

0.1 Matching of resummation to fixed-order calculations

Having obtained a resummed expression such as ?? for the shape cross sections at small values of τ , one can now match the resummed expression to the fixed-order NNLO calculations at large values of τ using the R-matching scheme [1]. The results presented in the previous sections allow us to compare the predictions at N³LL accuracy with the fixed-order calculations at NNLO.

In the R-matching scheme, at N³LL+NNLO accuracy the matching procedure is given by:

$$R_T(\tau) = (1 + C_1 \bar{\alpha}_s + C_2 \bar{\alpha}_s^2 + C_3 \bar{\alpha}_s^3) \exp \left\{ L g_1(\lambda) + g_2(\lambda) + \alpha_s g_3(\lambda) + \alpha_s^2 g_4(\lambda) \right\} \quad (1)$$

$$+ D_1(\tau) \bar{\alpha}_s + D_2(\tau) \bar{\alpha}_s^2 + D_3(\tau) \bar{\alpha}_s^3,$$

where the coefficients C_i are determined by imposing the normalization $R_T(\tau_{max}) = 1$ of the fixed order calculation order by order, while the remainder function D_i are determined by subtracting from the fixed order terms A, B and C the logarithmic terms already present in ?? (see ??).

D_1 is analytical [1]:

$$D_1(\tau) = C_F \left(-4 \text{Li}_2 \left(\frac{t}{1-t} \right) + \frac{9t^2}{2} - 2 \ln^2(1-t) + 6t(\ln(t) + 1) \right. \quad (2)$$

$$\left. + 4 \ln(1-t) \ln(t) + 3(1-2t) \ln(1-2t) \right),$$

while D_2 and D_3 are extracted numerically from interpolating the fixed order results at NNLO given in [2], the results are shown in ??.

By combining the resummed expression ?? and the fixed order results at NNLO, we can obtain the matched results at N³LL+NNLO accuracy, we also reproduced the NLO+NLL [1], [3] and NNLO+NNLL [4] accuracy already present in literature. The results are shown in fig. 1.

Resummation only slightly improves the fixed-order results at large values of τ as it includes some terms from higher orders in the perturbative expansion ??, see ??.

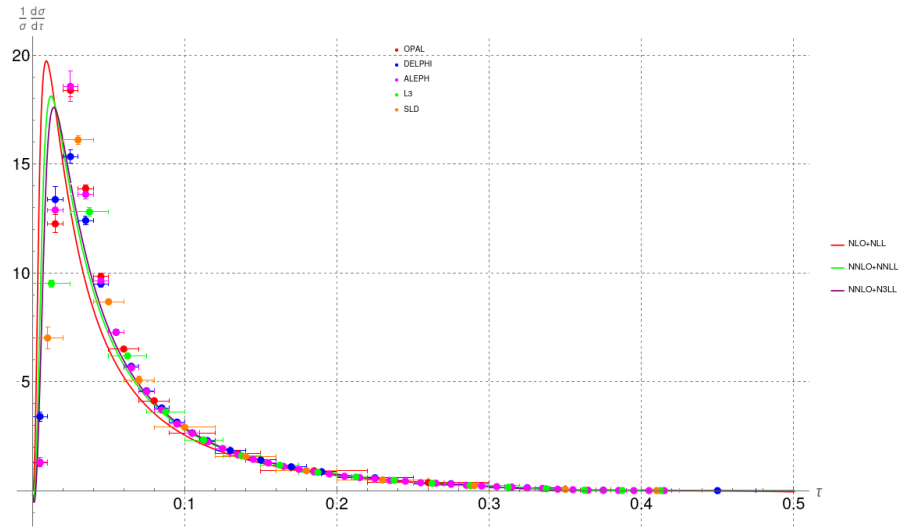


Figure 1: Plot of the matched Thrust distribution eq. (1) at NNLO+N³LL accuracy.

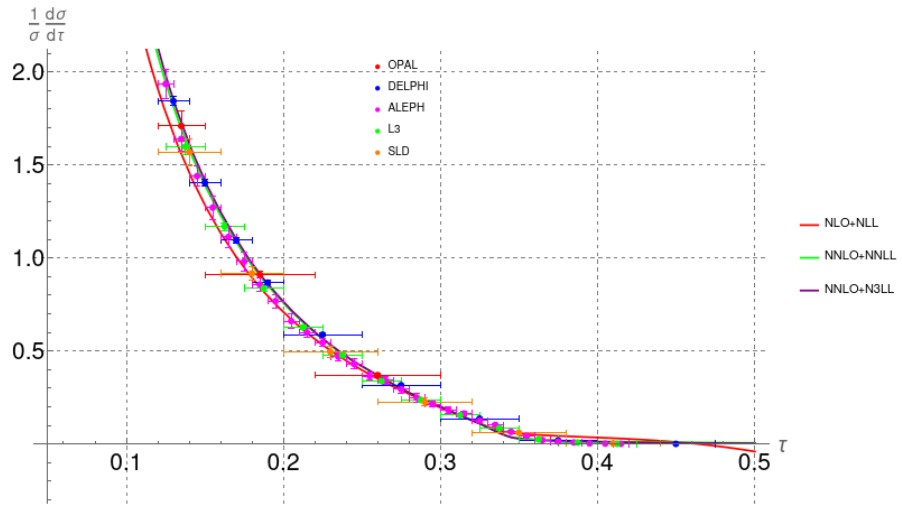


Figure 2: Plot of the matched Thrust distribution at NNLO+N³LL and NNLO+NNLL accuracy in the tail region.

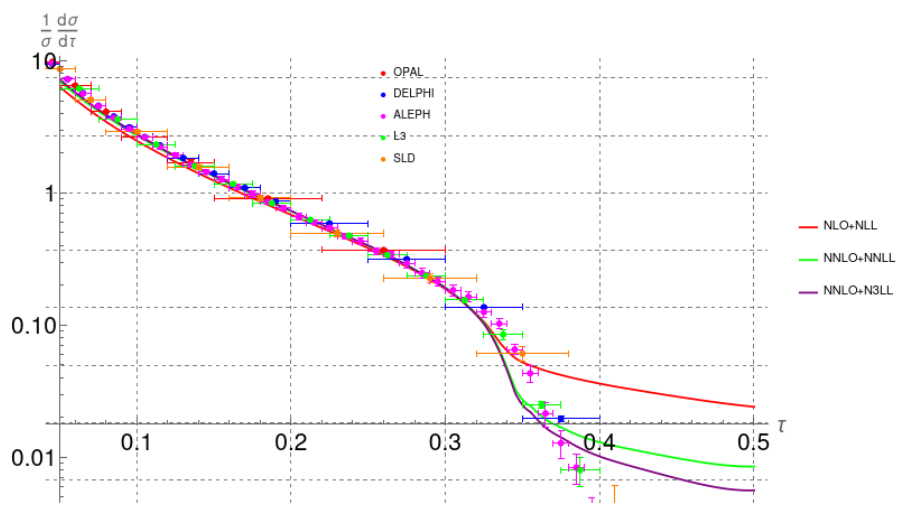


Figure 3: Log Plot of the matched Thrust distribution at NNLO+N³LL and NNLO+NNLL accuracy in the tail region.