GEM Foil Stretching Using a Low-Cost Infrared Heating Array

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Overview

- Purpose / Background
- Previous work
- Improvements to previous work
- Results
- Conclusions
- Future plans



Purpose

- Design a cost-effective, readilyimplemented method of stretching GEM (gas electron multiplier) foils, improving upon previous designs.
- I00cm x 50cm GEM foils stretched with this method will be used to upgrade the muon tomography station of Florida Institute of Technology's High Energy Physics Lab A.

Why Stretch GEM Foils?



- GEM foils are a crucial component of detectors such as the triple GEM detector on the left.
- In order to be useable, they must be uniform.
- This uniformity is obtained through stretching, usually in a clean room oven.

Muon Tomography Station (MTS)



 Two 30cm x 30cm GEM detectors were built for Florida Tech's muon tomography station using the following method. [GEM Detectors] Below: Imaging area seen with two blocks of high-Z material.



Previous Work



- Designed to stretch 100cm x 50cm GEM foils – scaled-up from 30cm x 30cm design – as cost-efficiently as possible using locally-sourced materials.
- Aluminum frame supports eight/sixteen 250W infrared heat lamps.



 Used to stretch foils at 45°C - 50°C.



Why 35°C?



 The above GEM foil was stretched at 50°C. Note the ridging of the spacer ribs! Lower temperatures minimize / eliminate this! (CERN stretches at 37°C).



Current Design



- I"-diameter aluminum rods support the frame – allows for greater versatility and mobility. Several stations can easily be set up on the same optical table.
- Sixteen 125W heat lamps were used in place of the previous 250W bulbs.
- Used to stretch foils at 35°C.

Results

Temperature Profile



Mean: 35.12°C RMS: 0.1669







Top: Unstretched 100 x 50cm GEM foil at ~25°C.

Bottom: Stretched 100×50 cm GEM foil at 35° C.

Note the reflection of the light bulbs in the foil!





Conclusions

- I25 W light bulbs provided a very uniform temperature of ~35°C. Temperature variations were minimal and did not affect the operation of the array.
- Current results: RMS: 0.1669 compared w/ previous results: RMS: 1.367.
- Foils stretched using this method appeared to be uniformly stretched.



Future Plans

 Improve the methods of temperature control.



- Build multiple arrays for more efficient detector construction.
- Use the array to stretch 100cm x 50cm GEM foils for use in upgrading Florida Institute of Technology's muon tomography station.



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