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MicroMesh Transparency

Short Update

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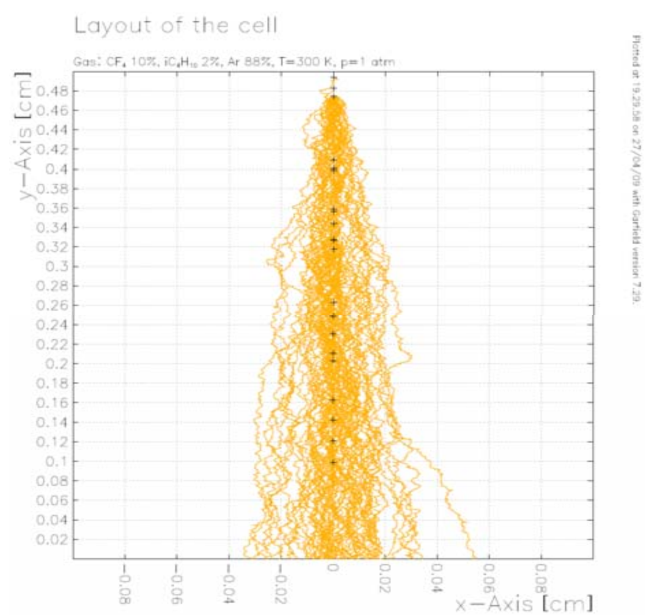
5th RD51 meeting - WG4 Simulation

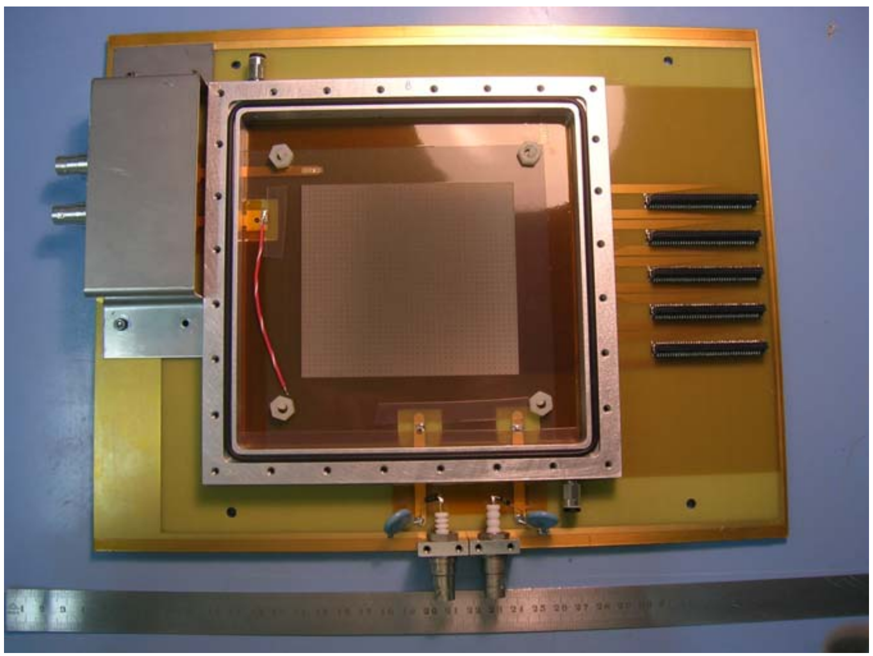
23rd February 2010



MicroMesh Transparency

Aim is to understand the micromesh transparency for electrons by comparing experimental measurements to simulations

→ First results shown in 3rd RD51 meeting in June



For this study a “standard” (10 cm x 10 cm) chamber has been used.

Basic chamber characteristics:

- “T2K” mesh

400 line/inch = 63.5 μm pitch (calendered)

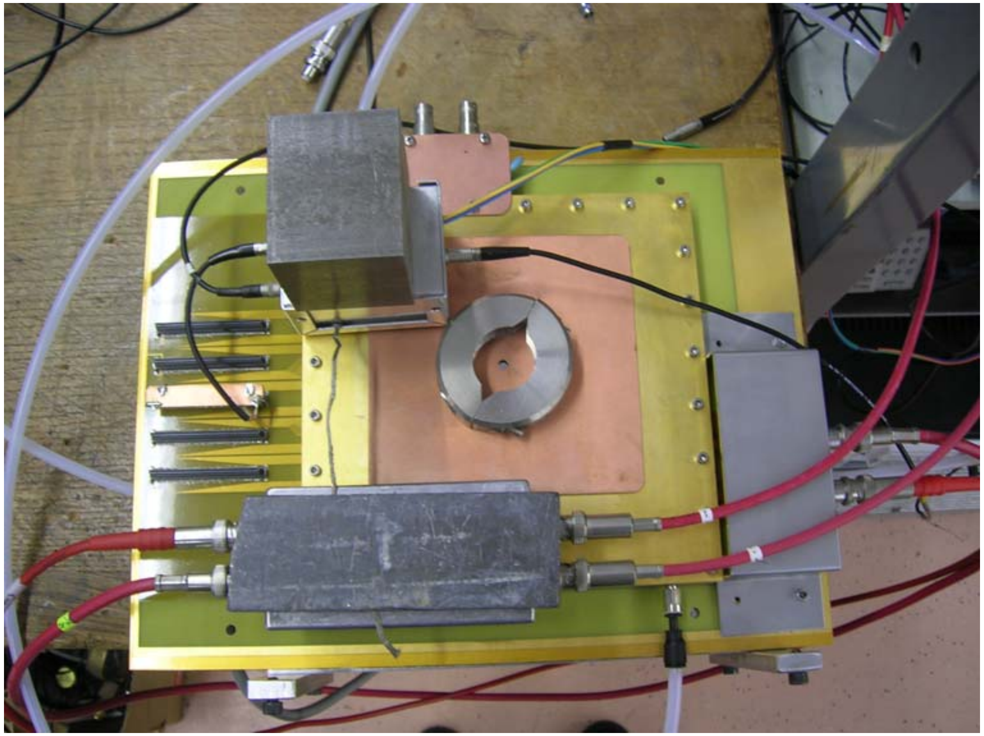
18 μm wire diameter

128 μm amplification gap

Segmented mesh

- Drift distance = 2.0 mm
- Ar 85% CO_2 15%

Measurement Set-up



Measurements with ^{55}Fe / ^{241}Am and long integration time (1 μs)

Sum signal of strips to observe total charge.

Gas gain and electron transparency measurements

→ The latter to be considered here.

Simulation

- Use ANSYS to calculate field maps for different electric field configurations

  → Both rectangular and cylindrical mesh wires used

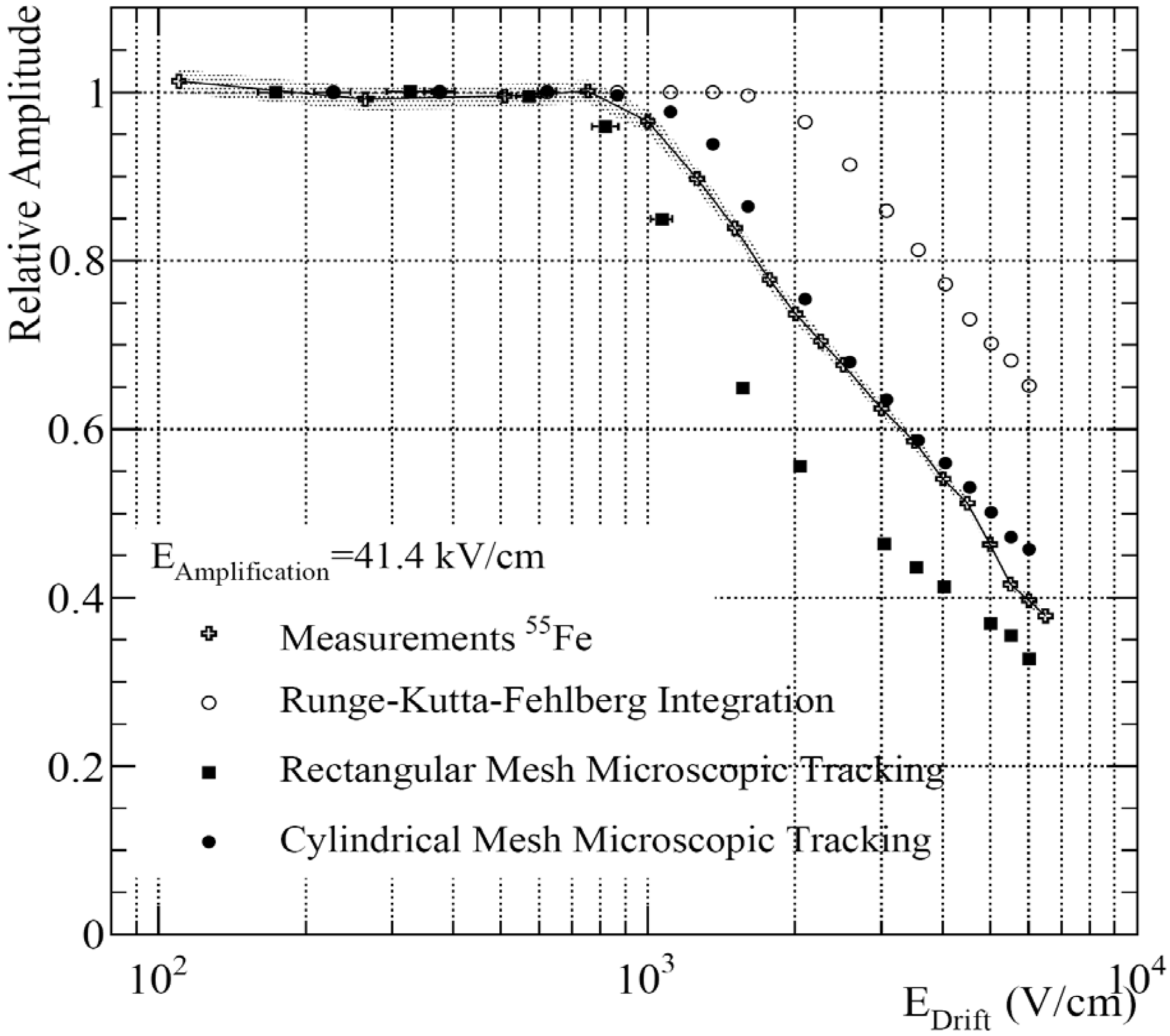
  → Assume mesh wires pass through one another at the intersections (reasonable approximation since calendered mesh used)

- Use GARFIELD/MAGBOLTZ microscopic tracking to produce monte-carlo experiments

  → Take into account diffusion/attachment

- Compare with Runge-Kutta-Fehlberg integration

γ 5.9 keV



Relative Amplitude
0
0.2
0.4
0.6
0.8
1
10^2
10^3
10^4
E_{Drift} (V/cm)
$E_{Amplification}$=41.4 kV/cm
Measurements ^{55}Fe
Runge-Kutta-Fehlberg Integration
Rectangular Mesh Microscopic Tracking
Cylindrical Mesh Microscopic Tracking

Results with the cylindrical grid approximation

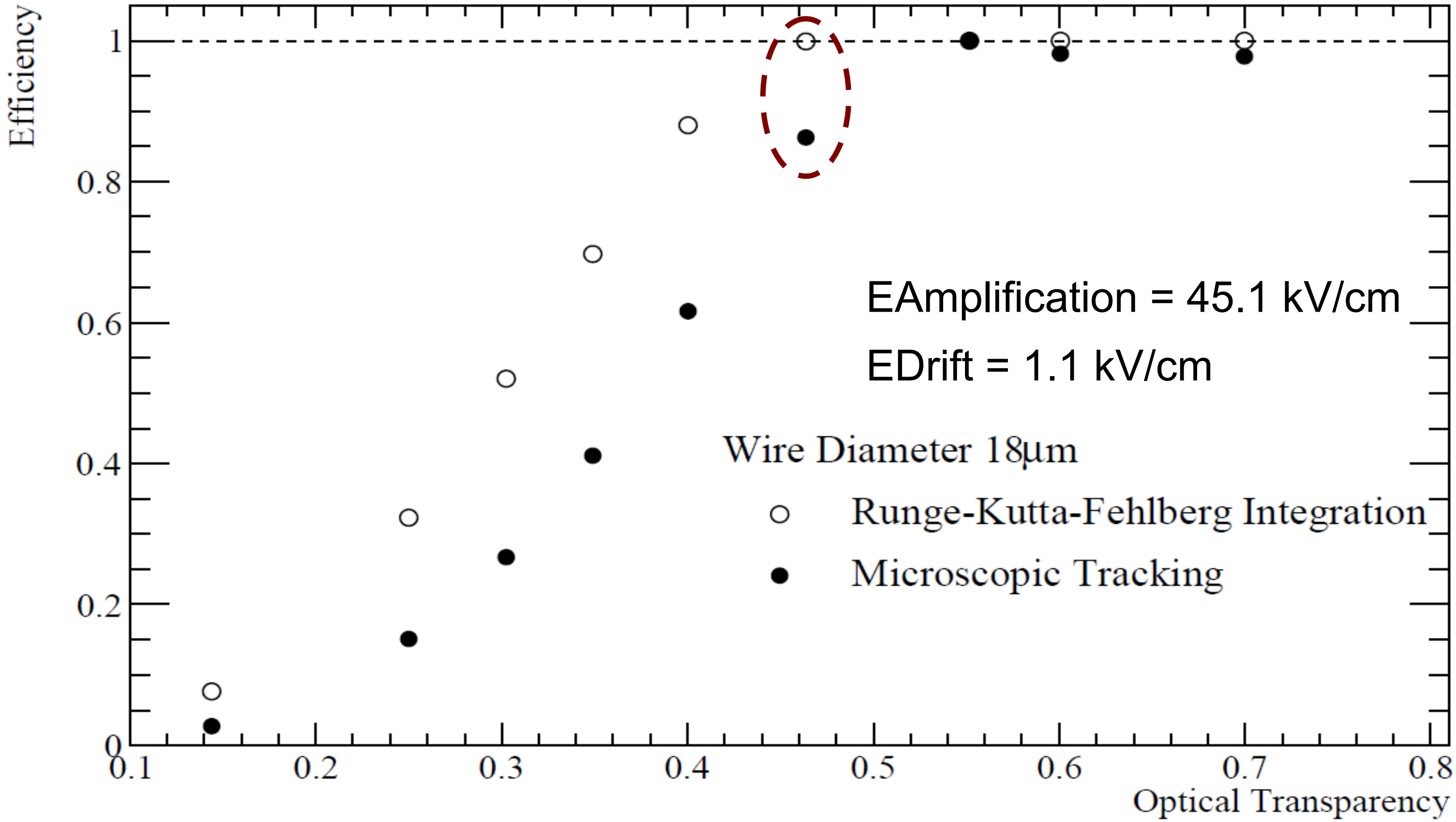
→Clearly, the rectangular mesh is not a good approximation.

→The cylindrical mesh does a much better job, correctly describing the whole efficiency curve

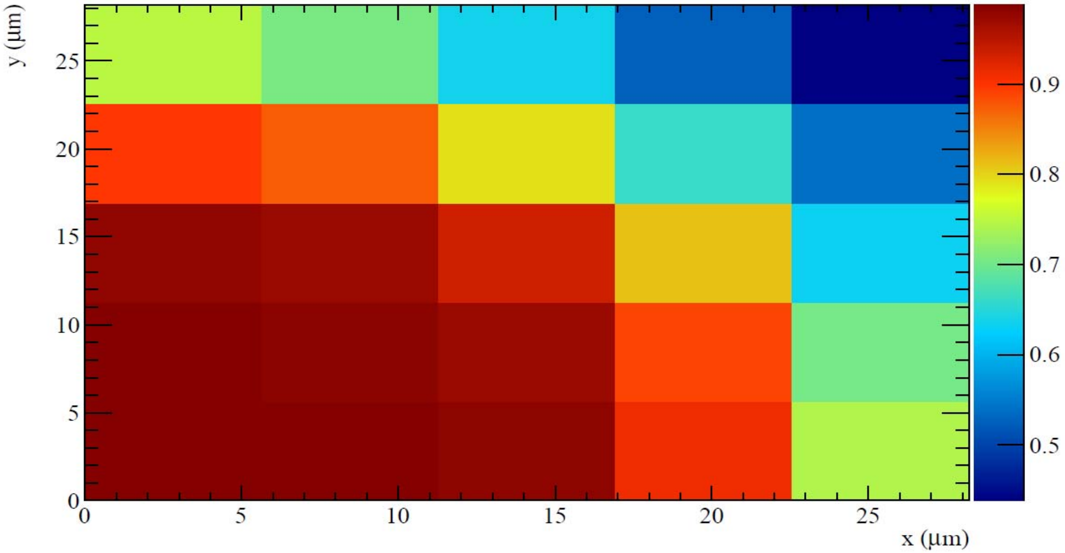
→The RKF integration, which practically counts the fraction of flux lines entering the amplification region, overestimates the efficiency, as expected (no diffusion taken into account)

Effect of Wire Pitch @ Constant Wire Diameter

Nominal mesh geometry



Effect of initial position of the electron



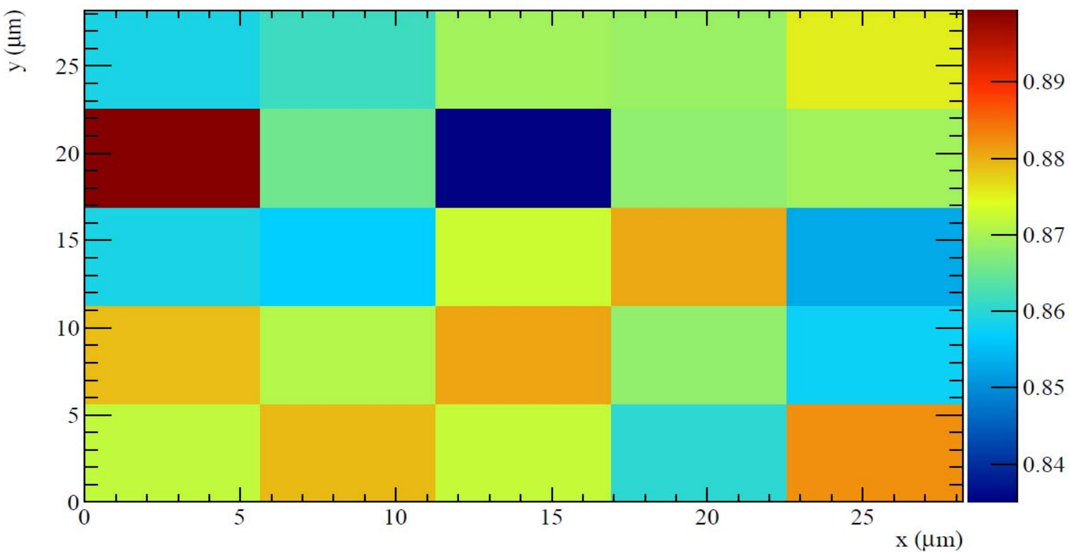
Electron released

5µm above the mesh

Electron released

100µm above the mesh

(statistical error 1.5%)



100 µm (or even 50 µm) of drift smear correlation between transparency and initial position of the electron

Summary

The micromesh electron transparency has been studied.

→The rectangular approximation of the mesh wires was found not to be adequate.

→The RKF integration and the microscopic tracking give similar discrepancies wrt the measurement but with opposite sign.

→If one is constrained on the applied field voltages (eg double stage micromegas) try to keep transparency high by tuning geometrical parameters of the mesh

→Due to the very small size of the Micromesh cell, practically no correlation between the initial position of the electron the efficiency to pass in the amplification region is observed

Many thanks to **Rob Veenhof** for all the discussions and help.