Validating the position of particle detector electrodes for the ATLAS muon spectrometer

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Small-strip thin gap chambers (**sTGCs**) will be used to track muons in the **ATLAS experiment at CERN**. For precision tracking, the position of the internal electrodes must be known to within 100 µm.

GOAL: Validate measurements of strip electrode positions using cosmic muon data.

sTGCs

- **Multiwire ionization chambers** that hold thin gas volumes held under $\vec{E}$
- Strip electrodes pick up signal caused by a muon's ionization avalanche
- Four sTGCs are glued into a **quadruplet** so muon tracks can be reconstructed locally **(see fig. 2)**

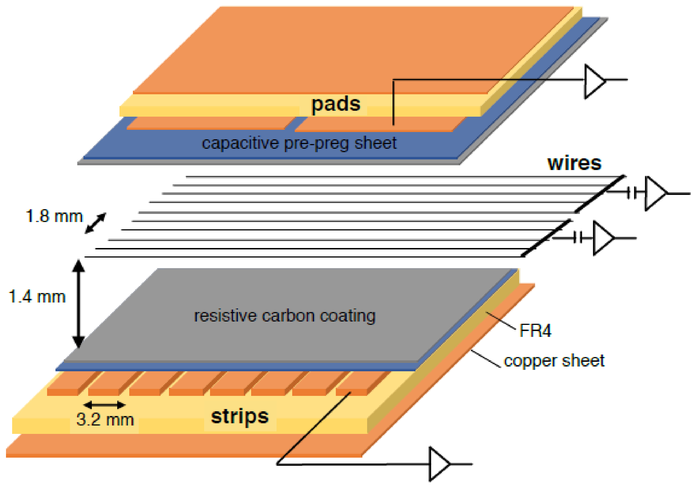


Fig. 1: sTGC internal structure.

Cosmic Muon Data

- Quadruplets are characterized using cosmic muons
- Scintillator + PMT array provides trigger to readout quadruplet
- See **fig. 2** for how cosmics data can be used to study relative strip positions

Effect of Misalignments

- Local offsets between strip layers shift the reconstructed muon position
- Track residuals are a measure of relative strip offsets between layers

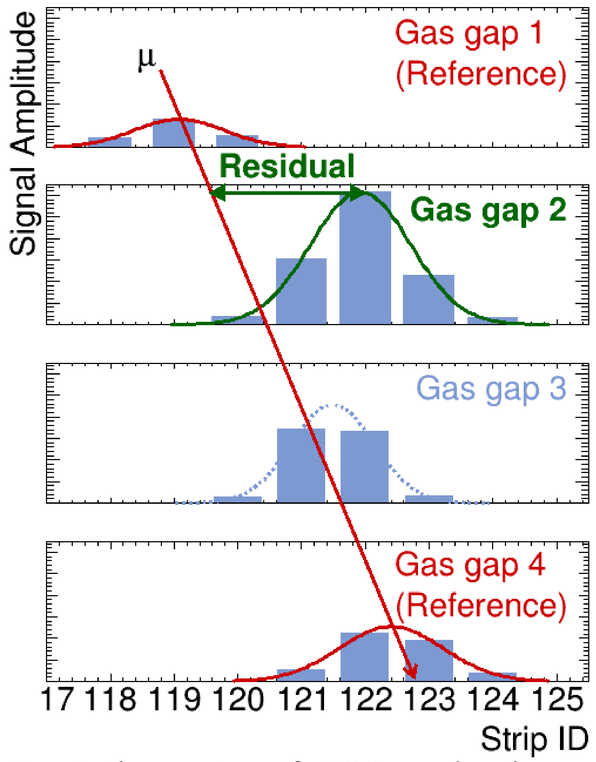
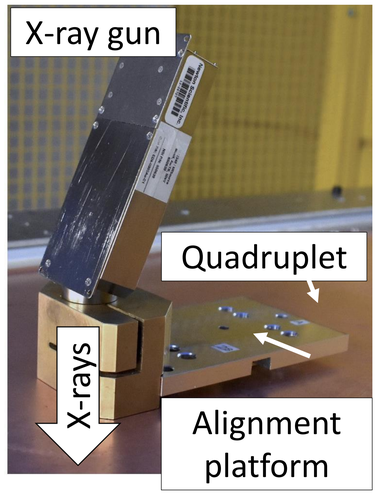


Fig. 2 Abstraction of sTGC quadruplet and effect of local strip offsets on track residuals.

X-ray method for strip positions



- Measure local strip position *w.r.t* alignment platform by reconstructing x-ray beam profile centroid
- Compare to perfect geometry
- **To compare to cosmics, calculate residuals in same way as fig. 2**

Results

- Compare x-ray residuals to mean cosmics residuals for each quadruplet and all choices of reference layers

Fig. 3 Mean cosmics residuals on layer 2 w.r.t *layers 1 and 4 for quadruplet QL2.C.4. The x-ray residuals (in mm) are represented by the annotated black points.*

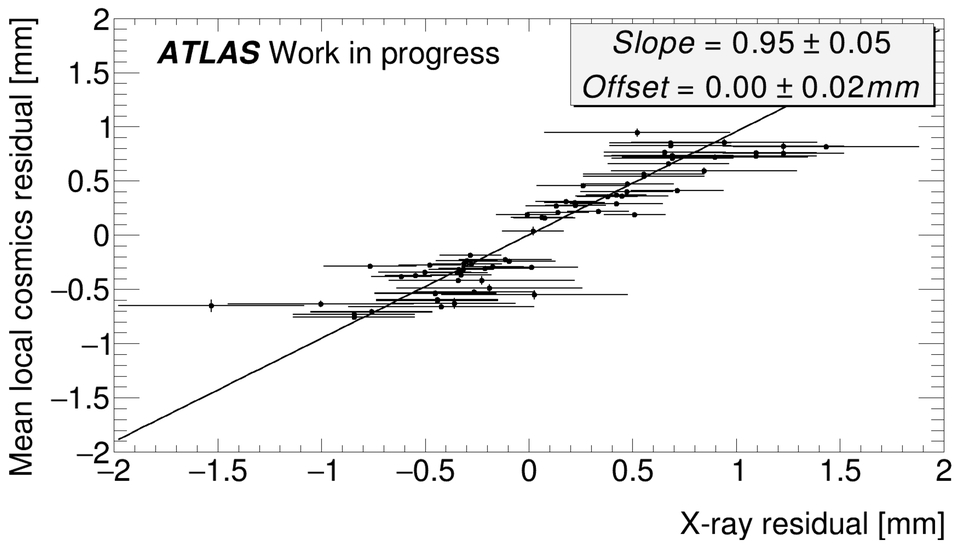


Fig. 4 Mean cosmics residuals compared to corresponding x-ray residual for all reference layer choices for QL2.C.4.

Summary

- Relative strip positions measured using cosmics data are correlated with x-ray position measurements
- Next step: Use cosmics data to further constrain strip positions