$\Sigma(1480)$ production in 2.83 GeV p+p collisions

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The reaction $pp \to K^+ pY^*$ has been measured at ANKE at a beam energy of 2.83 GeV. At this energy six hyperons can be produced: $\Lambda(1116)$, $\Sigma(1192)$, $\Sigma(1385)$, $\Lambda(1405)$, $\Sigma(1480)$ and $\Lambda(1520)$ with excess energies from 424 MeV down to 20 MeV for $\Lambda(1116)$ and $\Lambda(1520)$, respectively. Some of their properties are listed in Table 1.

Table 1. Properties of strange baryons
Values with errors from Ref. [1].

	mass (MeV/c^2)	FWHM (MeV/c^2)	mean life (s)
$\Lambda(1116)$	1115.683±0.006	$2.501 \cdot 10^{-12}$	$(2.632 \pm 0.020) \cdot 10^{-10}$
$\Sigma(1192)$	1192.642±0.024	0.008895	$(7.4 \pm 0.7) \cdot 10^{-20}$
$\Sigma(1385)$	1383.7±1.0	36±5	$1.828 \cdot 10^{-23}$
$\Lambda(1405)$	1406±4	50±2	$1.316 \cdot 10^{-23}$
$\Sigma(1480)$	1480	45	$1.463 \cdot 10^{-10}$
$\Lambda(1520)$	1519.5±1.0	15.6±1.0	$4.219 \cdot 10^{-23}$

The $\Sigma(1480)$ hyperon is particularly interesting due to the lack of information about it. In the 2002 Review of Particle Physics it is described as a 'bump' with unknown quantum numbers [1].

The $\Sigma(1480)$ hyperon is produced at COSY directly in $pp \to K^+ p\Sigma(1480)$ reactions and the ANKE spectrometer permits the simultaneous observation of different decay modes: $\Sigma(1480) \to \pi^+\Sigma^-$, $\Sigma(1480) \to \pi^-\Sigma^+$, $\Sigma(1480) \to K^- p$. The measurement of pp interactions using a cluster-jet hydrogen target was carried out in spring 2002 [2]. 3-fold $K^+ p\pi^+$ coincidences were selected by three different parts of the ANKE detector system (side, forward and negative) to study the $\Sigma(1480)$ in the first stage of the analysis. The missing mass spectrum for the reaction $pp \to K^+ p\pi^+ M_X$ consists of a flat plateau with a peak at approximately 1195 MeV [2]. The peak corresponds to the decay $\Sigma(1480) \to \pi^+\Sigma^-$. If only events with $M_X = (1195 \pm 20)$ MeV are selected, then the m_x spectrum in the reaction $pp \to K^+ p$ ($m_x = \pi^+ + M_X$) shows two peaks with a width of 45 MeV each (data points in Fig. 1). The background from misidentified particles is $<10\%$.

The first peak corresponds to the contributions of $\Sigma(1385)$ and $\Lambda(1405)$. The second peak can be ascribed to the production of $\Sigma(1480)$ with a contribution from $\Lambda(1520)$.

Monte Carlo simulations have been performed using the GEANT-3 code, including the phase-space event generator GENBOD. To reproduce the experimental missing mass distribution observed in the reaction $pp \to K^+ pY^*$ at $T_p = 2.83$ GeV we have simulated four reactions:

$$pp \to K^+ p\Sigma(1385),$$
$$pp \to K^+ p\Lambda(1405),$$
$$pp \to K^+ p\Sigma(1480),$$
$$pp \to K^+ p\Lambda(1520).$$

In Fig. 1 the solid line is the sum of Monte Carlo simulations for the four above mentioned reactions. The relative contribution from each reaction has been fitted to obtain the best agreement between the simulated and experimental distributions. In Fig. 2 the Monte Carlo simulated missing mass distributions are shown for four strange baryons. The best agreement has been obtained for the $\Sigma(1480)$ mass being equal to 1470 MeV.

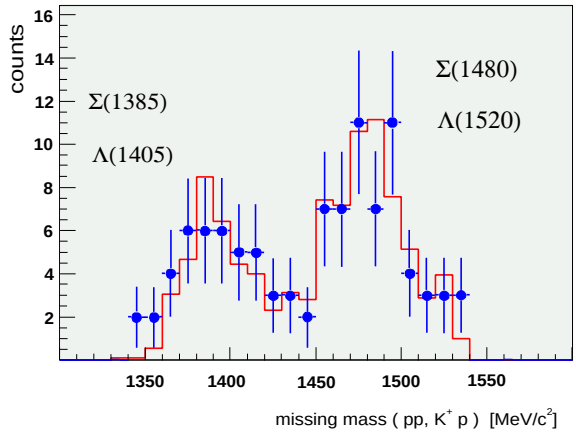

Fig.1. Missing mass spectrum for the reaction $pp \to K^+ pm_X$. The data points are measured at ANKE, the solid line shows Monte Carlo simulations.

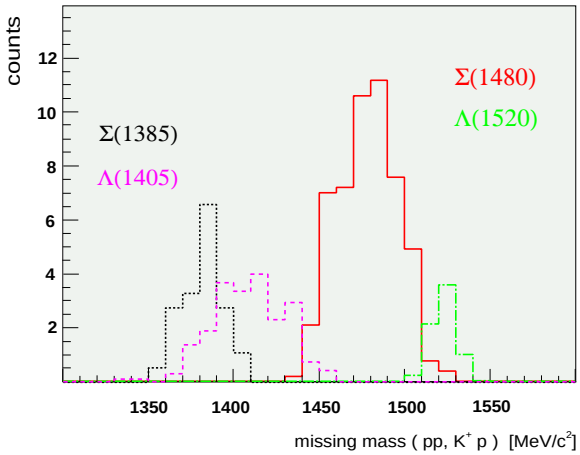

Fig.2. The simulated missing mass distributions for four strange baryons: $\Sigma(1385)$ (dot), $\Lambda(1405)$ (dash), $\Sigma(1480)$ (solid), $\Lambda(1520)$ (dot-dash).

References:

[1] K. Hagiwara et al., Phys. Rev. **D 66**, 010001 (2002)
[2] V.Koptev et al., Annual Report 2002, "Hyperon Production at ANKE"

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