Quality check of GEM-foils for large detectors

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REGARD

RMKI ELTE Collaboration

on Gaseous Detector
Research and Development

UNIVERSITAS BUDAPESTINENSIS DE ROLANDO EÖTVÖS NOMINATA

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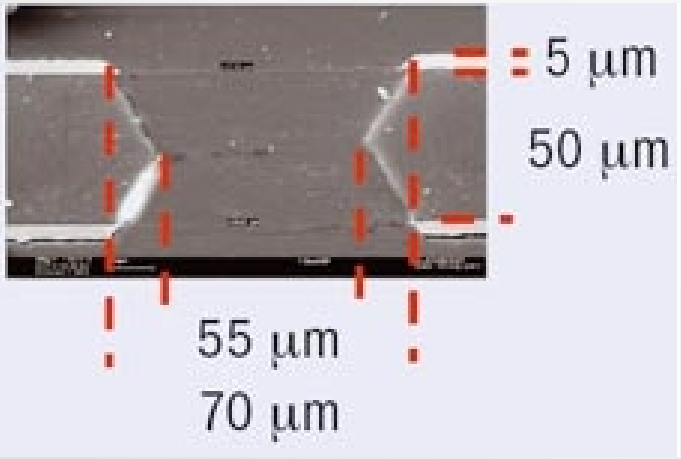
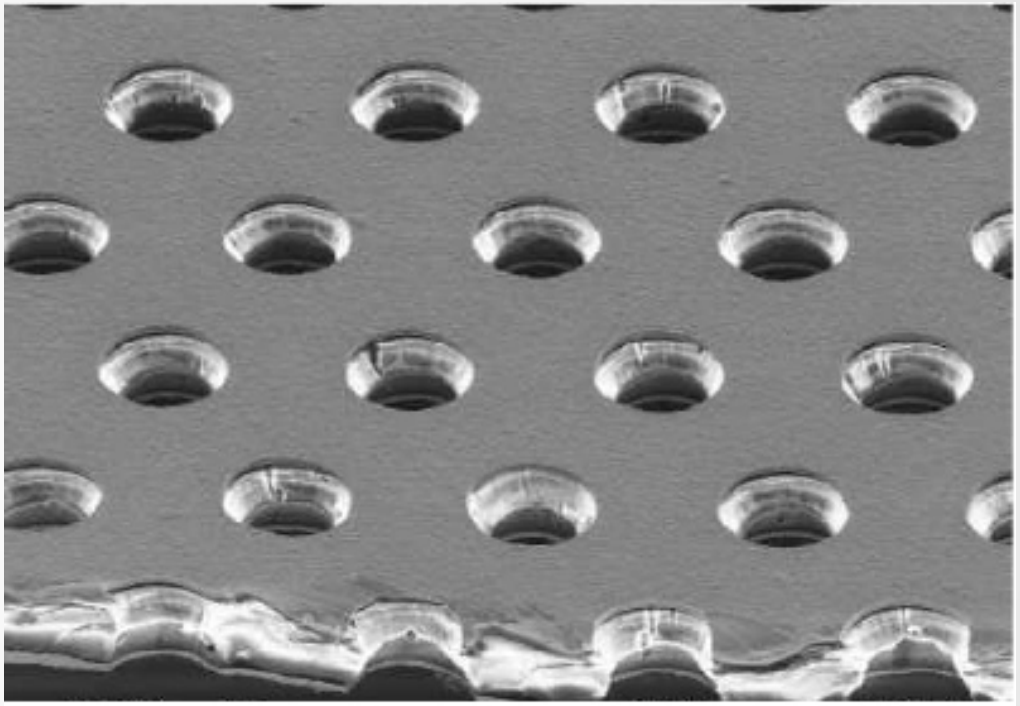
WIGNER

Gaseous Electron Multiplier in general

- Microstructure, typical sizes: ~ 10 um
- Faster signal → better time resoution
- Possibility for large areas

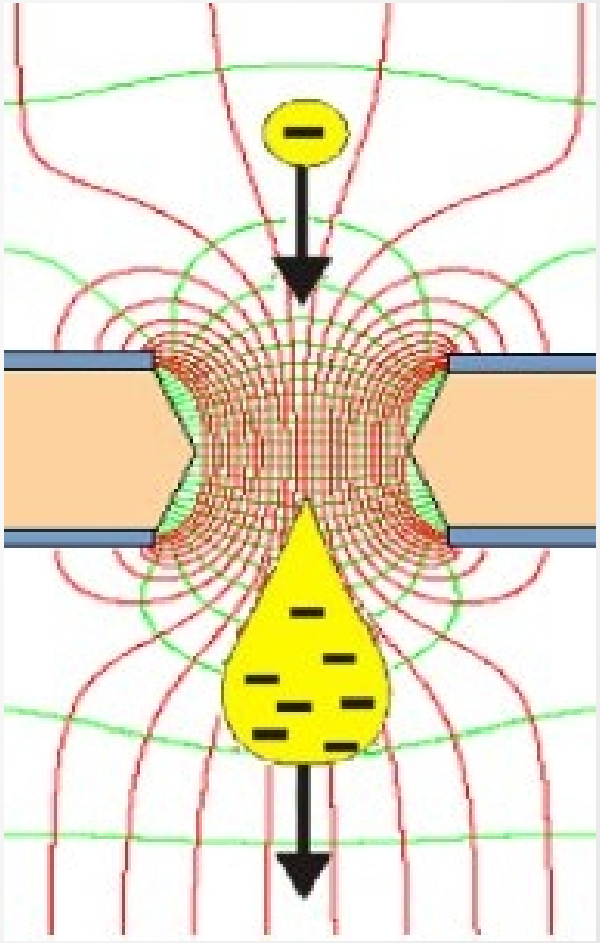




Microscpoic picture of a GEM foil

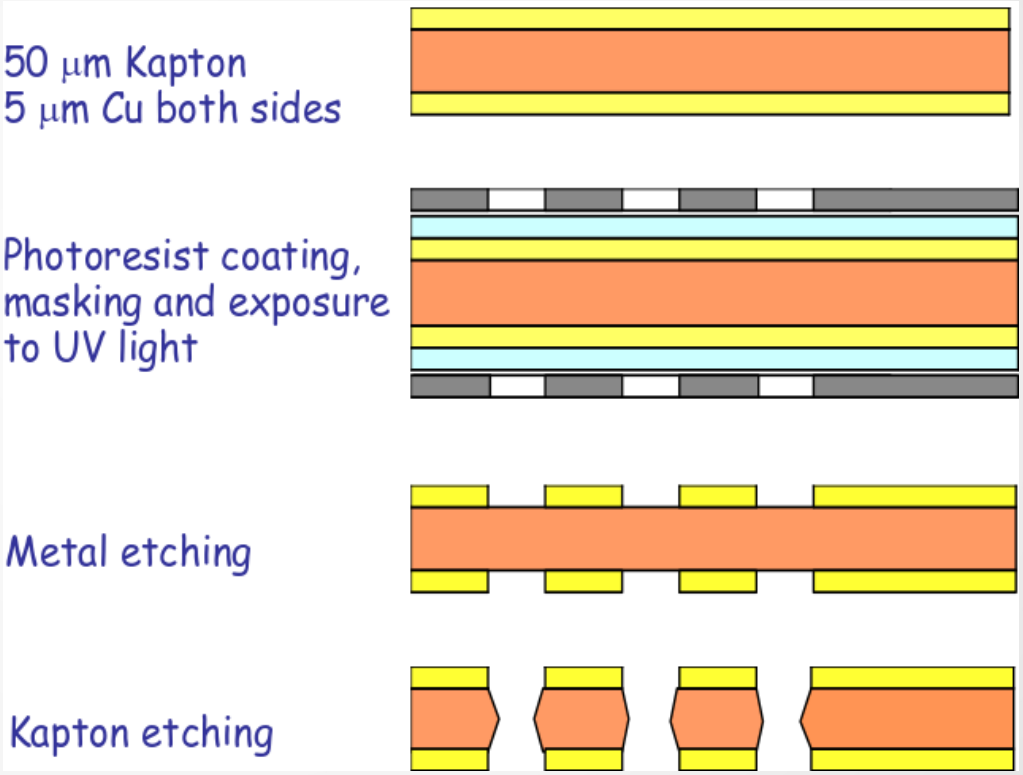
Gaseous Electron Multiplier in general

- Main process: ionization
- High voltage on electrodes
- Amplification ~ 10-100 for a single foil
- Can be cascaded, typically of 3 foils



GEM construction techiques

- Chemical etching
- Double mask / single mask technology
- Possibility of large GEM foils (~ 1m2)
- Local errors may occur



Motivation of quality assurance

- During fabricating errors may occur...
  - Fusion of two or more holes
  - Inhomogenity in diameter, number density
  - Missing hole
  - Over etching
  - Assymetric hole

All these errors have effect on the local gain of the gem foils, thus modify the results of measurements!

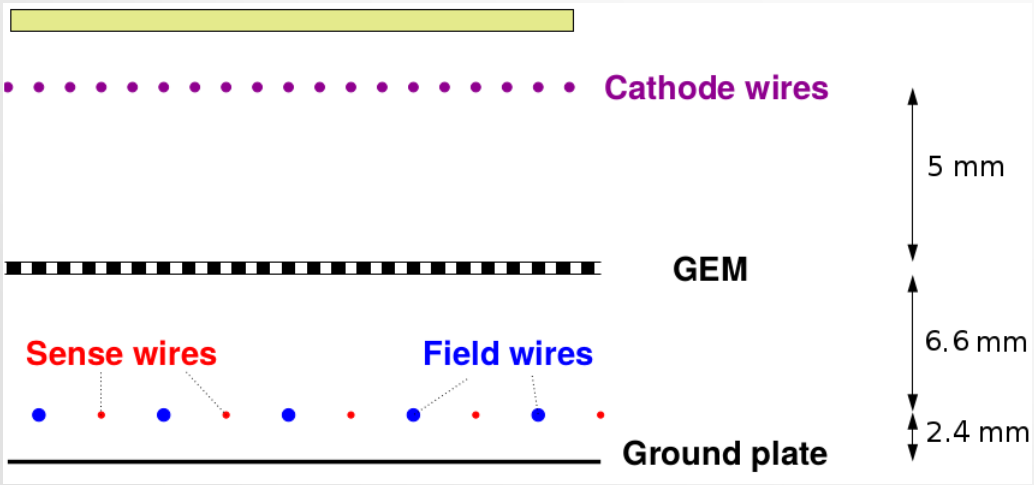
It is important to make sure whether the gem foils work well

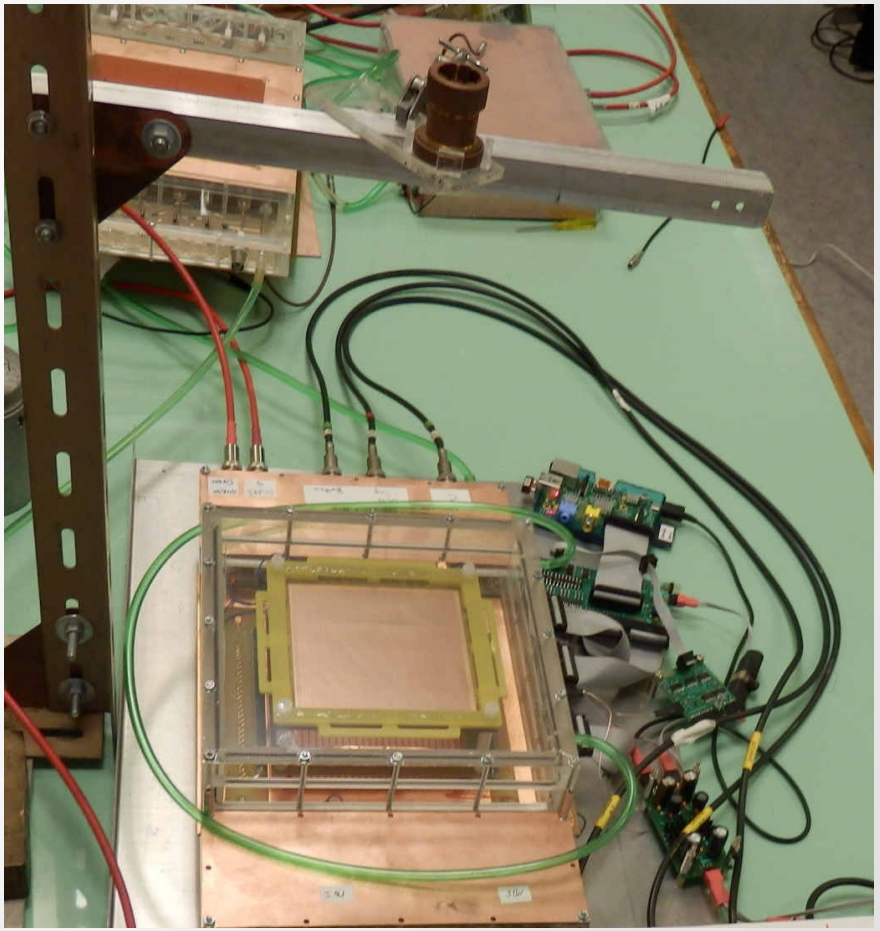
Methods for GEM Quality Assuarance

- Optical scanning
  - Map on the geometry parameters of the holes
    (inner diameter, outer diameter, ellipsoidic asymmetry)
  - Excellent position resolution (~ 5um)
- Gain scanning
  - Meausring the gain of the GEM foil point by point
  - Measure on an actually working detector
  - Few mm resolution

The Budapest Setup for Gain Scanning

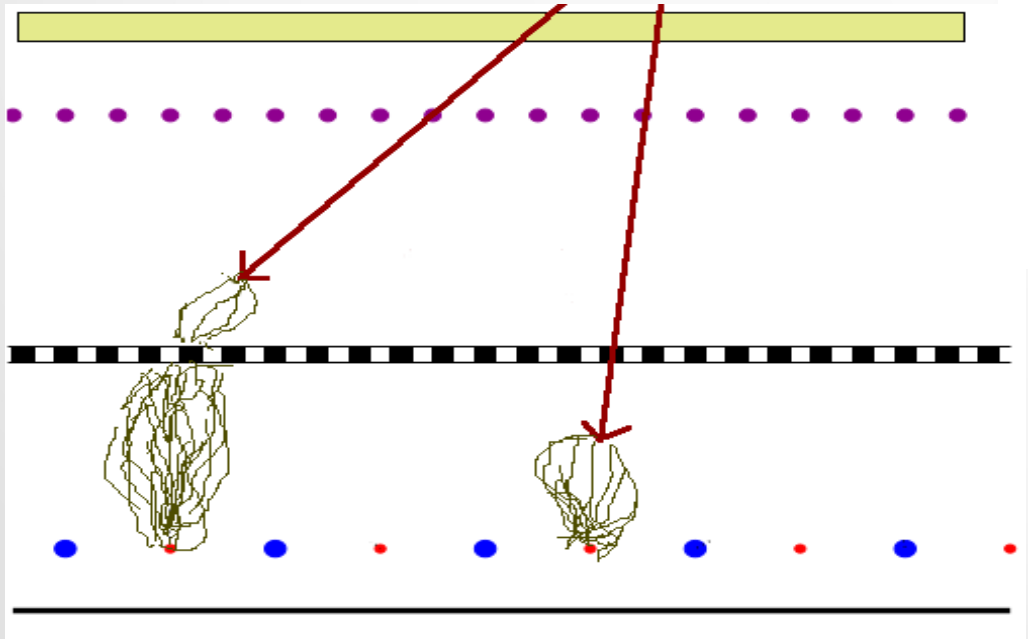
- MWPC readout
- Fe-55 source
- Two dimensional position resolution of 2x2 mm2

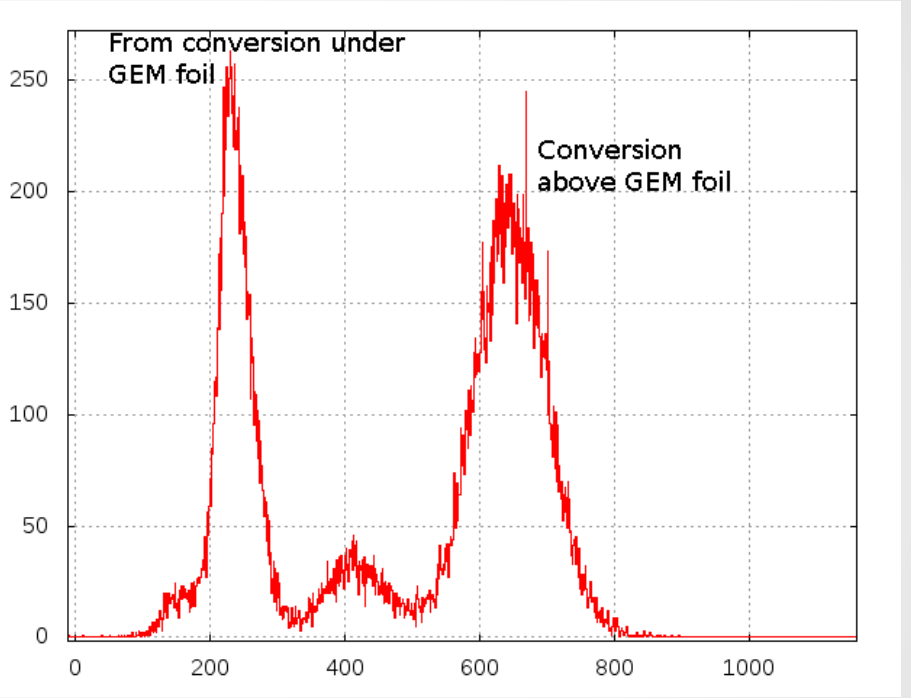




Measuring amplification of the GEM

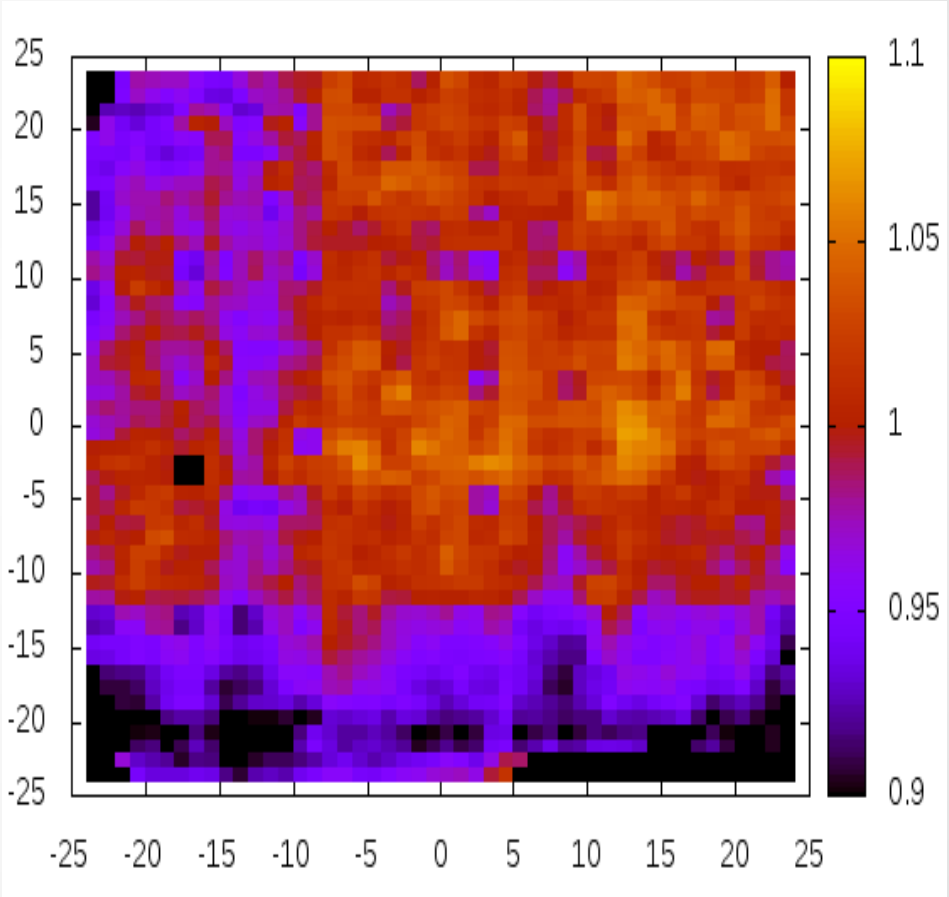
- Incoming gamma particle converts at two places
- Proportion of the peaks gives the gain of the GEM





Making the gain map

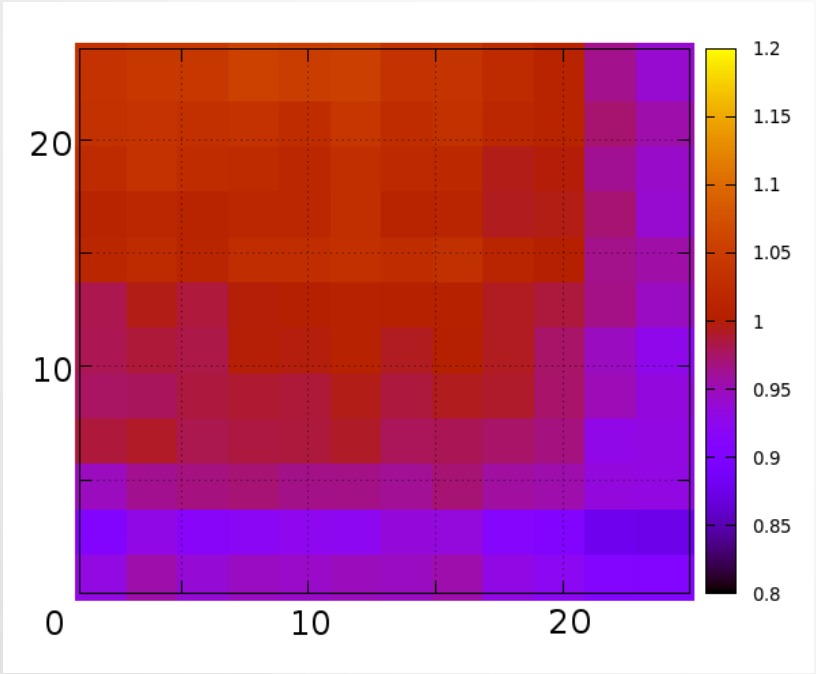
- Irradiating the whole surface of the detector, gain can be measured point by point with 2mm resolution
- Gain difference down to 1% can be measured



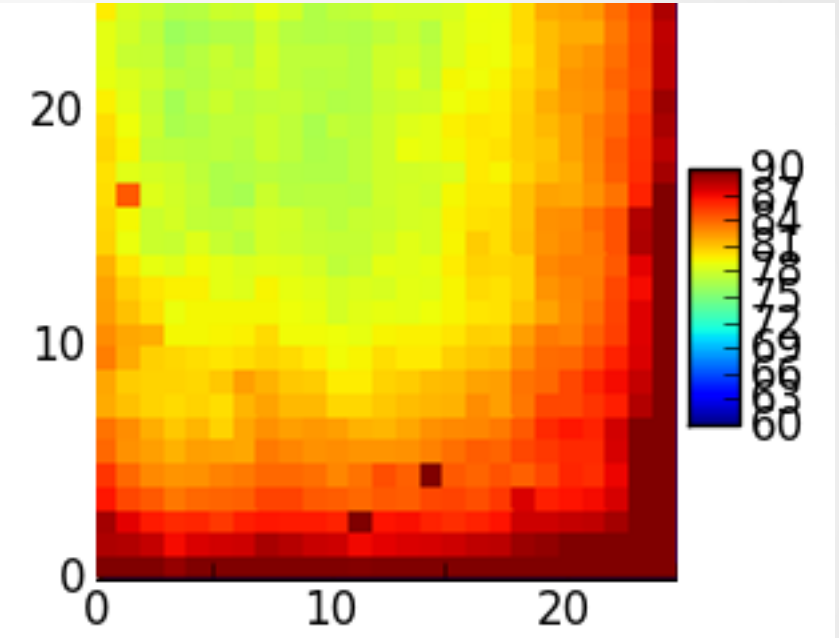
Typical gain map of a GEM foil

Qualitative correlations

- Smaller diameter of the hole makes bigger amplification



Gain map



Optical scanning (outer diameter)

Further plans

- Large GEM foils are to installed into ALICE TPC to reach better time resolution
- A gain measure setup has been verified, a large system for the ALICE upgrade is under construction
- Next year many large GEM foils will be quality checked
- Two method will be applied paralell in order to find further correlation between the geometric parameters and the gain

Summary

- Advantages of GEM based detectors
- Typical fauls during construction
- Importance of GEM-QA
- Alice TPC upgrade
- QA Methods
- Gain scanning

Thank you for your attention!