Study of e^+e^- pair production in pp collisions at 4.5 GeV with HADES

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Abstract: The subject of this thesis is the ana-lysis of the inclusive production of e^+e^- pairs in proton-proton reactions at a beam kinetic energy of 4.5 GeV measured with the HADES (High Acceptance Di-Electron Spectrometer) detector at GSI, Darmstadt. The objective is, on the one hand, to provide a reference for nuclear matter studies, and on the other hand, to study the role of baryonic resonances ($\Delta(1232)$, $N(1520)$, ...) and vector mesons ($\rho/\omega/\phi$) in the production of e^+e^- pairs. These measurements provide information about the Dalitz decay of baryonic resonances ($B \rightarrow Ne^+e^-$) and their coupling to vector mesons. The thesis begins with a presentation of the results obtained from previous analyses by the HADES collaboration, performed at lower energies, and the motivations for this new experiment. A detailed description of the HADES spectrometer is then provided to understand the different components used for particle detection. The analysis starts with the event selection and the identification of electron and positron tracks. The combination of information provided by the RICH detector, the electromagnetic calorimeter ECAL, and the time-of-flight detectors RPC and TOF allows for optimizing this selection. The correlated e^+e^- signal is obtained after subtracting the combinatorial background from all e^+e^- combinations. This background is mainly due to photon conversion, which requires the implementation of different cuts to reduce this contamination. The results obtained are compared to simulations produced by the Pluto event generator and the hadronic model SMASH. This comparison allows to extract the production cross-sections of mesons ($\pi^0, \eta, \rho, \omega$, and ϕ) as well as the study of the contribution of different baryonic resonances, taking into account the transition form factors. These results will serve as a reference for heavy-ion collisions planned using beams provided by the future SIS100 accelerator at FAIR/GSI.