Search for Short-Lived Particles Produced by 300 and 400 GeV/c Protons in Nuclear Emulsions.

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At present, there is a considerable experimental effort on the search of charmed particles, which should have masses around 2 GeV, lifetimes of the order of 10^{-13} s and should be produced in pairs in hadron-hadron collisions ([1]). The interest on charmed particles was awakened first by the discovery of weak neutral currents and of the J/ψ particles. Indications and/or evidence for the existence of charmed particles came from several experiments ([2-9]).

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The short lifetimes involved in the decays of charmed particles make their direct observation (direct in the sense of separating production and decay vertices) possible only in nuclear emulsions. A charm event candidate would have two particles (charged or neutral) decaying into two or more particles, the decay vertices being connected to the primary production vertex.

This paper describes a search for the associated production of charmed particles in the interactions of 300 and 400 GeV/c protons with emulsion nuclei. We have chosen rather high momenta in order to be well above any possible threshold and to have higher production cross-sections.

Two stacks of Ilford G5 emulsions have been exposed to protons of 300 and 400 GeV/c, respectively, at the Fermilab accelerator. The first stack made of 80 plates, each 600 μm thick and (10×10) cm^2 in area, received about 10^5 protons per cm^2. The second stack, made of 80 plates each 600 μm thick and (5×10) cm^2 in area, received about 3×10^4 protons per cm^2. The development of the emulsions was performed at CERN.

Using standard microscopes, with $10\times$ wide field oc, $22\times$ ob, we performed an area scan for primary proton interactions in a band perpendicular to the beam direction, covering on each plate an area of (2×8) cm^2 at 300 GeV/c and (0.5×6) cm^2 at 400 GeV/c. The scanning area was chosen at the entrance of the beam in order to minimize the number of secondary interactions. We have scanned a total of 56 plates.

Once an interaction was found, it was carefully looked for decays of neutral and charged particles coming from the interaction point. The decays were looked for in an area which extended 300 μm around the primary vertex and 600 μm downstream of it.

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