

Study of the Scintillating Fiber Tracker for MICE

H. Sakamoto, M. Yoshida, and the MICE working group

Neutrino Factory based on a muon storage ring is proposed to study neutrino oscillations with highly precision. To realize Neutrino Factory it is important to reduce emittance of muon beam by ionization cooling, which has never been demonstrated in practice. MICE is the first experiment to verify the effect of ionization cooling with muon beam. In addition to the cooling channel composed with liquid hydrogen absorbers and high-gradient RF cavities, particle detectors are also necessary to measure the beam emittance before and after the cooling channel. The Tracker based on $350 \mu\text{m}$ scintillating fibers will be used in MICE. Due to the low light yield from such fine fibers, the photo detector, VLPC, with a high quantum efficiency is employed. In order to shift the wavelength to green where VLPCs are most sensitive, the fibers are doped with 3HF as a secondary dye.

The beam test at KEK-PS T1 beam line was performed in 2004 to optimize the concentration of 3HF. The measurement results are shown in Fig.1, in which the measured light yields in various scintillating fibers are plotted as a function of 3HF concentration. For the scintillating fiber with 3HF doped in 5000 ppm arranged in double layer, the light yield of 11.2 ± 0.5 p.e. was measured by a photo multiplier with GaAsP photo cathode. After passing through 4m-long clear fiber, which is the same situation in MICE, 5.2 ± 0.4 p.e. was measured. The result suggests that the light yield of 8 p.e. is expected to detect by VLPC, and it is concluded that $350 \mu\text{m}$ scintillating fibers by KURARAY meets the requirement for MICE Fiber Tracker.

For further study of the MICE tracker, we developed a large-area high-time-resolution scintillating counter to distinguish muons from pions and to measure momentum. The performance of a prototype of the TOF counter was checked at KEK-PS $\pi 2$ beam line in 2005. As a result, we observed high time-resolution of about 50 ps as required.

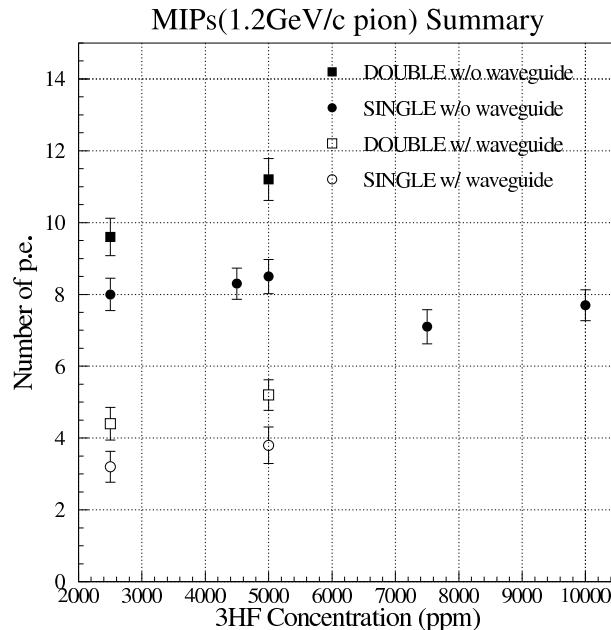


Figure 1: The light yield in scintillating fiber by pions as a function of 3HF concentration measured in T553. The circle point means the result of the single layer, and rectangle point means double layer. The black-color points are the results without 4m clear fiber and the open-color points are those with 4m clear fiber.