A Measurement of $\Lambda_c^+$ Baryon Production in Proton-Proton Interactions at $\sqrt{s} = 62$ GeV.

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Summary. — The production of open charm has been studied in proton-proton interactions at $\sqrt{s} = 62$ GeV. We report on the observation of the charmed baryon $\Lambda_c^+$, in coincidence with an electron from the associated anticharm decay, via the reaction $p + p \rightarrow e^- + \Lambda_c^+ + X$, in the kinematical region defined by $|x_F| = 0$ and $p_t > 0.5$ GeV/c for the $e^-$, and $|x_F| > 0.35$ for the $\Lambda_c^+$. The longitudinal and transverse momentum distributions of the $\Lambda_c^+$ have been derived. The cross-section for $D\Lambda_c^+$ associated production has been estimated extrapolating to the full phase space the observed production distributions. The suppression factor with respect to $\Lambda_c^0$ production, at ISR energies, turns out to be about $1/50$ in the high-$|x_F|$ range. The results confirm that the "leading" particle effect dominates baryon production in proton-proton interactions.

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1. - Introduction.

Due to the semi-leptonic decay branching ratio of open heavy-flavoured states, lepton detection in hadronic interactions is particularly suitable to pick out heavy flavours from the bulk of multihadron production. Following this idea, experiment R422 was performed to study heavy-flavour production, charm and beauty, in proton-proton collisions at $\sqrt{s} = 62$ GeV. The detector was the SFM (Split Field Magnet) charged-particle spectrometer of the CERN-ISRF. It was equipped, in the 90° regions with respect to the beam axis, with threshold Cherenkov counters and
electromagnetic shower detectors in order to trigger on single electrons or positrons at relatively high transverse momentum. The trigger lepton was interpreted as a signature from a semi-leptonically decaying heavy-flavoured state. In each triggered event a search was made for the associated heavy-flavoured partner, via an invariant mass study of its predominant hadronic decay modes into charged particles. The results described herein refer to the charm production process:

\[ p + p \rightarrow e^- + \Lambda_c^+ + X, \]

where the \( \Lambda_c^+ \) baryon is identified via its exclusive decay channel:

\[ \Lambda_c^+ \rightarrow p + K^- + \pi^+. \]

These results (already published [1] in a preliminary version), represent an extension of those obtained in our previous R415 experiment [2-5], which was also performed at the ISR but with lower statistics.

2. - Experimental apparatus.

Figure 1 shows the split field magnet detector (SFM) of the ISR, with all its auxiliary devices. The main detector components were the following:

i) A system of multiwire proportional chambers (MWPC), surrounding the interaction region with almost 4\( \pi \) coverage [6]. This system allowed track reconstruction in the magnetic field over \( \sim 95\% \) of the solid angle, and momentum analysis with \( \Delta p/p \lesssim 30\% \) resolution for \( \sim 75\% \) of the outgoing charged particles.

ii) Two small wire chambers with analog read-out [7] (DE/DX), named 109, 209 in fig. 1, placed very close to the beam pipe, and whose acceptance entirely covered the single electron trigger region. Each chamber was made of four planes of wires. The DE/DX chambers have been used in the data analysis as an essential tool to detect and reject uninteresting narrow e\(^+\)e\(^-\) pairs mainly coming from neutral hadron decay and photon conversion.

iii) A system of scintillation counters [8] (TOF in fig. 1), used for time-of-flight measurement, and hence for particle identification purposes. Its small solid-angle coverage, despite the large counter system surface, limited the p/K/\( \pi \) identification power to \( \sim 10\% \) of the charged hadrons produced below about 1 GeV/c momentum.

iv) Six threshold Cherenkov counters [9] \((C_0, C_1, C_2, C_3, C_4, C_5)\), each subdivided into four cells viewed by photomultipliers, used for electron/hadron separation. Their geometrical configuration (fig. 1) roughly defined two cones at 90\( ^\circ \) with respect to the beam axis \((y\text{-axis})\), both pointing at the interaction region and both aligned, in opposite directions, along the ISR radius \((x\text{-axis})\). Within each cone, the sensitive area of a double Cherenkov coincidence \((C_0 \cdot (C_3 + C_4), C_1 \cdot (C_2 + C_5))\) covered the electron trigger region defined by the electromagnetic calorimeters, as described below.

v) Two electromagnetic shower detectors (SW, LST), whose request of a minimum energy deposit guaranteed an adequate rejection power of the electron trigger against the charged-hadron contamination. Two different techniques were used for the electromagnetic calorimetry: in the \( x > 0 \) hemisphere (which will be identified from now on as the \( \beta^- \) side of the detector, where \( \beta^- \) indicates a direction opposite to the pp centre-of-mass motion), a system of two lead-scintillator [10]...