Event generator for the $p\pi^0$, $n\pi^+$, $K^+\Lambda$, and $K^+\Sigma^0$ electroproduction channels at Q^2 from 5 to 12 GeV^2

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Event Generator for $p\pi^0$, $n\pi^+$, $K^+\Lambda$, $K^+\Sigma^0$ electroproduction channels for Q^2 from 5 to 12 GeV^2

CLAS data provided cross sections for a number of exclusive channels: $p\pi^0$, $n\pi^+$, $K^+\Lambda$, $K^+\Sigma^0$ and others at Q^2 below ≈ 5-6 GeV^2

http://clas.sinp.msu.ru/jlab/

Upgrade of the JLAB accelerator increases the beam energy to 11 GeV and the new CLAS12 detector will allow to extend the kinematic region up to $Q^2 \approx 12$ GeV^2 This region remains unexplored. Evaluation of the CLAS12 detector efficiency requires the creation of the realistic event generator at Q^2 from 5 to 12 GeV^2.

EG is based on the extrapolation of the integrated cross sections from the available CLAS data on exclusive electroproduction channels into the Q^2 range from 5 to 12 GeV^2.

Extrapolation procedure of the fully integrated cross sections.

Contribution from the exclusive channels to inclusive structure functions F_1 and F_2 were evaluated from the integrated cross sections.
In the OPE approximation:

$$\sigma_{ch}=\sigma_{T,ch}+\epsilon\,\sigma_{L,ch},\ \ \sigma_{L,ch}\approx 0.2\,\sigma_{T,ch}$$

$$W_1=\frac{K}{4\pi^2\alpha}\sigma_T,\ W_2=\frac{\sigma_L+\sigma_T}{4\pi^2\alpha}\frac{\left(2\nu M_p-Q^2\right)Q^2}{2M_p\left(Q^2+\nu^2\right)}$$

$$F_{1,channel}=M_p W_1,\ F_{2,channel}=\nu W_2$$

In spirit of the operator product expansion we assumed that

$$F_{1,2}\left(W,Q^2\right)=C_0+\sum_{\tau}C_{\tau}\left(\frac{\Lambda^2_{QCD}}{Q^2}\right)^{\tau/2}$$

Q^2-dependence of $F_{1,ch}$ and $F_{2,ch}$ were fit at each W by

$$F_{1,channel}\left(W,Q^2\right)=\sum_{n=0,1,2}C_n\frac{1}{\left(Q^2\right)^n}$$

In the Q^2 range, where the data are available. Then F_1 and F_2 were extrapolated to higher Q^2.

Extrapolation procedure of the fully integrated cross sections.

The fit of F_1 and F_2 was performed in the Q^2 range, where data are available with the requirement that

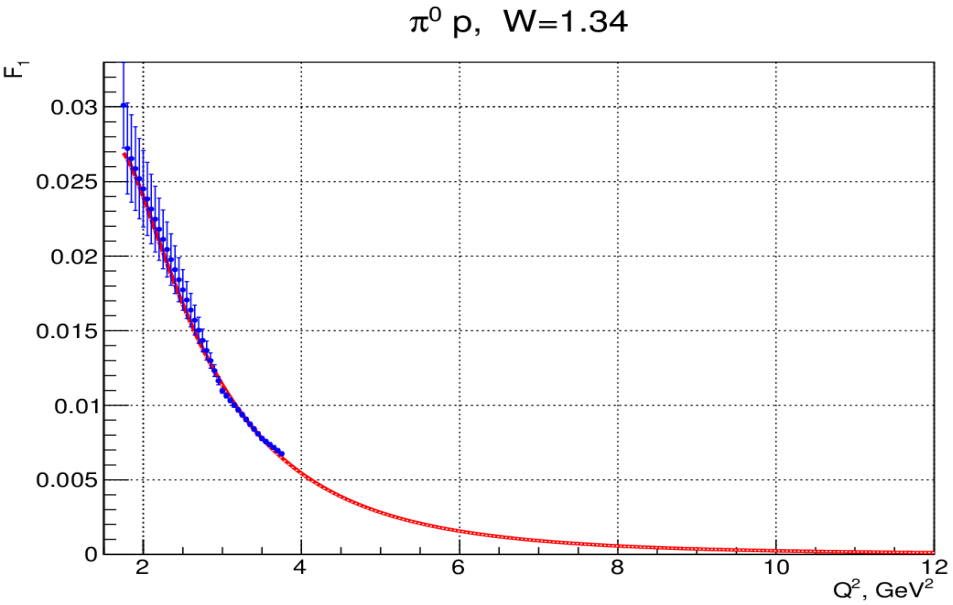
$$0 < (R_{1,2} = F_{1,2,channel}/F_{1,2,inc.}) < 1,$$

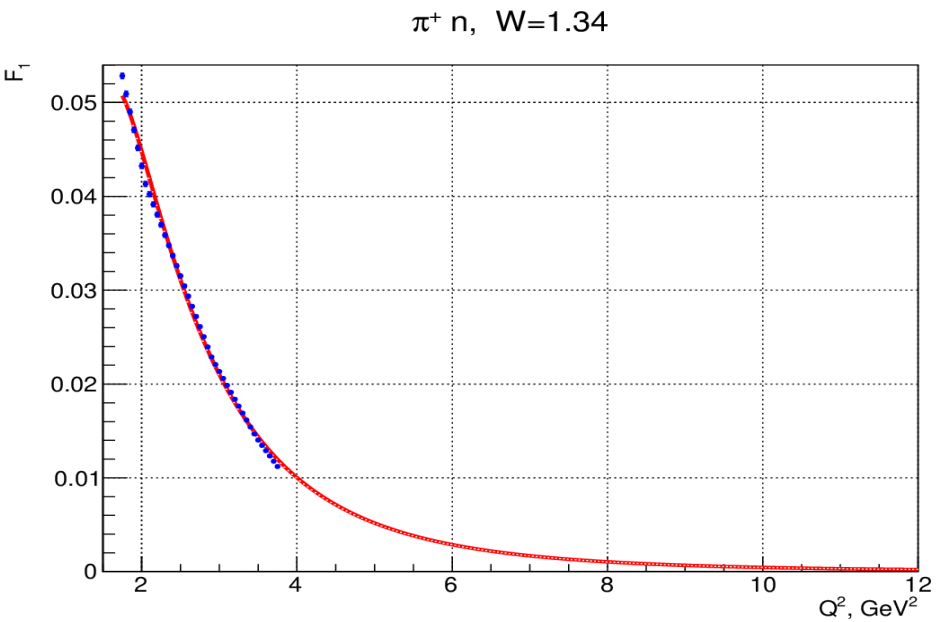
where $F_{inc.}$ is from [*M.E.Christy. P.E. Bosted arXiv:0712.3731*]

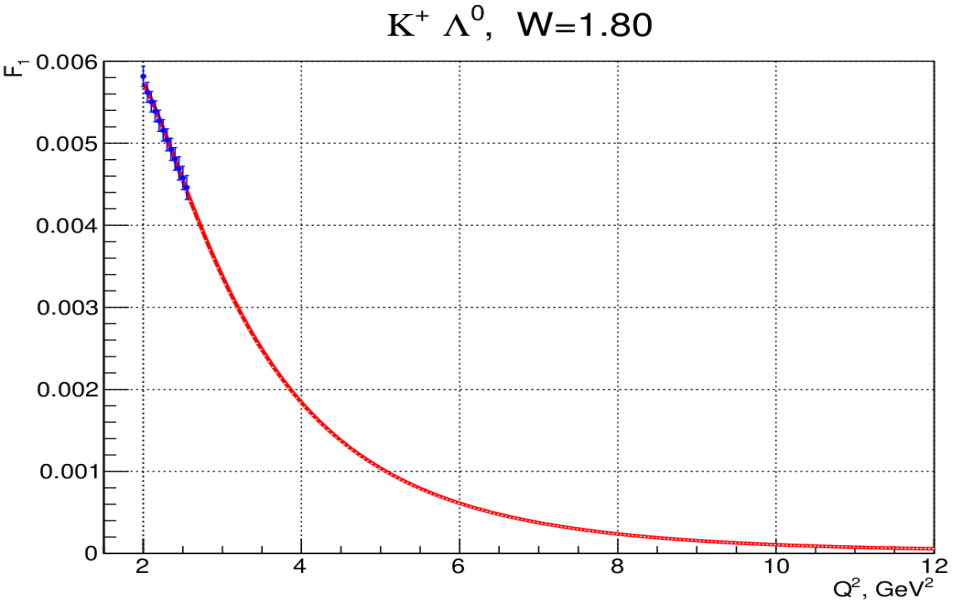
Then F_1 and F_2 were extrapolated into higher Q^2 and the integrated cross sections were calculated from F_1 and F_2.

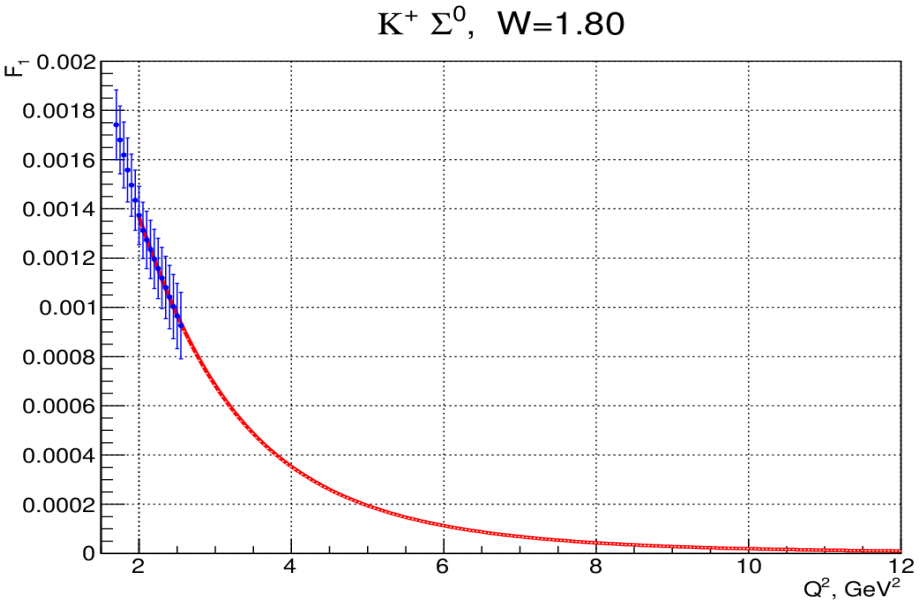
The shape of the extrapolated cross sections was set to be the same as it is in the experimental data at the maximal achievable Q^2.

Fit and Extrapolation of the contribution of the exclusive channels into the structure function F_1

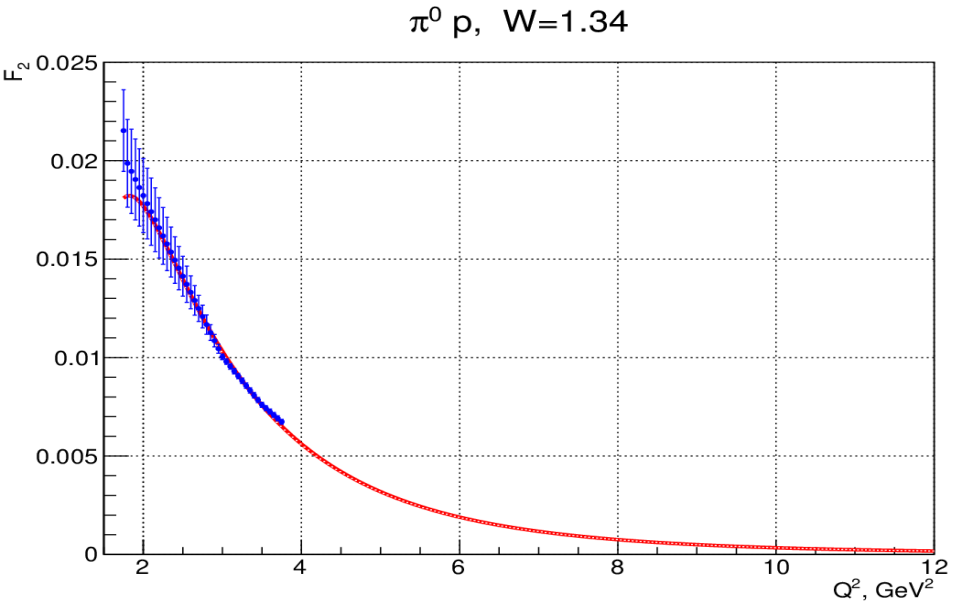


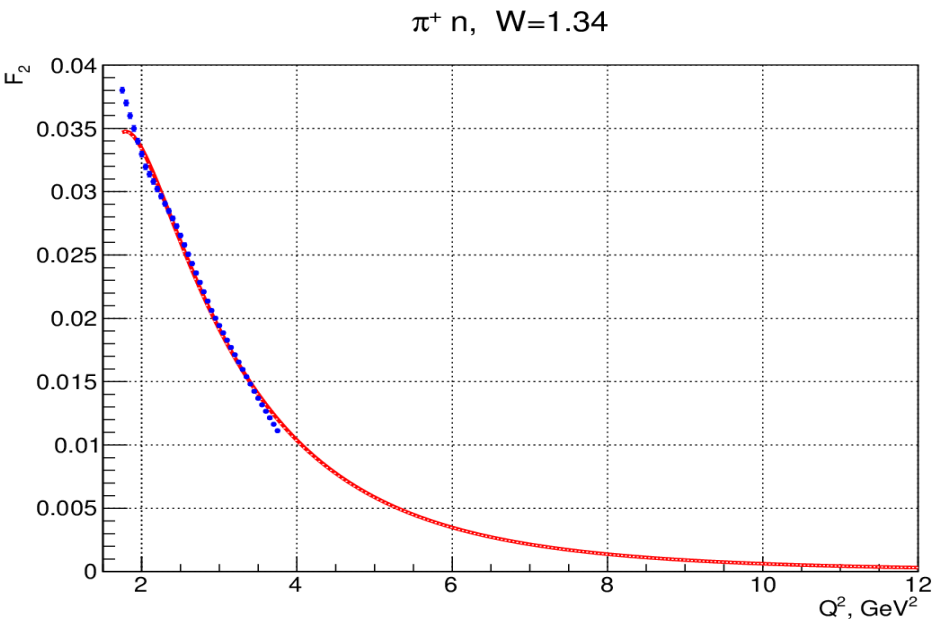


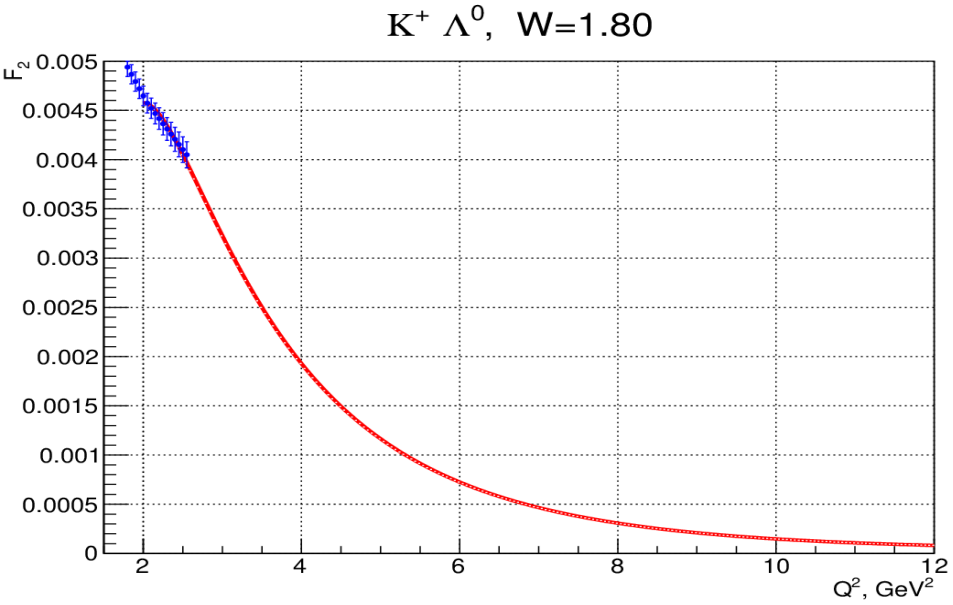


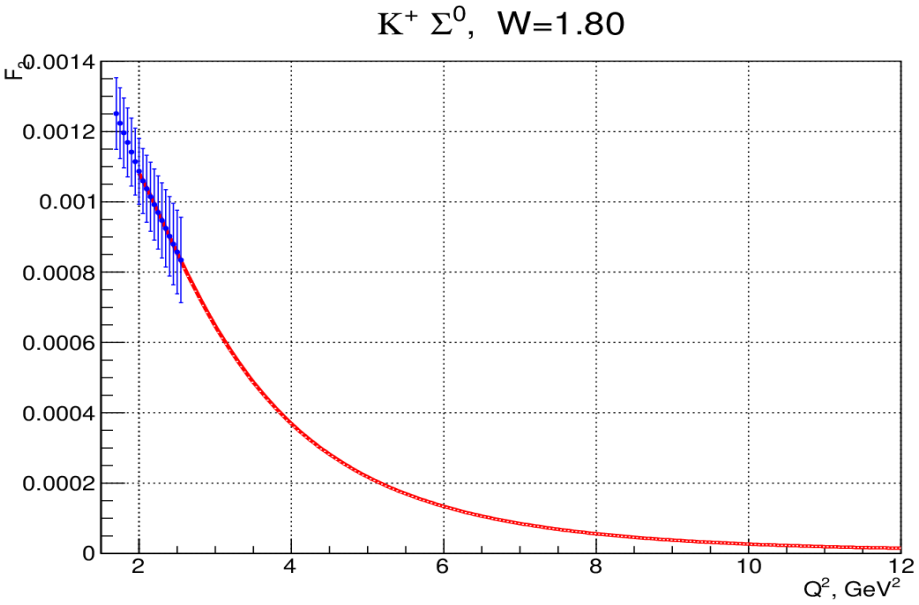


Fit and Extrapolation of the contribution of the exclusive channels into the structure function F_2

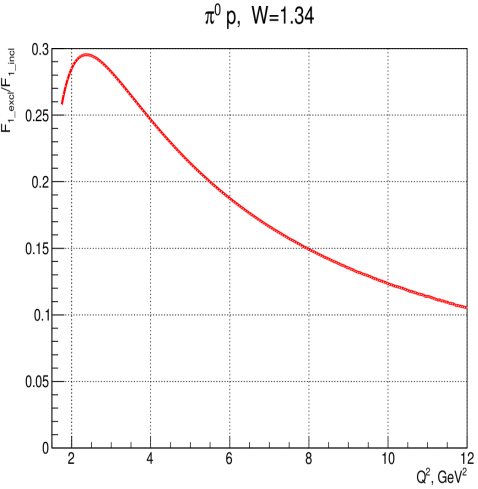


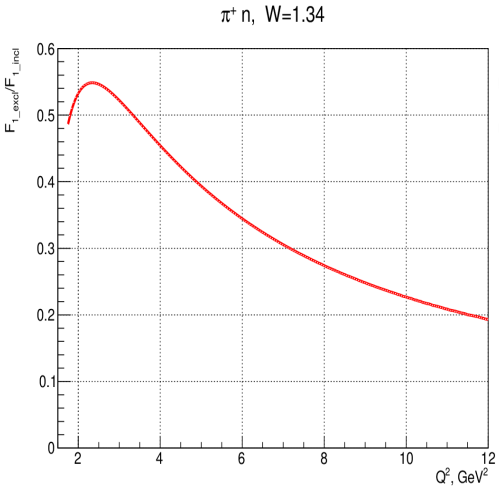


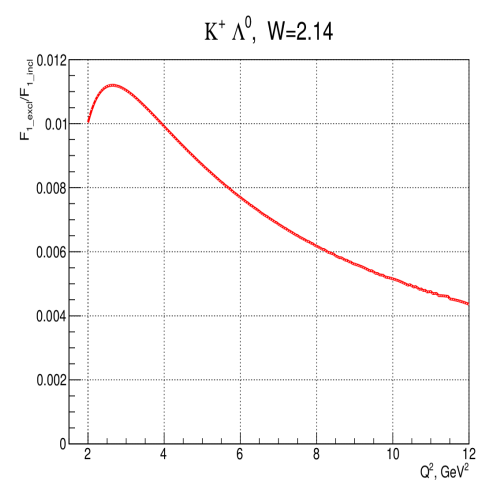


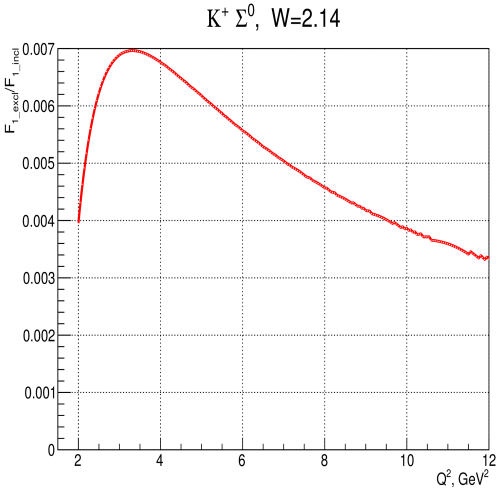


$F_{1,channel}/F_1$

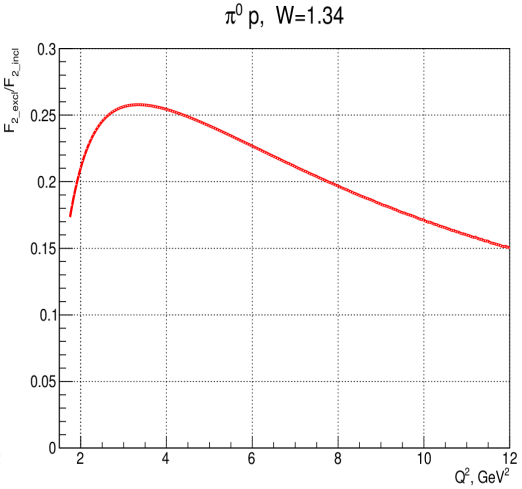


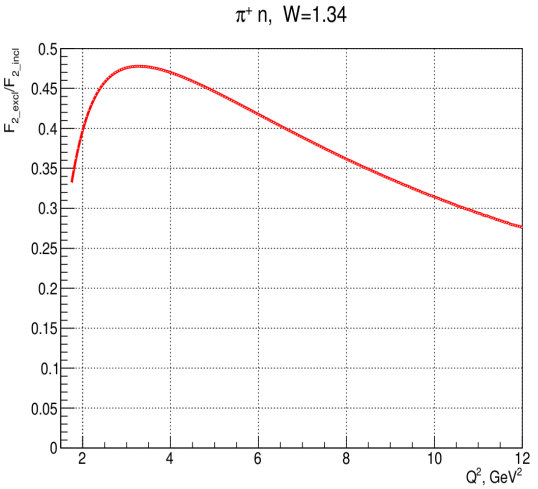


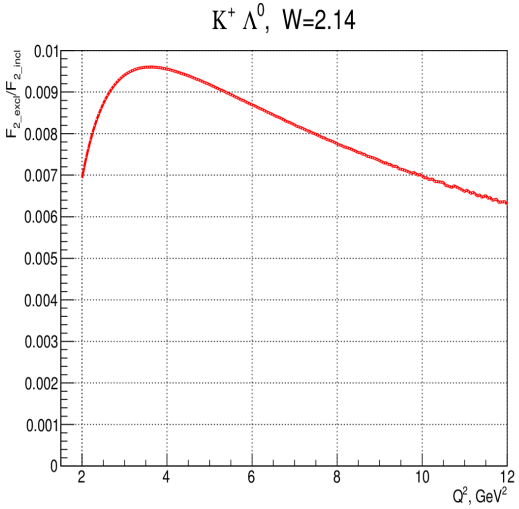


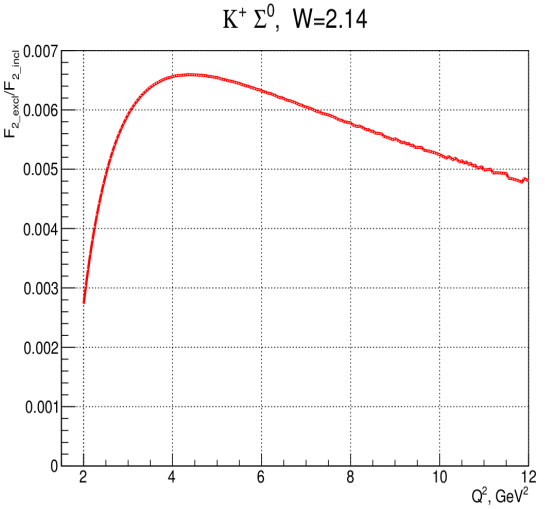


$F_{2,channel}/F_2$

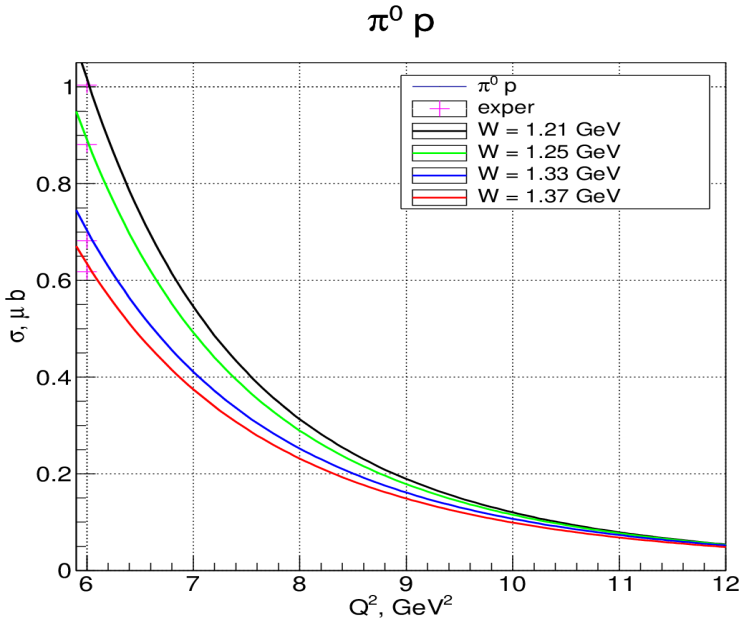


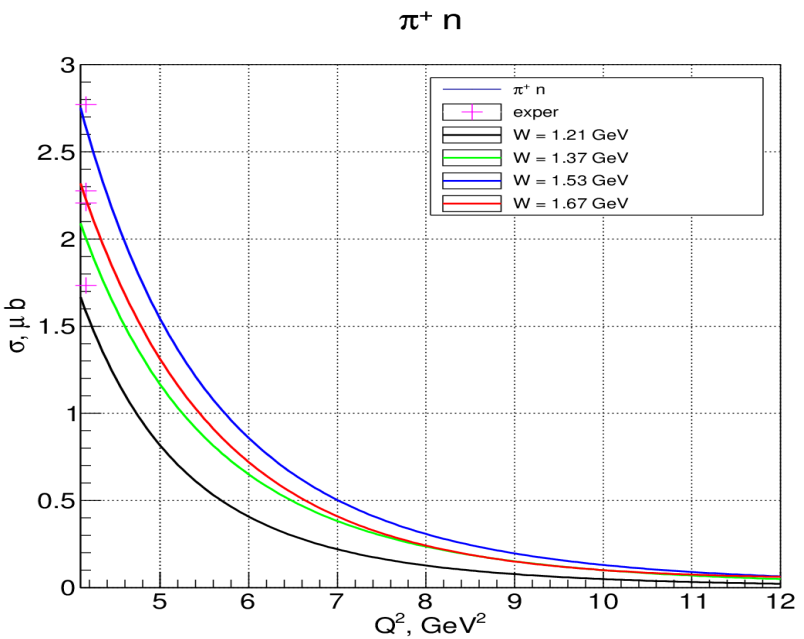


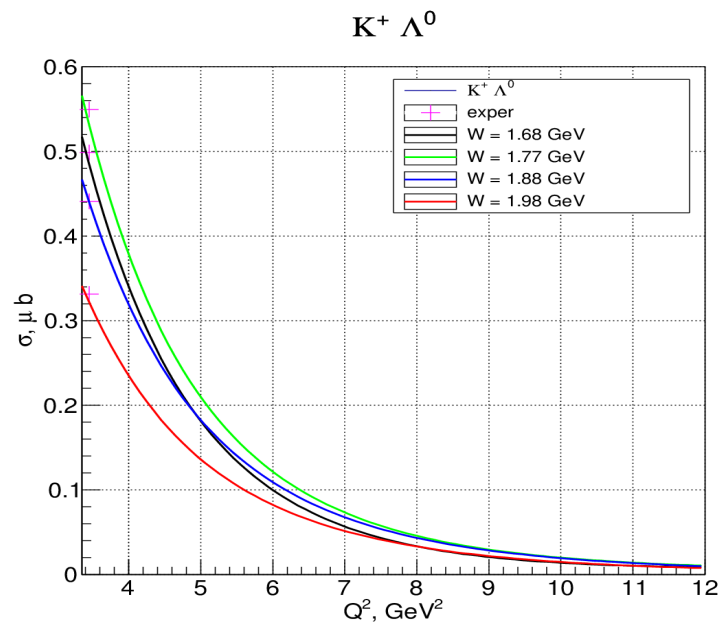


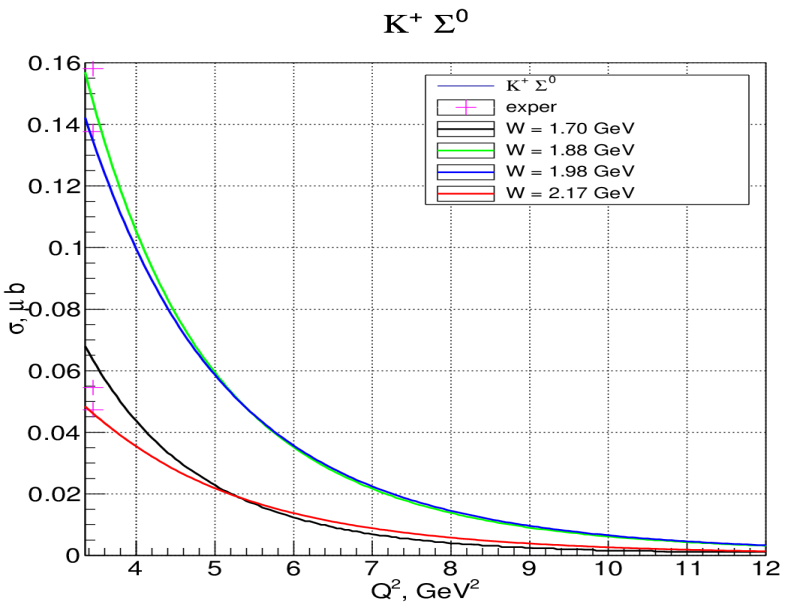


Integrated cross sections extrapolated over Q^2 at different W

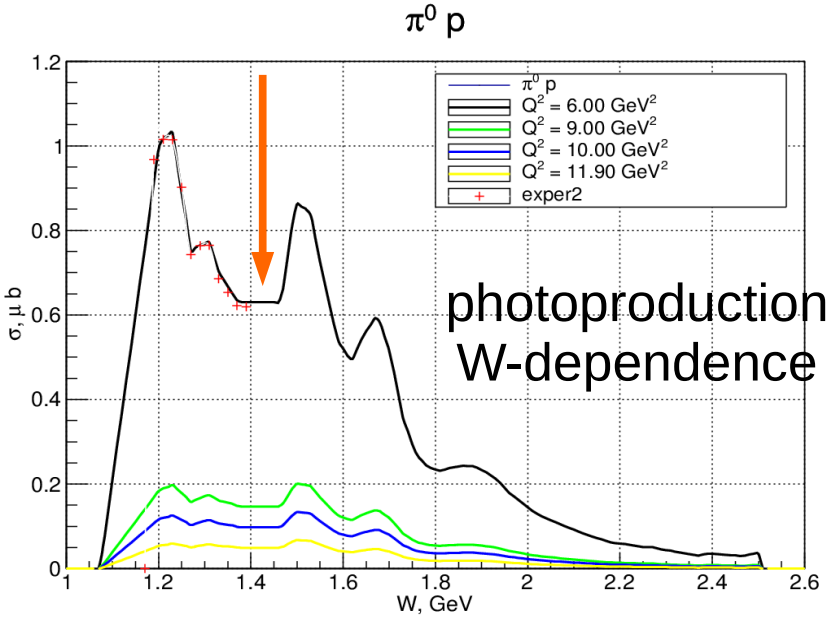




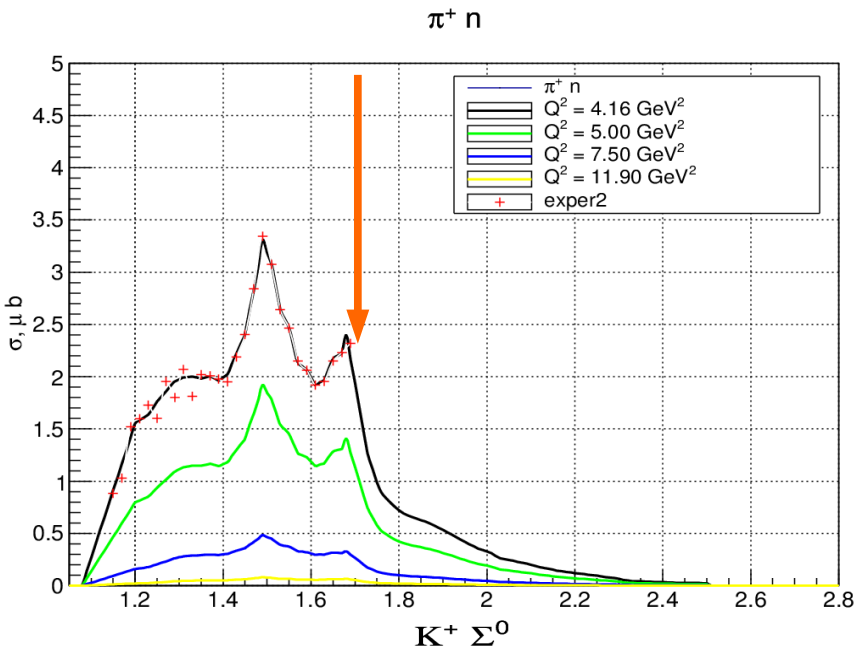


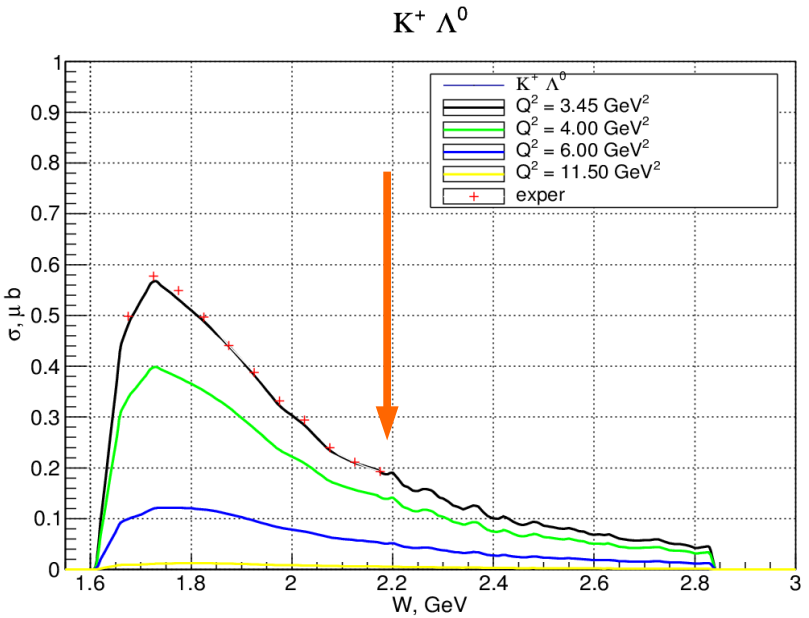


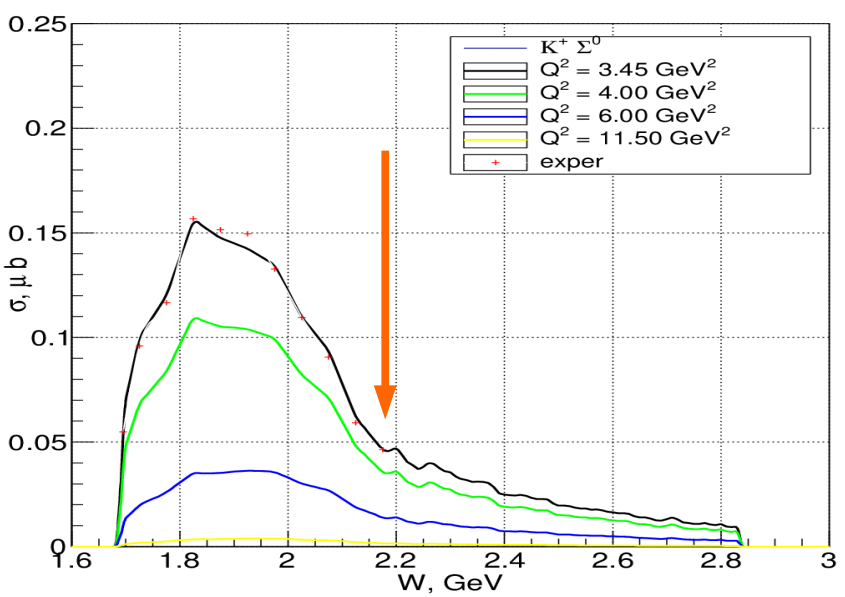
Extrapolation of the cross section into larger W region was done from W-dependence of the photoproduction data



photoproduction W-dependence

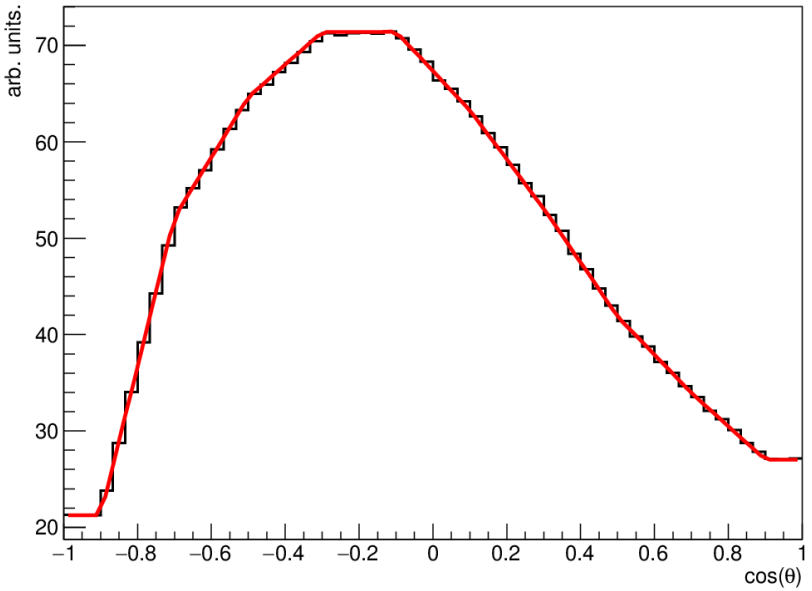




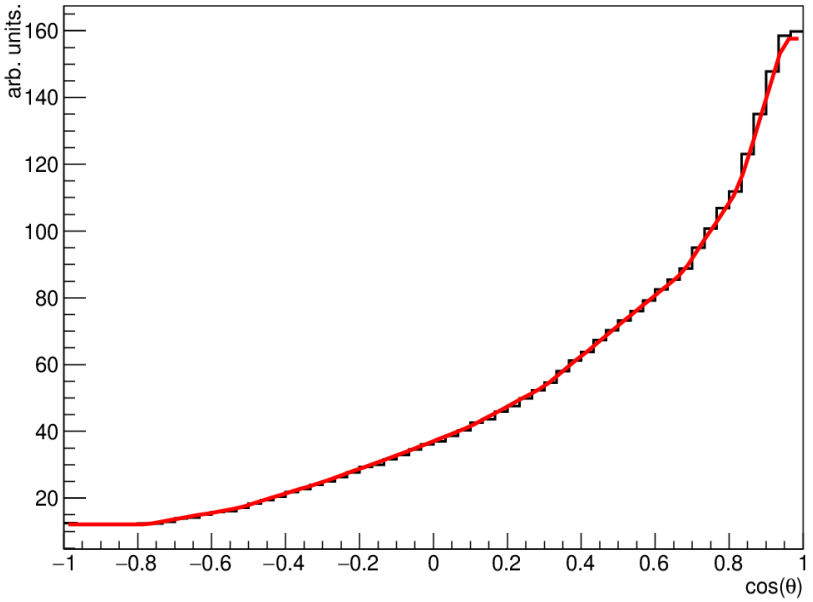


Event Generator

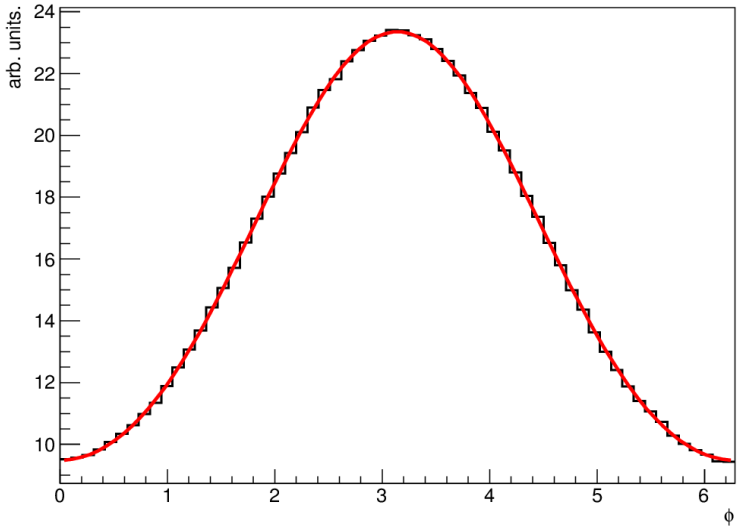
e p → π^+ n, Q^2=5.5, W=1.55



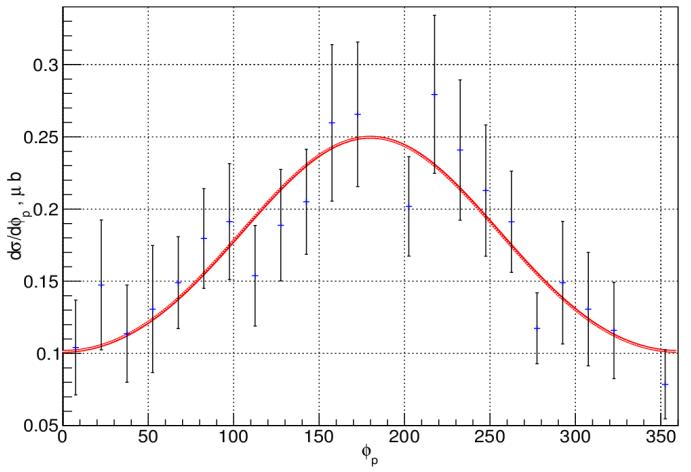
e p → Λ^0 K^+, Q^2=5.5, W=1.82



e p → π^0 n, Q^2=4.16, W=1.27, cos(θ)=0.3



π^0 n Q^2 = 4.16 GeV^2, W = 1.27 , cos = 0.30



$A + B \cos(\varphi) + C \cos(2\varphi)$

Summary

The model to extrapolate the integrated cross section of the exclusive channels: $p\pi^0$, $n\pi^+$, $K^+\Lambda$, and $K^+\Sigma^0$ in kinematics region of $5 < Q^2 < 12$ GeV^2 was developed. It is based on the extrapolation of the contribution of these channels into the structure functions F_1 and F_2. The model extrapolates only the integrated cross section.

EG for the mentioned electroproduction channels was made.
The θ and φ dependencies of the cross section in the extrapolated region are set to be the same as they are in the experimental data at the maximal achievable Q^2.

Extrapolation procedure can be extent to other exclusive channels.