The double pion production in NN and $N\overline{N}$ collisions

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In an effective Lagrangian model, we give a full analysis to the $NN \to NN\pi\pi$ and $N\bar{N} \to N\bar{N}\pi\pi$ reactions by exploring the role of various resonances with mass up to around 1.7 GeV. We find large contributions from $N^*(1440) \to N\sigma$, $N^*(1440) \to \Delta\pi$, double- Δ , $\Delta(1600) \to N^*(1440)\pi$, $\Delta(1600) \to \Delta\pi$ and $\Delta(1620) \to \Delta\pi$. Our model also indicates sizeable contributions from $\Delta \to \Delta\pi$, $\Delta \to N\pi$, $N \to \Delta\pi$ and nucleon pole in the considered energy region. We well reproduce the total cross sections of different isospin channels of $NN \to NN\pi\pi$ and $N\bar{N} \to N\bar{N}\pi\pi$ up to beam energies of 2.2 GeV. Our model agree with the existing data of differential cross sections of $pp \to pp\pi^+\pi^-$, $pp \to nn\pi^+\pi^+$ and $pp \to pp\pi^0\pi^0$ which are measured at CELSIUS and COSY. Our results provide important hints to the ABC effect and are meaningful to the future experimental project at COSY and HIRFL-CSR. We point out that the PANDA at FAIR can be an essential place for studying the properties of resonances and the data with (anti-)baryon in final states are worth analyzing.

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