Evidence for an Excited Hyperon $Y^{0*}(1480)$

I.Zychor[a] for the ANKE Collaboration

The reaction $pp \to pK^+Y$ has been studied with the ANKE spectrometer to investigate hyperon production. The final results have been accepted for publication in Phys. Rev. Lett.[1].

The measurements were performed at a proton beam momentum of 3.65 GeV/c incident on a hydrogen cluster–jet target. A final state comprising a proton, a positively charged kaon, a pion of either charge together with an unidentified residue X was investigated in the reaction $pp \to pK^+Y \to pK^+\pi^\pm X^\mp$. As an example, in Fig.1 the missing–mass distribution $MM(pK^+\pi^+)$ vs $MM(pK^+)$ is shown for the reaction channels $pp \to pK^+\pi^+X^-$. The triangular shape of the distributions is due to the combination of kinematics and ANKE acceptance.

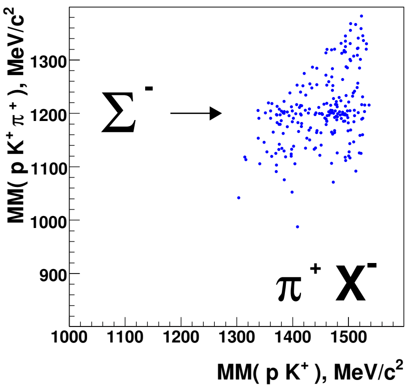

Fig. 1: The missing-mass $MM(pK^+\pi^+)$ vs $MM(pK^+)$ distribution obtained in the reaction 3.65 GeV/c^2 $pp \to pK^+\pi^+X^-$.

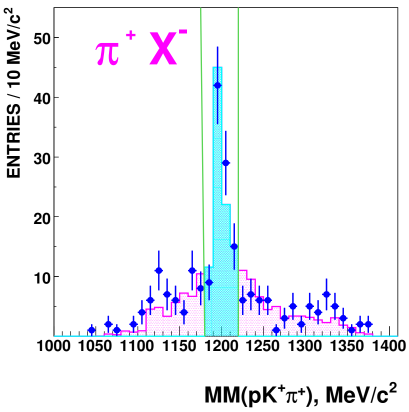

Fig. 2: Projections of Fig.1 onto the three-particle missing mass $MM(pK^+\pi^+)$. Vertical lines show the Σ^- band used for event selection. The results of simulations for $MM(pK^+\pi^+) >$1050 MeV/c^2 are shown as a filled histogram.

A missing–mass $MM(pK^+\pi^+)$ spectrum in the reaction $pp \to pK^+\pi^+X^-$ consists of a flat plateau with a peak at approximately 1195 MeV/c^2, see Fig.2. The peak corresponds to the decay $Y \to \pi^+\Sigma^-(1197)$. In the charge–mirrored $pp \to pK^+\pi^-X^+$ case, the π^- may originate from different sources and the missing–mass distribution for the (π^-X^+)-final state is more complicated.

The missing–mass spectra $MM(pK^+)$ have been analyzed and compared with extensive Monte Carlo simulations.

In the first step we have assumed that measured missing–mass $MM(pK^+)$ spectra can be explained by the production of hyperon resonances and non-resonant contributions. Monte Carlo simulations have been performed including the production of well established excited hyperons ($\Sigma^0(1385), \Lambda(1405)$ and $\Lambda(1520)$) and non-resonant contributions like $pp \to pK^+\pi X$ and $pp \to pK^+\pi\pi X$, X denotes any hyperon which could be produced in the experiment. The comparison of measured and simulated missing–mass distributions shows a necessity to include an additional excited hyperon Y^{0*} with a mass $M(Y^{0*}) = (1480 \pm 15)$ MeV/c^2 and a width $\Gamma(Y^{0*}) = (60 \pm 15)$ MeV/c^2.

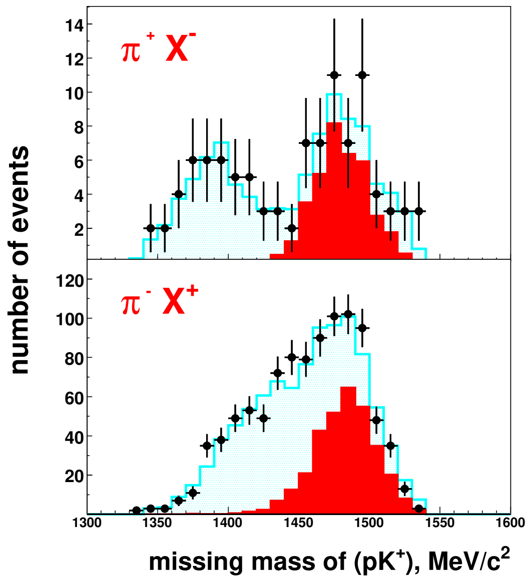

Fig. 3: Missing–mass $MM(pK^+)$ spectra for the reaction $pp \to pK^+\pi^+X^-$(upper) and $pp \to pK^+\pi^-X^+$(lower). Experimental points with statistical errors are compared to the fitted overall Monte Carlo simulations (shaded histogram, blue). The contribution form the Y^{0*} resonance with mass of $M(Y^{0*}) = (1480 \pm 15)$ MeV/c^2 and a width $\Gamma(Y^{0*}) = (60 \pm 15)$ MeV/c^2 is shown as a solid (red) histogram.

In summary, we have found indications in proton–proton collisions at 3.65 GeV/c for a neutral hyperon resonance Y^{0*} decaying into π^+X^- and π^-X^+ final states. Since it is neutral, it can be either a Λ or Σ^0 hyperon. The production cross section is of the order of few hundred nanobarns.

On the basis of available data we cannot decide whether it is a 3–quark baryon or an exotic state. However, it seems to be difficult to validate that a $Y^{0*}(1480)$ hyperon is a 3q–baryon.

References:

[1] I.Zychor et al., Phys. Rev. Lett. **96**, 012002 (2006)

[a]The Andrzej Sołtan Institute for Nuclear Studies,Świerk,Poland