Compact Muon Source with Electron Accelerator for a Mobile μSR Facility

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In order to enlarge application fields of μSR spectroscopy, it is essential to increase the number of muon-producing accelerators to more than existing major facilities. As a possible approach, a conceptual design study was made on compact (within a trailer size) and inexpensive (below 10 M$) muon source,

There are two methods of πvμ production by particle accelerators. A) hadron nuclear reaction; p(n) + A $\rightarrow$ $\pi^{\pm}$ + B, (energy above 280 MeV). B) photo nuclear reaction; e^- + A $\rightarrow e^-$ + B + γ, γg C $\rightarrow$ D + $\pi^{\pm}$, (energy above 140 MeV). For a compact muon source, an electron accelerator is the only choice [1]: 1) for a ring accelerator, a proton machine needs a substantially larger radius; 2) because of lower threshold energy, electrons are preferable; 3) since the real photon process is dominant over virtual photon/pair-production processes, separated targets can be employed for high-Z photon and low-Z π/μ production. This allows the unused electrons to be swept away after the first target and placement of the second target inside a πvμ capture solenoid.

Here, for the electron source, we considered an electron microtron, where re-circulating acceleration is initiated by a 10-MeV linac to reach an energy above 140 MeV. A table-top model is now available. Dai-Omega muon capture [2] and acceleration to a muon micro-beam [3] should be adopted as in Fig. 1.

Our design study concludes that, with a 10-μA 300-MeV electron microtron, more than 10^4/s surface μ^+ will be obtained at Dai-Omega exit and more than 100/s micro-beam. These muons will be used for μSR radiography on 1) medical application including brain function studies, 2) spintronics device development at electronics industry, 3) iron behavior inspection in blast furnace, 4) inspection of re-enforced concrete, etc.

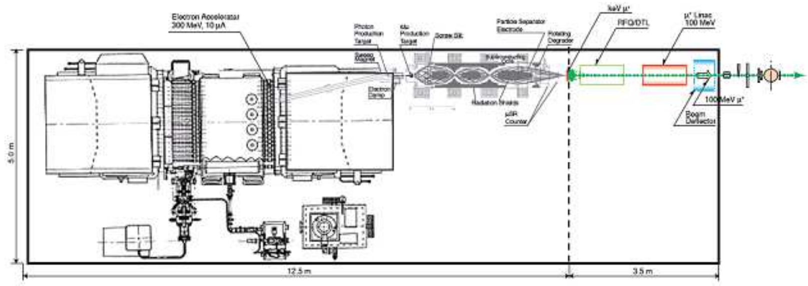

Fig. 1. An example of a compact muon source using a 300-MeV electron microtron.

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