**Introduction**

L1 muon trigger rate is high in the forward region: fakes are currently 90% of the trigger rate in the end-cap region. Rate increases with luminosity: After LS2 LHC’s instantaneous luminosity will be 2.3 x 10^{34} cm^{-2} s^{-1} (and up to 5-7 x 10^{34} cm^{-2} s^{-1} at HL-LHC), one bunch crossing every 25 ns.

**Goal of the NSW:**
- Reconstruct muon tracks with high precision (Micromegas detectors, MM)
- Provide information for the Level-1 trigger (small-strip Thin Gap Chambers, sTGC)

**Performance requirements:**
- 1 mrad angular resolution
- 100 μm position resolution

**Small-Strip Thin Gap Chambers**

Each module is built with 4 gaps each containing:
- Strips, wires, pads

Important to measure the angle of the muon trajectory: need high resolution on the strips.

- Precise (<40 μm) alignment between layers by machining together strips with precision brass insert
- Cathode boards flat and parallel to better than 80 μm using honeycomb filler
- Avoid mechanical deformations by using the same composite material (FR-4) everywhere

**Construction Steps**

1. Components quality control: Check precisely thickness and dimensions.
2. Part cleaning:
   - Use acetone and isopropyl-alcohol on strip boards and assembling parts (remember to dry off).
   - Remove dust with dry air.
3. Cathode board preparation:
   - Laminate 0.1 (0.2) mm pre-pressed ribboned copper layers
   - Cover support and frame areas with graphite mixture.
4. Spacer, gluing and wire winding:
   - Glue the wire and internal support spacers using epoxy glue.
   - Using two layer winding machine.
5. Single layer assembling:
   - Place clean cathode boards on a granite table (flatness deviations of less than 20 μm).
6. Doublet, quadruplet assembling:
   - Glue two single plates on granite table with honeycomb supports.

**Experimental Setup at the Fermilab Test Beam**

**Beam:**
- 32 GeV pion beam
- Rate 1kHz
- Beam spread: 1 cm²

**EUDET Telescope:**
- 3×3 pixel sensors:
  - 2cm (high) x 1cm (width)
  - Pixel size: 18 x 18 μm

**Read-out:**
- VMM: chip interface connected to the chamber (shaper discriminator)
- Jack’s Cards: configure VMM and do the Analog → Digital conversion

**Trigger:**
- 2+2 scintillators + PMTs around the first and last pixel sensors

**Test Beam Data Analysis and Results**

**sTGC-telescope combined**

\[
\Delta y = \gamma_{sTGC} - \gamma_{telescope-track}
\]

- Extract alignment and non-linearity corrections
- Check uniformity across chamber

**Charge sharing between pads**

\[
F = \frac{PDO_0 - PDO_{n+1}}{PDO_0 + PDO_{n+1}}
\]

~45 μm resolution (perpendicular incidence) uniform within 3mm RMS in tested area (65 × 11 cm²)

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*The small-strip Thin Gap Chambers will provide the Muon New Small Wheel with excellent triggering and tracking capabilities. The construction protocol has been validated by test beam experiments on a real-size prototype showing the performance requirements are met.*