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# Comparison study of muon sources

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Muon plays an essential role in both fundamental physics research and applied sciences. And the high quality of muon beam is the key to realizing research and application. A muon beam is typically produced in a proton accelerator complex through the proton-on-target process. Recently, other types of particles, such as high-energy electrons, gamma rays, and laser beams, have been proposed to produce high-intensity muon beams. Here we compared the number, energy distribution, and angle distribution of muons generated under the drive of proton, electron, and photon by the Geant4 simulation. Through the analysis of the simulation results, it is found that the energy and angle distribution of the muon driven by the three particles is similar. For graphite targets with low atomic numbers, the number of muons driven by electrons and photons is 2 or 3 orders of magnitude smaller than that of protons for the same incident particle number. For tungsten targets with a higher atomic number, the number of muons increases by one order of magnitude. Using Shanghai SHINE's parameters, we estimated the intensity of the muon beam to be around  $10^8$  /s. This research provides a check for the feasibility of using the electron beams of the SHINE to generate muon beams.

**Primary authors:** WANG, Jiangtao (SJTU); LV, Meng; Mr LIU, Fangchao; CHEN, Siyuan; LIANG, wang

**Presenters:** WANG, Jiangtao (SJTU); LV, Meng; Mr LIU, Fangchao; CHEN, Siyuan; LIANG, wang

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