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## In-medium $\Delta$ related cross sections

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The ratio  $Y(\pi^-)/Y(\pi^+)$  ( $\pi^-/\pi^+$ ) of the yields of the different charge states of  $\pi$  is considered an important observable for determining the symmetry energy density in the high-density region. However, there remains much controversy in using it to constrain the resulting symmetry energy. This requires us to further explore the physical mechanisms associated with the production of  $\pi$ , i.e., the in-medium  $\Delta$  and  $\pi$  production and propagation, which are the foundation for reliable determination of the symmetry energy in the future.

In this report, we will show the in-medium  $\Delta$  related inelastic scattering in isospin asymmetric nuclear matter in frame work of the one-boson exchange model.  $\Delta$  and isovector mesons, i.e.,  $\rho$ ,  $\delta$  are included in order to reasonable describing the isospin asymmetric nuclear matter. Based on this model, we will perform the systemically study on in-medium  $NN \rightarrow N\Delta$ ,  $N\Delta \rightarrow NN$ ,  $N\pi \rightarrow \Delta$  cross section and  $\Delta \rightarrow N\pi$  decay width.

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