Scintillating fibres coupled to silicon photomultiplier prototypes for fast beam monitoring and thin timing detectors

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3 layers of square 250 x 250 μm² fibers
length/fiber ~ 25 cm
Saint-Gobain multi-clad BFC12 fibers
100 nm of Al coating around fibers
2 SiPM/fiber
SiPM: Hamamatsu S12825-050C 1.3x1.3 mm²

Result 1: The prototype performances...
Collected light (m.i.p.): 8.5 Nphe/fiber (AND)
Detection efficiency:
single fiber: ε (AND)~74% ε (OR)~92%
single layer: ε (AND)~79% ε (OR)~96%
double layer: ε (OR) > 99.9%
Fiber optical cross-talk < 1%

Result 2: ...as Beam monitoring:
The high detector segmentation combined with the fast detector response allows to work at the highest continuous muon beam intensity in the world (2 x 10⁸ μ/s)

Result 3: ...as Timing detector:
Timing resolutions of the order of 500 ps already achieved with a single layer (250 μm thick) prototype detecting m.i.p.

Thin standalone timing detector either Scintillating fiber trackers and scintillating fiber timing detector complementing trackers made either by wire chambers or by silicon wafers are straightforward applications of this technology

Particle ID: clear separation between e⁺ and μ⁺
μ⁺ beam profile: 3D view
Single hit: timing resolution thr > 0.5 Nphe
Double hit: timing resolution thr > 0.5 Nphe

σcore ~ 550 ps
σcore ~ 410 ps