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Constraining neutrinophilic mediators at Forward Physics Facilities

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High energy collider neutrinos have been observed for the first time by the FASERν experiment. The detected spectrum of collider neutrinos scattering off nucleons can be used to probe neutrinophilic mediators with GeV-scale masses. We perform an analysis on the measured muon spectra at FASERν, and find that the bounds on the vector mediator from the current FASERν data are comparable to the existing bounds at $m_{Z'} \approx 0.2$ GeV. We also study the sensitivities to a neutrinophilic mediator at future Forward Physics Facilities including FLArE and FASERν2 by using both the missing transverse momentum and the charge identification information. We find that FLArE and FASERν2 can impose stronger bounds on both the scalar and vector neutrinophilic mediators than the existing bounds. The constraints on the scalar mediator can reach 0.08 (0.1) for m_ϕ
$lesssim$1 GeV with (without) muon charge identification at FASERν2.

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