



“Experimental Setup to capture high resolution images for Quality Control of GEM Foils”

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Acknowledgments

- Universidad Antonio Nariño
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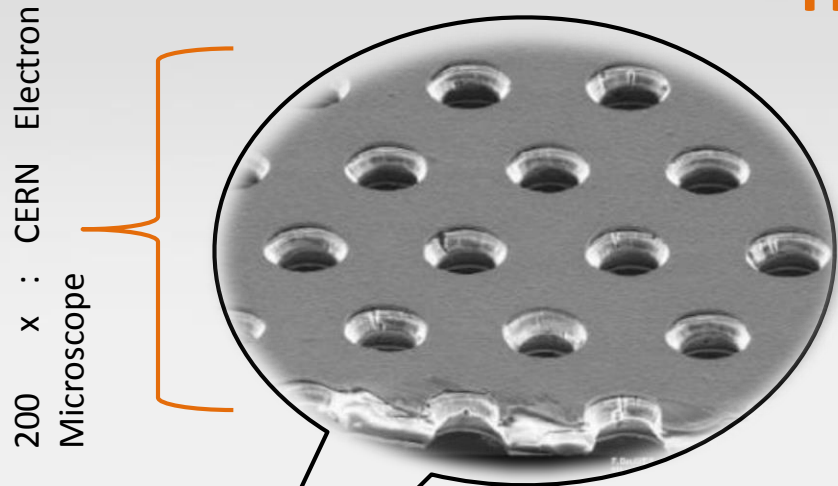
Outline

1. *Introduction*
2. *Methods*
3. *Results and Discussions*
4. *Conclusions*
5. *Perspectives*

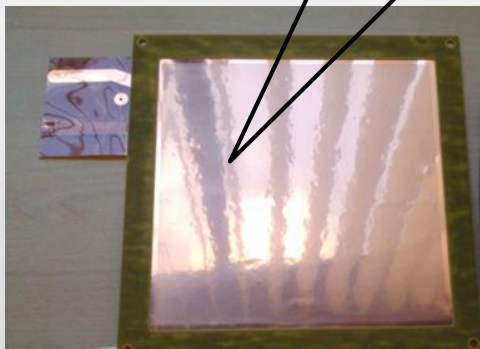


The GEM-Foils

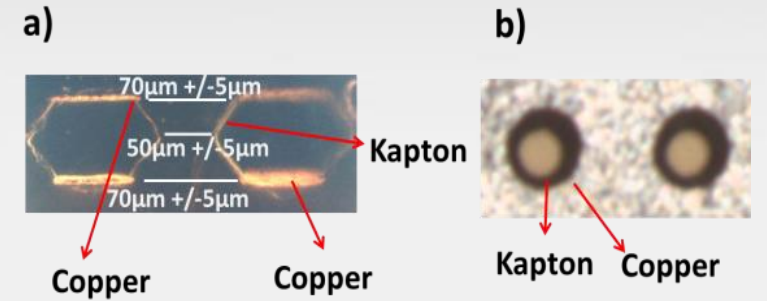
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Picture taken from CERN webpage



Picture taken at CICBA Lab.
GEM-foil 10 x 10 cms

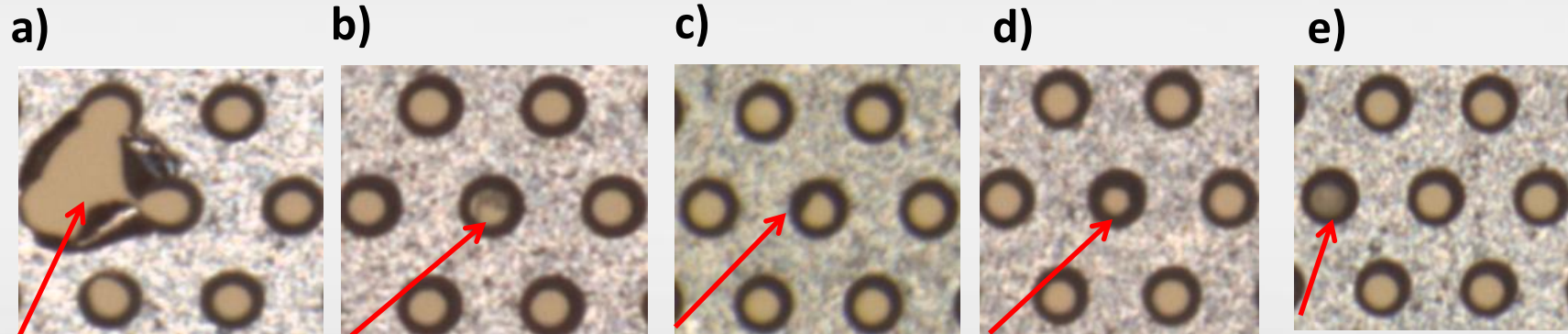


- Cross section of a GEM-foil (Image taken from Technology Transfer Agency, TECHTRA).
- Image of a hole captured from above and perpendicular to the plane of the hole.



The GEM-Foils

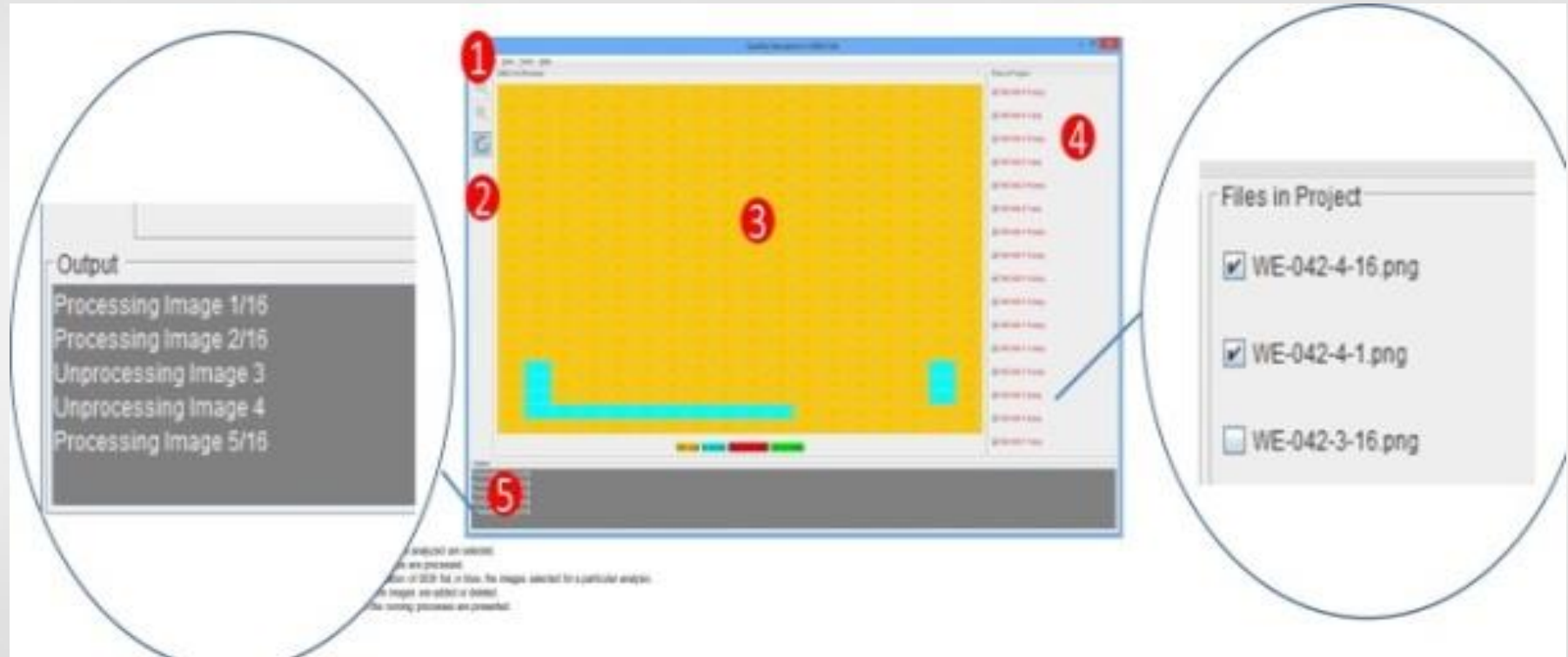
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(a) Triangular damage by acid. (b) Partial obstruction by dust. (c) Incomplete Kapton drilling. (d) Conical section affected. (e) Total obstruction by dust.

SOFA (Software for Foils Analysis)

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SOFA Analyze 432 images in 36 minutes



Setup Components (High Resolution Camera)

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- Sensor Aptina 1/2.3 inch color CMOS
- Resolution: 4912x3684 pixels (18M pixels); Pixel size: 1.25 μm x 1.25 μm ;
- Frame speed: 5.6fps at 4912x3684, 18.1fps at 2456x1842, 32.2fps at 1228x922

Setup Components (High Resolution Camera 2)



- 14 megapixel Panasonic sensor 1/2.3 inch
- Model: Camera with HDMI 1080P @60FPS USB2.0 @ 30FPS two output
- Transverse and vertical line: Support multi-color, 5 pcs of transverse lines/vertical lines, moveable
- Image resolution: 4320*3240 (for TF card) 1920 *1080 @ 60FPS(for TF card);1920*1080 (for USB)
- Video format: MP4(for TF card) ; Image format: JPG; USB Video resolution: 1920 *1080 @ 30FPS

Setup Components (Monocular 300 X)

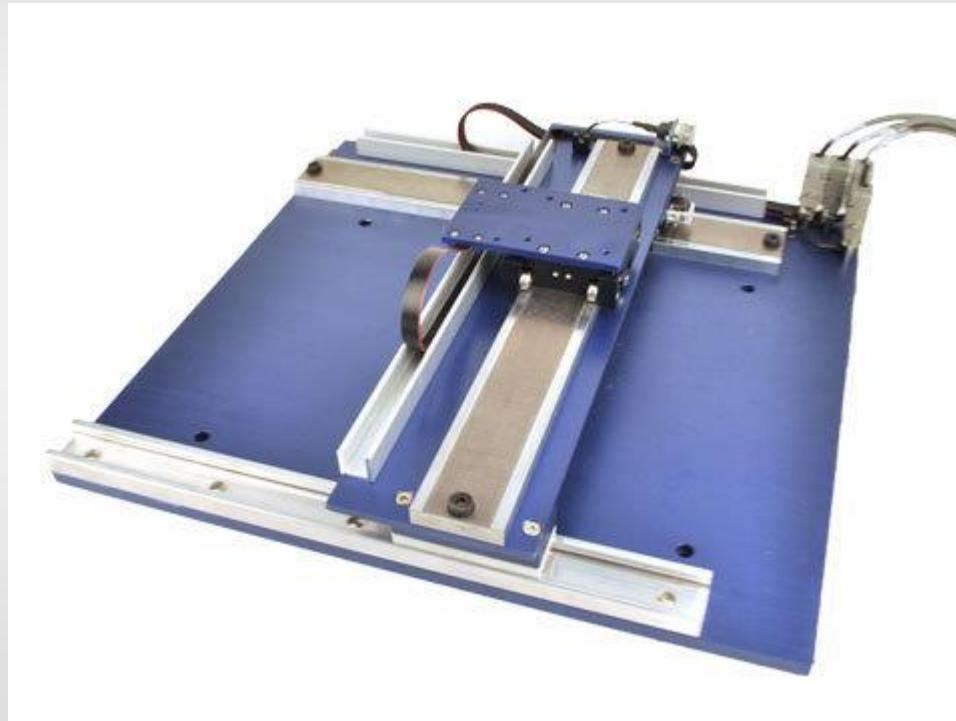
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- Objective Magnification Power by 0.7 - 4.5X(about 10 - 300X on the display)
- Size: 24.5mm(L) * 50mm(DIA),1.0X C-mount adapter
- C-mount Lens Working distance: 105mm-115mm
- Monocular 300X Industry Zoom C-mount Lens
- focusing mechanism : Focusing handwheel tightness is adjustable focusing range 15mm & 40mm



Setup Components (Linear Stepper)



- X Travel: 12 in (300 mm)
- Y Travel: 12 in (300 mm)
- Resolution: 1 micron
- Speed: 0.1 to 60 in/s (1.5 m/s)
- Payload: Up to 5 lbs (2 kg)
- Acceleration: 0.1 to 2 Gs
- Repeatability: +/- 0.001 in (25 microns) .

• *Introduction*

• *Methods*

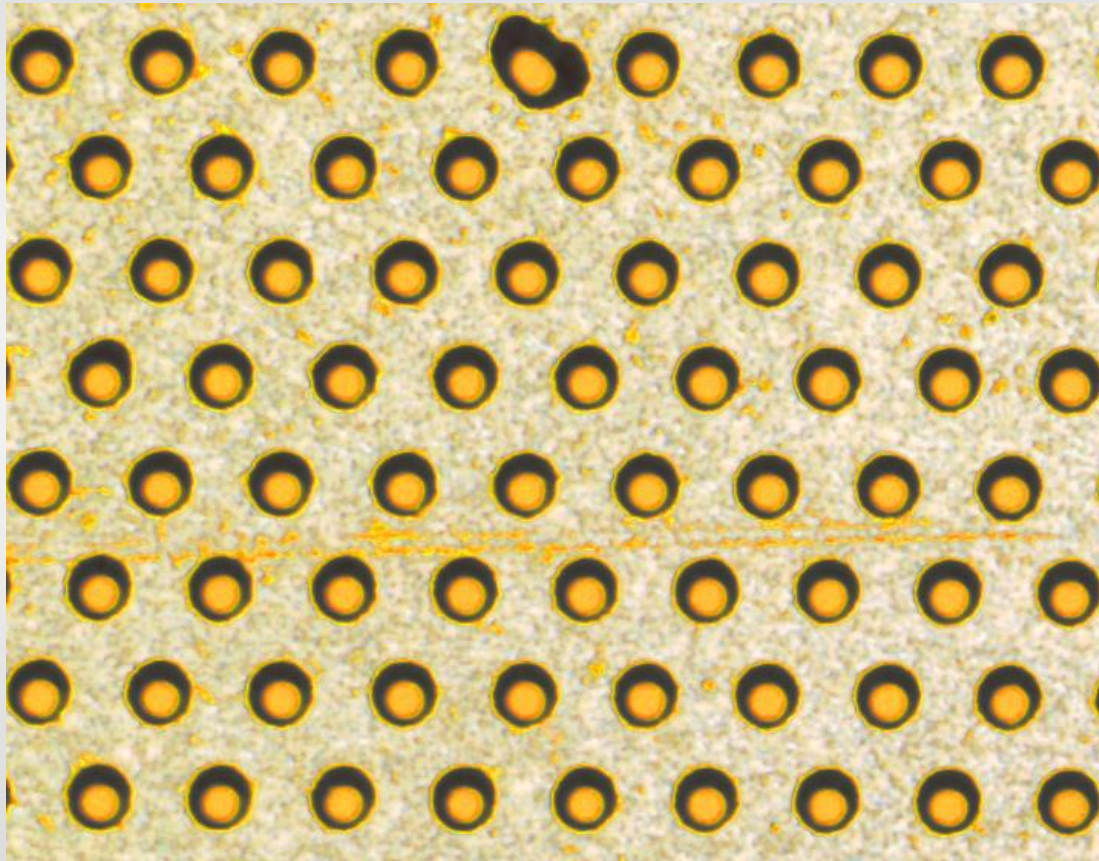
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Acquired Image

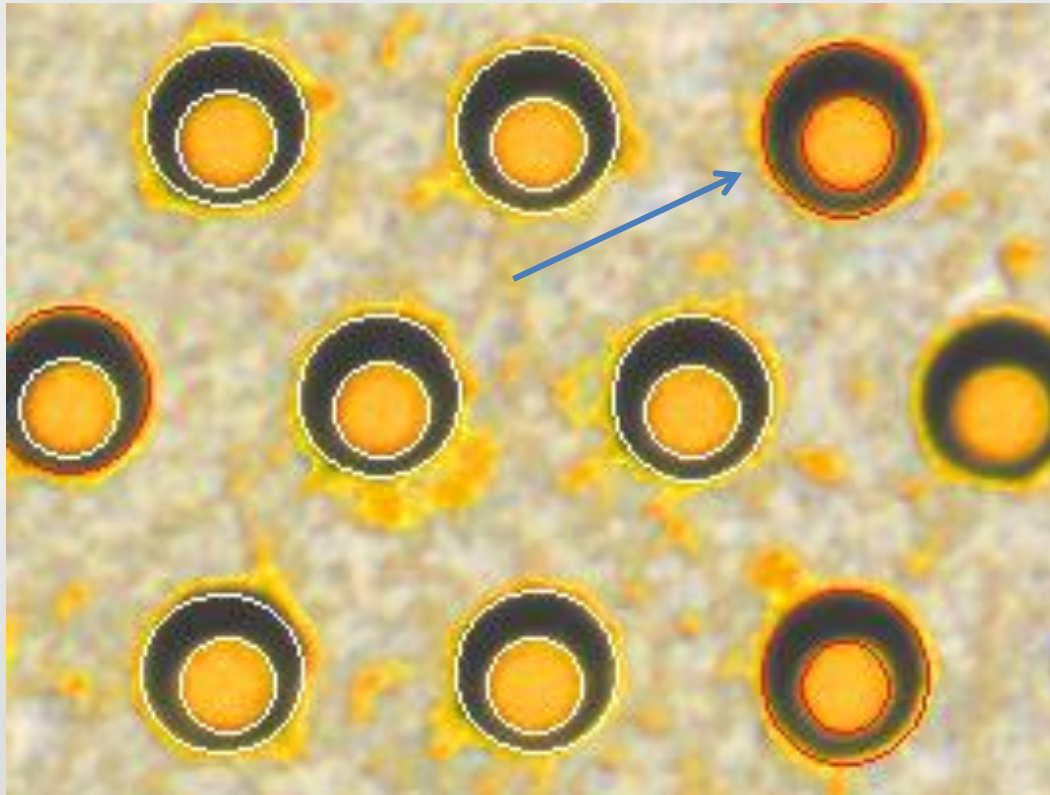


- ❖ Image captured Manually
- ❖ Image captured at Detector Lab
- ❖ Resolution: 4912x3684 pixels (18 Megapíxel).
- ❖ Area: 3 x 2 mm (aprox).
- ❖ Format: .PNG
- ❖ Size: ~35 MB
- ❖ Cantidad: 520



Software Analysis

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Inner Radius and outer Radius

The defective hole is highlighted in red;
the good holes are highlighted in white



Discussions

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- Although the images have a better resolution, we have to generate a synchronization process between the camera's shutter and the speed of the device.
- SOFA offers an effective solution to lighting variations on the GEM-full image, however, we need to explore different light sources with the purpose to improve the results.
- We need to experiment with methods such as stitching and registration because in most of the cases some holes remain on the edges of images.



Conclusions

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This work presents an experimental setup to capture high-resolution images with quality control purposes. The results demonstrate that SOFA and the setup are compatible to detect defects in GEM-Foils. Therefore, the presented software and setup is a not expensive and faster alternative to the current GEM-foil quality control processes. SOFA is also an effective tool to support a R&D process to correlate the performance of GEM detectors with GEM-foil quality.



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VIDEO RECORDING

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We are working on GEM-foil quality control using video recording and machine learning techniques such as pattern recognition. This will allow in the future to do an online inspection using less time and resources.



Questions