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Recent Progress in Solar Atmospheric Neutrino Searches with IceCube

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Cosmic-rays interacting with nucleons in the solar atmosphere produce a cascade of particles that give rise to a flux of high-energy neutrinos and gamma-rays. Fermi has observed this gamma-ray flux; however, the associated neutrino flux has escaped observation. In this contribution, we put forward two strategies to detect these neutrinos, which, if seen, would push forward our understanding of the solar atmosphere and provide a new testing ground of neutrino properties. First, we will extend the previous analysis, which used high-energy through-going muon events collected in the years of maximum solar activity and yielded only flux upper limits, to include data taken during the solar minimum from 2018 to 2020. Extending the analysis to the solar minimum is important as the gamma-ray data collected during past solar cycles indicates a possible enhancement in the high-energy neutrino flux. Second, we will incorporate sub-TeV events and include contributions from all neutrino flavors. These will improve our analysis sensitivity since the solar atmospheric spectrum is soft and, due to neutrino oscillations, contains significant contributions of all neutrino flavors. As we will present in this contribution, these complementary strategies yield a significant improvement in sensitivity, making substantial progress towards observing this flux.

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Primary authors: VILLARREAL, Joshua (Harvard University); ROELLINGHOFF, Gerrit; LAZAR, Jeffrey (University of Wisconsin-Madison)

Presenter: VILLARREAL, Joshua (Harvard University)

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