

IceCube bounds on sterile neutrinos above 10 eV

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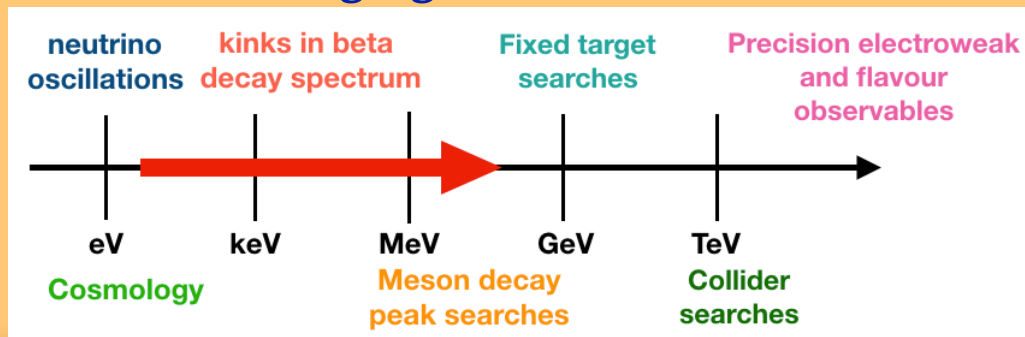
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Motivation

neutrino masses most easily explained by introducing right-handed neutrinos



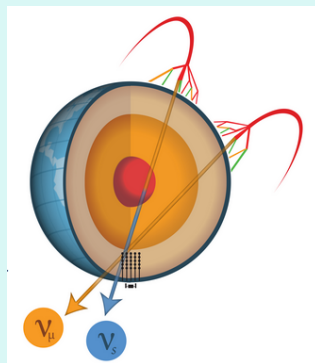
Oscillation probability

with the approximations: ν_e decoupled, free normalisation of events, leading order in sterile mixing angles, neglect Δm_{31}^2

muon neutrino disappearance probability:

$$P_{\mu\mu} \simeq 1 - V_{NC}^2 |U_{\tau 4}|^2 |U_{\mu 4}|^2 L^2$$

analyse atmospheric neutrino disappearance at IceCube in average-out regime for sterile oscillations ($L/E \gg 1$): $\Delta m^2 > 100 \text{ eV}^2$



first time this region of parameter space is probed with IceCube data

SuperKamiokande [1] & DeepCore [2] probed the same parameter range but for $\Delta m^2 > 0.1 \text{ eV}^2$

NOMAD & CHORUS [3] tested

ν_τ appearance from ν_μ through vacuum oscillations

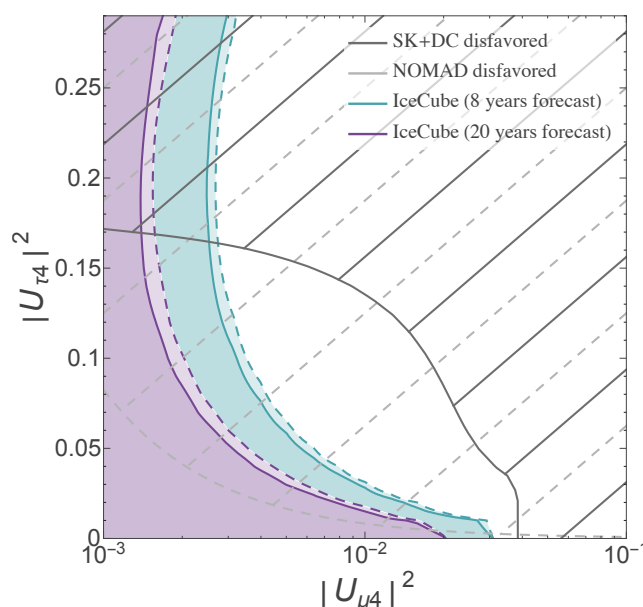
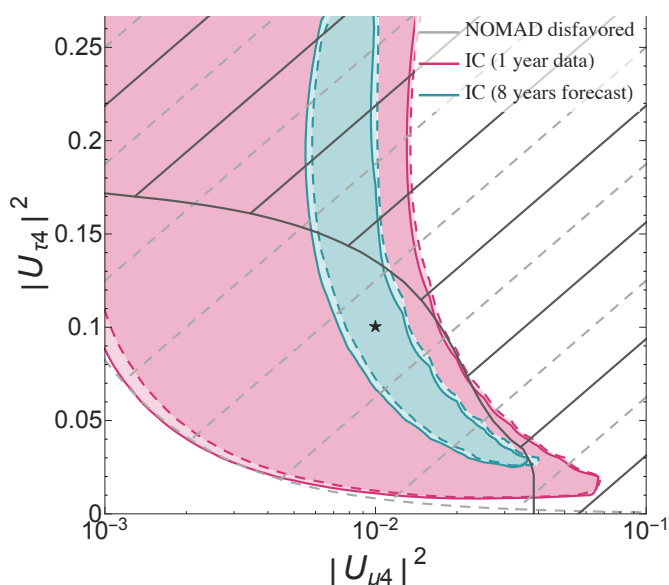
Results @ 90% C.L.

- neutrino flux computed with the analytic air shower code using cosmic ray flux from HondaGaisser model with Gaisser-Hillas H_{3a} correction with the hadronic model QGSJET II-04
- neutrino propagation simulated with nuSQuIDS
- nuisance parameters: uncertainty in the pion-kaon ratio of initial flux (prior: $\sigma_{\pi/k} = 0.05$), DOM efficiency, overall flux normalization
- 1 energy bin, 40 bins for zenith angle

- 1-year IceCube disfavours non-zero sterile mixing at around 2σ

- in strong tension with NOMAD & CHORUS results

- forecasted 8 years of IceCube data can improve over current constraints and is sufficient to either confirm present preference or exclude it with a high significance



[1] Phys. Rev. D bf 91 (2015) 052019, arXiv:1410.2008 [hep-ex], [2] Phys. Rev. D 95 (2017) no.11, 112002, arXiv:1702.05160 [hep-ex], [3] Nucl. Phys. B bf 611 (2001) 3, hep-ex/0106102