Investigation of different b^* prescriptions in SCETlib.

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SCETlib: Markus Ebert, Johannes Michel, FT

$$\frac{\mathrm{d}\sigma}{\mathrm{d}p_T} = \int_0^\infty \mathrm{d}b_T \, J_0(p_T b_T) p_T b_T \, \tilde{\sigma}[b_T, \mu_i(...)]$$

- One always resums ratio of high scale $\sim Q$ / low scales $\sim 1/b_T \sim p_T$

- Canonical logs are resummed by canonical scale choices
$$\mu_H = \nu_B = Q \,, \qquad \mu_B = \mu_S = \nu_S = b_0/b_T$$

- α_s appears at $\alpha_s(\mu_H)$, $\alpha_s(\mu_B)$, $\alpha_s(\mu_S)$, PDFs appear at $f_i(\mu_B)$
  - Encounter Landau pole for $b_0/b_T < 1\,\mathrm{GeV}$
  - This is actually *not* an artifact of b_T-space evolution or scale setting, it's a physical effect signifying sensitivity to nonperturbative effects
    (analogous effect also appears in exact p_T-space evolution [Ebert, FT, 1611.08610])

b^* Prescription(s).

Basic idea: Replace

$$b_T \to b^*(b_T) = \frac{b_T}{\sqrt{1 + (b_T/b_{\max})^2}} \quad \Rightarrow \quad \begin{cases} b^*(b_T \to 0) \to b_T \\ b^*(b_T \to \infty) \to b_{\max} \end{cases}$$

- $b_0/b^*(b_T \to \infty) \to b_0/b_{\max}$, so take $b_0/b_{\max} \sim 1\,\mathrm{GeV}$ as cutoff

Different options:

- "Global b^*": original, most often used

$$\tilde{\sigma}(b_T) \equiv \tilde{\sigma}[b_T, \mu_i(b_T)] \to \tilde{\sigma}(b^*) \equiv \tilde{\sigma}[b^*, \mu_i(b^*)]$$
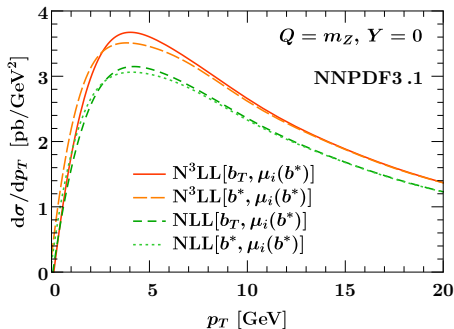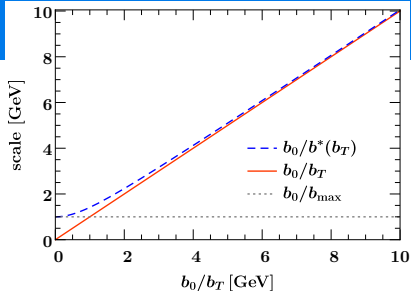
- "Local b^*": when keeping all RGE scales explicit

  [for more details see Lustermans, Michel, FT, Waalewijn, 1901.03331]

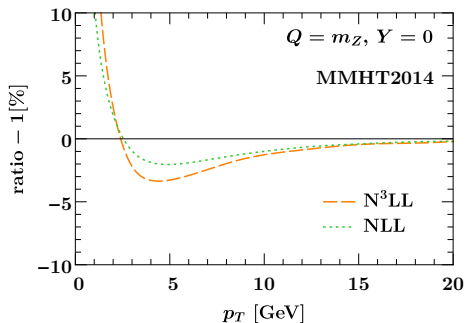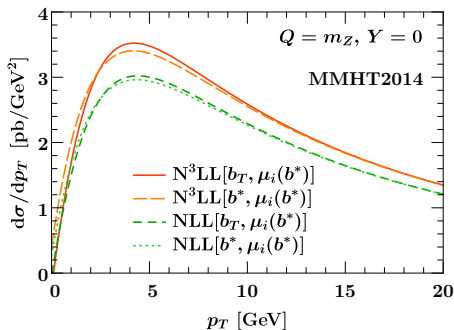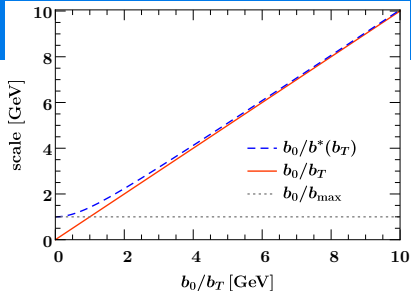$$\tilde{\sigma}[b_T, \mu_i(b_T)] \to \tilde{\sigma}[b_T, \mu_i(b^*)]$$

- Intermediate versions are possible as well
  - ▶ All amount to factorizing pert. from nonpert. contributions, "ad-hocness" introduced in pert. prediction is cancelled by nonpert. completion
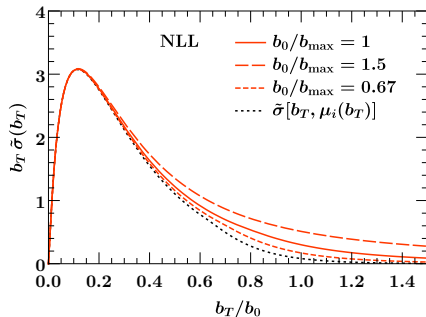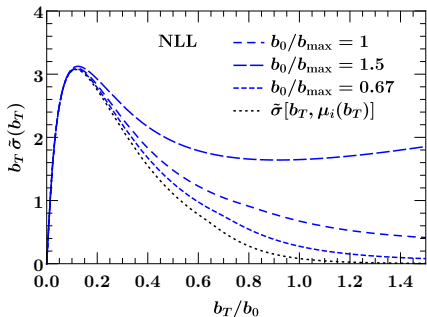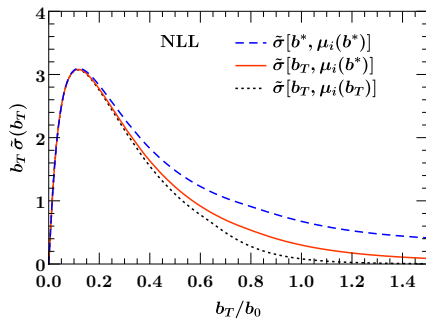
Comparison in p_T space.
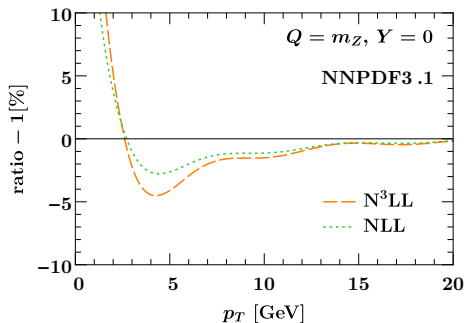
Comparison in p_T space.

Comparison in b_T space.

Comparison in b_T space.