H1prelim-05-031

H1 Search for a Narrow Baryonic Resonance Decaying to $\mathbf{K^0_s p(\bar{p})}$

H1 Collaboration

Abstract

Recently observations of a narrow baryonic state decaying to charged kaons and neutrons or K_s^0 mesons and protons have been reported by several experiments. This resonance could be identified as a candidate for the exotic $\theta^+(1530)$ pentaquark state. The H1 results on the search for the $\theta^+(1530)$ and its antiparticle in the invariant mass combinations of K_s^0 mesons with protons and antiprotons in deep inelastic scattering at HERA are reported.

The analysed data was collected in the years 1996 to 2000 by the H1 detector and corresponds to a luminosity of $75\mathrm{pb}^{-1}$. The kinematic range $Q^2 > 5\mathrm{GeV}^2$ and $0.1 < y < 0.6$ is investigated.
Upper limits at 95% confidence level on the cross section $\sigma(ep \rightarrow e\theta X \rightarrow eK^0p(\bar{p})X)$ are extracted as a function of the invariant K_S^0p mass in bins of Q^2 for a visible range $p_T(K_s^0p) > 0.5\mathrm{GeV}$ and $|\eta(K_S^0p)| < 1.5$ of the pK^0 system.
Over the mass range $1.48 < M < 1.7\mathrm{GeV}$ these upper limits vary between 40 and 120 pb. For comparison with ZEUS upper limits are also extracted for the highest Q^2 bin, $20 < Q^2 < 100\mathrm{GeV}^2$, using a visual dE/dx selection and restricting protons to $p(pr) < 1.5\mathrm{GeV}$. At a mass of M=1.522 GeV an upper limit on the θ^+ production cross section of 90 and 116 pb is observed, assuming a detector resolution of 5 and 8 MeV, respectively. This upper limit is compatible with the observed cross section of $\sigma(ep \rightarrow e\theta^+X \rightarrow eK^0pX) = 125 \pm 27(stat) + 36 - 28(syst.)pb$ at $Q^2 > 20\mathrm{GeV}^2$, $0.04 < y < 0.95$, preliminary result from the ZEUS collaboration.

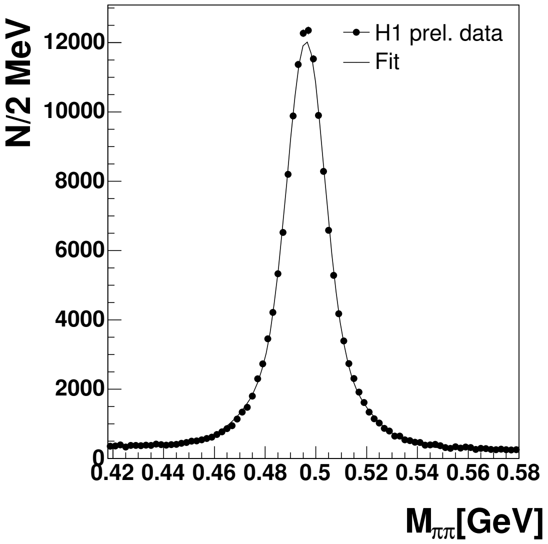

Figure 1: Inclusive K_S^0 signal for $Q^2 > 5\mathrm{GeV}^2$. We observe $142505 \pm 430 K_S^0$ at a mass of $M = 496.08 \pm 0.03$ MeV using a fit of a polynomial describing the background and two gaussians with a width of $\sigma_1 = 7.06 + -0.07$ MeV and $\sigma_2 = 17.47 + -0.02$ MeV, respectively.

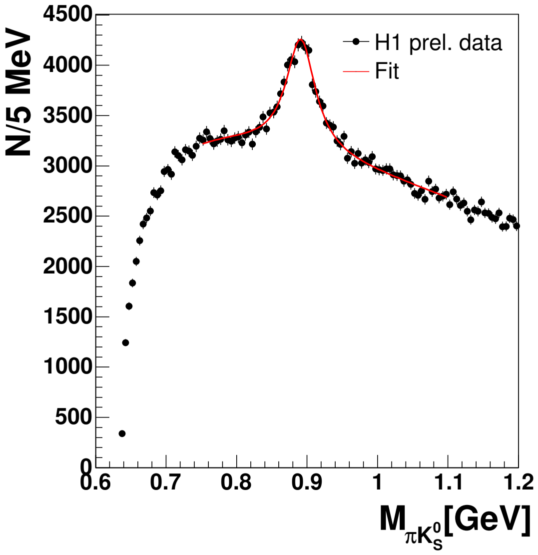

Figure 2: Inclusive K^* signal for $Q^2 > 5\mathrm{GeV}^2$. The signal is fitted by a convolution of a Breit-Wigner function with a fixed natural width of 50.9 MeV and a guassian. We observe 18939 ± 844 K^* at a mass of $M = 0.891 \pm 0.0007$ GeV. The gaussian width of 7.79 ± 2.34 MeV refelects the detector resolution.

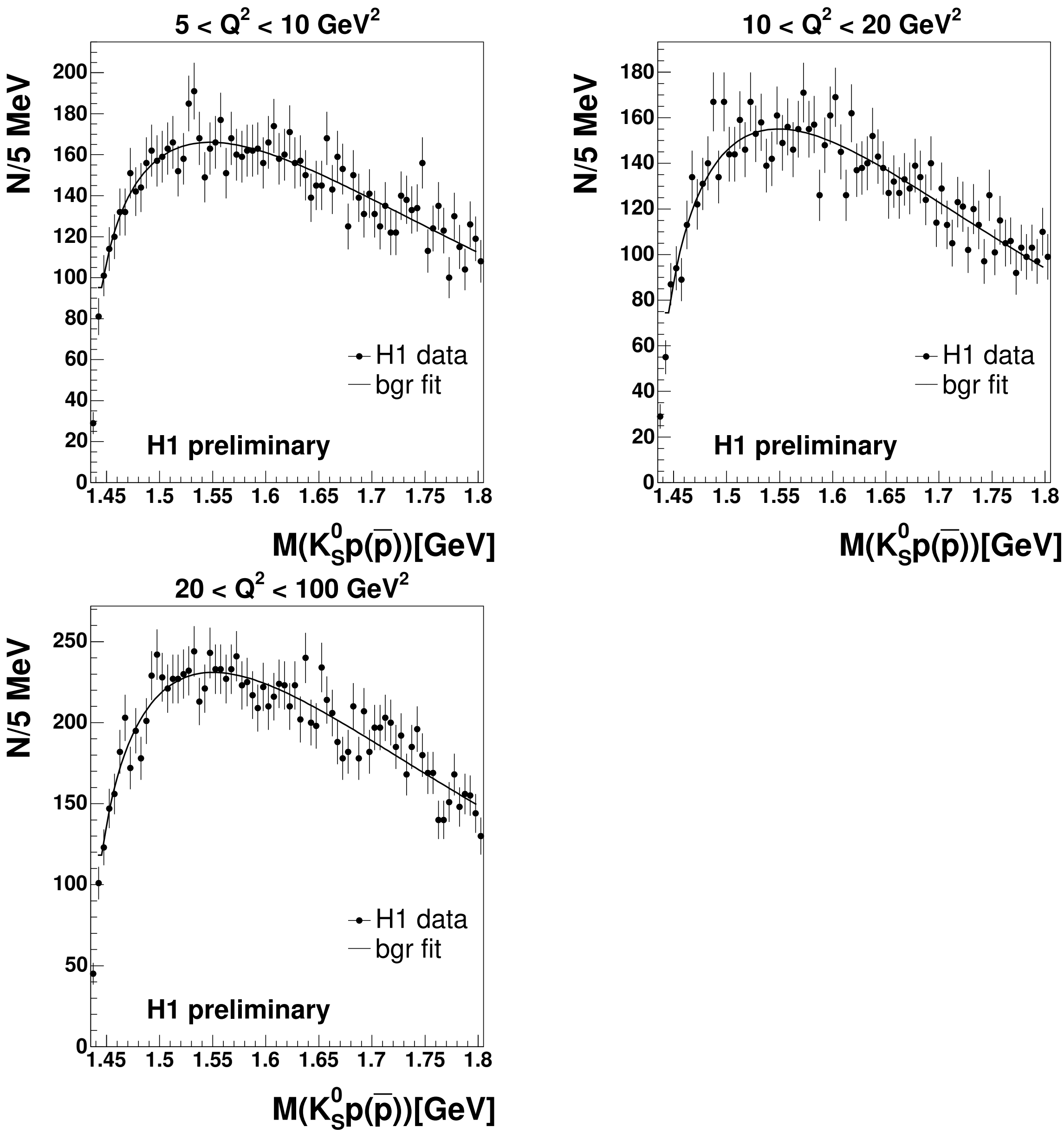

Figure 3: Invariant $K^0_S p(\bar{p})$ mass spectra for the standard H1 dE/dx selection in bins of Q^2, which are used for the limit extraction. The full line shows the result from the fit of a background function to the data. The mass spectra show upward fluctuations at different masses but no significant peak is observed.

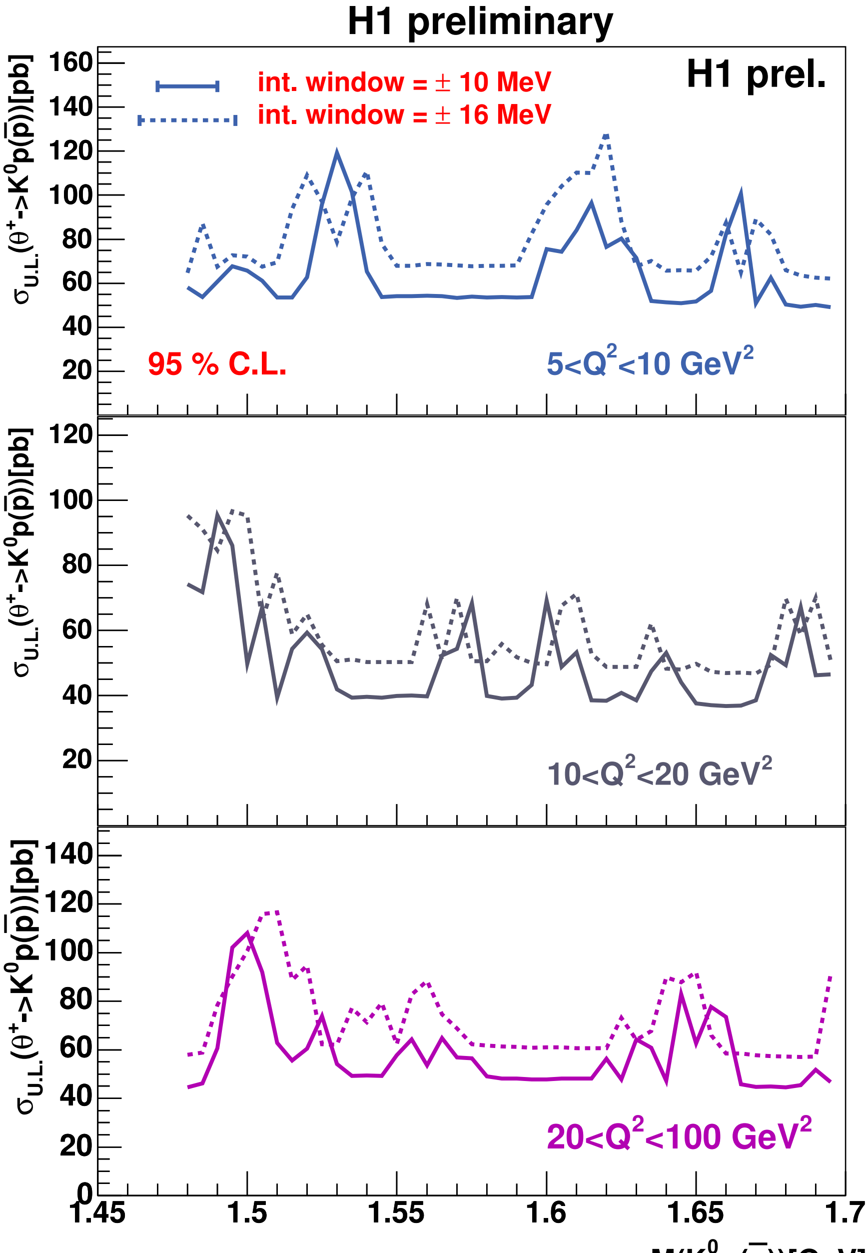

Figure 4: Upper limits on the cross section $\sigma_{U.L.}(ep \to e\theta^+X \to eK^0p(\bar{p})X)$ at 95% confidence level in bins of Q^2 in the visible range $p_T(K_s^0 p) > 0.5$GeV and $|\eta(K_S^0 p)| < 1.5$. The full and dashed line represents the limit assuming a detector resolution of 5 and 8 MeV, respectively.

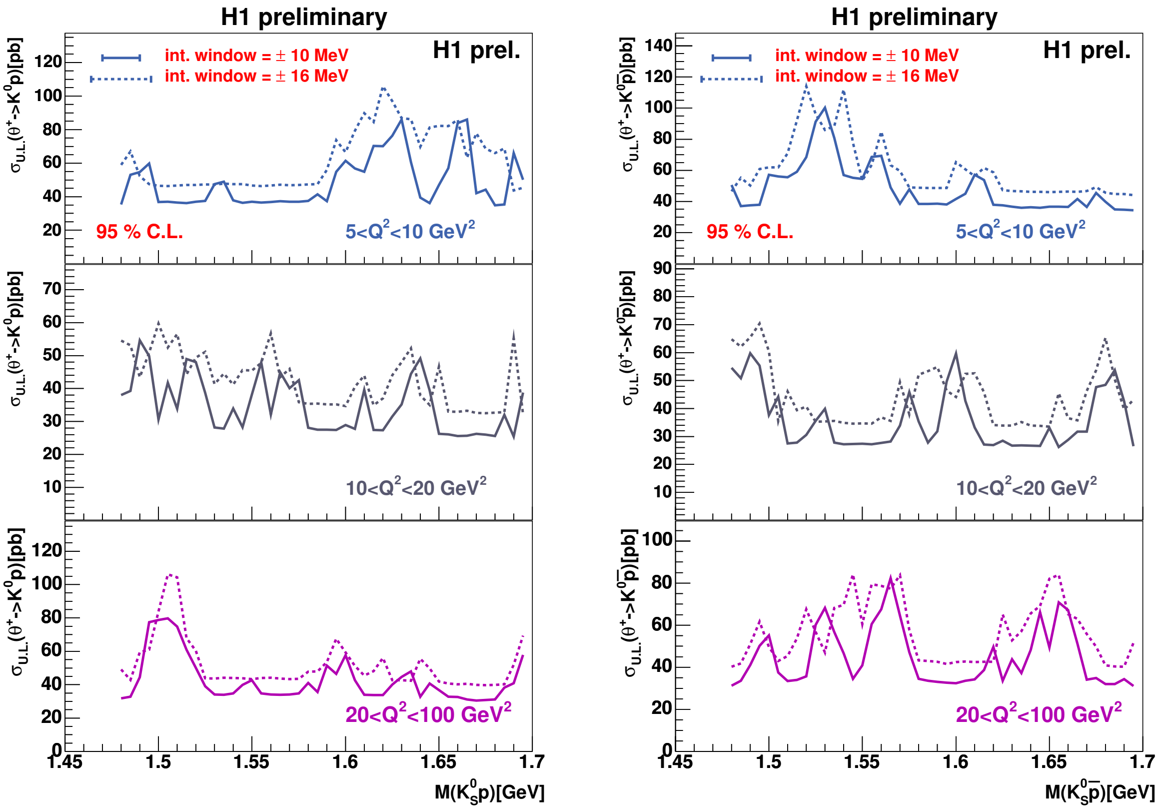

Figure 5: Upper limits on the cross section $\sigma_{U.L.}(ep \to e\theta^+X \to eK^0pX)$ at 95% confidence level in bins of Q^2 for K_s^0p (left) and $K_s^0\bar{p}$ (right) separately.

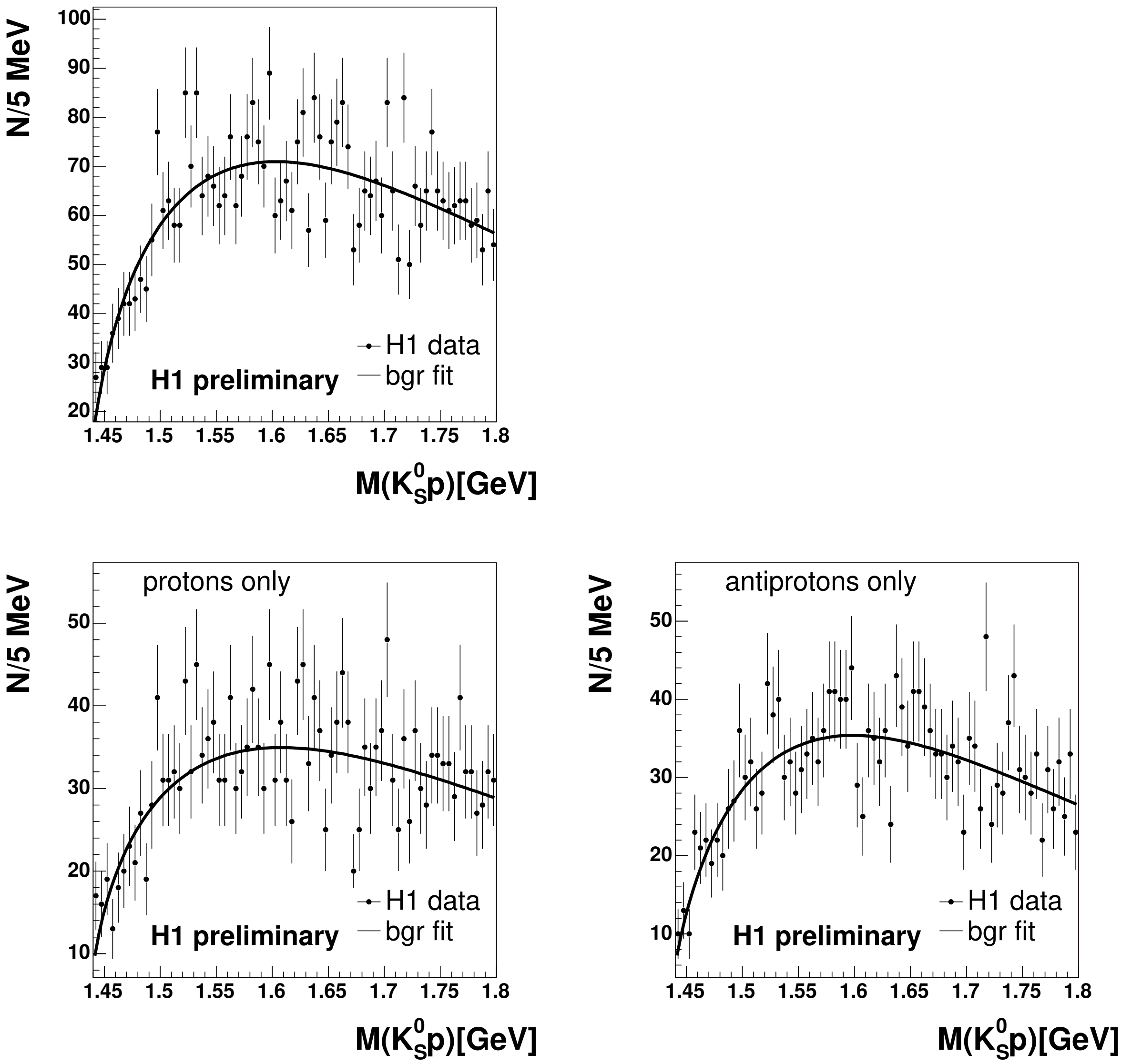

Figure 6: Invariant $K^0_S p$ mass spectra in the highest Q^2 bin, $20 < Q^2 < 100\mathrm{GeV}^2$, for the low momentum dE/dx selection, where instead of likelihoods a visual dE/dx selection and an upper momentum cut $p(pr) < 1.5\mathrm{GeV}$ is applied. The upper left plot shows the invariant mass for $K^0_s p$ and $K^0_s \bar{p}$ combinations, the lower left and right plot the mass spectra for the positive and negative combinations, respectively.

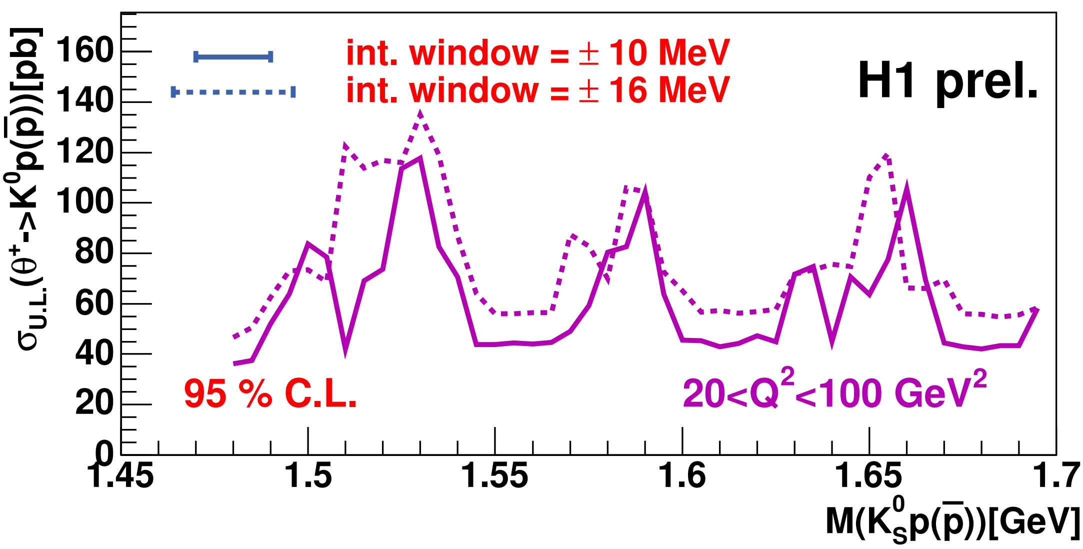

Figure 7: Upper limits on the cross section $\sigma_{U.L.}(ep \rightarrow e\theta^+ X \rightarrow eK^0 p(\bar{p})X)$ at 95% confidence level for $20 < Q^2 < 100 GeV^2$ and the low momentum dE/dx selection.

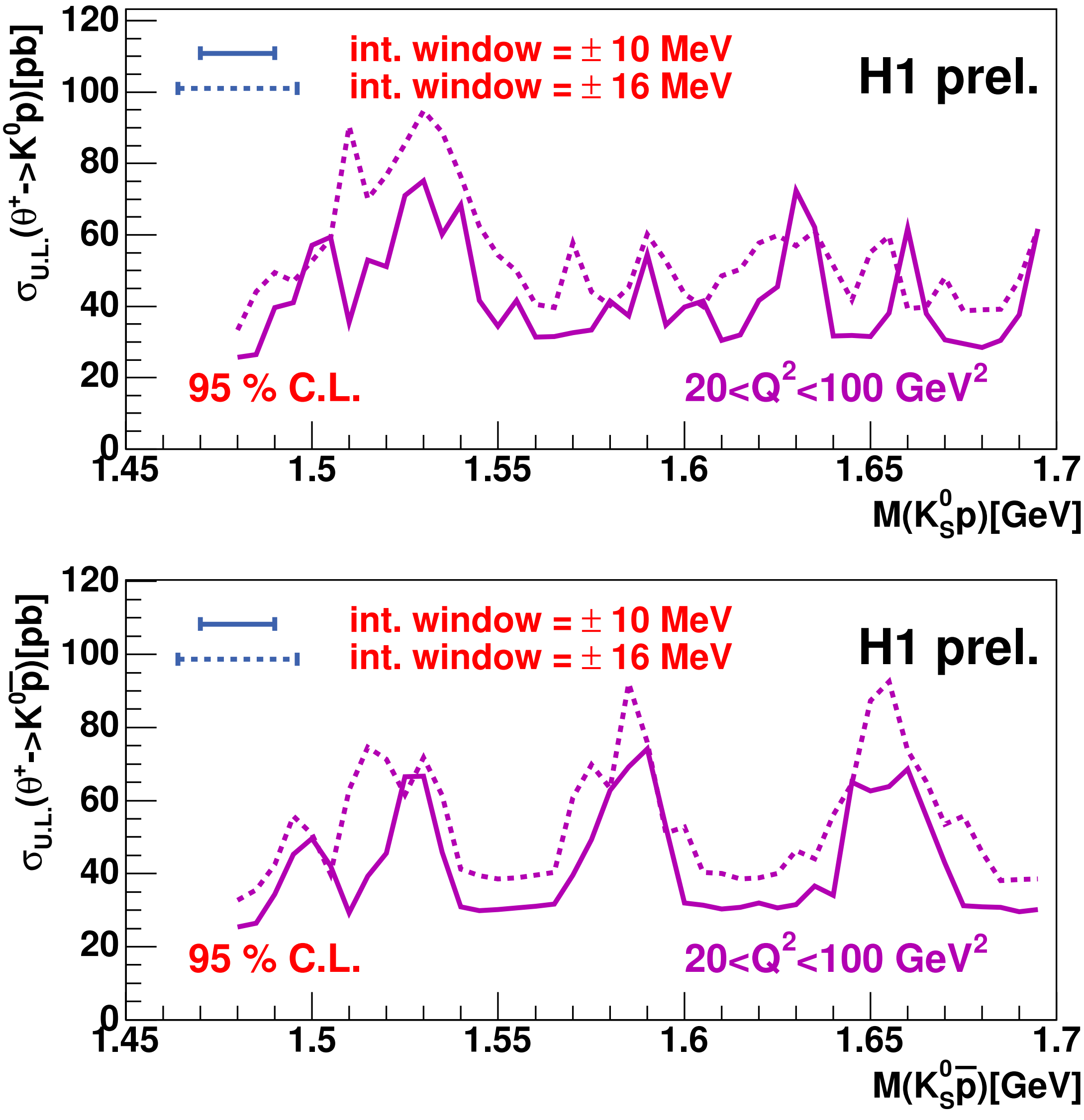

Figure 8: Upper limits on the cross section $\sigma_{U.L.}(ep \rightarrow e\theta^+X \rightarrow eK^0p(\bar{p})X)$ at 95% confidence level for $20 < Q^2 < 100GeV^2$ and the low momentum dE/dx selection for K_s^0p (top) and $K_S^0\bar{p}$ (bottom).