Poster session 1 - Monday 4 July

P1.043 **Towards T2K neutrino flux predictions using the replica target measurements by NA61/SHINE**

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The precise knowledge of the neutrino flux composition and kinematics is one of the biggest challenges of long-baseline experiments such as T2K. Neutrinos are made by the in-flight decay of unstable hadrons produced by the interactions of 31GeV=c protons in a long graphite target. Mostly pions are created, leading to the $\nu\mu$ flux. As kaons and muons are also produced, an irreducible background of other neutrino types is also present.

The main source of uncertainty in the flux prediction is driven by the lack of data on the proton-carbon interaction in this energy range. The measurements performed by the NA61/SHINE large-acceptance experiment at CERN are used by the T2K collaboration to improve the flux predictions. Two datasets have been taken: using a thin target to study the primary interaction, and a replica of the T2K target to account for the re-interactions. Currently, the T2K flux predictions are constrained by the thin target data, allowing 60% of the neutrinos to be directly tuned. The total flux uncertainty at peak energy currently amounts 9%.

The recently released differential multiplicity distributions of $\pi^{\pm}$ along the replica target measured in NA61/SHINE will be presented. This dataset is now in the process of being used by T2K to further constrain the flux prediction as 90% of the neutrinos will be directly tuned.

Instead of tuning each interaction leading to the neutrino production, a weight is only applied to the pions when they escape the target. A reduction of the overall flux uncertainty is foreseen, and preliminary results will be presented in this poster. It is the first time this method has been developed. Physicists from the current and future neutrino experiments at Fermilab are now also taking data with NA61/SHINE and plan to elaborate similar methods for the flux predictions.