

Far-forward neutrinos at the LHC and QCD

W. Bai, M. Diwan, M.V. Garzelli, Y.S. Jeong, M.H. Reno

`maria.vittoria.garzelli@desy.de`

EF06 meeting - Preparation of LOI's
August 26th, 2020

LOI: “Far-forward neutrinos at the LHC and QCD”

- * Main Aim: develop physics predictions as accurate as possible for forward ν fluxes from pp collisions at the Large Hadron Collider.
 - * Main Motivation: new experiments proposed or already under construction, which will use forward ν fluxes impinging on various targets, to infer ν interaction cross-sections and BSM physics effects. Control and understanding of ν fluxes will be an important key for interpreting the experimental results.
 - * Preliminary work: our paper (W. Bai et al. JHEP 06 (2020) 032) + first flux estimates computed by the experimentalists in their proposals.
 - * Program: we plan to focus on the **uncertainties** of perturbative and non-perturbative origin:
 - missing higher orders in pQCD
 - multiple parton interactions
 - flavour number scheme
 - parton distribution functions
 - fragmentation/(PS+hadronization)
 - intrinsic $\langle k_T \rangle$
 - tunes, etc.
- ⇒ Will these uncertainties hamper the possibility of clearly disentangling BSM physics effects ?

LOI: “Far-forward neutrinos at the LHC and QCD”

- * Distinguishing ν production mechanisms by heavy- and light- flavour h decays:
 - for the first ones pQCD is applicable down to $p_{T,h} = 0$, but non-perturbative QCD effects are expected to play some role as well, especially at low $p_{T,h}$.
 - for the second ones, low $p_{T,h}$ distributions are expected to be dominated by non-perturbative physics.
- * We expect/hope that the experimental results from Forward ν Facilities will help in better constraining non-pQCD effects in the production process.
 - ⇒ Cyclic process expected in the next few years:
initial theory predictions → comparison with experimental data →
→ improved theory predictions → etc.....
 - ⇒ Up to which extent will it be possible to constrain the relative role of different non-pQCD effects ?
- Complementary results from other LHC experiments + future colliders (e.g. EIC and LHeC) are expected to also help in this respect!

LOI: “Far-forward neutrinos at the LHC and QCD”

- * First EF06-related LOI, submitted by W. Bai, M. Diwan, M.V. Garzelli, Y.S. Jeong, M.H. Reno already in the middle of July.
- * cross-reference with other frontiers/groups: improving predictions for ν fluxes at the LHC might lead to improved predictions for ν production in astroparticle physics (astrophysical neutrino sources/Earth atmosphere)
- * Work already in progress (e.g. estimate of PDF uncertainties). Additionally, we are active since years in the astroparticle field.
- * Further Snowmass work more focused on physics opportunities at a forward ν facility at the HL-LHC in progress in collaboration with F. Kling et al.
- * For further information or for collaborating with us on specific aspects of this program/Snowmass paper(s), please feel free to contact me (maria.vittoria.garzelli@desy.de).