Resolved Photons at HERA and THERA

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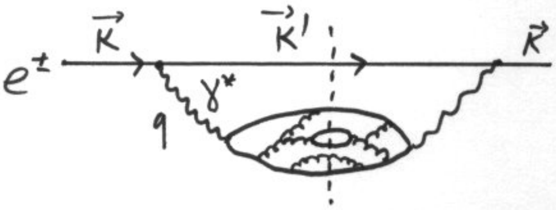
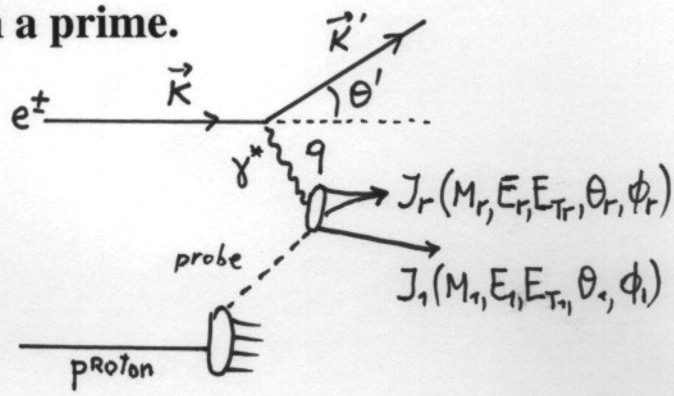
Let consider NC interactions and denote the components of the incoming $e^{\pm}$ and p momenta as follows

$$\mathcal{K} = (\epsilon, 0, 0, -k), \quad \mathcal{P} = (E, 0, 0, p)$$

and mark the scattered particles with a prime.





The transverse size R_T of the virtual photon γ^* is $R_T^{\gamma^*} \sim 1/Q$. To resolve the photon structure one need to hit it with a probe (parton) of the size $R_T^{probe} < R_T^{\gamma^*}$. This means the virtuality of the probe has to be under control and larger as compared to the photon virtuality.

If the photon remnant jet is not detected it is difficult to keep control under the probe virtuality. This explains decrease of the ratio of dijet cross sections (see Fig. 1): as Q^2 increases $R_T^{\gamma^*}$ decreases and become smaller R_T^{probe} (degrades of the probe resolving power).

After a reconstraction of the photon remnant jet and a highest E_T jet the probe virtuality can be calculated as follows

$$P^2 = Q^2 - (M_r^2 + M_1^2 + 2E_rE_1) + 2[E_{T_r}E_{T_1}cos(\phi_r - \phi_1) + E_rE_1cos\theta_r cos\theta_1]$$
$$+ 2|\vec{q}|[(E_{T_r}cos(\phi - \phi_r) + E_{T_1}cos(\phi - \phi_1))sin\theta'$$
$$+ (E_rcos\theta_r + E_1cos\theta_1)cos\theta']$$

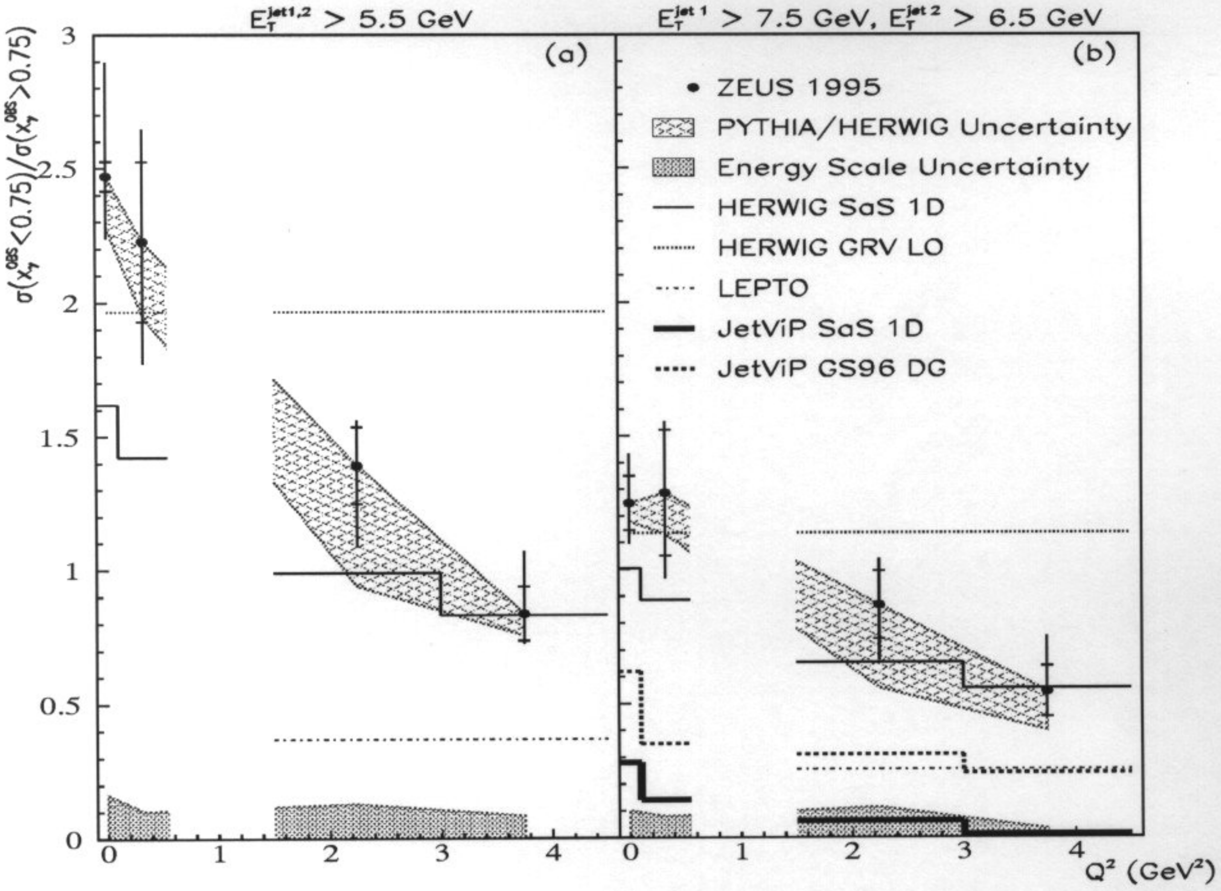


Fig. 1. **The ratio of dijet cross sections $\sigma(x_\gamma^{OBS} < 0.75)/\sigma(x_\gamma^{OBS} > 0.75)$, as a function of photon vituality, Q^2, for dijet events selected with the k_T algorithm (Phys. Lett. B 479(2000)37)**

We have to get an answer to the question: How the THERA kinematics favours the study of the resolved photon structure at $Q^2 < 10\,GeV^2$?

Scattering at small angels (THERA)

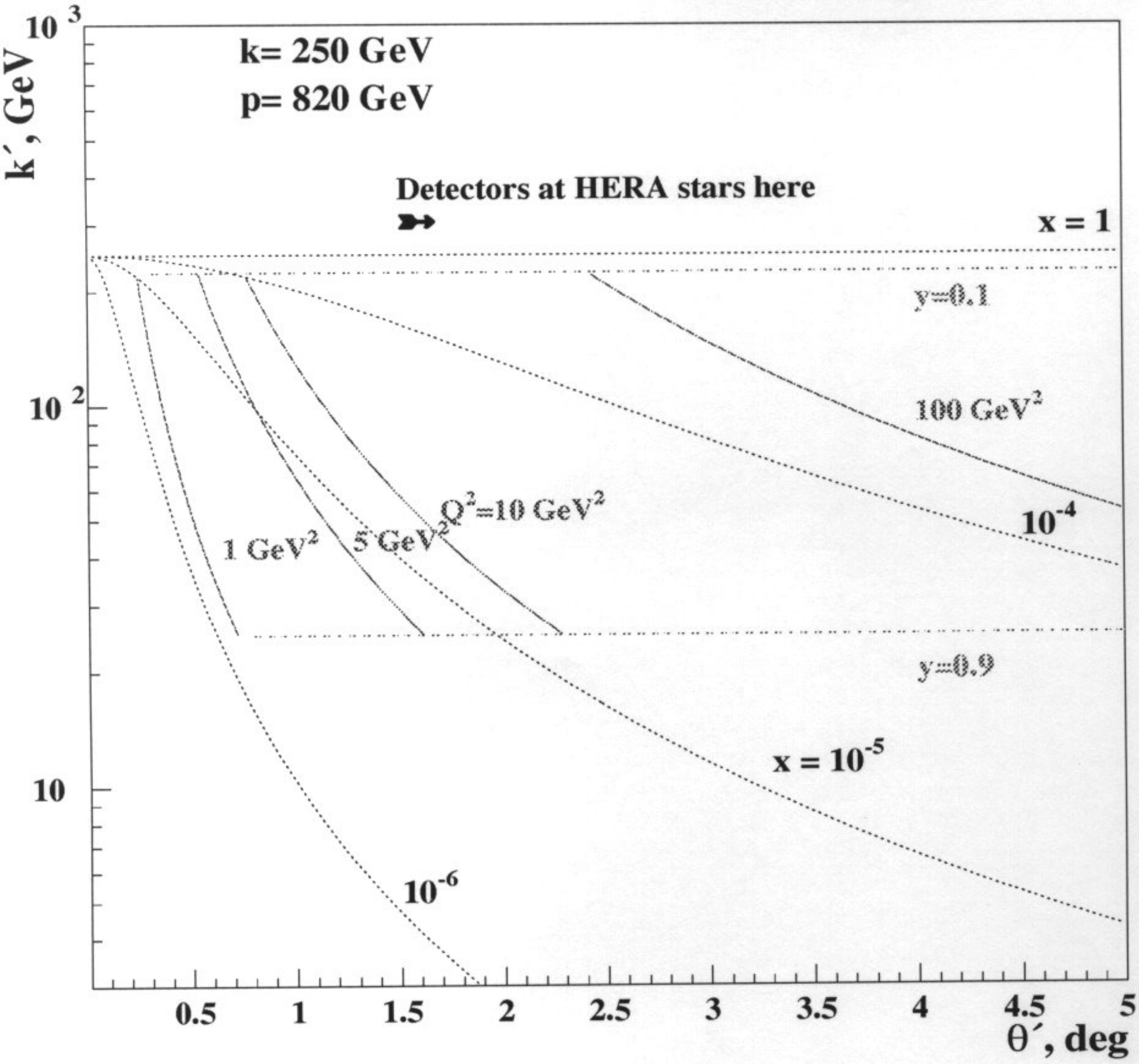


Fig. 2. Iso-lines of kinematic variables x, Q^2, y in the (θ', k') plane. The polar angle θ' of the final $e^{\pm}$ is defined relative to the incoming $e^{\pm}$ direction.

The region $Q^2 \leq 10\ GeV^2$ where cross sections are not small for the study of the virtual photon strucrure at THERA will be shrinked into domain $\theta' < 1.5°$.

Conclusion

- **For study of the virtual photon structure in a soft DIS regime ($Q^2 < 10GeV^2$) the THERA kinematics sets a very challenging task to construct a detector which will be able to reconstruct scattered $e^{\pm}$ and the photon remnant jet in a very backward ($\theta > 179^{\circ}$) direction.**