Further remarks on the Drell-Yan process in the fixed-target regime

Werner Vogelsang

Tübingen Univ.

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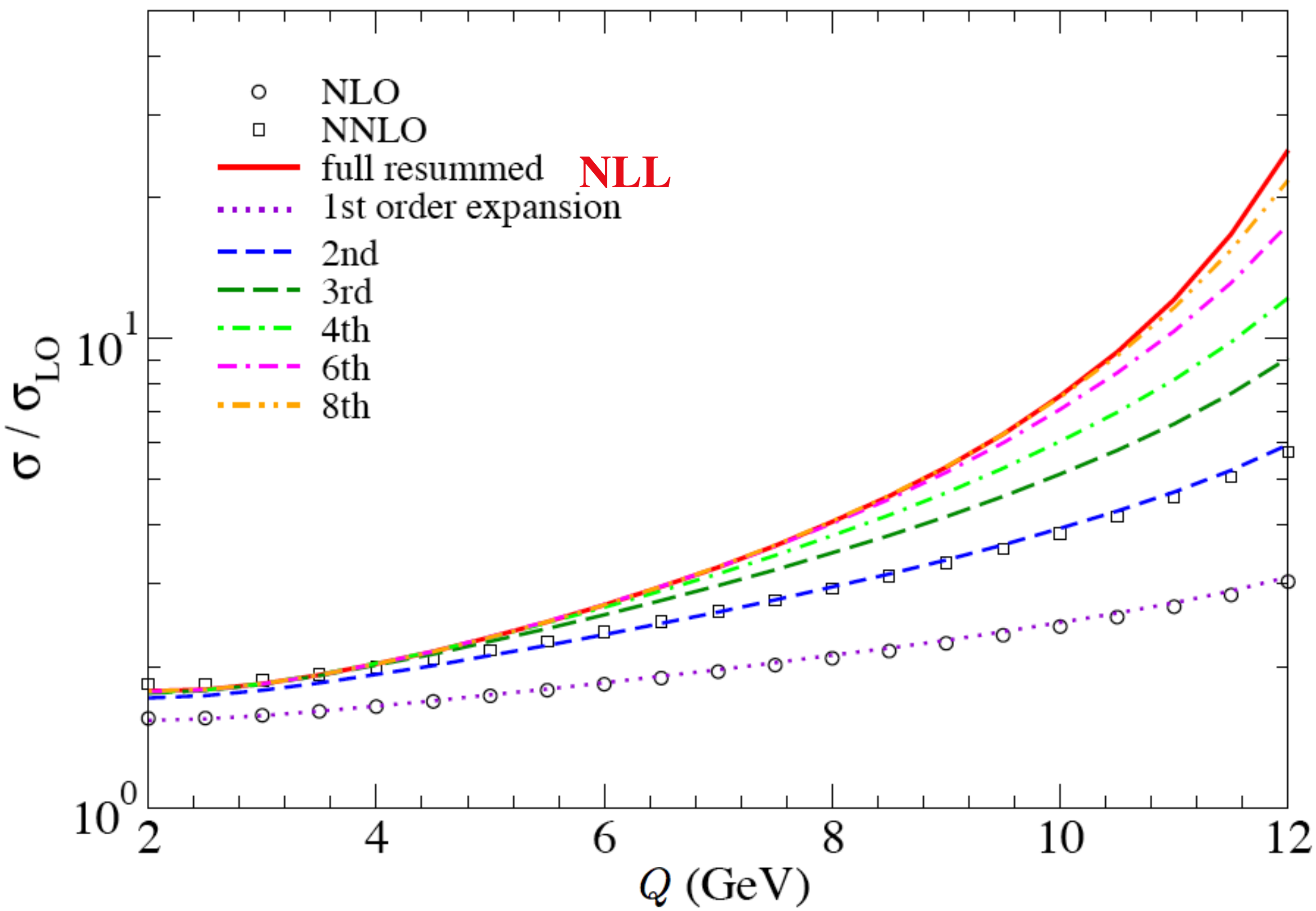
- understanding of higher-order QCD corrections in Drell-Yan cross section very advanced: NLO, NNLO, resummations to NLL, NNLL

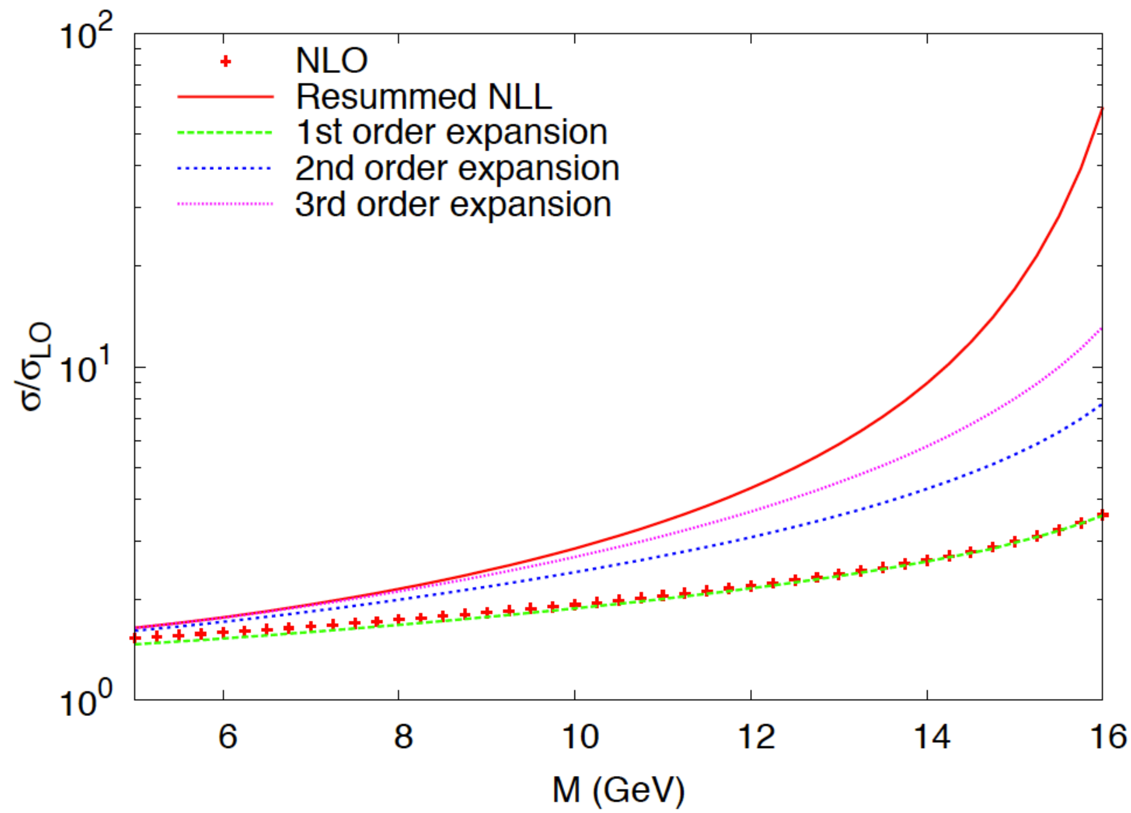
- pQCD corrections important, in particular in fixed-target regime

- power corrections ?

Drell-Yan $p\bar{p}$ @ $\sqrt{S} = 14.5\,\mathrm{GeV}$



Shimizu, Sterman, Yokoya, WV



$$\pi^- p$$

$$s = 300\,\mathrm{GeV}^2$$

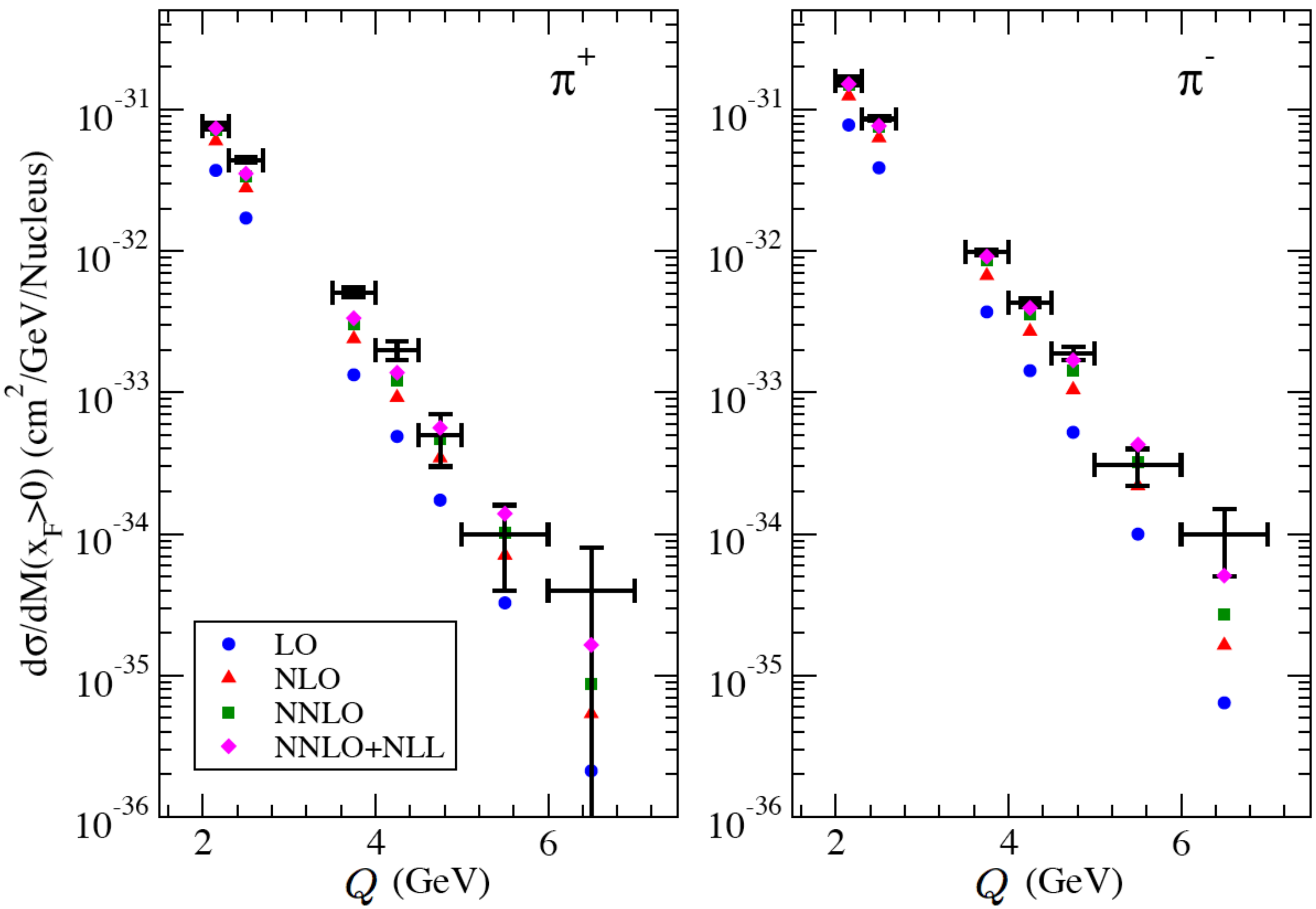
Aicher, Schäfer, WV

Pion parton distributions:
From new fit to NA10 data

Any evidence for large effects in Drell-Yan ?

$$\pi^{\pm}\mathbf{N} \rightarrow \mu^{+}\mu^{-}\mathbf{X} \qquad \mathbf{E}_{\pi} = \mathbf{39.5\ GeV}$$

CERN WA39



Shimizu,Sterman,Yokoya,WV

$$\text{DY:} \qquad \exp\left[\frac{2C_F}{\pi} \int_0^1 dy \, \frac{y^N - 1}{1-y} \int_{Q^2}^{Q^2(1-y)^2} \frac{dk_\perp^2}{k_\perp^2} \, \alpha_s(k_\perp^2) \; + \; \ldots \right]$$

- ill-defined because of strong-coupling regime

$$\exp\left[\frac{2C_F}{\pi} \int_0^{Q^2} \frac{dk_\perp^2}{k_\perp^2} \, \alpha_s(k_\perp^2) \left\{ K_0\left(\frac{2Nk_\perp}{Q}\right) + \ln\left(\frac{Nk_\perp}{Q}\right)\right\} + \ldots \right]$$

- regime of very low $k_\perp$:

$$\exp\left[\frac{2C_F}{\pi} \frac{N^2}{Q^2} \int_0^{\lambda^2} dk_\perp^2 \, \alpha_s(k_\perp^2) \, \ln\left(\frac{Q}{Nk_\perp}\right)\right] \sim \exp\left[\frac{2C_F}{\pi} \frac{N^2}{Q^2} \left\{ g_1 + g_2 \ln\left(\frac{Q}{NQ_0}\right)\right\}\right]$$

- overall powers even, exponentiating

Sterman, WV;
Beneke,Braun;
Gardi,Grunberg

- numerically not too large, unless really close to threshold

Also in q_T differential cross section:

$$\exp\left[\int_0^{Q^2}\frac{dk_\perp^2}{k_\perp^2}\left(J_0(bk_\perp)-1\right)\left\{\frac{2C_F}{\pi}\alpha_s(k_\perp^2)\ln\left(\frac{Q^2}{k_\perp^2}\right)+\ldots\right\}\right]$$

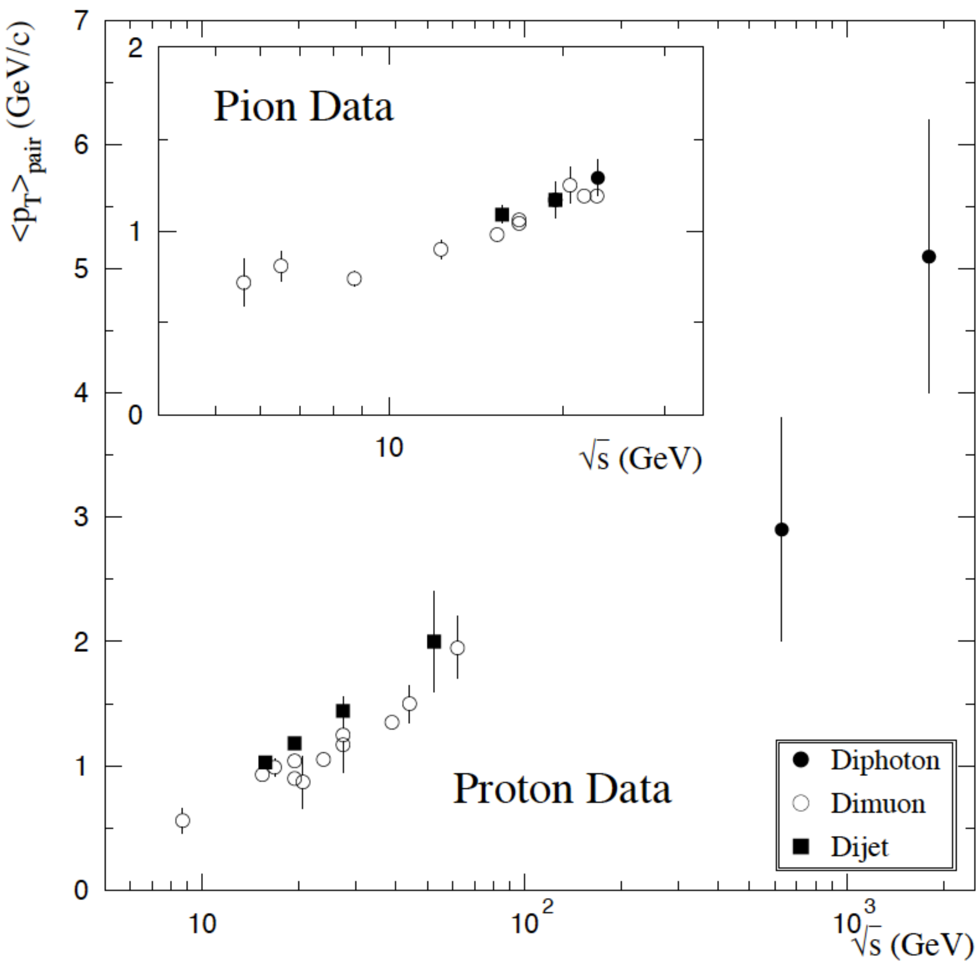
Contribution from low $k_\perp$

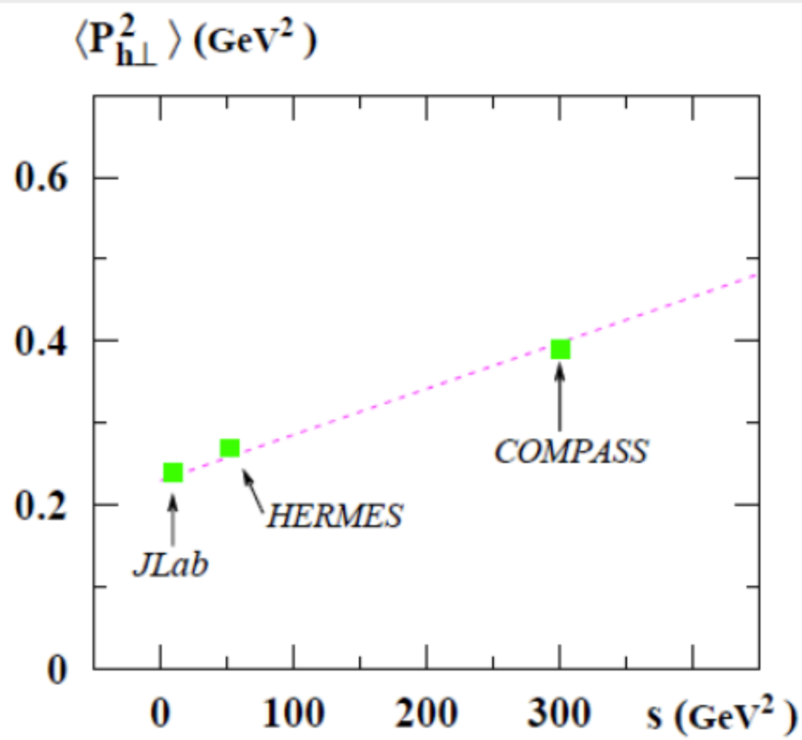
$$\exp\left[-b^2\frac{C_F}{\pi}\int dk_\perp^2\,\alpha_s(k_\perp^2)\ln\left(\frac{Q}{k_\perp}\right)\right]$$

$$\underbrace{\qquad\qquad}_{g_1 + g_2\ln(Q^2/Q_0^2)}$$

• from di-muon / di-photon / di-hadron data :

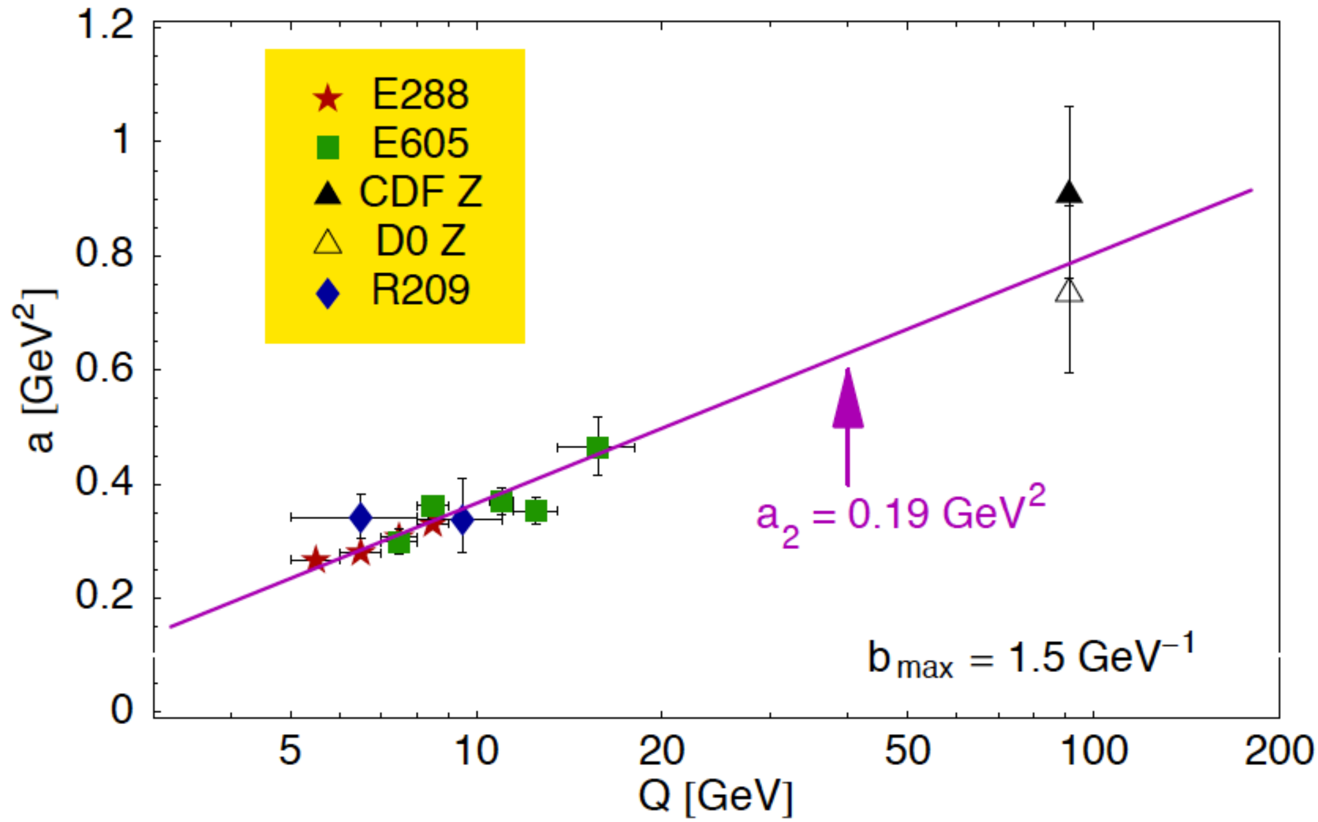
Begel





Konychev, Nadolsky

$$a(Q) \equiv a_1 + a_2 \ln\left[Q/(3.2\ \text{GeV})\right] + a_3 \ln\left[100 x_1 x_2\right]$$



- model: cut off exponent at $k_\perp \leq \mu_0$

$$\rightarrow \int_{\max(Q/N,\mu_0)}^{Q} \frac{dk_\perp^2}{k_\perp^2}\,\alpha_s(k_\perp^2)\ln\left(\frac{Nk_\perp}{Q}\right)$$