

Resummation benchmarking

LHC EW precision group workshop

April 24, 2020

Benchmarking levels

- Benchmarking of resummed $p_T Z$, $p_T W/p_T Z$:
 - Inputs: <https://gitlab.cern.ch/arapyan/pt-comparison>

1) Canonical logarithms (as much as possible)

- ▶ Strictly $\ln(Qb_T/b_0)$, $\ln(q_T/Q)$, i.e. $\mu_H = Q_{\text{res}} = Q$, $\mu_r = \mu_f = Q$
- ▶ Including b^* or equivalent prescription, but no nonpert. form factor etc.
- ▶ Result in b_T space (if possible)
- ▶ Result in q_T space

Great progress in 2019!

2) Nominal, favourite logarithms

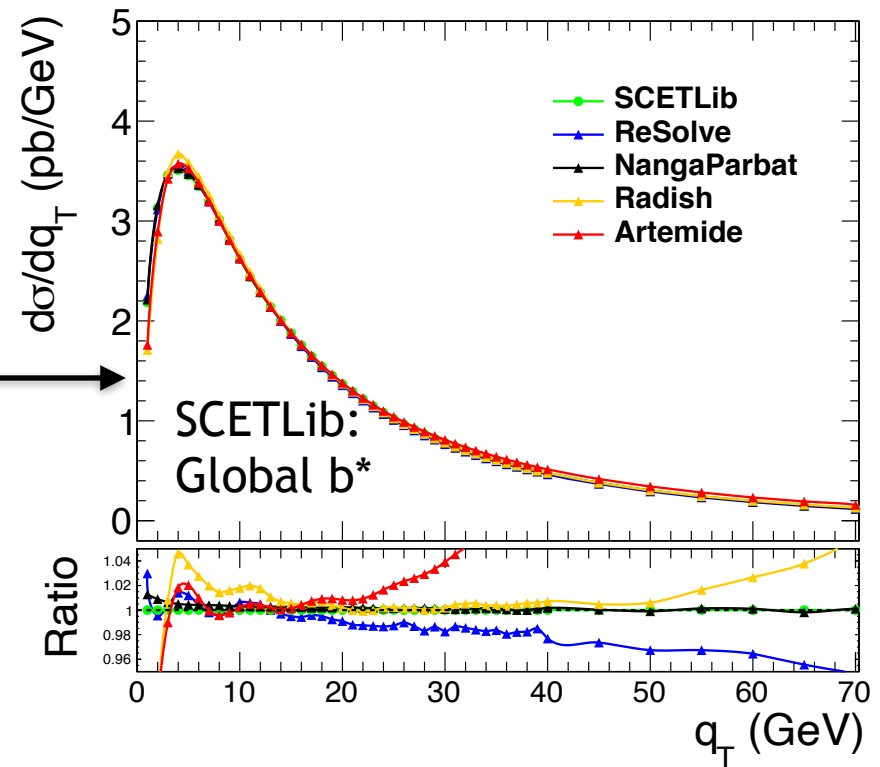
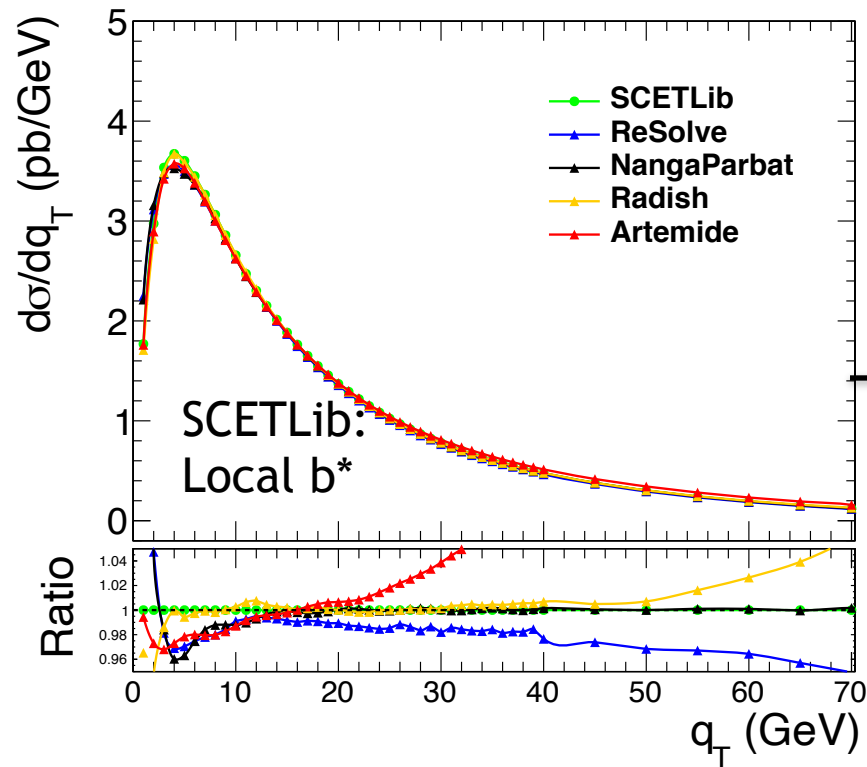
- ▶ Including turning off resummation at large q_T , e.g. $Q_{\text{res}} = Q/2$, profile scales, $\ln(b_T) \rightarrow \ln(1 + b_T)$, etc. ...

3) Resummation as in 2) plus matching nonsingular FO correction

Order	Boundary cond. (FO singular)	Anomalous dimensions γ_i (noncusp)	$\Gamma_{\text{cusp}}, \beta$	FO matching (nonsingular)
LL	1	-	1-loop	-
NLL	1	1-loop	2-loop	-
NLL' (+NLO ₀)	α_s	1-loop	2-loop	α_s
NNLL (+NLO ₀)	α_s	2-loop	3-loop	α_s
NNLL' (+NNLO ₀)	α_s^2	2-loop	3-loop	α_s^2
N ³ LL (+NNLO ₀)	α_s^2	3-loop	4-loop	α_s^2
N ³ LL' (+N ³ LO ₀)	α_s^3	3-loop	4-loop	α_s^3
N ⁴ LL (+N ³ LO ₀)	α_s^3	4-loop	5-loop	α_s^3

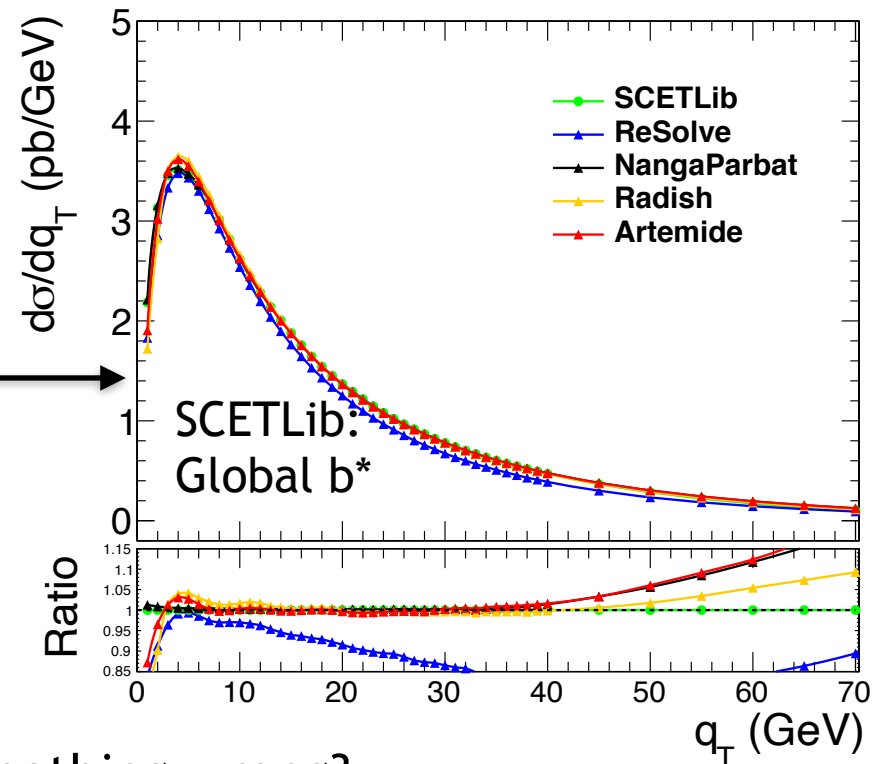
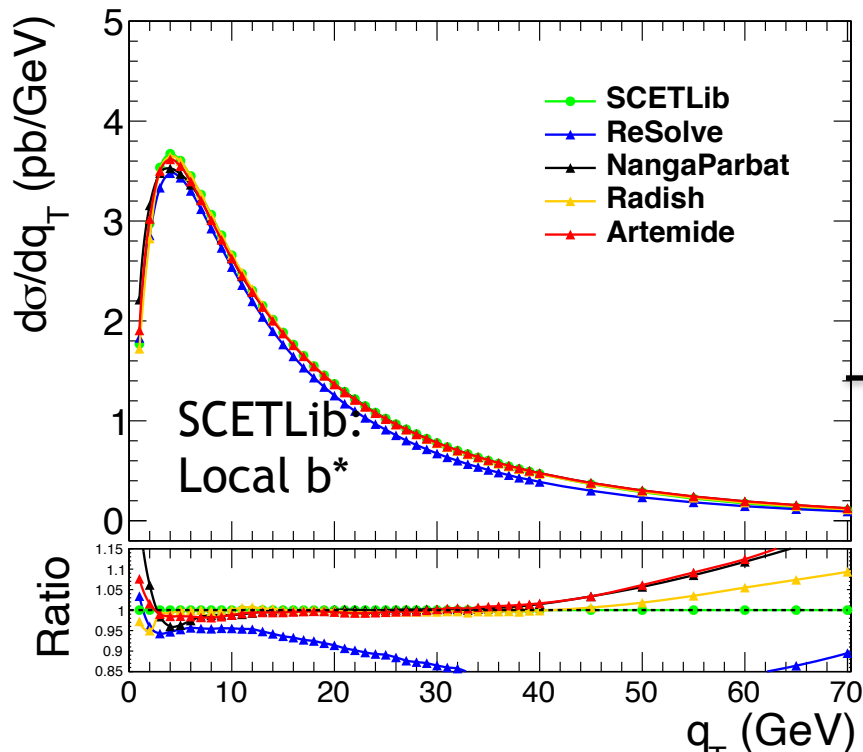
Level-1 benchmarking

- First step of benchmarking has been quite successful
 - ReSolve, NangaParbat, DYTurbo, Radish, SCETLib and Artemide
 - Demonstrated that low q_T ($<10\text{GeV}$) differences for b-space calculations are due to Landau-pole regularization procedure



Level-2 benchmarking

- Level-2 benchmarking
 - Inclusion of modified logs
 - Different codes use their ‘nominal’ settings
 - e.g. favorite Landau pole regularization (left plot)



Resolve: did I pick up something wrong?

Leve-2 benchmarking input status

- Systematic uncertainties become relevant for this step
 - Perturbative uncertainties (μ_R/μ_F and resummation scales)
- Status of the inputs:
 - Radish has provided all the variations separately
 - Aretmide has provided the overall uncertainty band
 - Resolve, SCETLib, and NangaParbat to provide the uncertainties on git
 - DYTurbo to provide the the Level-2 predictions and uncertainties