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The Feasibility Study of the GeV-Energy Muon Source Based on HIAF

Muon tomography has attracted significant attention in diverse application areas, yet it is currently limited by the low flux and wide energy spread of cosmic ray muons. To overcome these drawbacks, considerable efforts have been made, such as generating a mono-energetic, high-energy muon beam using accelerator facilities. One potential accelerator facility is the High Intensity Heavy-Ion Accelerator Facility (HIAF), which is currently under construction in Huizhou City, China.

Considering the projectile energy and beamline length, a high-intensity and GeV-energy muon flux could be produced and delivered by the High Energy Fragment Separator (HFRS) beamline of the HIAF facility. In this paper, the flux intensity and purity of muon beam based on HIAF are discussed in detail.

For the μ^+ beam, the highest muon yield reaches 8.2×10^6 μ/s with the purity of approximately 2% at a momentum of 3.5 GeV/c; meanwhile, for the μ^- beam, the maximum muon yield is 4.2 $\times 10^6$ μ/s with the purity of around 20% at a momentum of 1.5 GeV/c. The results also indicate that, for muon beams with an energy of several GeV, by applying a suitable purification strategy, we can get a muon beam with a purity of 100\% and an intensity of the order of 10^5 μ/s.

This GeV-energy muon source would unlock the potential of muon tomography, and also provide a unique platform for the exploration of new physics beyond the standard model.

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