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PRELIMINARY RESULTS OF THE MEASUREMENT OF THE (π^+, ^4He) INTERACTION AT 115 AND 150 MeV

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Recently some experiments have been performed to study the $\pi^\pm$ scattering on ^4He[1]. In particular a group of JINR[2] studies with a high pressure streamer chamber spectrometer, the π^- mesons interaction on helium at 60, 100 and 140 MeV with pions of both signs. A comparison between these two charge simmetric processes, can yield informations about the electromagnetic structure of the pion. On the other hand, the experiments performed at CERN with a double achromatic spectrometer[3] analyze the elastic scattering of only negative pions in the 3 - 3 π-nucleon resonance energy region.

The preliminary CERN results show that the general features of (π^-, ^4He) elastic scattering drastically differ from those of (π^-, ^{12}C) and that the 150 MeV data agree very well with the diffusion cloud chamber results of Budagov et al. [4]. The diffusion chamber method, as known, allows also to study all the pion absorption processes in ^4He and gives more complete informations on nuclear effects than other techniques.

Therefore we have studied with a diffusion chamber the π^+ absorption cross section on ^4He in the 90-180 MeV pion energy range. It is interesting to compare our π^+ results with the π^- data obtained by other authors at the same energy.

Our diffusion cloud chamber (38 cm diameter), filled with helium at 15 atm in magnetic field of 5 kG, has been exposed to the positive pion beam[5] of the LEALE Laboratory of Frascati[6]. The Fig. 1 shows an outline of the experimental set up. The e^- beam of the Frascati LINAC impinges upon a tungsten target (the "radiator") giving rise to a Bremsstrahlung γ beam. The γ beam, in turn, hits a graphite target (the "pion source") and photoproduces positive and negative pions.

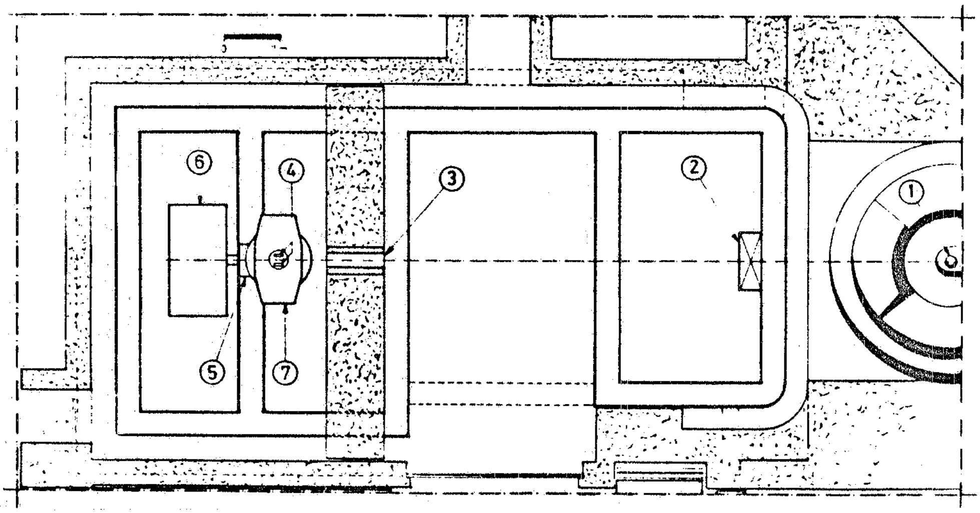

Fig. 1. Layout of the experimental apparatus, (1) - Focus of the analyzing magnet; (2) - quadrupole lens; (3) - collimator (15x2) cm^2; (4) - cameras; (5) - flash unit; (6) - refrigerator; (7) - magnet and diffusion cloud chamber.

The radiator and the pion source are 36.5 cm afar: in between a bending magnet with a 6 cm gap, maximum field 12 kG and shorted fringing field, sweeps downward the primary e^- beam so that it cannot reach the pion source.

The tungsten radiators installed presently have various thicknesses ranging from 0.025 to 0.25 r.l. and are mounted in a remote controlled mechanism: this allows to change the pion beam intensity, by simply changing the radiator, without affecting the LINAC operating conditions. The pion beam is accepted at 90^o with respect to the γ beam by an analyzing magnet which selects pion's momenta and is focused by a large magnetic quadrupole lens. The distance between the pion source and the diffusion chamber is 14 m. To determine the contamination of μ^+ mesons and positrons in the beam, and also to monitor the energy, range-energy curves in iron were measured using a scintillation counter telescope. The average energy of the beam agreed with good accuracy with the central energy accepted by the analyzing magnet. To measure the beam contamination, a 30 cm lucite Cerenkov counter has also been used, in coincidence with the scintillation counter telescope. The results obtained with the two methods were in agreement within the experimental uncertainties. The total contamination of μ^+ and positrons in the beam amounted to (12 ± 2) %. About 10^5 photographs, with an average number of $8\pi^+$ per picture, have been taken. In Fig. 2 the pion energy distributions, in the

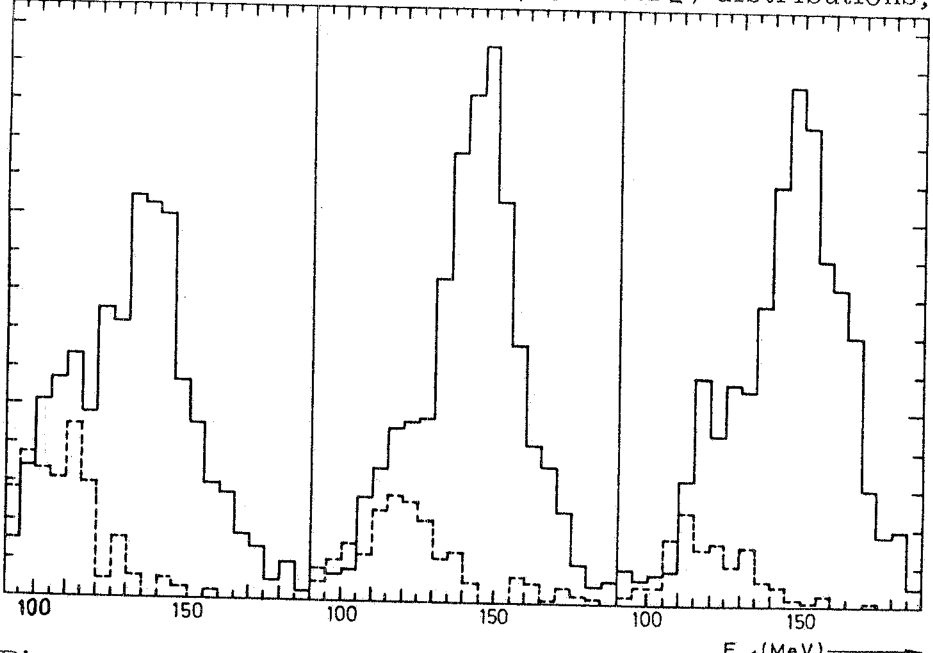

Fig. 2. Pion energy distribution for three different central energies and alignements of the π^+ beam. The full line hystograms were deduced taking into account only the central part of the beam (± 5 mm from the middle plane); the dashed line hystograms represent the low energy contributions from the edges of the collimator and of the diffusion chamber window. The sum of each pair of hystograms gives the total pion spectrum in the diffusion chamber.

diffusion cloud chamber, for three different energies and alignements of the π^+ beam, are given. The tracks were reconstructed by measuring eight points with a semi-automatic image plane digitizer. The data we report represent the preliminary results obtained by scanning about one third of the available photographs, which corresponds to a total π^+-meson track lenght of 4.3×10^6 cm. The events have been grouped in two parts corresponding to (115 ± 15) MeV and (150 ± 20) MeV π^+ energies. The data have been divided in 10^o angular bins. Large angle events ($\theta > 110^o$ for $E_\pi = 150$ MeV, $\theta > 90^o$ for $E_\pi = 115$ MeV) have been preliminary combined into one interval. Cases with $\theta < 15^o$ were not taken in account, in order to avoid ambiguity with the incident beam and with small angle decays. No corrections have been introduced for the azimuthal angle φ and for the angular resolution ($\Delta\theta \leq 1^o$). The errors quoted are only statistical. Fig. 3 shows the differential elastic cross-sections we have obtained,

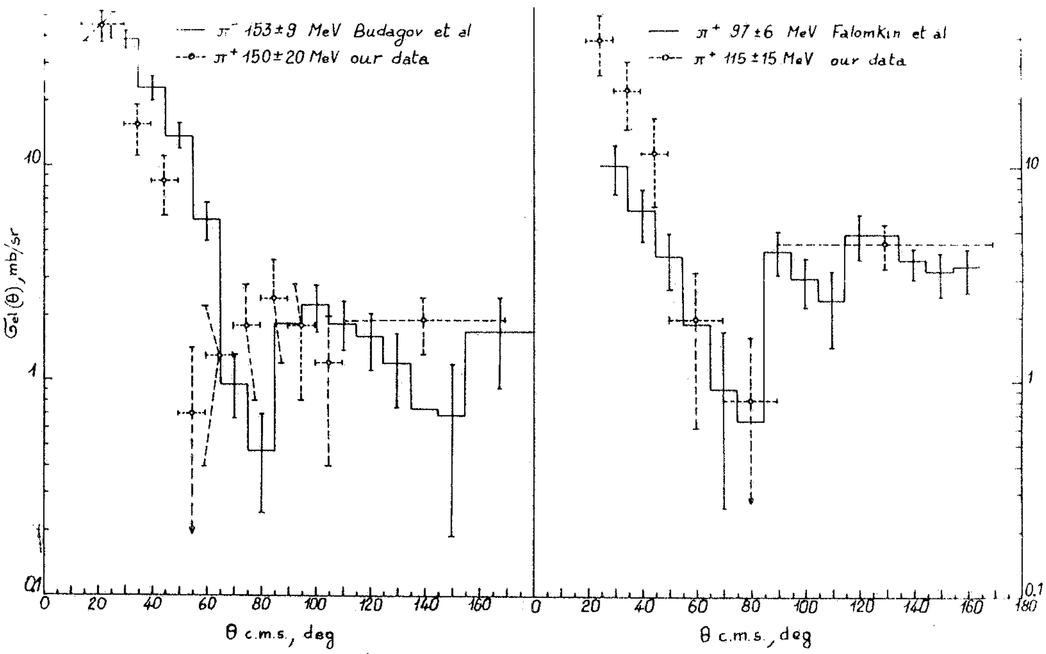

Fig. 3. Preliminary (π^+, ^{4}He) elastic scattering cross-sections compared with those of ref. 2) (π^+ of 97 MeV) and ref. 4) (π^- of 153 MeV).

together with the preliminary results of the JINR group[2)] for π^+ of (97 ± 6) MeV and with the (153 ± 9) MeV π^- data of Budagov et al.[4)]. The comparison with the π^- data shows apparently a small difference at forward angles.

As far as the overall inelastic cross-section is concerned, we measured the value of (173 ± 10) mb and Budagov et al. (171 ± 12) mb. At 115 MeV our values are also in good agreement with those of the JINR group.

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