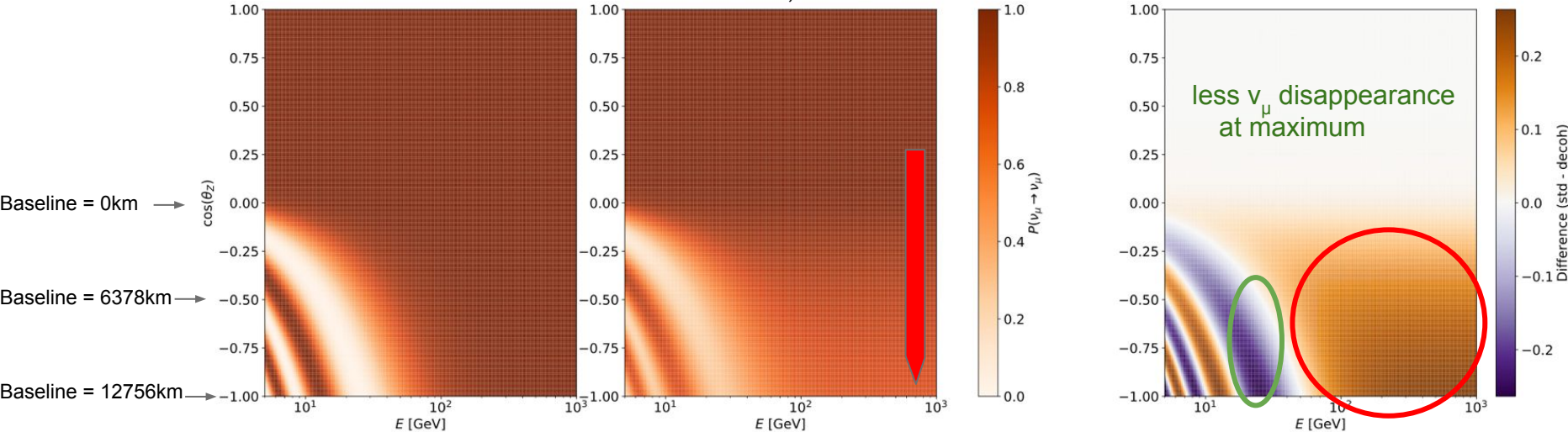
# Mapping the oscillation probability

$\nu_\mu$  survival probability

Standard oscillation

Decoherence,  $\Gamma_{32} = 23 \text{ feV}$

Difference

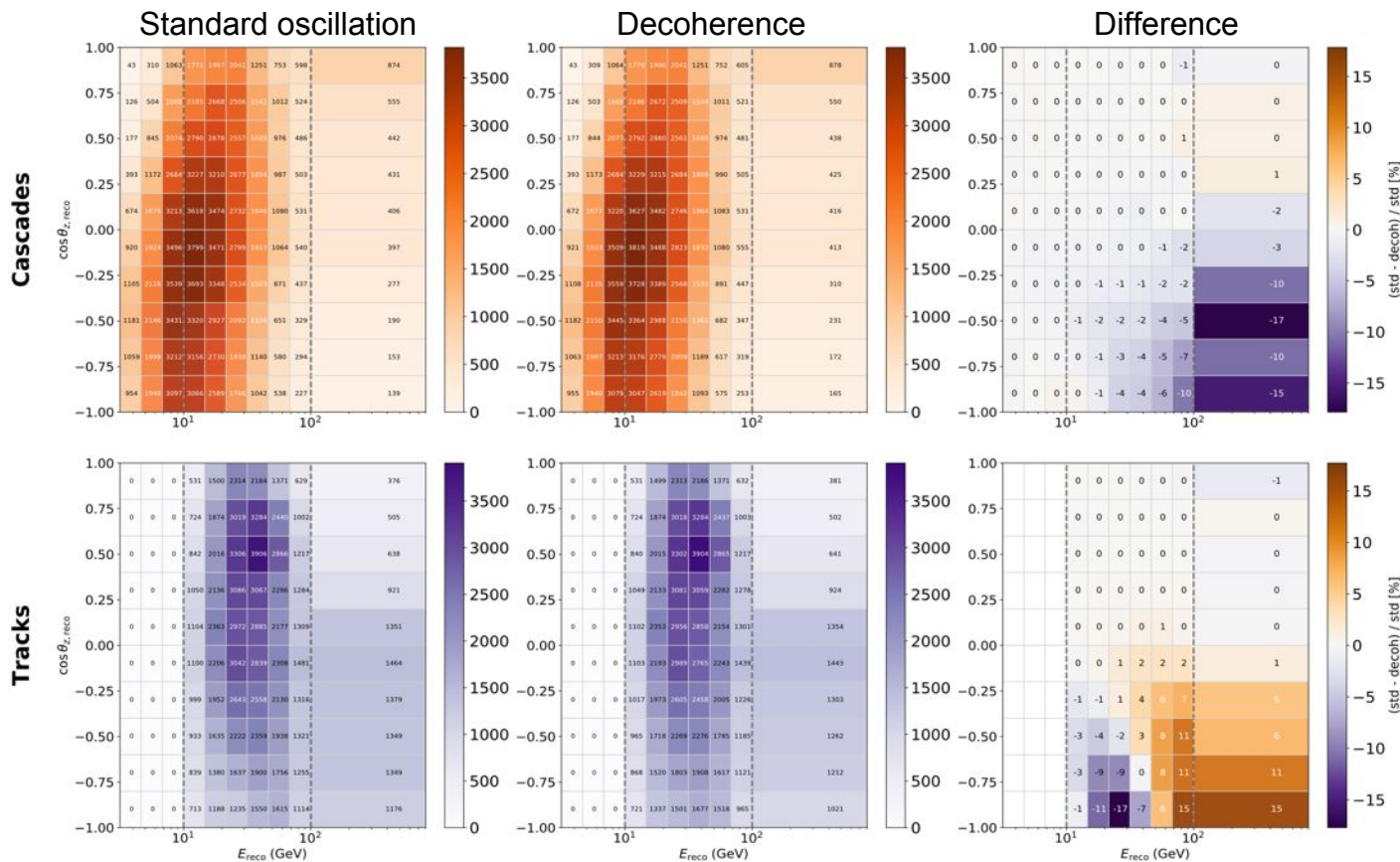


Effect increases with baseline

$\nu_\mu$  disappearance at high E

# prediction from monte carlo

$\nu_e$  and  $\nu_\tau$  like



$\nu_\mu$  like