First Measurements on pp → ppK$^+$K$^-$ at Threshold

COSY–11 Collaboration

A study of the reaction pp → ppK$^+$K$^-$ is especially motivated by the discussion on the nature of the scalar mesons f$_0$(975) and a$_0$(980). Existing data lead to differing interpretations: A two–quark two–antiquark state, a simple $s\bar{s}$ structure, and a $K\bar{K}$ molecule structure as well are suggested in case of the f$_0$ [1–6].
With no data being available up to few GeV excess energy, data of high precision and sufficiently large statistics are needed especially in the threshold region.
In addition, threshold experiments generally result in vanishing relative momenta of the reaction products. Thus, final state interaction should be observable for the two–proton, proton–kaon and two–kaon systems in near threshold K$^+$K$^-$ production.
In October 1995 first data on the reaction pp → ppK$^+$K$^-$ have been taken at the COSY–11 installation with beam momenta of 3.305 GeV/c and 3.308 GeV/c (threshold beam momentum p_{beam}^{thresh} = 3.3016 GeV/c), corresponding to excess energies of 1 MeV and 2 MeV, respectively. Using new beam optics (see separate contribution "The COSY–11 Optics" to this report) an estimated luminosity of $\approx 8 \times 10^{29}$cm^{-2}s^{-1} has been reached during these measurements.

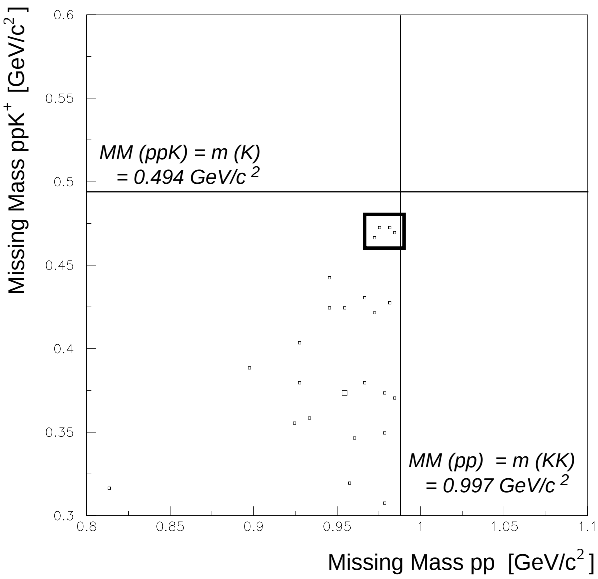

Figure 1: Reconstructed missing mass in the (ppK)–system as a function of the missing mass in the (pp)–system obtained from three track events.

Although the analysis of these data is being continued, first encouraging signals can already be presented.
Besides the reconstruction of the four–momenta of both protons in the exit channel of the pp → ppK$^+$K$^-$ reaction, the COSY–11 detection system allows for a detection of both charged kaons, with reduced acceptance due to the limiting gap of the analyzing COSY dipole (for a general description of the detection system and the experimental technique in more detail see [7, 8]).
Figure 1 shows a preliminary result of a four hour run at 3.308 GeV/c beam momentum out of a total of about 150 hours beam time: Only events with three reconstructed tracks crossing the start and stop scintillators S1 and S3 within wide areas limited by Monte Carlo simulations and corresponding to invariant masses of two protons and one kaon, respectively, are accepted. A group of four events close to the expected missing masses in the two subsystems are chosen to be candidates for a ppK$^+$K$^-$ final state. The reconstructed tracks from one of those four candidates are shown in fig. 2, indicating the corresponding hits in the drift chamber systems D1 and D2 as well as in the scintillation counters S1, S2 and S3.

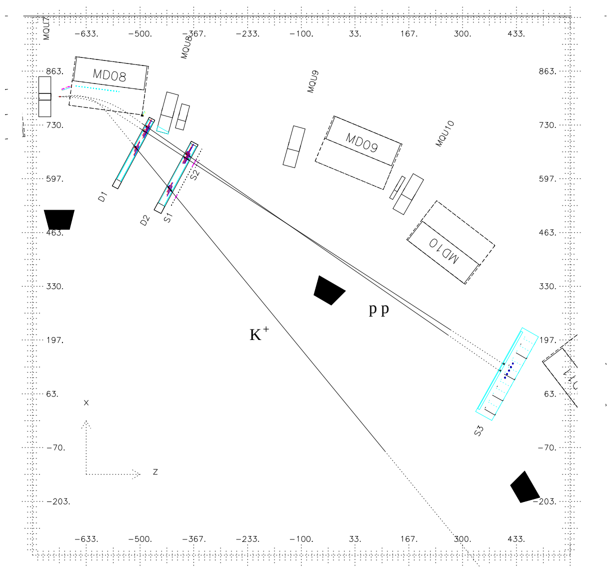

Figure 2: Schematic view of the COSY–11 detection system with reconstructed tracks of two protons and a positively charged kaon.

Further analysis of these data, including the determination of absolute cross section values, will go on in preparation for a second beam time on pp → ppK$^+$K$^-$ planned in early 1996.

References:

[1] R.Jaffe, Phys. Rev. D 15 (1977) 267.
[2] K.Au et al., Phys. Lett. 167 B (1986) 229.
[3] D.Lohse, J.W.Durso, K.Holinde, J.Speth, Phys. Lett. 234 B (1990) 235.
[4] J.Weinstein, N.Isgur, Phys. Rev. D 41 (1990) 2236.
[5] D.Morgan, M.R.Pennington, Phys. Lett. 258 B (1991) 444.
[6] R.J.Apsimon et al., OMEGA Photon Collaboration, CERN–PPE/92–135.
[7] J.Balewski et al., Annual Report IKP–KFA 1994 (1995) 40.
[8] J.Balewski et al., Report KFA–IKP(I)–1995–1.