The issue of matching

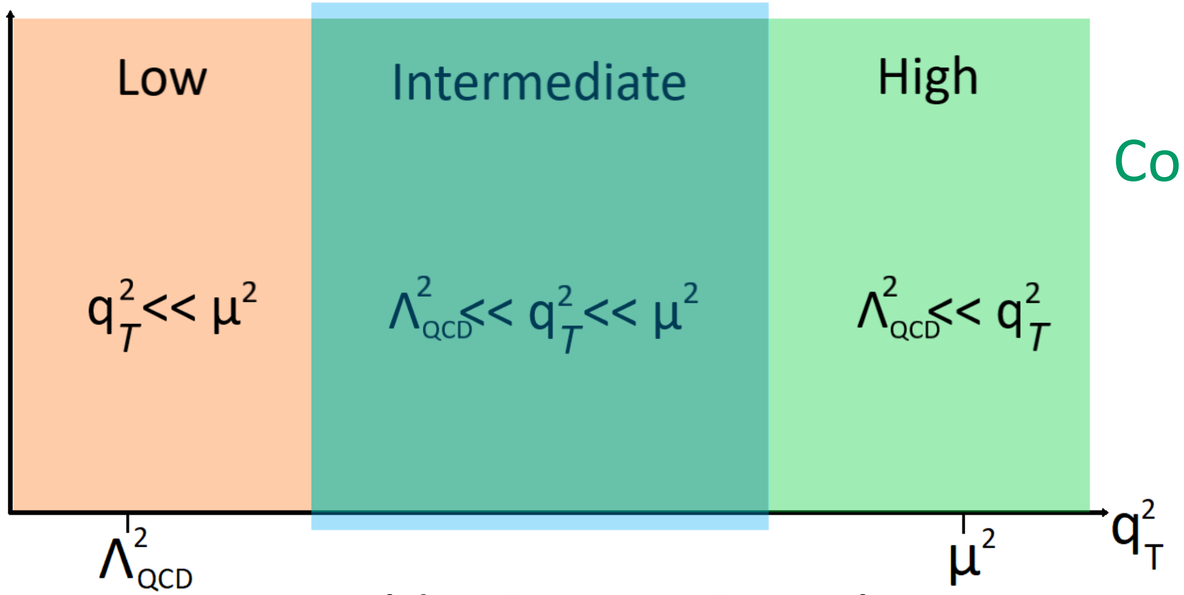
from Luca Maxia's talk

TMD factorization

↓

small transverse momentum

$q_T^2 \ll \mu^2$



Collinear factorization

↓

high transverse momentum

$q_T^2 \gg \Lambda^2_{QCD}$

It could exist a region where both schemes are valid

$\Lambda^2_{QCD} \ll q_T^2 \ll \mu^2$

Description of same dynamics? Need to be matched!

Bacchetta, Boer, Diehl, Mulders, JHEP 08 (2008)

Shape functions

Pieter Taels's talk

Large logarithm can be absorbed in the definition of the LDME in the TMD calculation:

$$\mathcal{F}_{UU,T} = \sum_n \mathcal{H}^{[n]}_{UU,T} \mathcal{C}\left[f_1^g \Delta^{[n]}\right](x, \mathbf{q}_T^2)$$

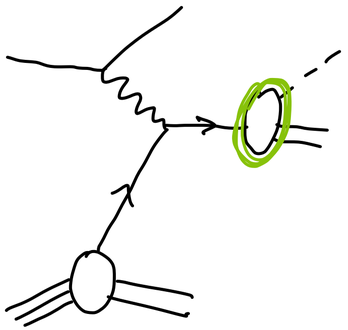
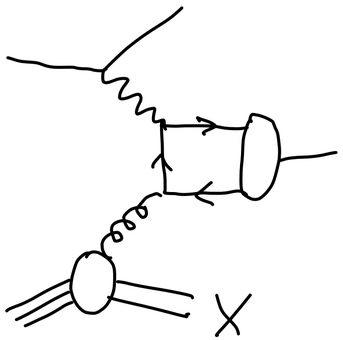
$$\mathcal{F}_{UU,L} = \sum_n \mathcal{H}^{[n]}_{UU,L} \mathcal{C}\left[f_1^g \Delta^{[n]}\right](x, \mathbf{q}_T^2)$$

$$\mathcal{F}^{\cos 2\phi_\psi}_{UU} = \sum_n \mathcal{H}^{[n],\cos 2\phi_\psi}_{UU,} \mathcal{C}\left[w h_1^{\perp g} \Delta^{[n]}\right](x, \mathbf{q}_T^2)$$

which is promoted to a 'shape function'

$$\Delta^{[n]}(\boldsymbol{k}_T^2, \mu^2) = \frac{\alpha_s}{2\pi^2 \boldsymbol{k}_T^2} C_A \langle 0|\mathcal{O}_c(n)|0\rangle \ln \frac{\mu^2}{\boldsymbol{k}_T^2}$$

Boer, D'Alesio, Murgia, Pisano, PT (2020)

	Low transverse momentum (TMD)	Matching region	High transverse momentum
Semi-inclusive DIS			
J/ψ inclusive production			

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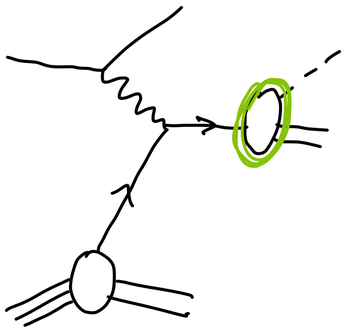
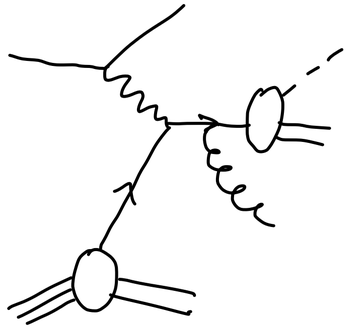
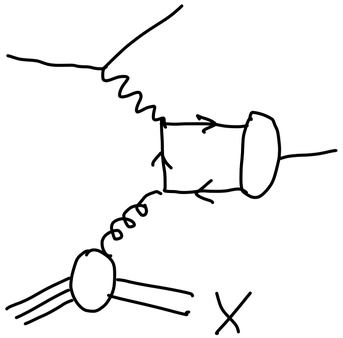
Semi-inclusive DIS			
J/ψ inclusive production			

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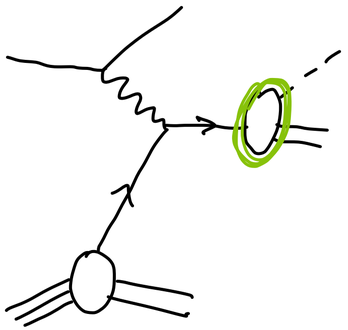
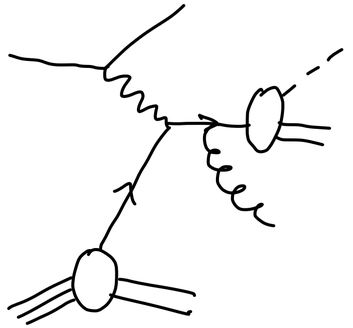
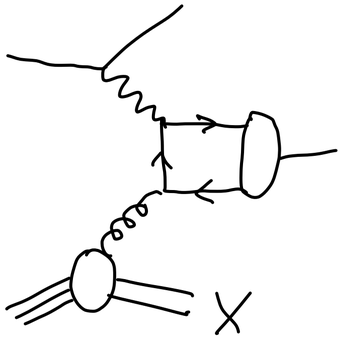
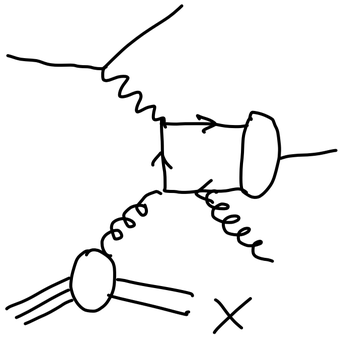
Semi-inclusive DIS			
J/ψ inclusive production			

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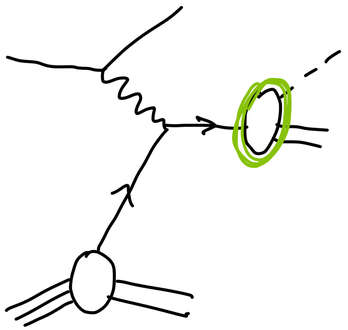
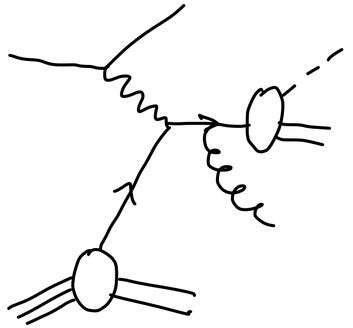
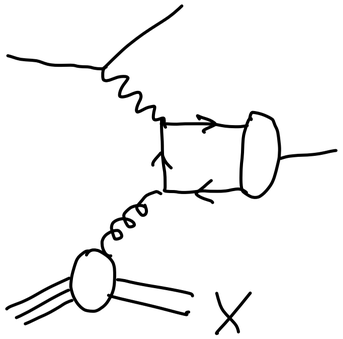
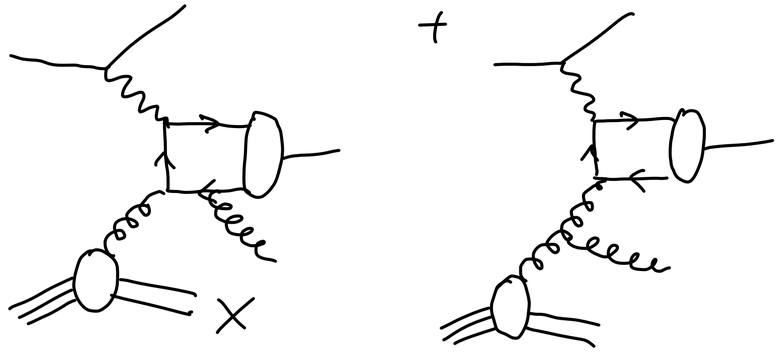
Semi-inclusive DIS			
J/ψ inclusive production			

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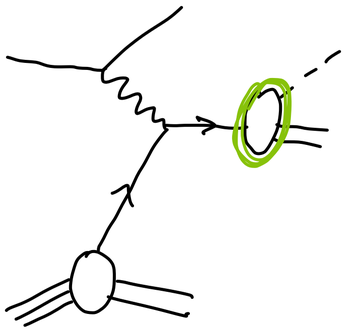
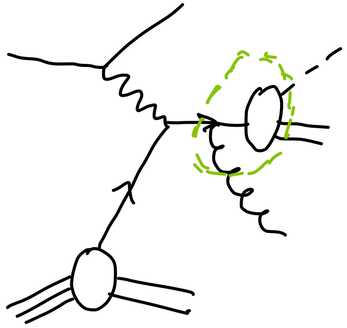
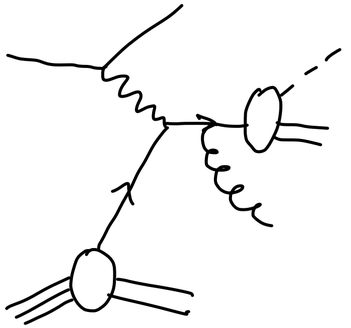
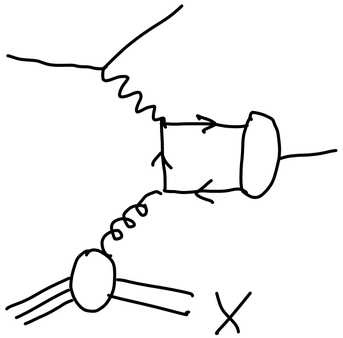
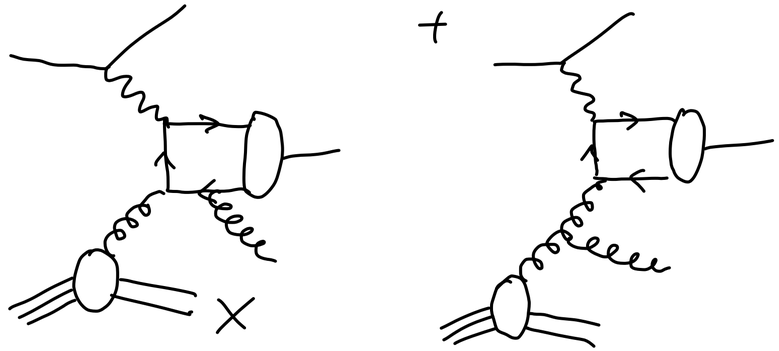
Semi-inclusive DIS			
J/ψ inclusive production			

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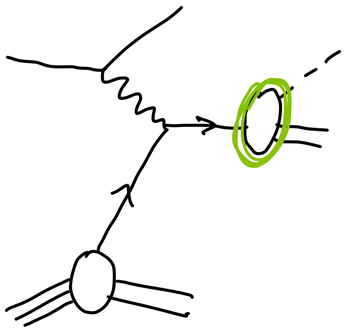
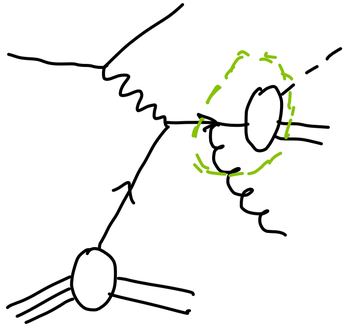
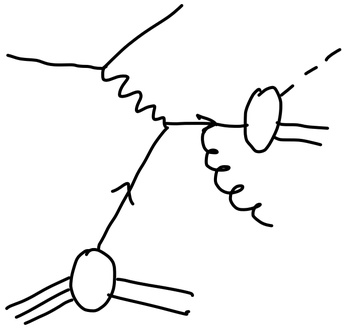
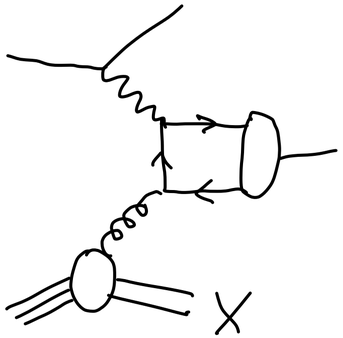
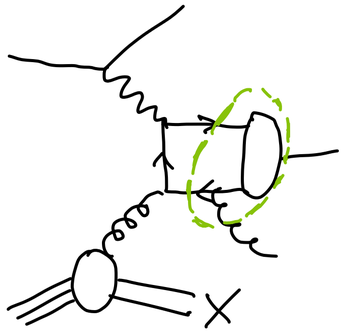
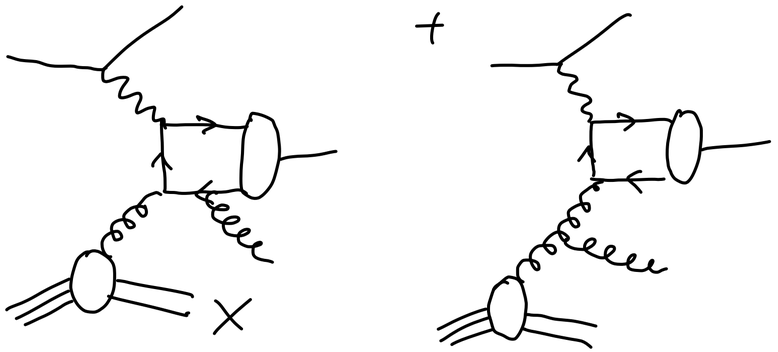
Semi-inclusive DIS			
J/ψ inclusive production			

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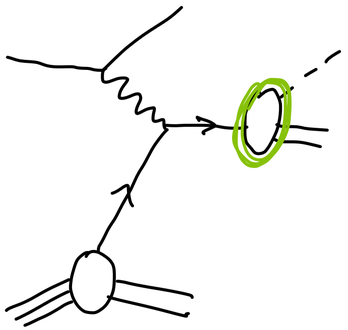
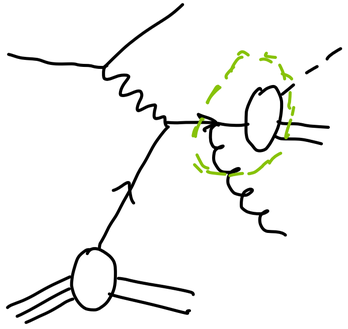
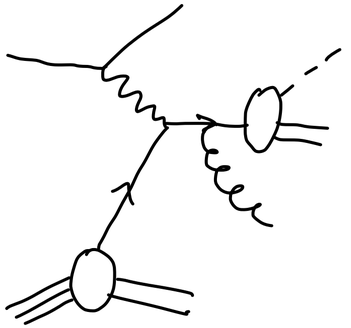
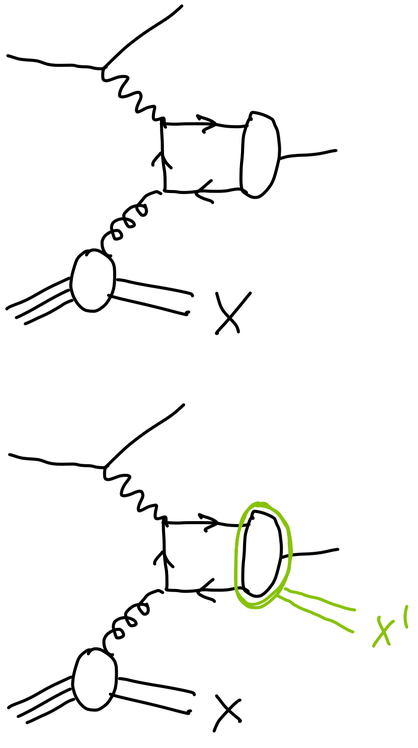
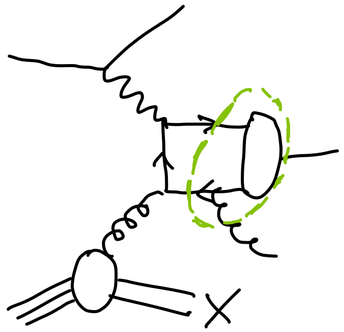
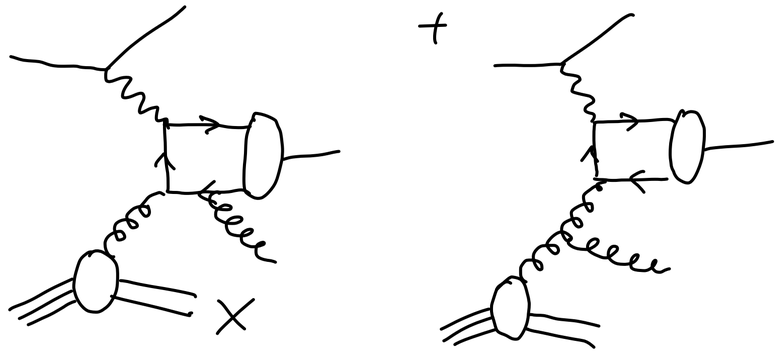
Semi-inclusive DIS			
J/ψ inclusive production			

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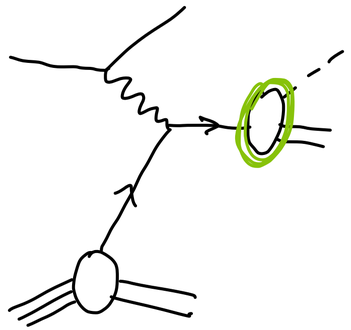
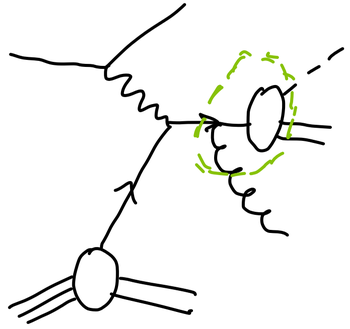
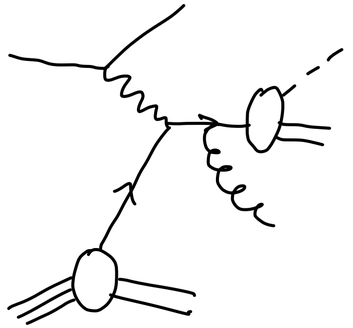
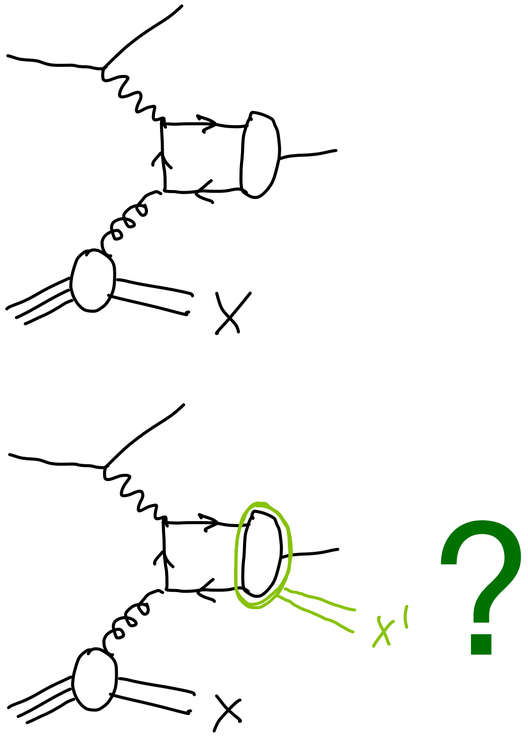
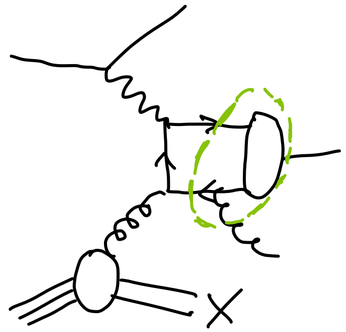
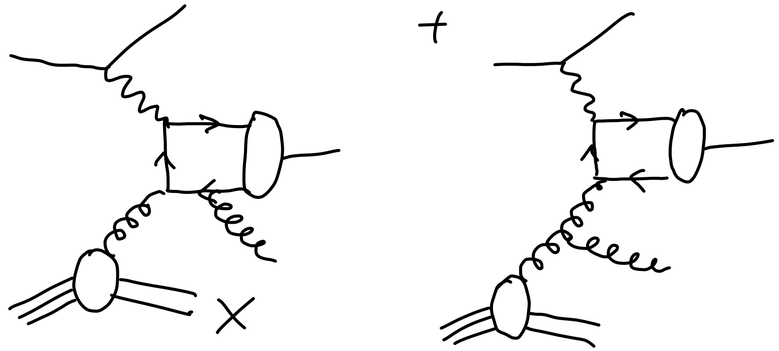
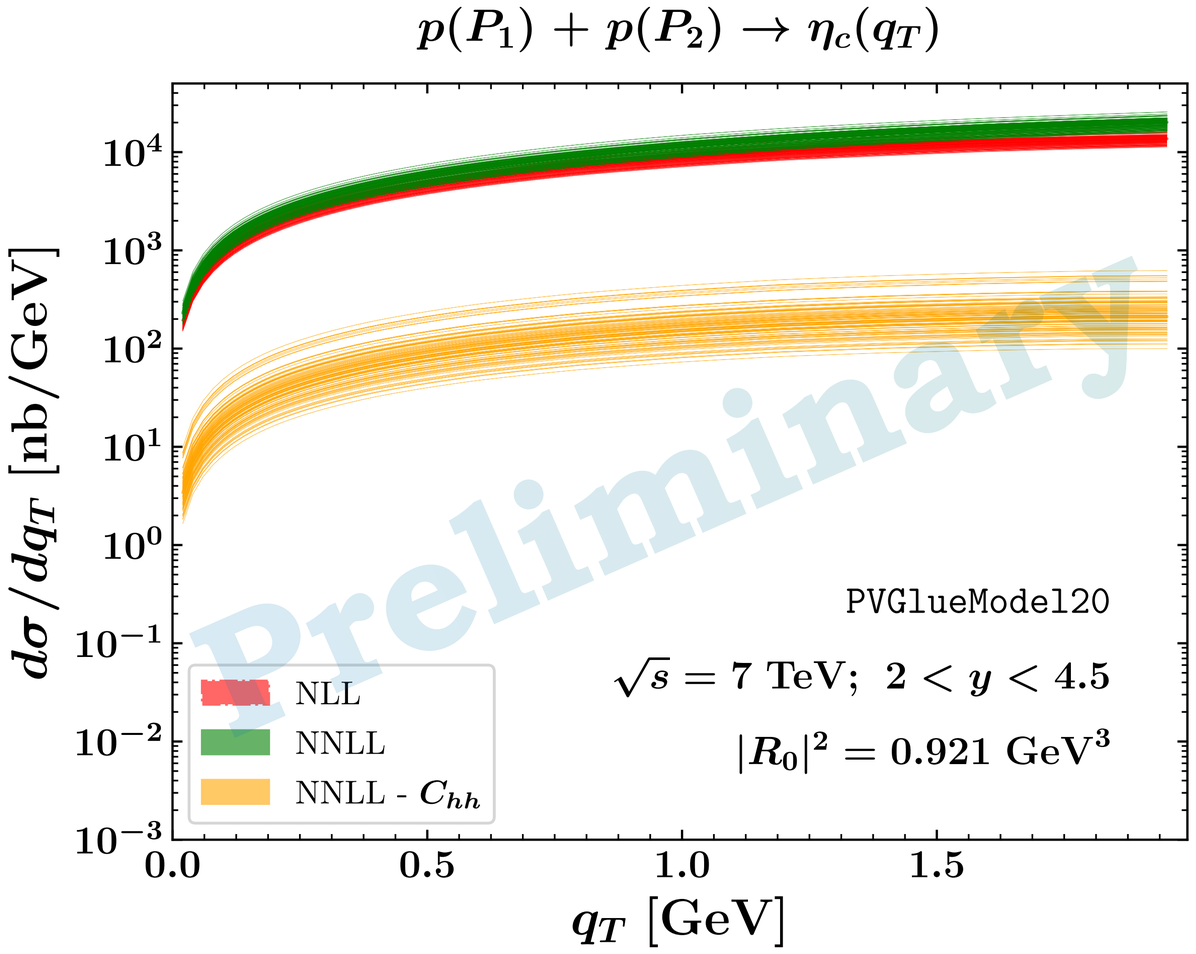
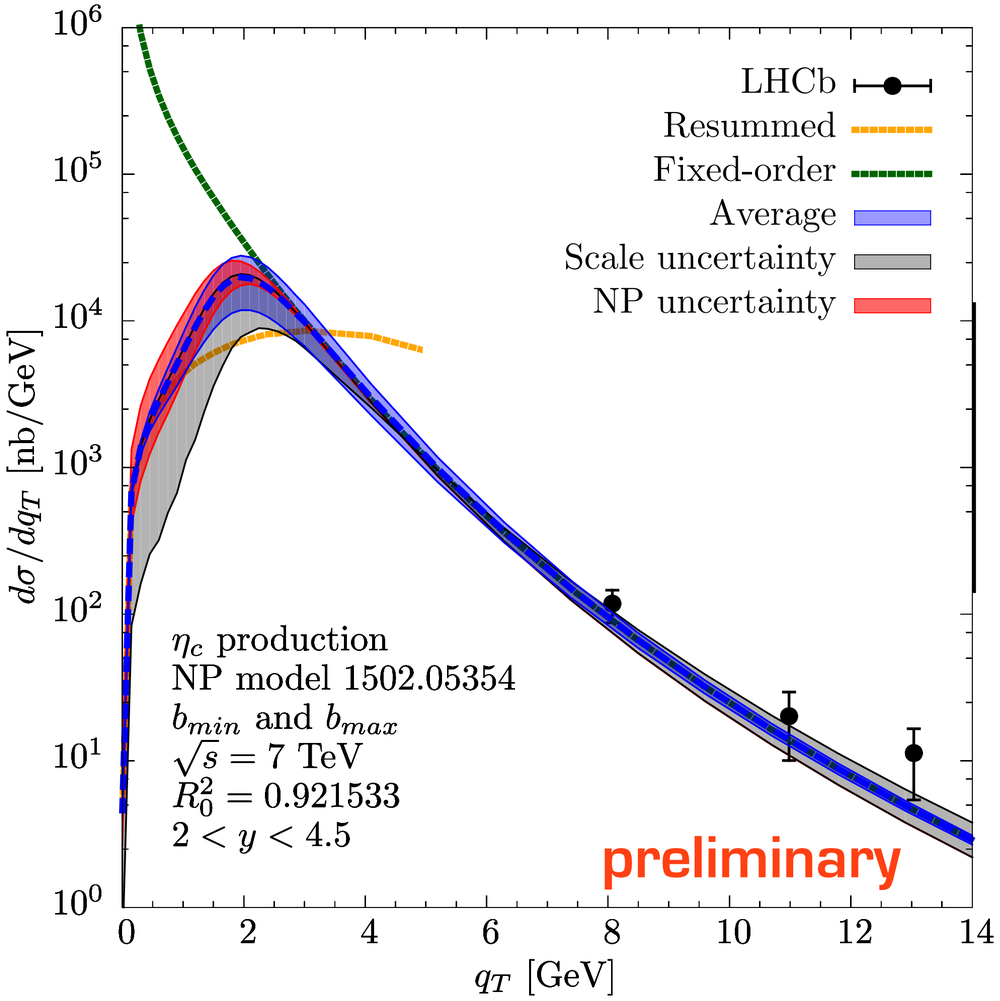
Semi-inclusive DIS			
J/ψ inclusive production			

TMD region

Francesco Celiberto's talk



Example of matching attempt



Different approach

Izabela Babiarz's talk