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Quality assurance for large-scale GEM-foils*

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A large scale GEM-based tracker has been designed [1] as a forward particle-track detector for the PANDA experiments. The detector system consists of three GEM-Discs, each working as a large-area planar GEM detector. The size of GEM-foils is three orders of magnitudes larger than the 'standard' one (10x10cm^2), therefore a fast and automated quality assurance method has to be established.

A 2D-scanning system has been designed to optically inspect the quality of GEM foils and micro-patterned readout structures to be exploited with a prototype GEM-tracker (active area of 30x30cm^2). The current system is capable to scan a maximum area of 40x40cm^2 at a time by moving a sample with a high-precision 2D-stage (ALS36240 Aerotech). The system is designed to use various devices for detector inspection and tests [2]. For an optical inspection of GEM-foils, a digital microscope can be mounted on the scanning system.

A control software of the 2D-scanning system has been made using LabVIEW to perform an automated image taking. Figure 1 demonstrates the scan results for a scale. The scanning reproducibility has been measured using a microscope (VHX-600 KEYENCE) by comparing images of the same scan position for different runs using an pattern matching algorithm. In order to inspect micro scale structure of GEM foils (fig.2 top), an analysis program has been developed detecting pre-definable objects e.g. contours of GEM holes (fig.2 bottom). The diameters which have been fitted with circles and resulting in parameters such as location of the respective centers and deviation from the ideal circle are plotted and stored in a file.

The scanning reproducibility has been deduced to be (1.7$\pm$1.1)μm for the test performed on a stone table in the clean room of the GSI detector laboratory. The 2D-stage and microscope head will be mounted on a dedicated supporting structure in spring 2014 to be constructed as the complete scanning system. Similar reproducibility tests are foreseen after the assembly.

Image analysis has been performed for 5 samples of standard GEM-foils with various optical settings to find an optimum setting for an appropriate image analysis. Currently, the analysis process is sensitive to the image quality and time consuming. Appropriate algorithms to speed up the whole processing as well as improvements on the hardware are under investigation.

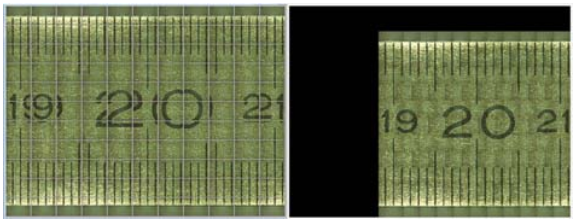

Figure 1: An example of an automated scan showing 121 consecutive images of a scale with 2mm pitch, unstitched (left) and successfully joined (right).

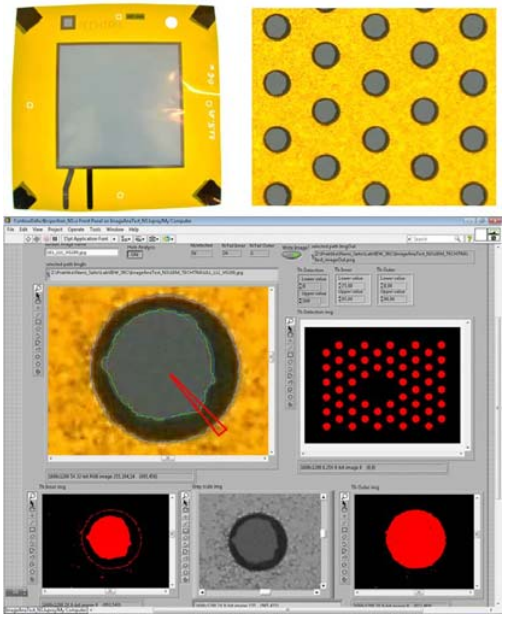

Figure 2: A sample GEM foil (top left) and a zoomed view (top right). GUI of the image analysis program (bottom). An example of analyzed contours and circular fit of an inner hole in the base material and an outer rim in the copper cladding of a GEM hole are shown. A large deviation from the ideal circle is detected and marked by a triangle.

References

[1] B. Voss et. al., GSI scientific rep. 2011, p123 (2012)
[2] A. Ehret et.al., contribution to this report

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