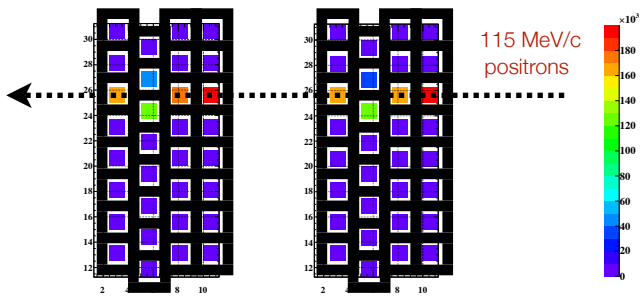
The fibre tracker R&D for the Mu3e experiment

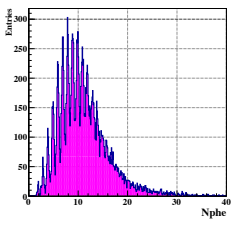
A. Papa on behalf of the Mu3e Collaboration

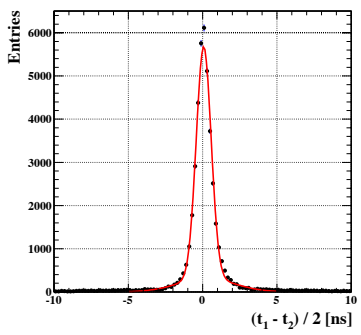
Prototypes

Square fibre prototypes

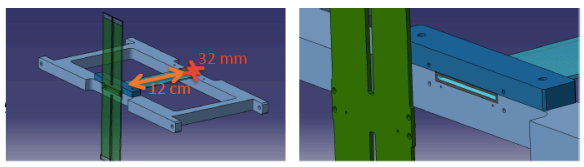


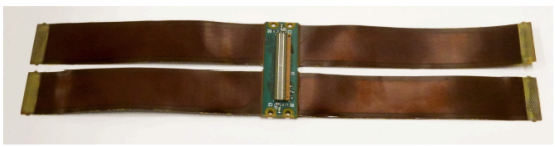
m.i.p. detection: ε_{dec} > 95%, σ_t ~ 550 ps

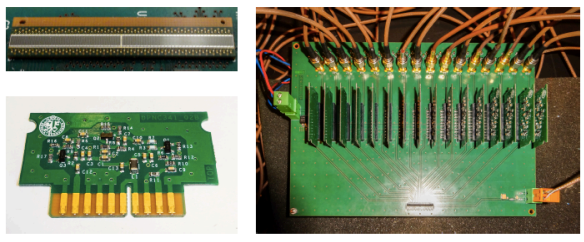


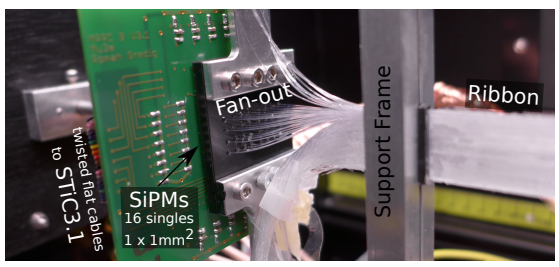


Round fibre prototypes





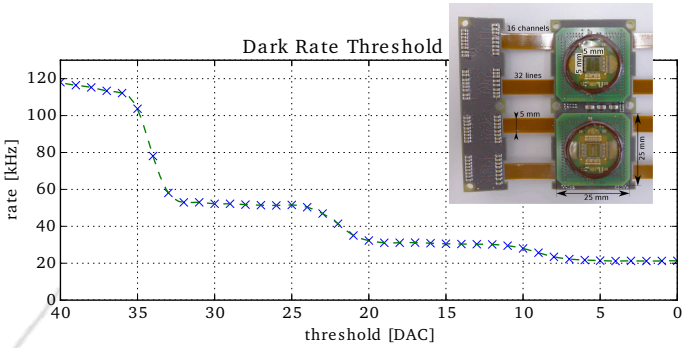


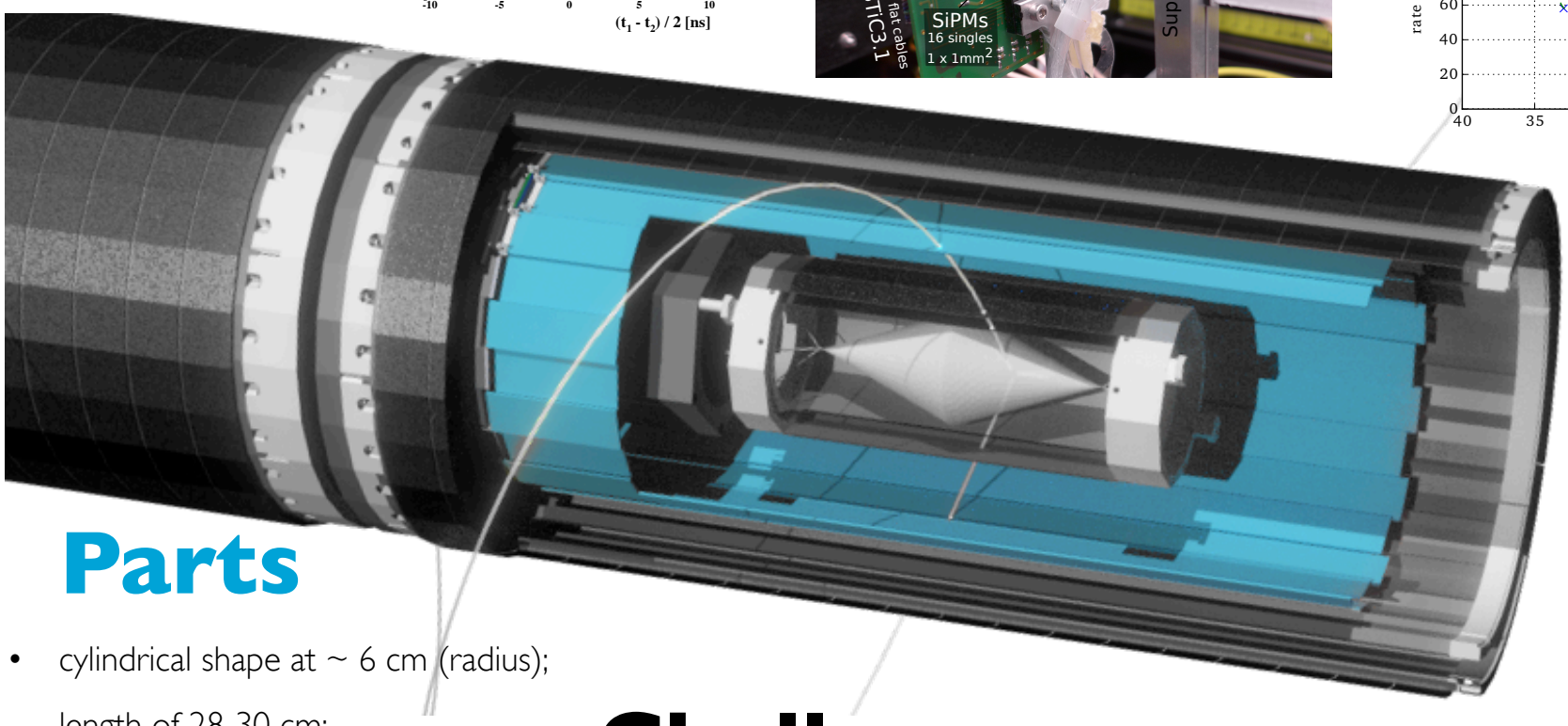


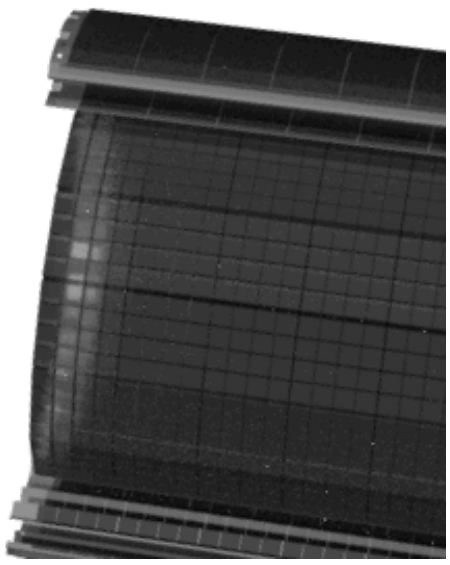
Readout electronics

- **1536** channels **1044** kHz/channel

STiC3.1	MuTRiG
tested	in development
64 channels	32 channels
160 Mbit/s links	1250 Mbit/s links
~40 kevents/s	~1200 kevents/s
no charge	debug features

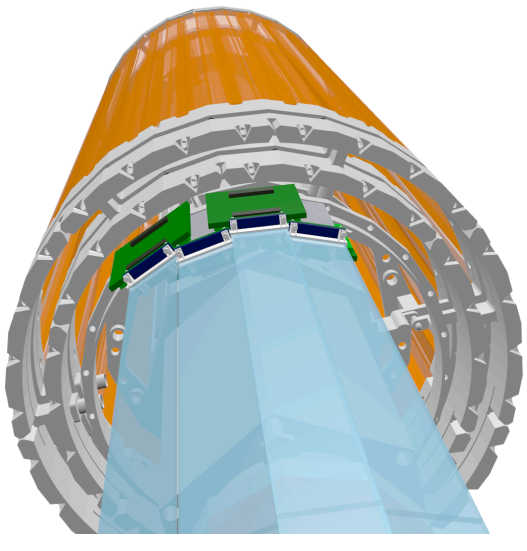






Parts

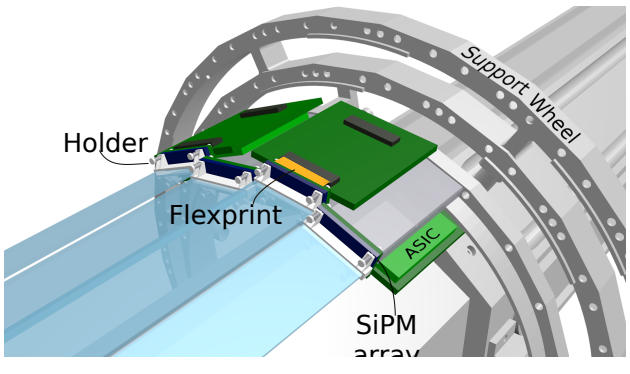
- cylindrical shape at ~ 6 cm (radius); length of 28-30 cm;
- 3-4 layers of round or square multi-clad 250 μm fibres
- fibres grouped onto SiPM array
- MuTRiG readout



Challenges

- m.i.p. high detection efficiency **ε** > 95%
- time resolution **σ** < 1 ns
- < 900 μm total thickness

  < 0.4 % X_0
- rate up to 250 KHz/fibre
- very tight space for cables, electronics and cooling



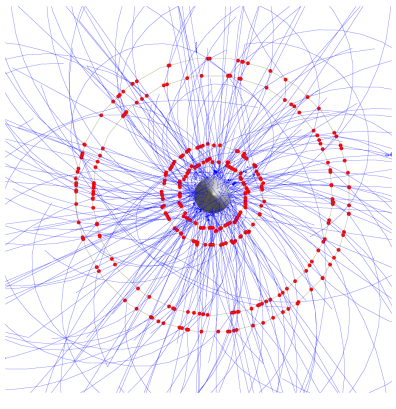
Impact

- strong accidental background suppression

s_fact	fibres	tiles	both
≥4 hits	35	5.3	72
≥6 hits	44	5.3	102

s_fact = background suppression factor

Frame: 50 ns



SciFi (1ns) + Tile (100 ps)