PROTONINDUCED PION-, ETA- AND KAON-PRODUCTION AT THRESHOLD

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As a starting point for the calculation of exclusive observables in protoninduced threshold production processes of heavy strange/non-strange mesons and exotic states on nucleons and nuclei we present some details of our recent theoretical investigations [1][2] on the total cross section of the reactions $pp \to pp\,\pi^0$, $pp \to pp\,\eta$ [3] and $pp \to p\Lambda K^+$ [4]. Applying standard nonrelativistic perturbation theory within the framework of meson exchange models (MEC) to all of the investigated processes we observe that theory is still far–off from a quantitative understanding of the existing data, although the qualitative behaviour of the threshold cross sections can be reproduced. The often quoted η^2–dependence of the $pp \to pp\,\pi^0$ cross section at threshold is due to a calculational mistake of Koltun and Reitan [5] and not based on theoretical grounds, where threebody phasespace behaviour would yield η^4, which can be affected by final state and short range effects. For $pp \to pp\,\pi^0$ we not only investigate standard contributions like IA, rescattering, heavy meson exchanges, but also the role of resonances $(P_{11}(1440), S_{11}(1535))$, recoil currents and box-diagrams. For the study of $pp \to pp\,\eta$ which is dominated by the excitation of the $S_{11}(1535)$ we developed a microscopic model for the vertex-functions of the meson-nucleon-resonance couplings which – in general – can be complex functions. To account for interference effects a systematic effective treatment of resonances and its implications to the imaginary part of couplings was strived for [6]. To respect the high momentum transfers for $pp \to pp\,\eta$ and $pp \to p\Lambda K^+$ relativistic models were developed. Hereby the η–production still is based on MEC [1][2], while the K^+ production was investigated in the quark-gluon-picture [4].

References

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