Dijet Production at Low Q2

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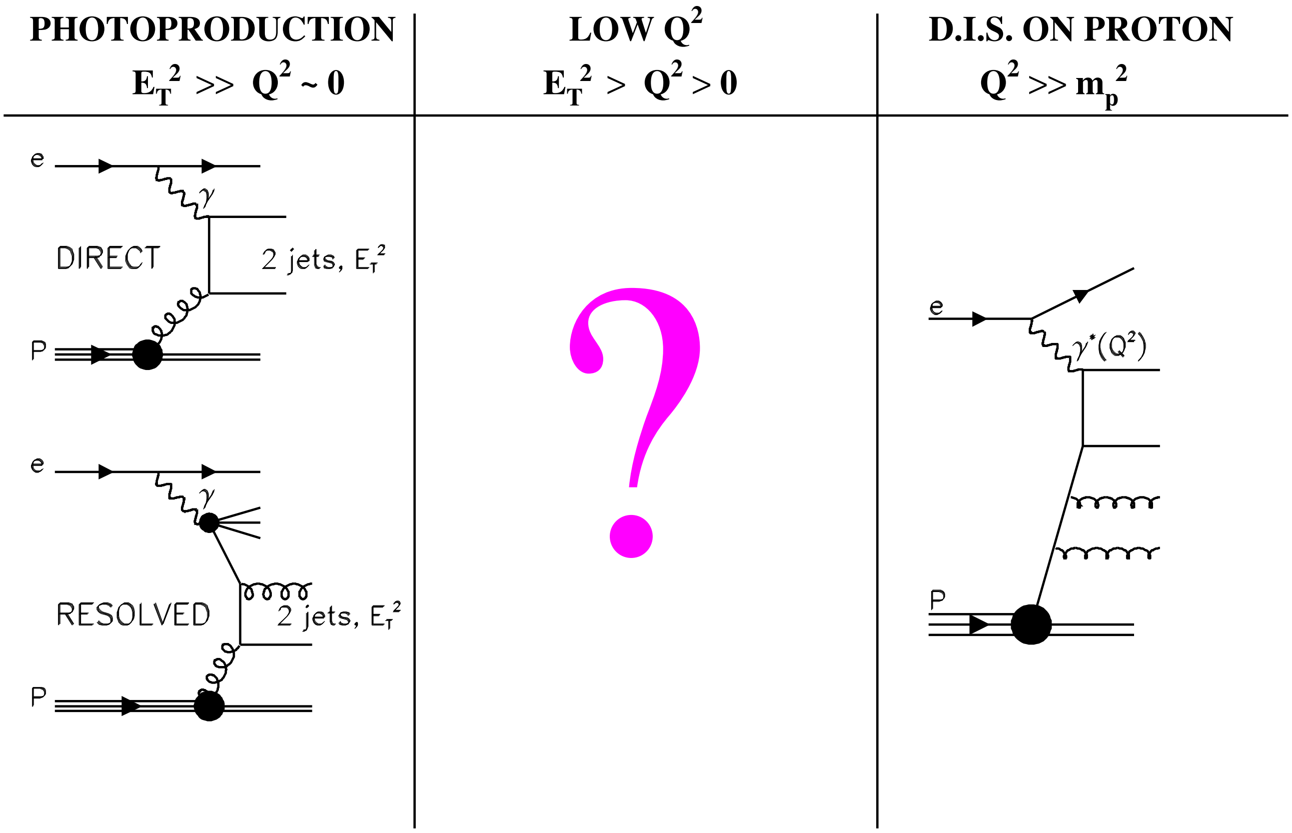
Representing **H1** Collaboration

- Di-jets at HERA
- DGLAP-like Concept
  - Longitudinally polarized γ_L^*
- CCFM-like Concept
- Conclusions

Di-jet Production at HERA



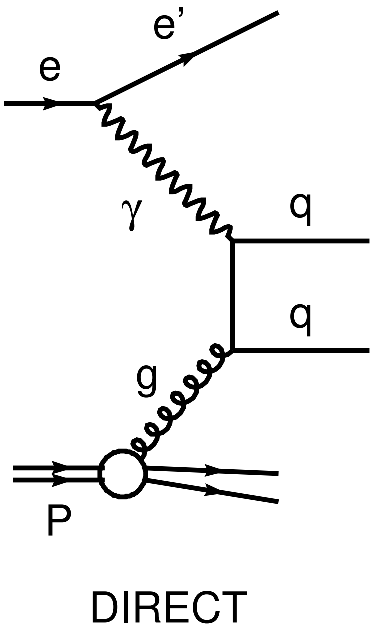
Possible concepts in low Q^2 region:

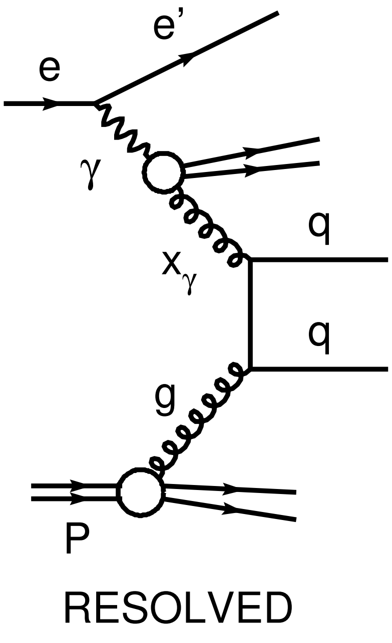
- Direct and Resolved processes of standard DGLAP-like MC programs (HERWIG, RAPGAP).
- k_t unordered initial parton cascade processes based on CCFM or BFKL evolution (CASCADE).
- NLO calculations.

All the previous approaches treat higher order corrections in different ways.

DGLAP Scheme (Direct and Resolved)

- Q^2 - virtuality of γ^*
- y - inelasticity
- E_t - transverse jet energy
- x_γ - fraction of the photon energy carried into the hard process





$$\sigma^{\mathrm{RES}} \sim \sum_{\mathbf{k=T,L}} \mathbf{f}_{\gamma^{\mathbf{k}}/\mathbf{e}} \otimes \mathrm{PDF}_{\gamma^*_{\mathbf{k}}} \otimes \mathrm{PDF}_{\mathbf{P}} \otimes |\mathbf{M_{ij}}|^{\mathbf{2}}$$

Resolved Processes: Difference between γ_T^* and γ_L^*

- Photon fluxes:

$$f_{\gamma^T/e}(y,Q^2) = \frac{\alpha}{2\pi}\left[\frac{2(1-y)+y^2}{y}\frac{1}{Q^2} - \frac{2m_e^2 y}{Q^4}\right]$$

$$f_{\gamma^L/e}(y,Q^2) = \frac{\alpha}{2\pi}\left[\frac{2(1-y)}{y}\frac{1}{Q^2}\right]$$

Note that for $Q^2 \gg m_e$:

$$y=0 \implies f_{\gamma^L/e} = f_{\gamma^T/e}$$
$$y=1 \implies f_{\gamma^L/e} = 0$$

- QED behavior of γ^* PDF in our kinematic region:

$$\left.\begin{aligned} \mathrm{PDF}_{\gamma^*_\mathbf{T}} &\sim \mathbf{h_1(x)} \cdot \ln\frac{\mathbf{E_t^2}}{\mathbf{Q^2}} \\ \mathrm{PDF}_{\gamma^*_\mathbf{L}} &\sim \mathbf{h_2(x)} \end{aligned}\right\} \text{ for } Q^2 \gg m_q^2$$

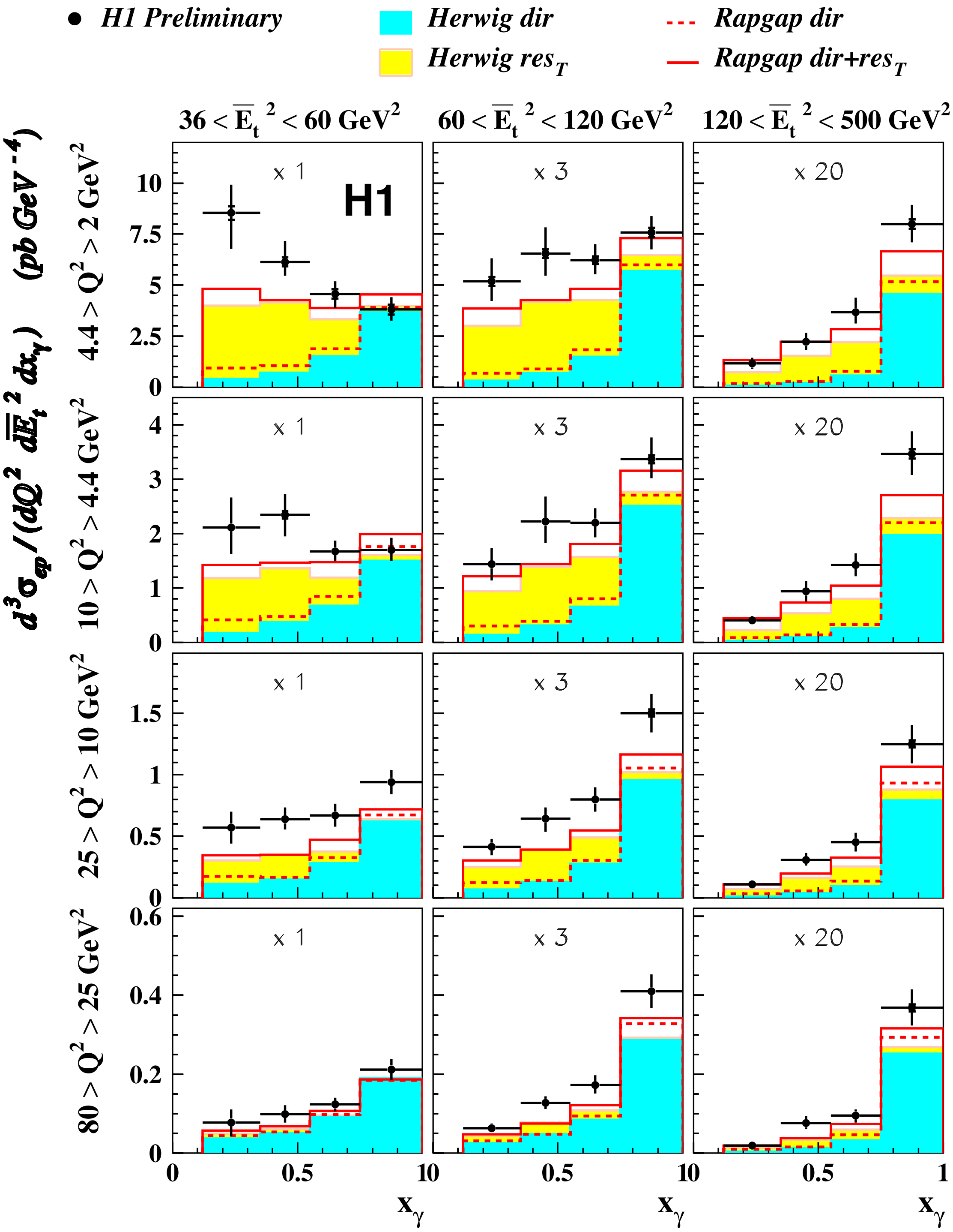
Phase Space of the Measurement

H1 (16.3 pb^{-1}, 1999)
$\sqrt{s} = 318$ GeV
$2\ \mathrm{GeV}^2 < Q^2 < 80\ \mathrm{GeV}^2$
$0.1 < y < 0.85$
$E_t^{jet\,1,2} > 5$ GeV $\overline{E}_t > 6$ GeV
$-2.5 < \eta^{jet\,1,2} < 0$

MC Models Used

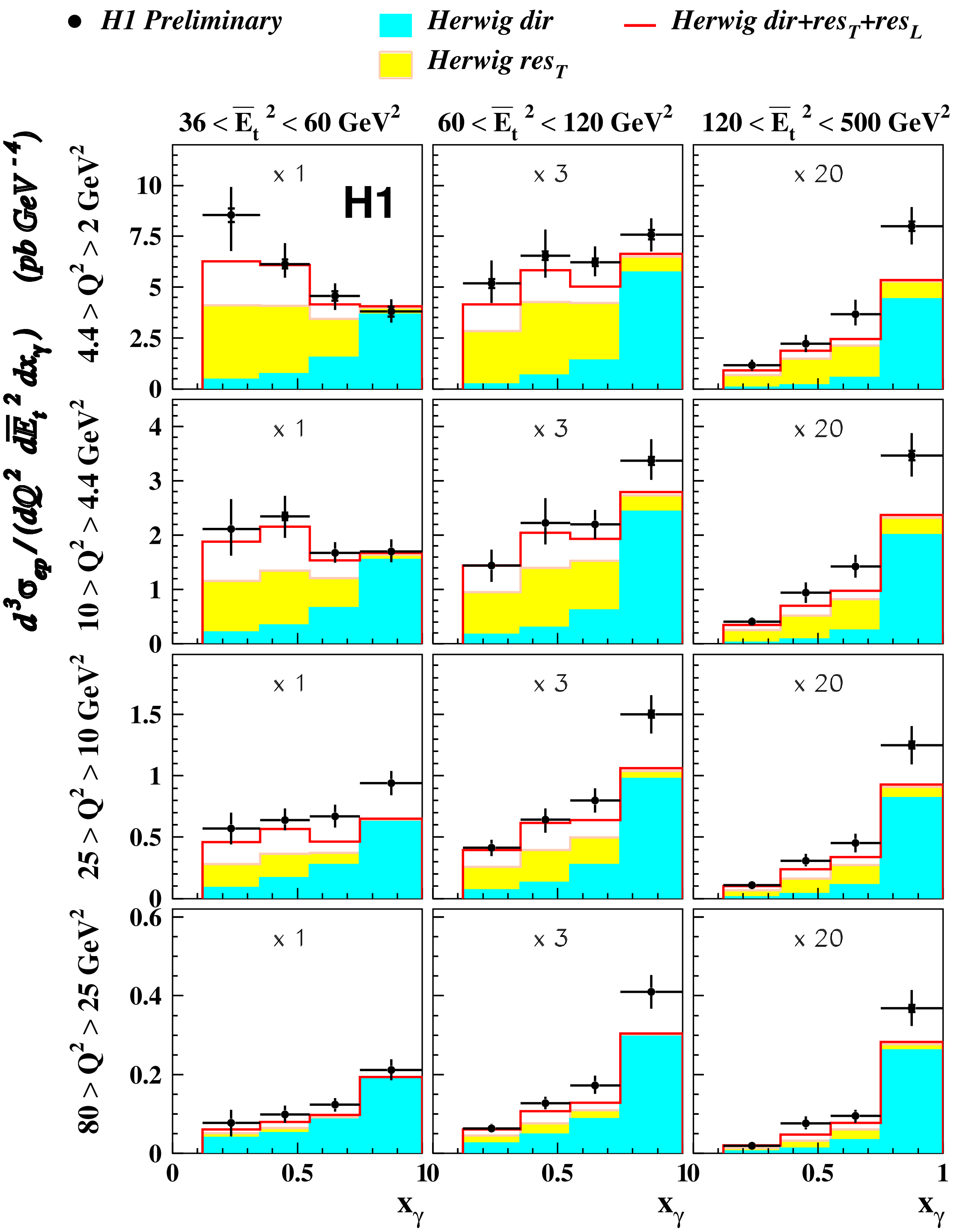
H1
HERWIG 5.9, RAPGAP 2.8: proton PDF: GRV LO γ_T^* PDF: SaS1D γ_L^* PDF: J. Chýla s.u.e. in HERWIG: 10%
CASCADE 1.0: Default setting

Di-jet Cross Section



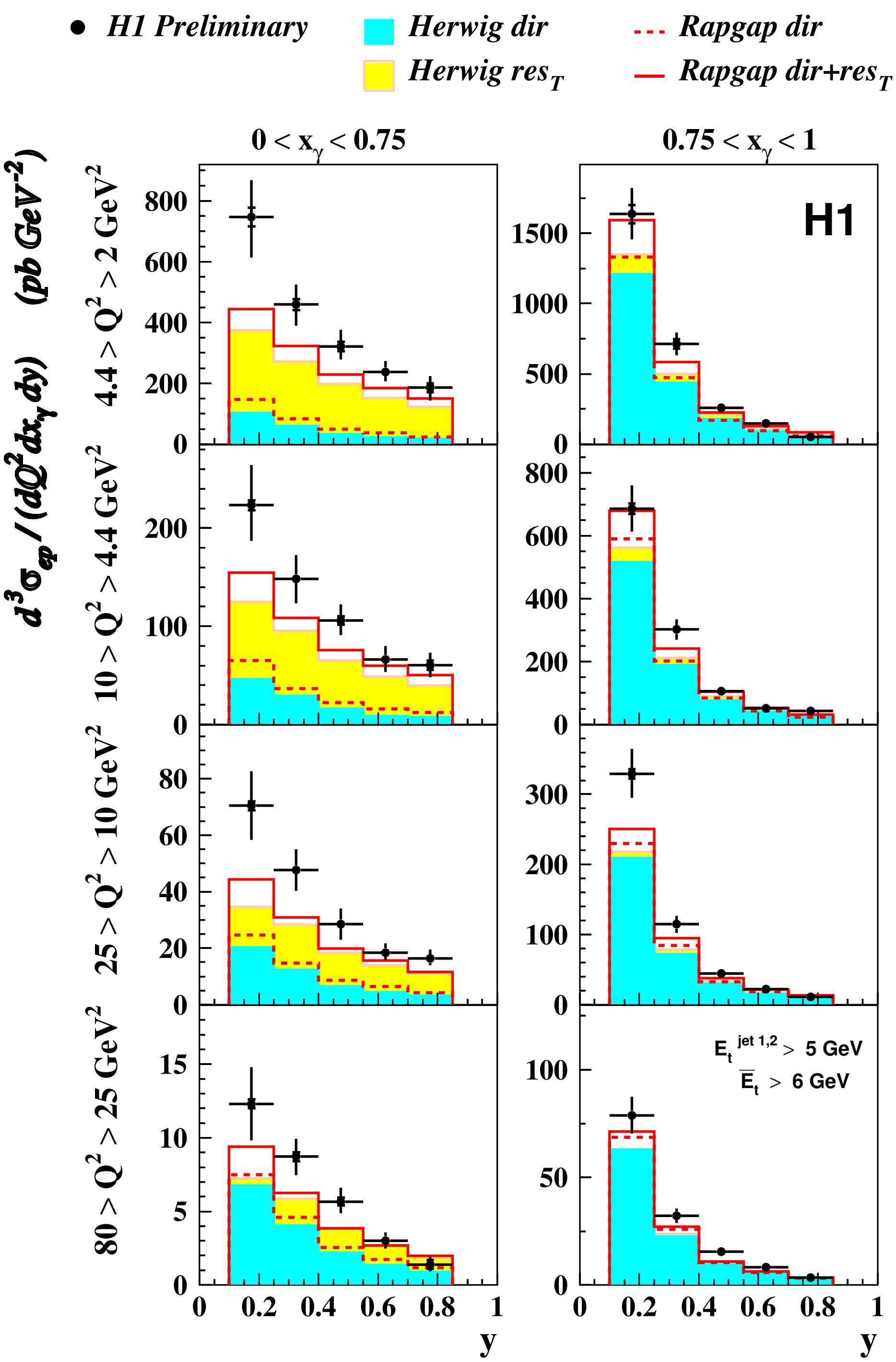
- Resolved significant when Q^2 decreases or $\overline{E}_t^2$ increases.
- LO predictions under the data. Do we miss something ?

Adding Longitudinal Photon



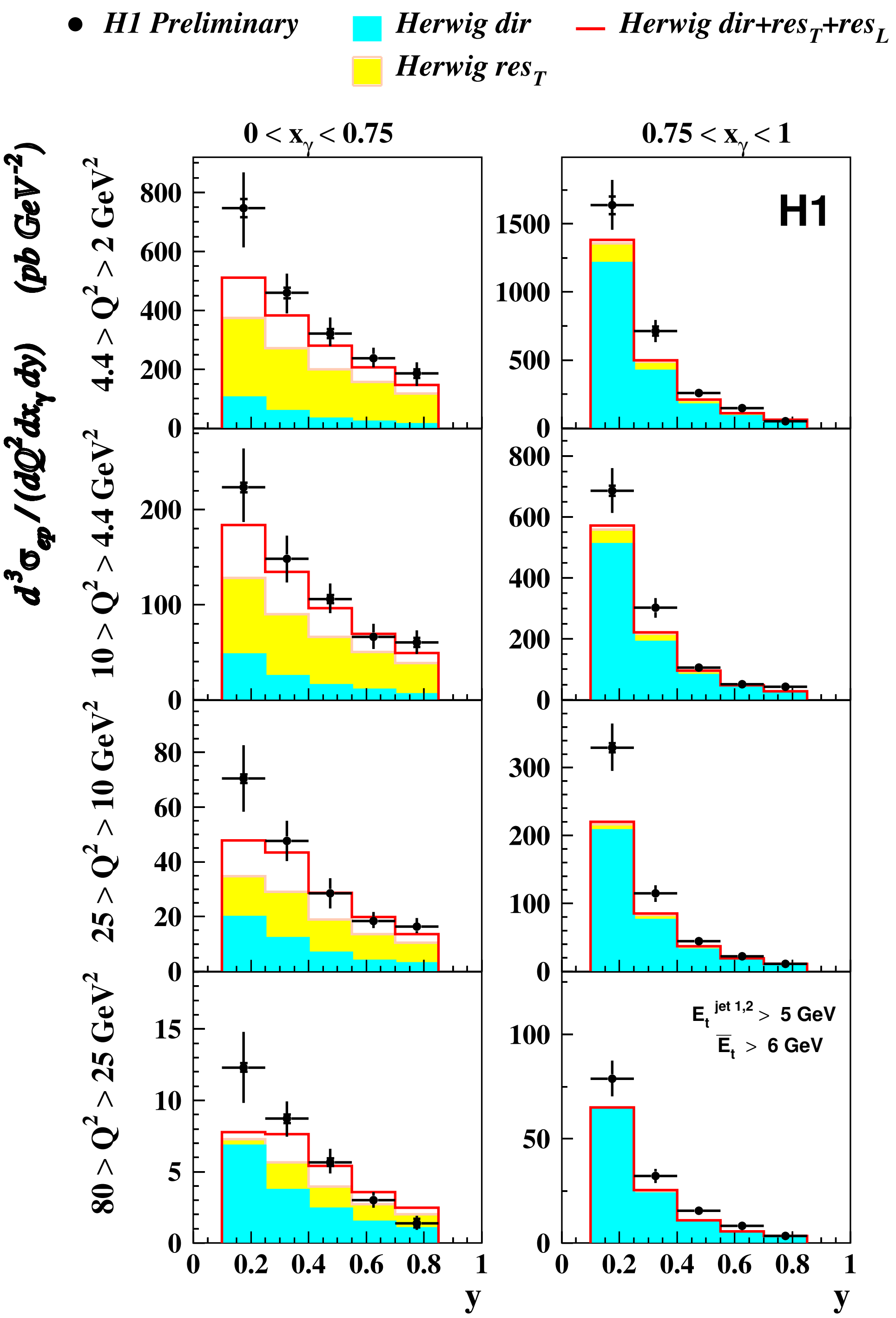
- Addition of γ_L^* helps to describe the data.
- Do we have other evidence for γ_L^* ?

y Dependence of Di-jet Cross-Section



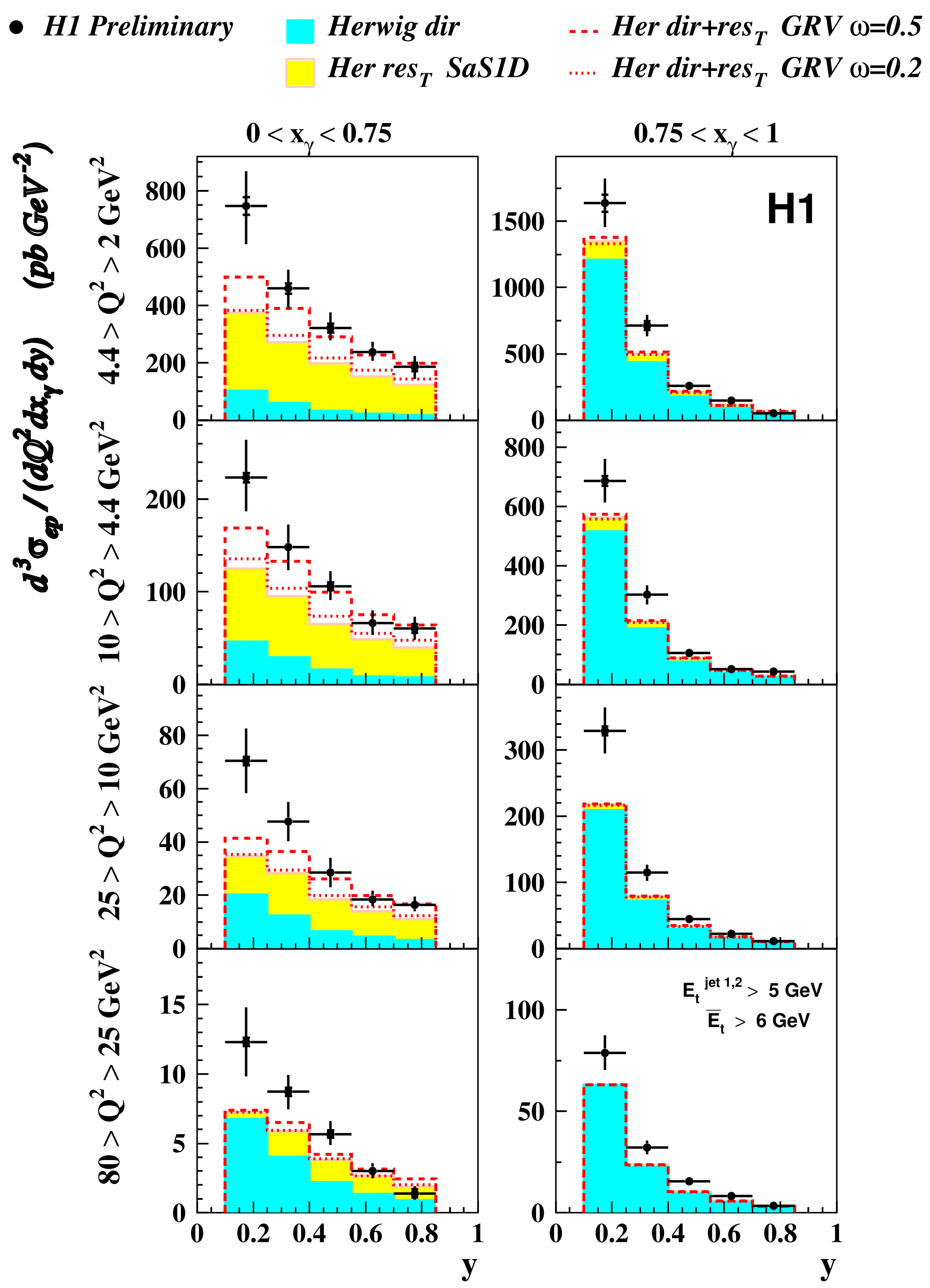
- The slope of y dependence is different in data compared to HERWIG or RAPGAP.

Adding Longitudinal Photon



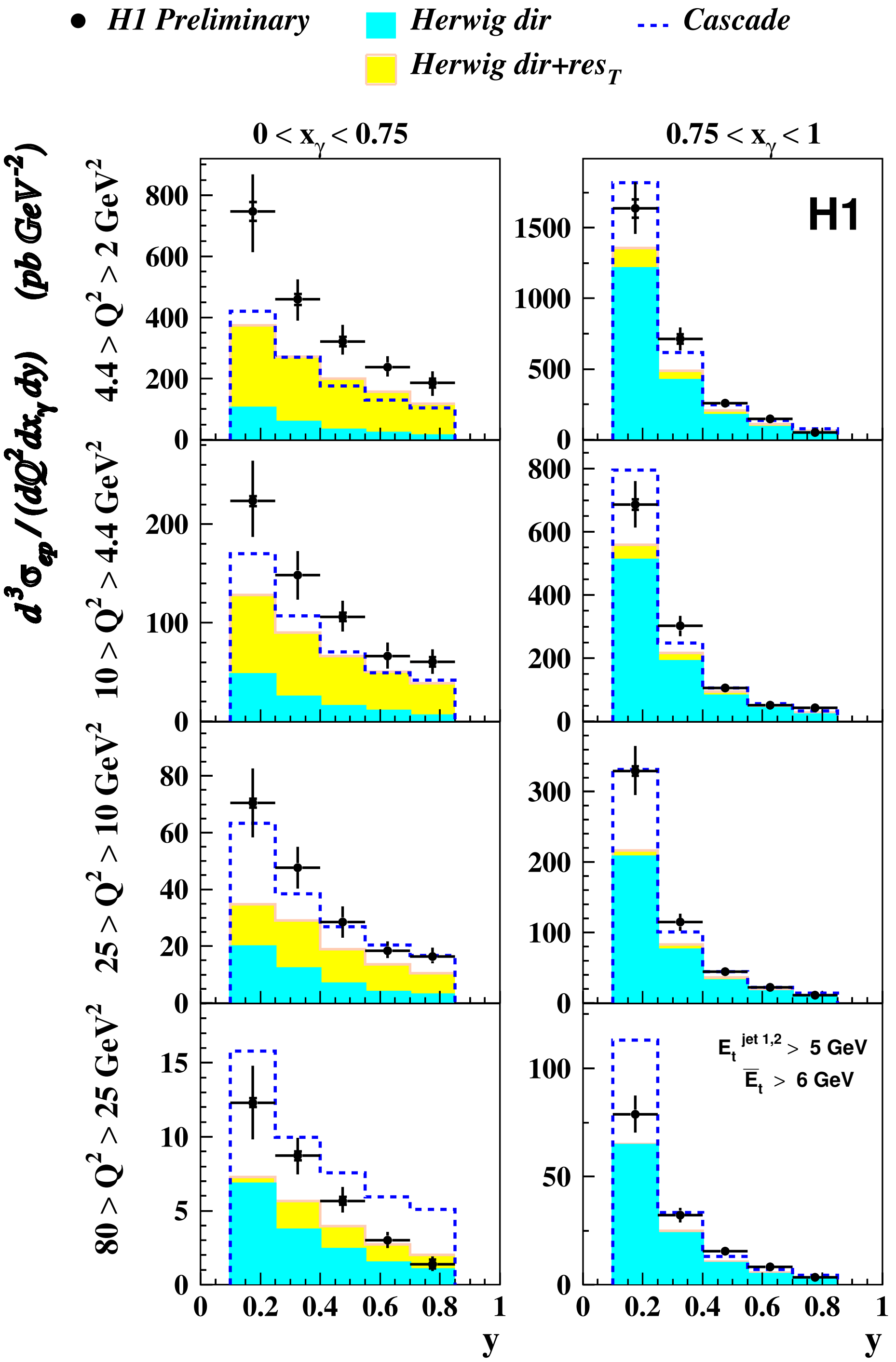
- The slope of y distribution in HERWIG comes closer to data if γ_L^* is added.

Just a check: Different γ^*_T PDFs



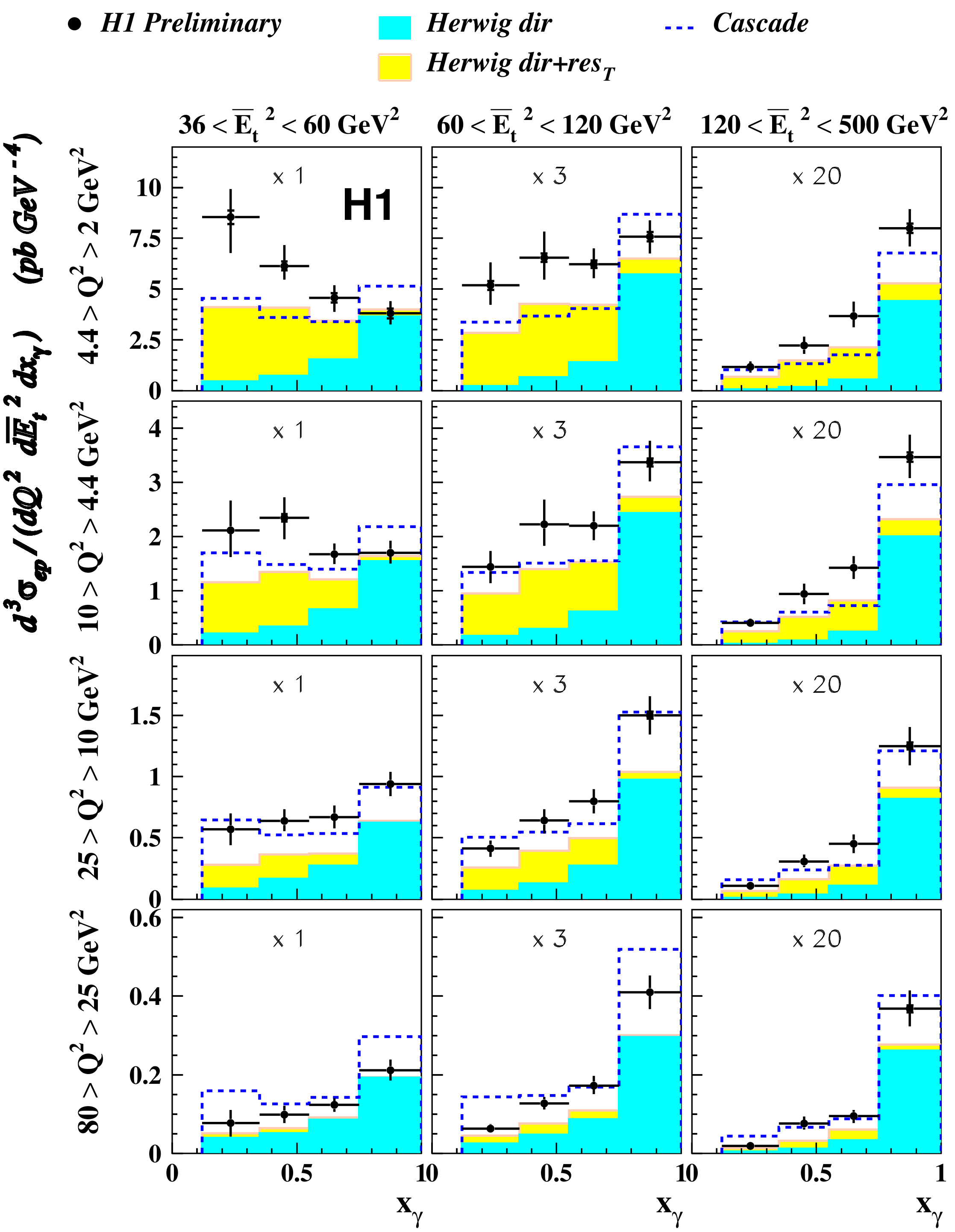
- Different PDFs of γ^*_T do not describe the shape of y.

CCFM Prediction (CASCADE)



- CASCADE MC (with k_T unordered parton evolution and no concept of photon structure) much closer to data than standard DGLAP direct.

CCFM Prediction (CASCADE)



Conclusions

- Di-jet cross-sections $d\sigma/dQ^2 d\overline{E}_t^2 dx_\gamma$ and $d\sigma/dQ^2 dx_\gamma dy$ were measured triple differentially in the region of low Q^2.
- DGLAP - HERWIG and RAPGAP (Direct + Resolved)
  - Data described by the direct interactions only in $Q^2 > E_t^2$ region.
  - In $Q^2 < E_t^2$ range, γ_T^* resolved contributions needed, but not sufficient to describe the data completely in low x_γ region.
  - γ_L^* resolved contribution helps to describe the shape of y and x_γ distributions of di-jet cross-sections.
- CCFM - CASCADE (unordered k_t approach)
  - Similar qualitative description of jet cross-section as direct + resolved in HERWIG and RAPGAP.
  - Q^2 dependence of di-jet cross-sections less well described.
- Work on NLO calculations in progress.

References

Literatur

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