Production of 2 jets and W/Z in kt-factorization

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DESY

in collaboration with
Florian Schwennsen

Hannes Jung and
Jochen Bartels

Motivations and Introductions

Improved parton model

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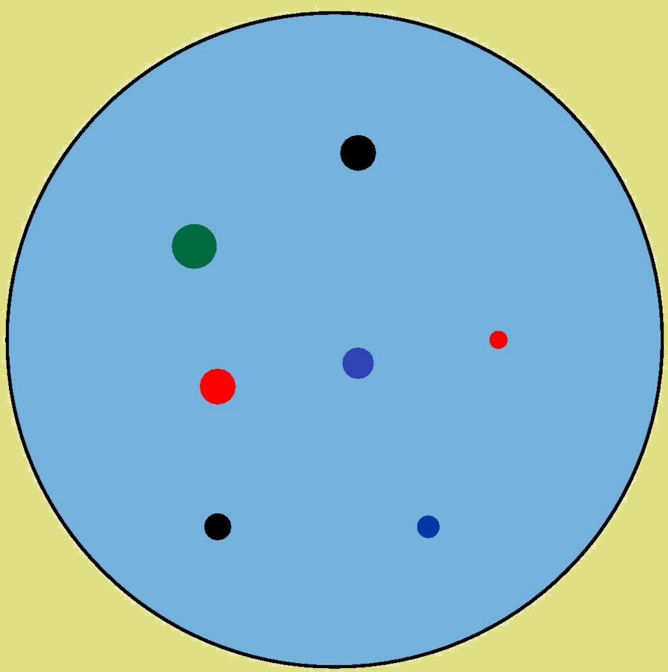
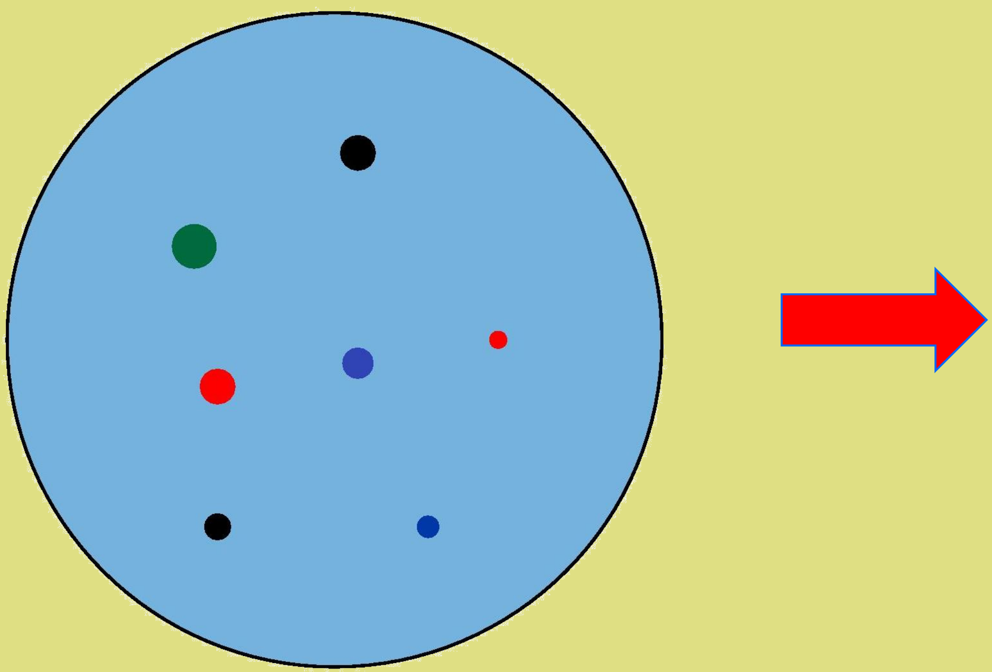


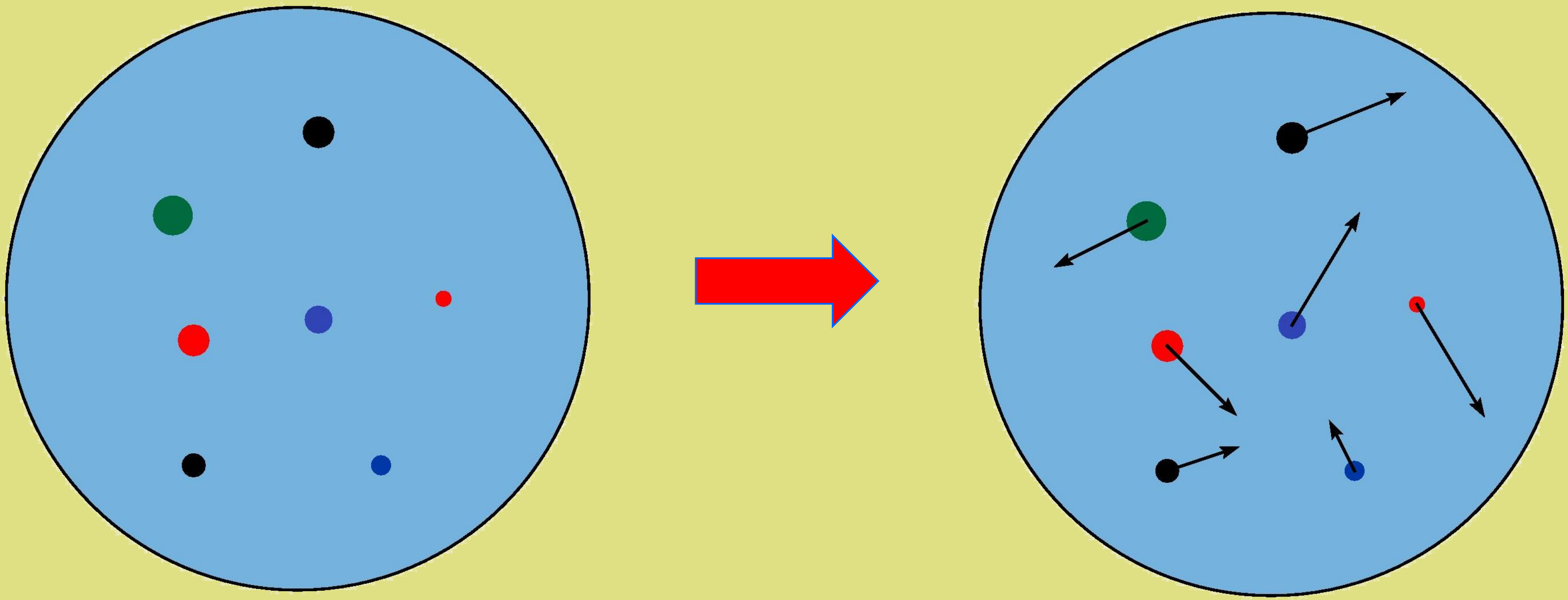
Motivations and Introductions

Improved parton model



Motivations and Introductions

Improved parton model



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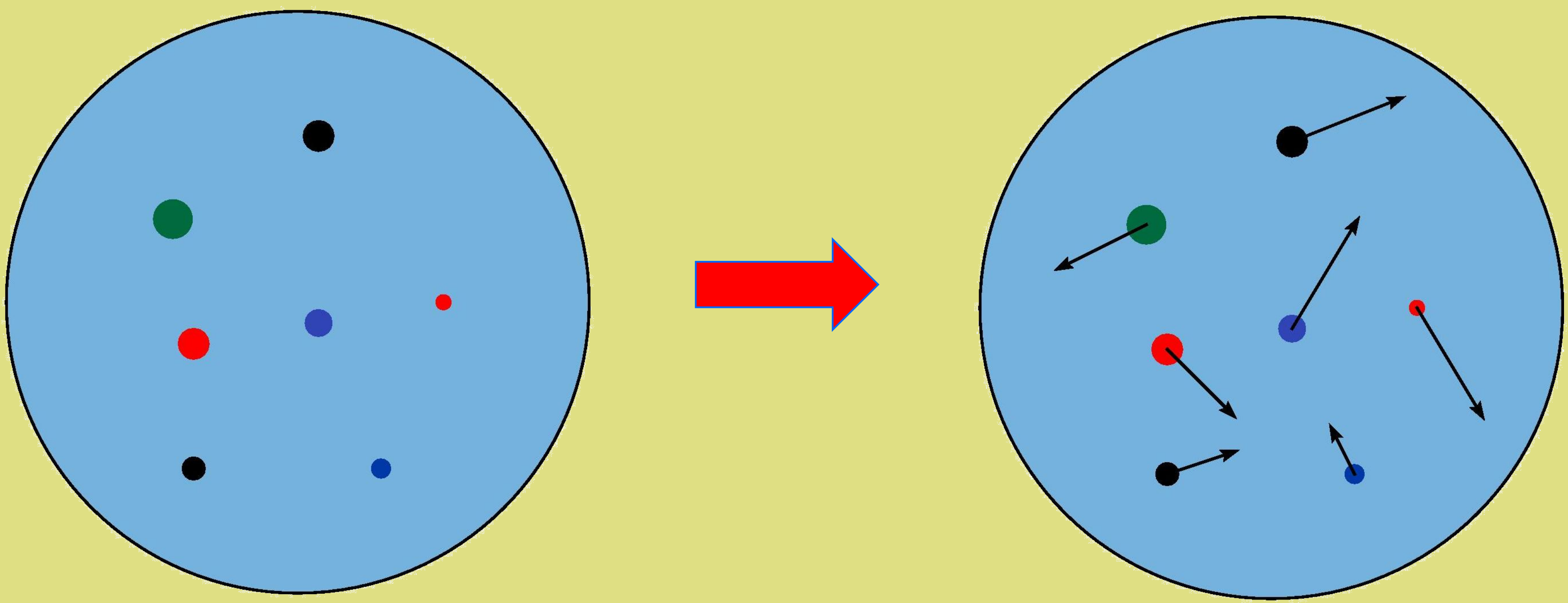

collinear approach
based on DGLAP evolution, PDFs

kt-factorisation
BFKL, CCFM, uPDFs (HERA)

Motivations and Introductions

Kinematics better treated

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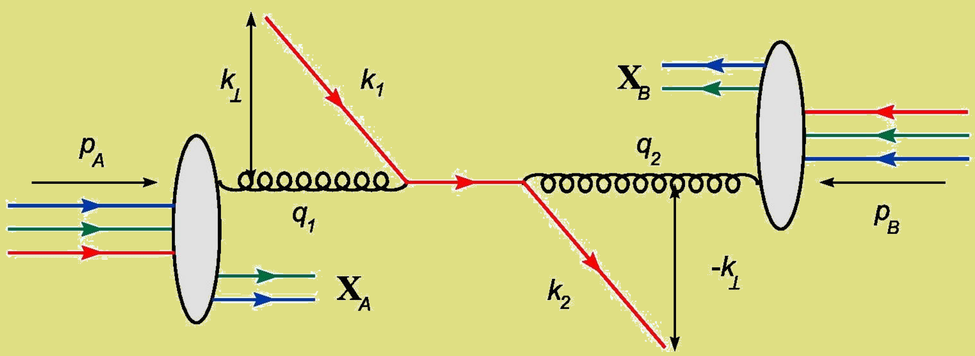

$$q_1 = x_1 p_A$$

$$q_2 = x_2 p_B$$

$$k_{1\perp} + k_{2\perp} = 0$$

Motivations and Introductions

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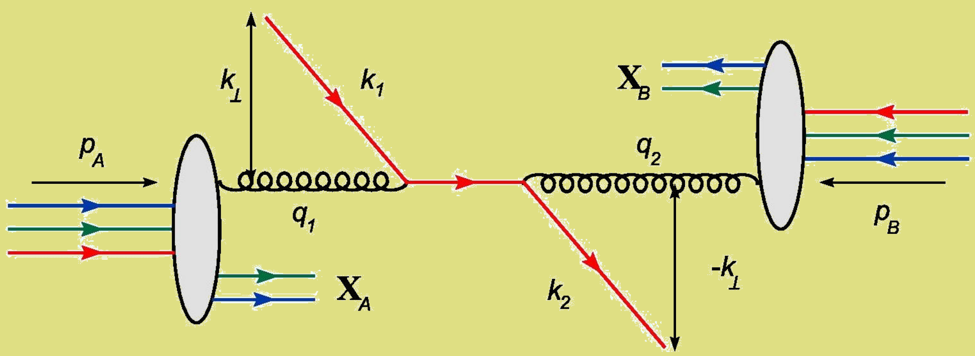

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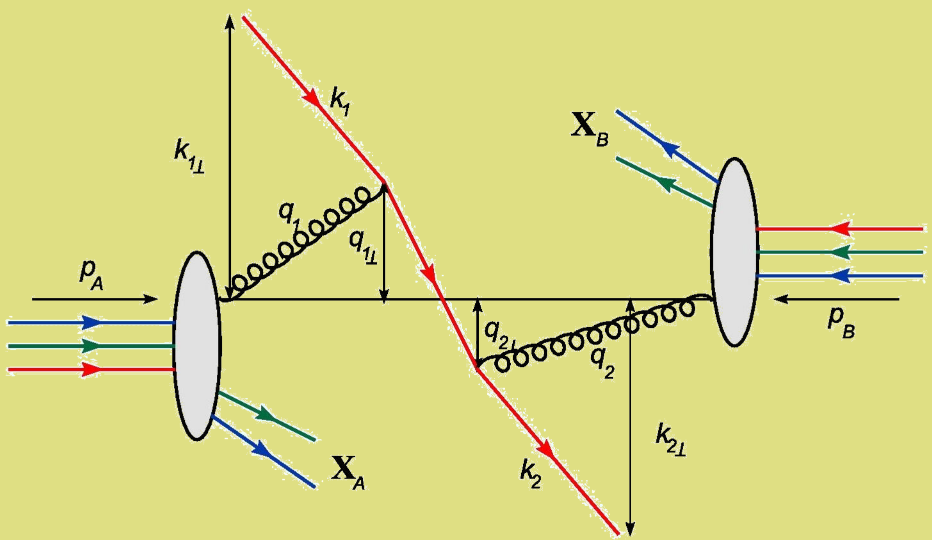

$$q_1 = x_1 p_A + q_{1\perp}$$
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$$k_{1\perp} + k_{2\perp} \neq 0$$

Motivations and Introductions

Offshell partons expected - interacting

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1. collinear partons

$$q_1^2 = \left(x_1 p_A\right)^2 = x_1^2 p_A^2 = x_1^2 m_A^2 \approx 0$$

Motivations and Introductions

Offshell partons expected - interacting

1. collinear partons

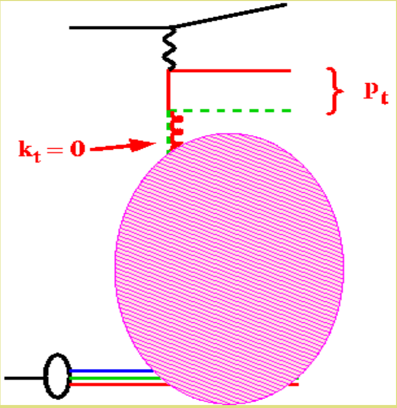
$$q_1^2 = \left(x_1 p_A \right)^2 = x_1^2 p_A^2 = x_1^2 m_A^2 \approx 0$$

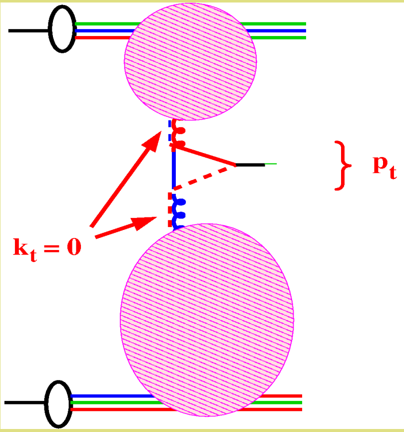
2. partons with transversal components of momenta

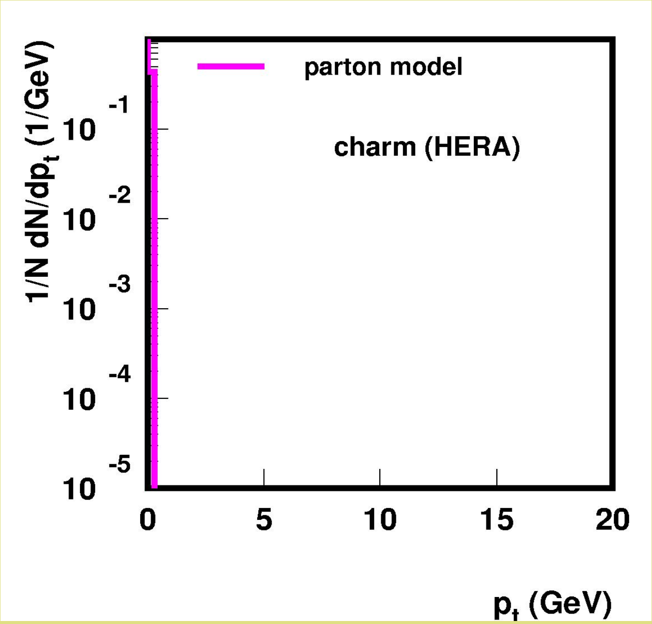
$$q_1^2 = \left(x_1 p_A + q_{1\perp} \right)^2 = \left(x_1 p_A \right)^2 + 2 x_1 p_A . q_{1\perp} + q_{1\perp}^2$$
$$= x_1^2 p_A^2 + 0 + q_{1\perp}^2 = x_1^2 m_A^2 + q_{1\perp}^2 \approx -q_{1\perp}^2 < 0$$

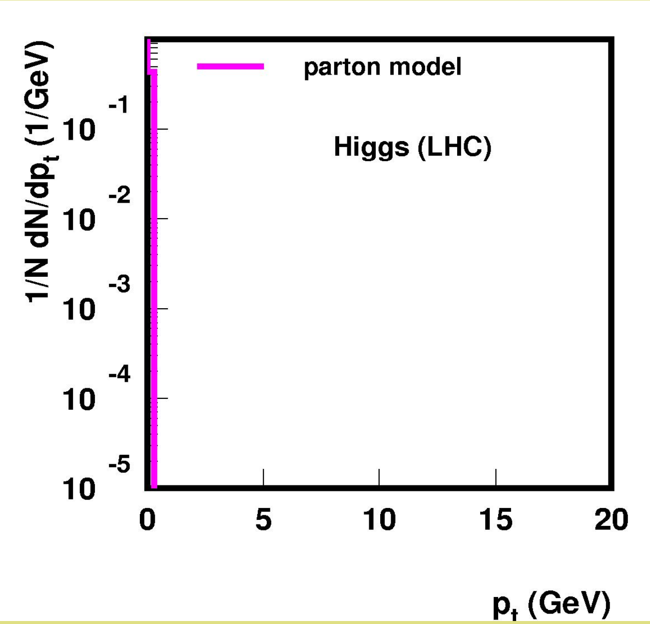
Motivations and Introductions

Examples of usual results (without parton showers)





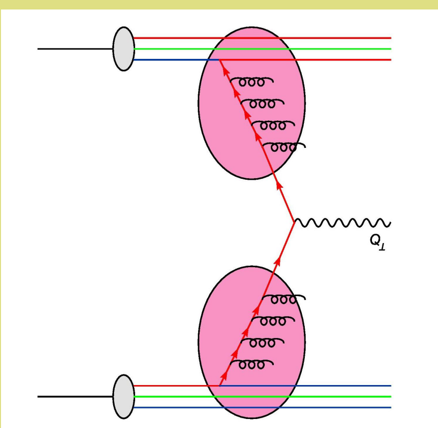


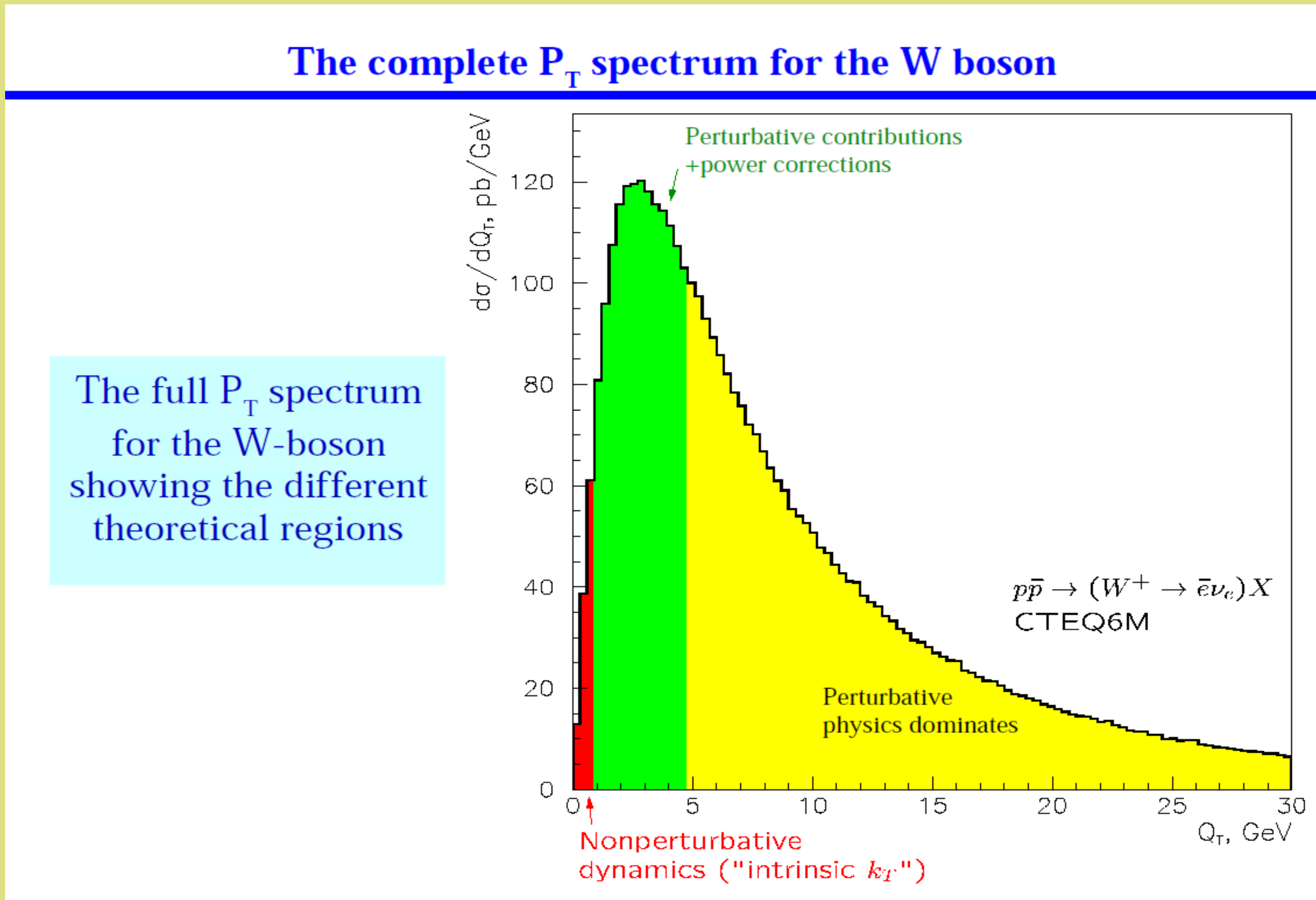


Motivations and Introductions

Usual approach

Collins, Soper, Sterman,
Nucl. phys. B250:199,1985





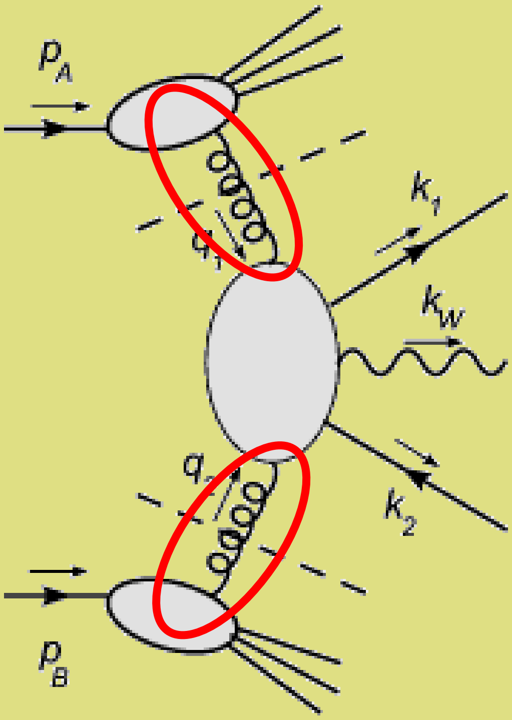
Fred Olness, CTEQ
summerschool 2003

BFKL formalism (kt-factorisation)

kinematic regime: $s >> |t|$

small x

rapidity ordering follows



$$q_1 = x_1 p_A + \xi_1 p_B + q_{1\perp}$$
$$q_2 = \xi_2 p_A + x_2 p_B + q_{2\perp}$$

$$x_1 >> \xi_1, \; x_2 >> \xi_2$$

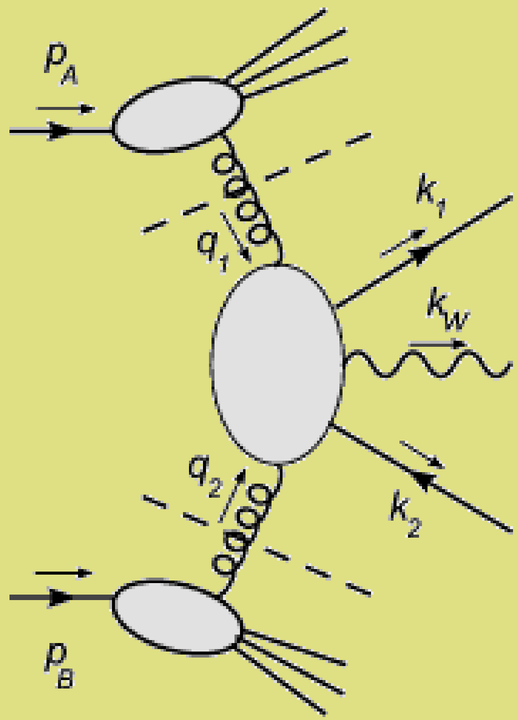
BFKL formalism (kt-factorisation)

Replace proton by a quark

Special example production of Z/W + 2 jets

Measurment of luminosity, background for beyond

SM processes, only way to have Z/W in kt-factorisation, uPDFs



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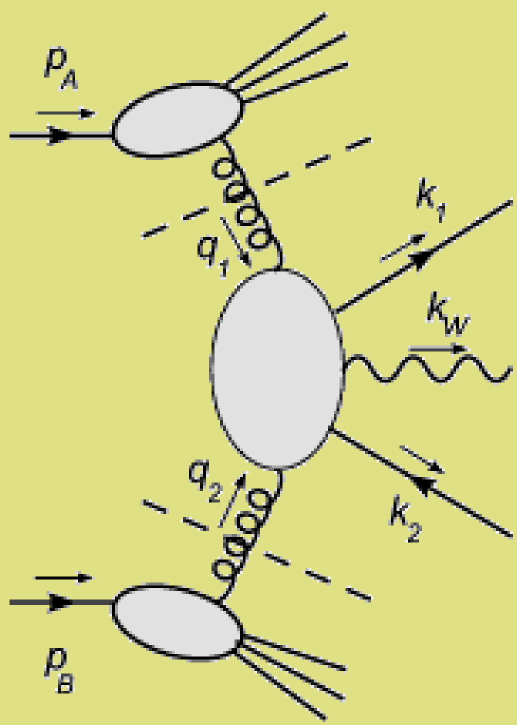

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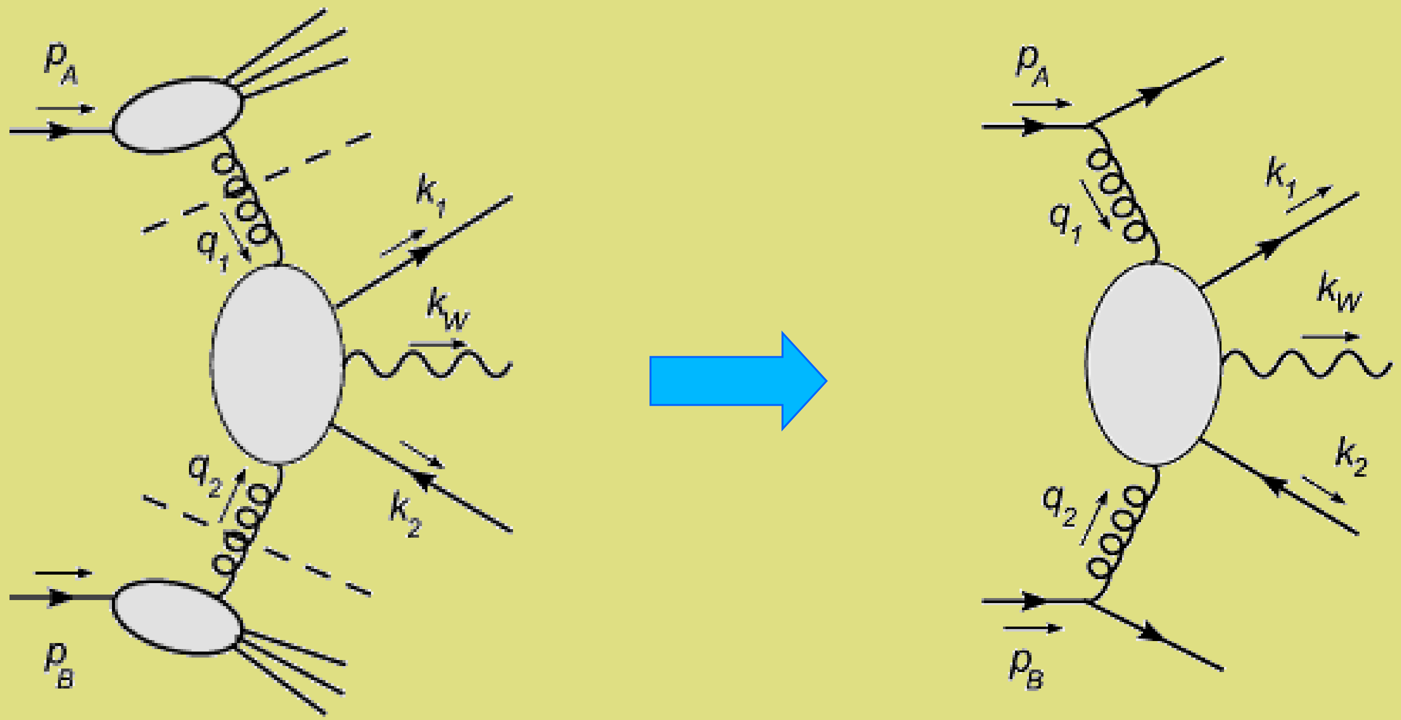
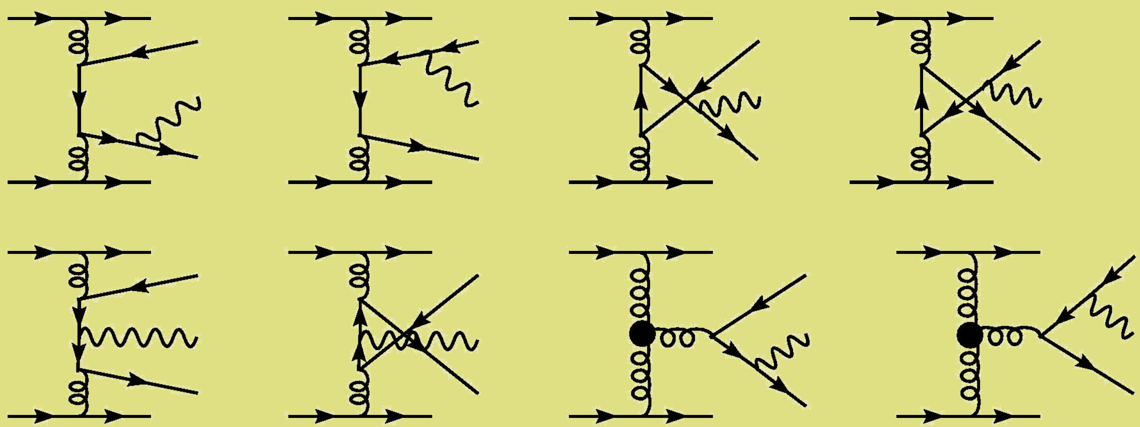
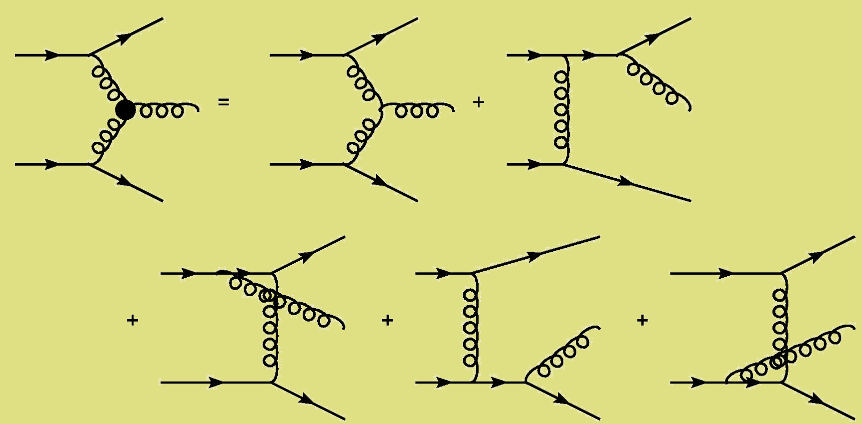


BFKL formalism → Calculation

Happily draw all the diagrams (note only gluon channel) of Z/W + 2 jets



Effective vertex:



Orthogonal amplitudes

Baranov, Slad,
hep-ph/0603090v1

Lipatov,
Sov. J. Nucl. Phys. 23, 338 (1976)

BFKL formalism → Calculation

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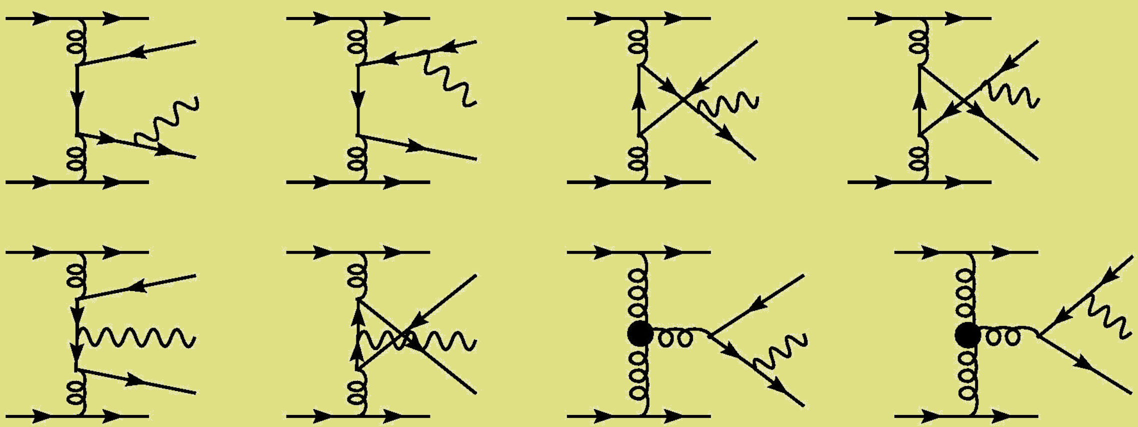

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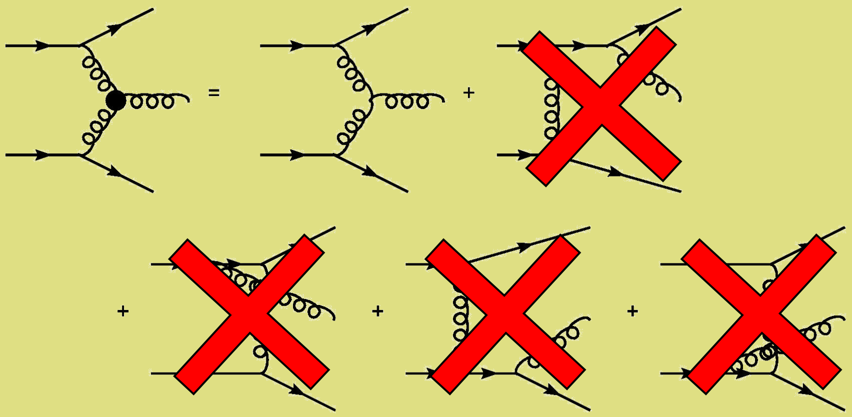


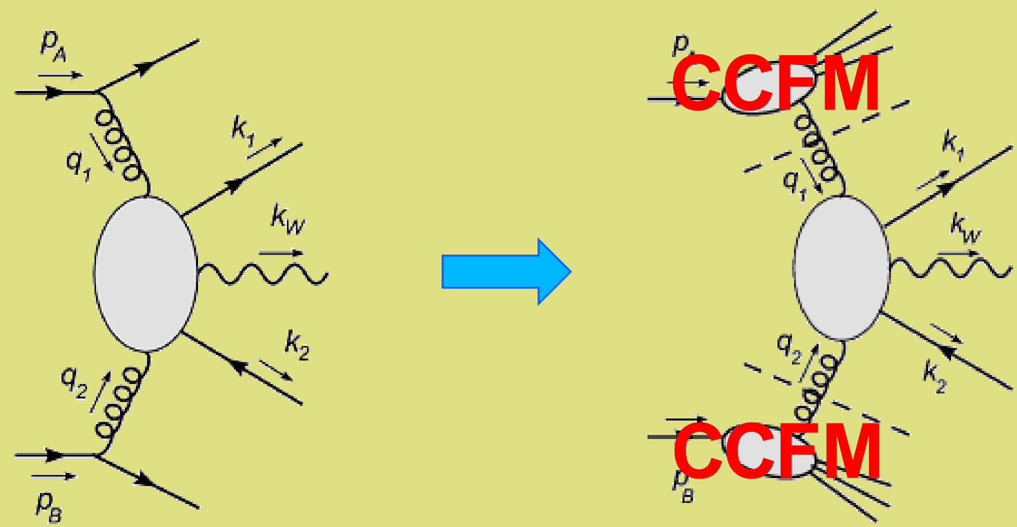
Axial gauge

Orthogonal amplitudes

Baranov, Slad,
hep-ph/0603090v1

Calculation

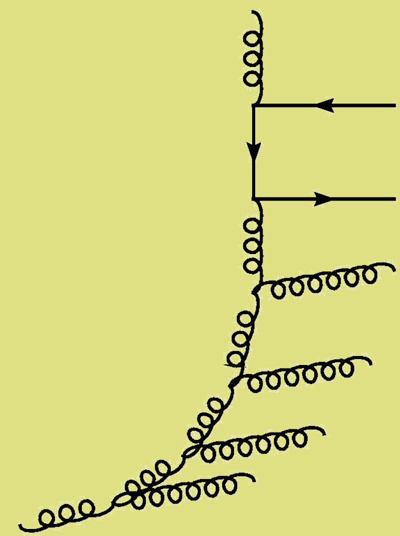
Getting back to proton



Jung,
Comput. Phys. Commun.143, 100 (2002)
[hep-ph/0109102]
Jung, Salam,
Eur. Phys. J. C19, 351 (2001)
[hep-ph/0012143]

CCFM is implemented in CASCADE

Implementation of matrix element of $gg \to W/Z + q_i\bar{q}_j$

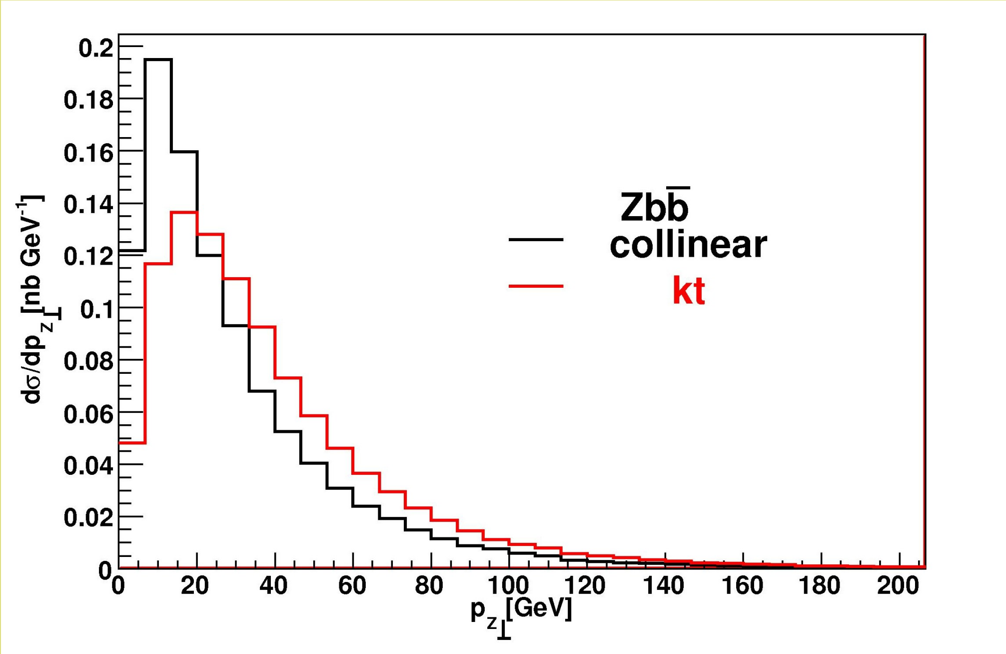


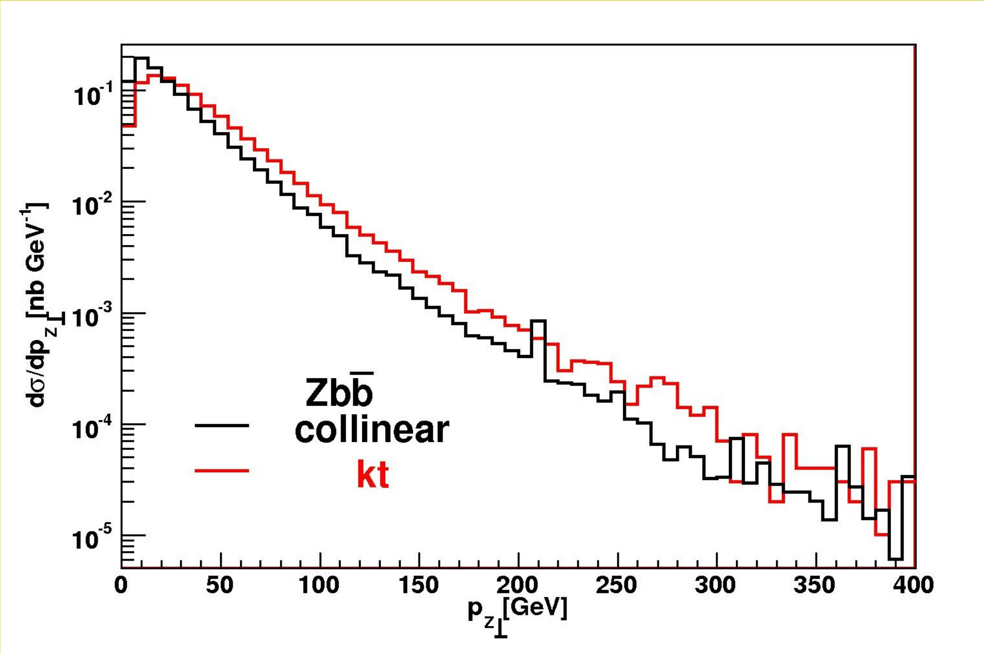
CCFM

Ciafaloni,
Nucl. Phys. B296 (1988) 49;
Catani, Fiorani, Marchesini,
Phys. lett. B234 (1990) 339;
Nucl. Phys. B336 (1990) 18;
Marchesini,
Nucl. Phys. B445 (1995) 49
[hep-ph/9412327]

Results

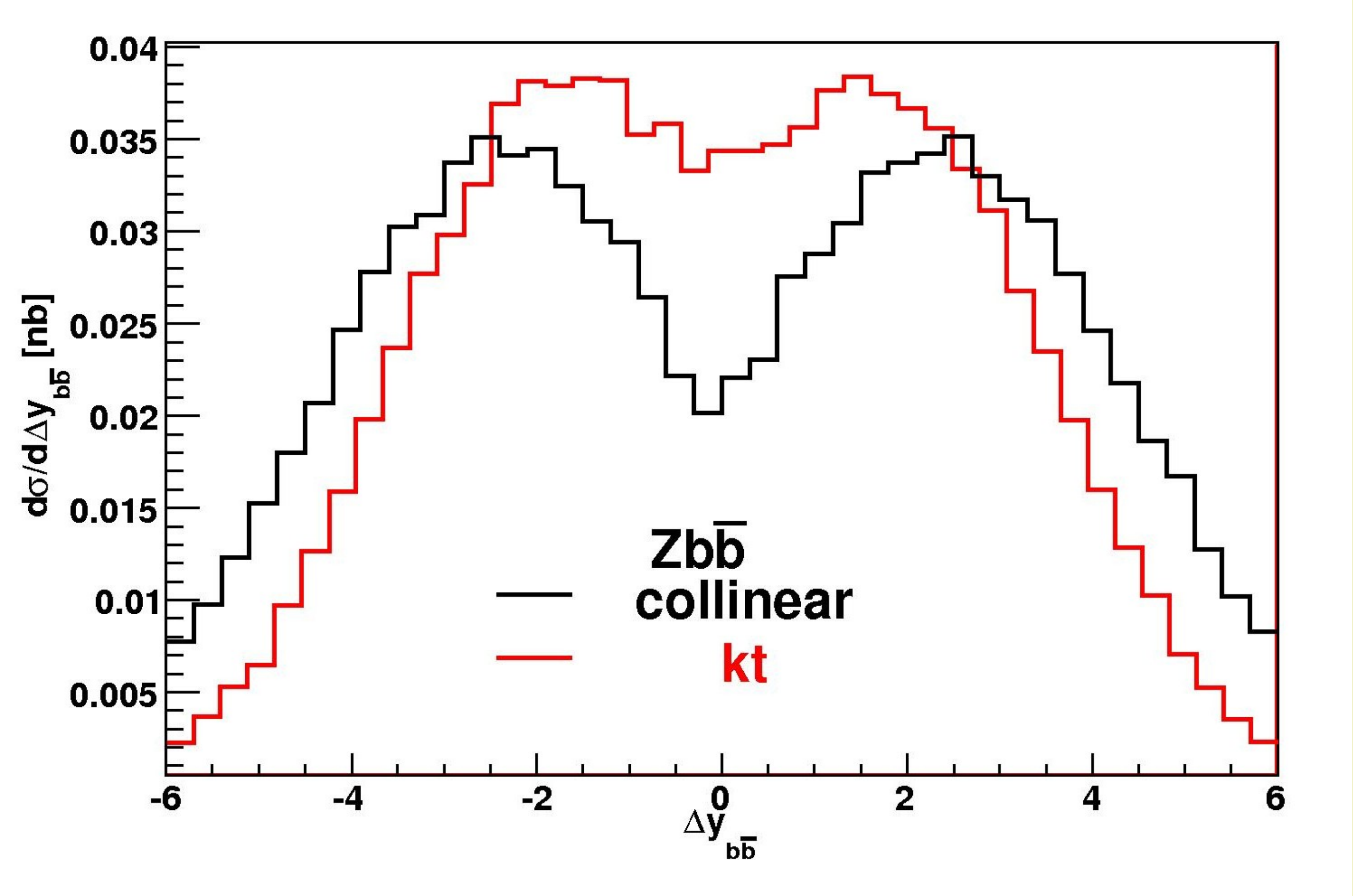
pt distribution of *Z* (comparison with MCFM LO)





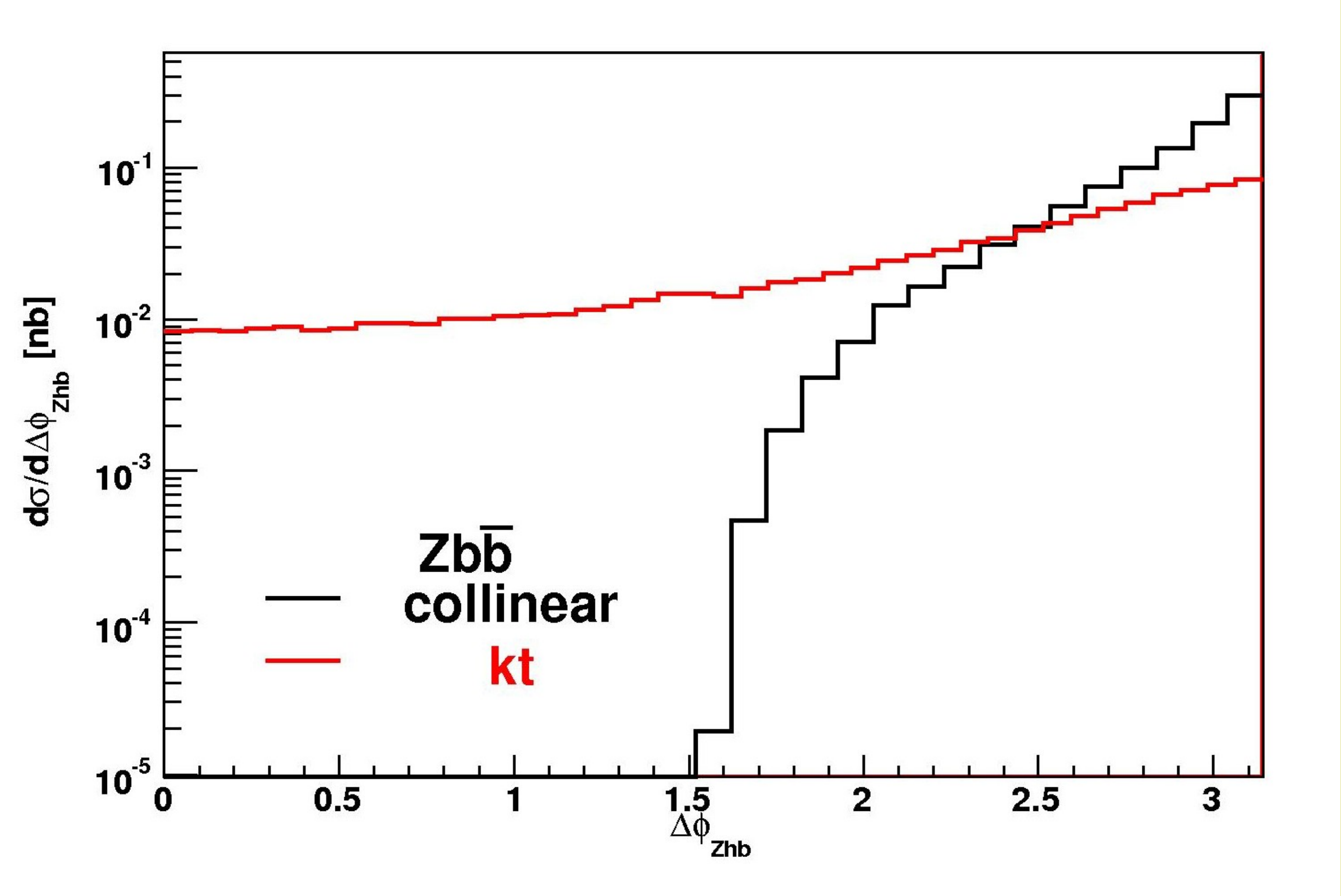
Results

Difference of rapidities of quark and antiquark (comparison with MCFM LO)



Results

Polar angle between higher pt quark jet and Z (comparison with MCFM LO)



Summary

The need for unintegrated parton densities was explained

Usual approach vs. BFKL formalism – kt-factorisation

One example of their application was shown

Results show similarity to usual approach and better kinematics treatment