

## Neutrinos from charm: forward production at the LHC and in the atmosphere

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Prompt atmospheric neutrinos are produced mostly by the charm hadron decays, which are from the cosmic ray interaction in the atmosphere. Theoretical predictions of their flux have large uncertainties due to the uncertainties in charm hadron production.

Prompt neutrinos can be abundantly produced at the LHC in the forward direction. New experiments at the LHC (FASER $\nu$  and SND@LHC) will start soon to probe the very forward region and measure the prompt neutrinos as well as charm hadron production. Also, the proposal for further upgrade of forward experiments, called Forward Physics Facility (FPF) is in preparation. We investigate the kinematic region relevant to the prompt atmospheric neutrino flux in terms of the variables for a collider.

Up to date, the LHCb experiment has measured the charm hadron production in the most forward region, whose rapidity is  $2 < y < 4.5$ . Forthcoming experiments, FASER $\nu$  and SND@LHC will cover the pseudo-rapidity of  $\eta \gtrsim 8.5$  and  $7.2 < \eta < 8.6$ , respectively. On the other hand, we find that as shown in the plot, the most important contribution to the prompt atmospheric neutrino flux at the energy of interest is from the charm hadron produced in  $4.5 < y < 6.5$ . Therefore, if the future FPF probe this rapidity range and provide the measurement data of the charm hadron production, it will improve the theoretical predictions of the prompt atmospheric neutrino flux.

