Recent test results of TGEM-Prototypes in INR, Moscow

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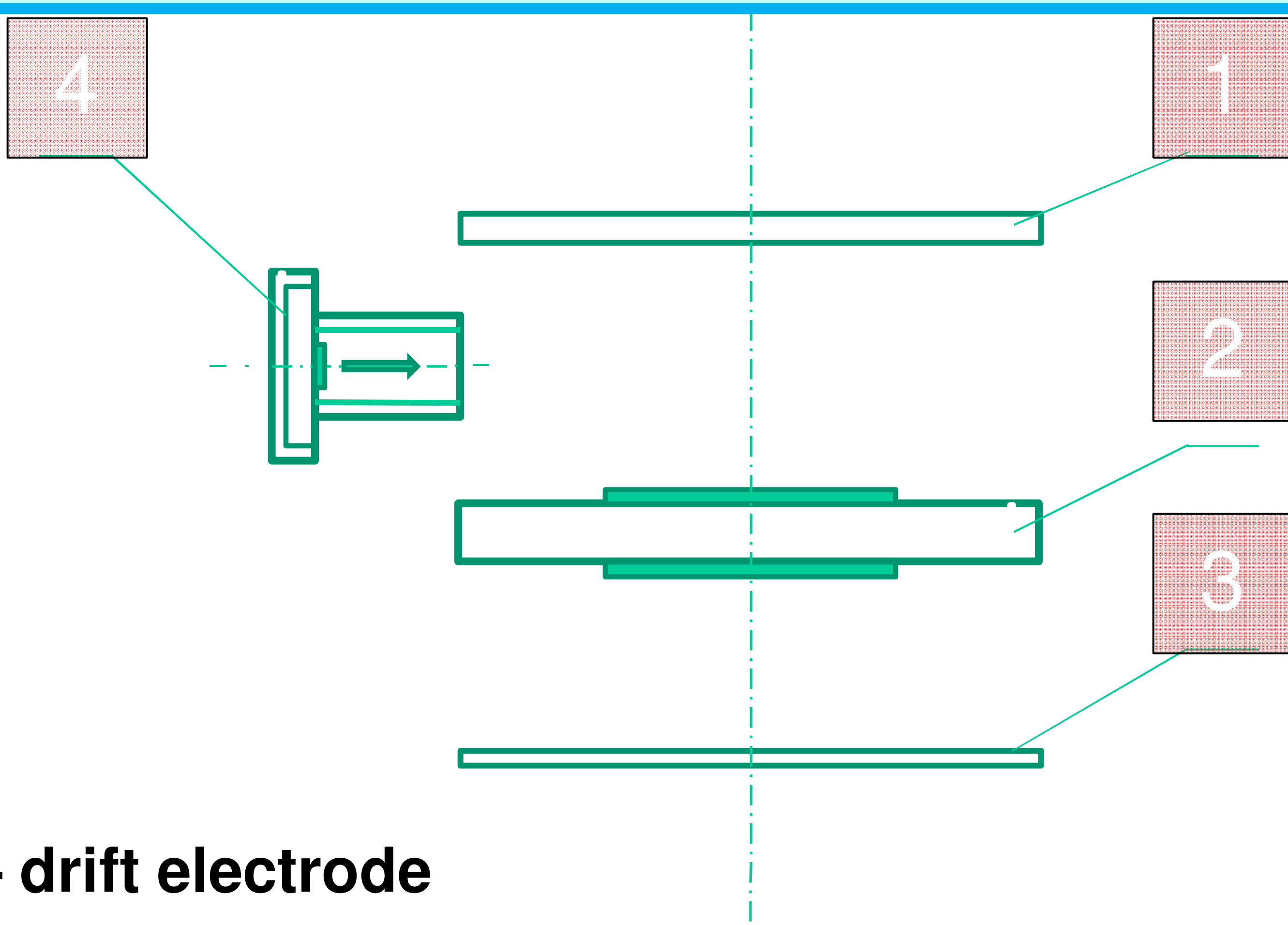
Outline

- TGEM-Prototype (G10);

  → tests by using α and β-particles;
- RETGEM-Prototype with a graphite coating;
- RETGEM-Prototype with polyvinylchloride (PVC) electrodes;
- Construction of TGEM of a new type – Wire GEM (WGEM);
- RICH-detectors with a focusing SiO_2-aerogel radiators:

  the opportunity of the development and application of photo-cathodes in a range λ = 500-600 nm for gas detectors (GEM) of large area;
- Conclusions;
- The work plan of INR-team for 2010 in the frame of R&D51;

TGEM-Prototype (G10)



1 – drift electrode

2 – TGEM

3 – collector

4 – α-source

Fig.1 TGEM Construction scheme

TGEM-Prototype (G10)

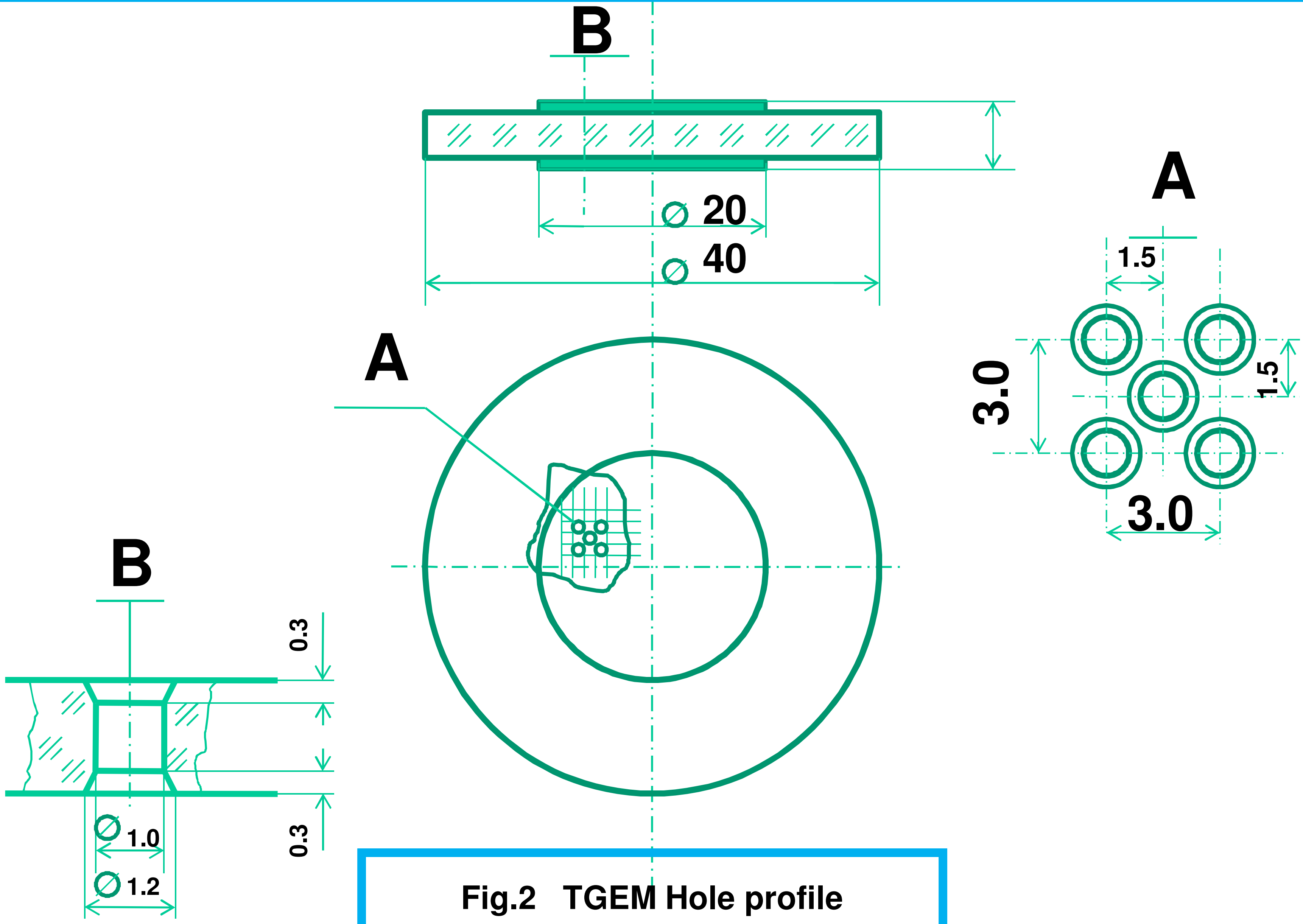


Fig.2 TGEM Hole profile

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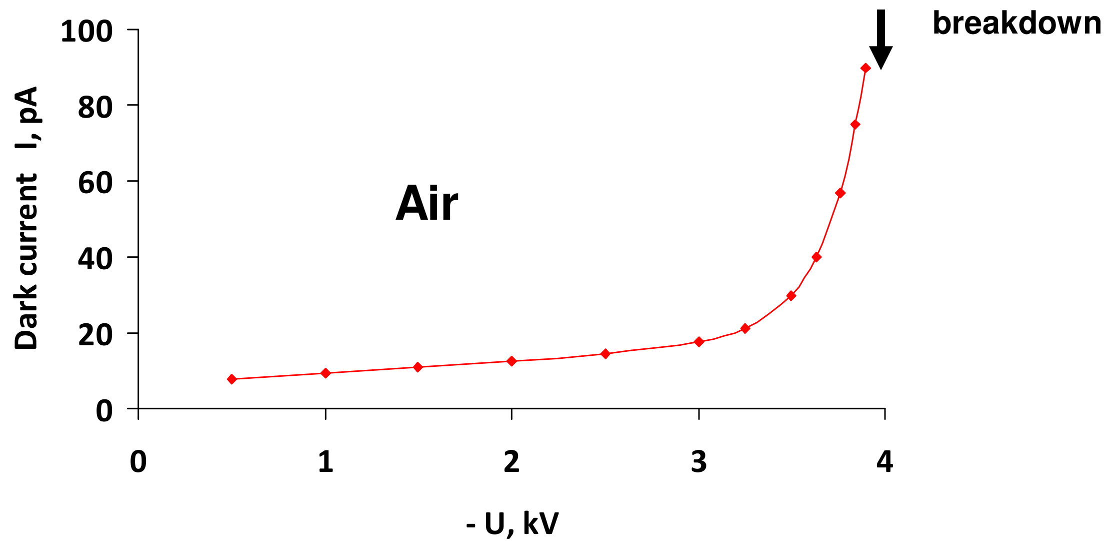
TGEM-Prototype (G10)



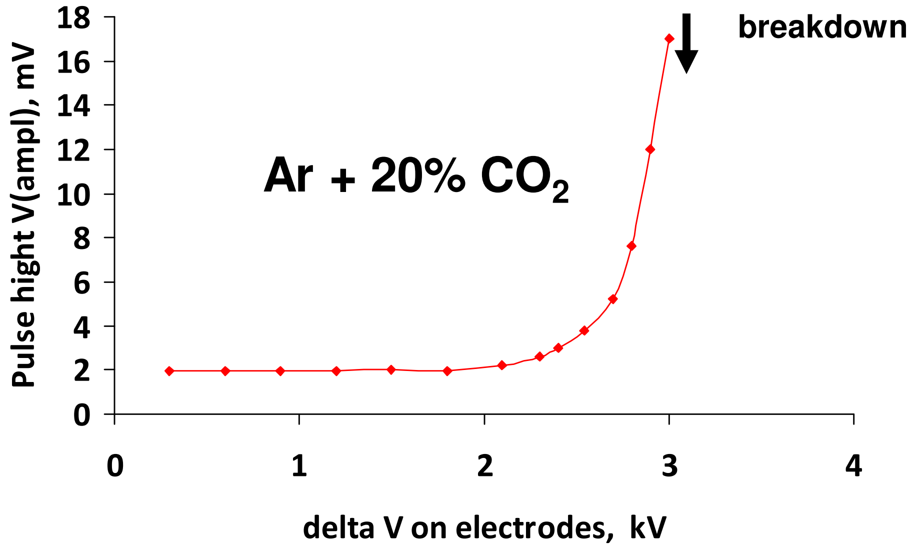
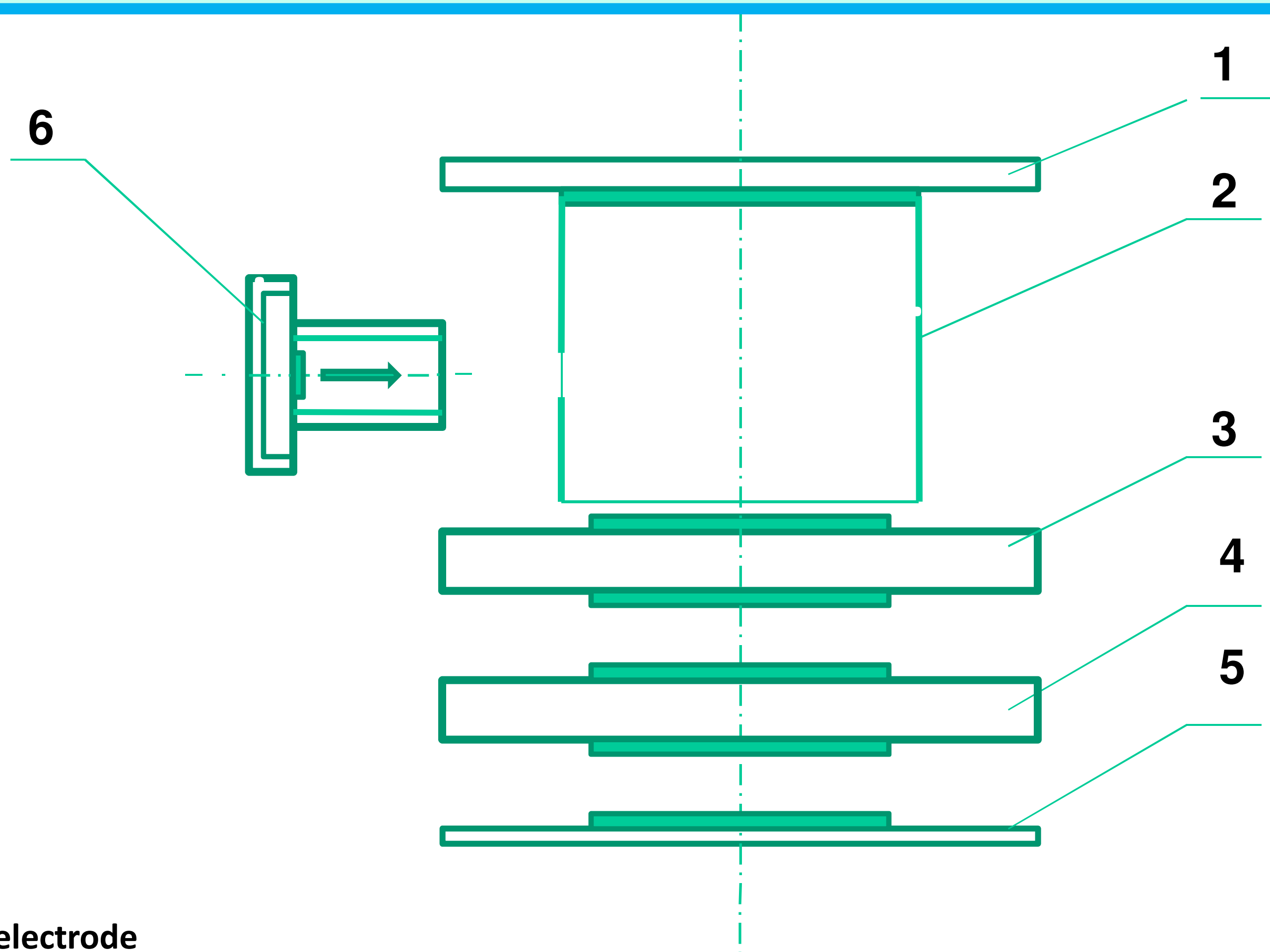


Fig.3

Double-TGEM-Prototype (G10)



1. Drift electrode
2. Field masking cylinder
3. TGEM1
4. TGEM2
5. Collector
6. β-source

Fig.4 Double-TGEM Construction scheme

Results of the simulation of the double-TGEM-Prototype geometry (“field masking cylinder”)

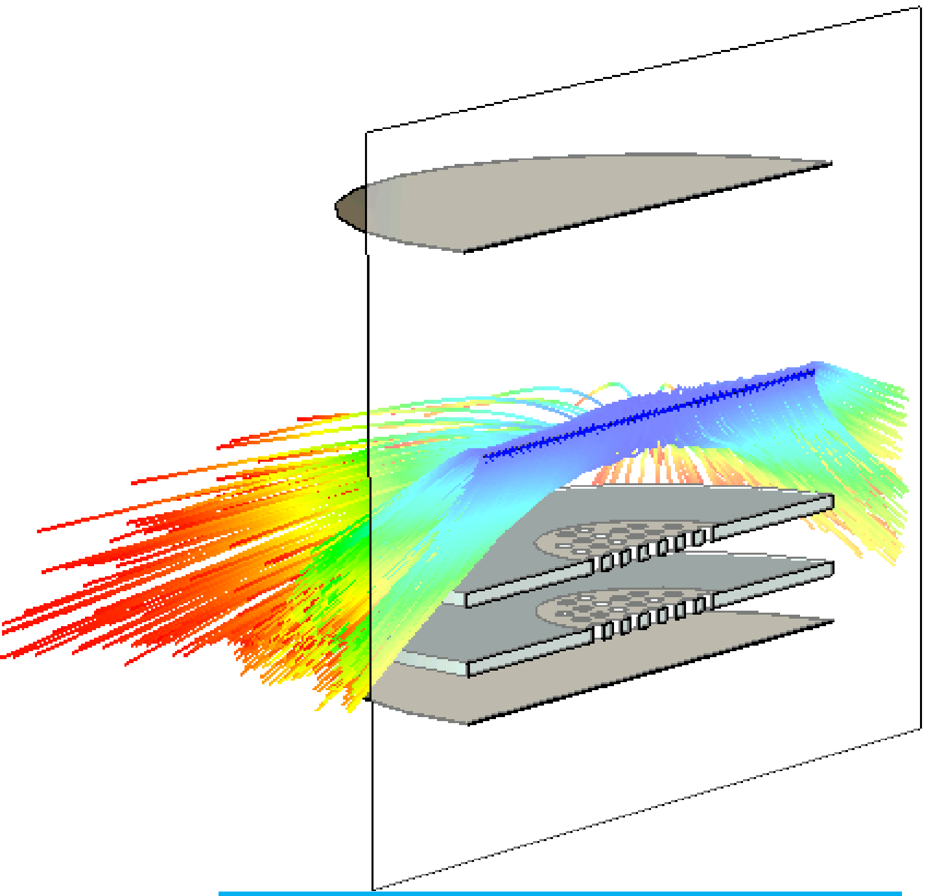


Fig.5 Charge avalanche without “field-masking cylinder”

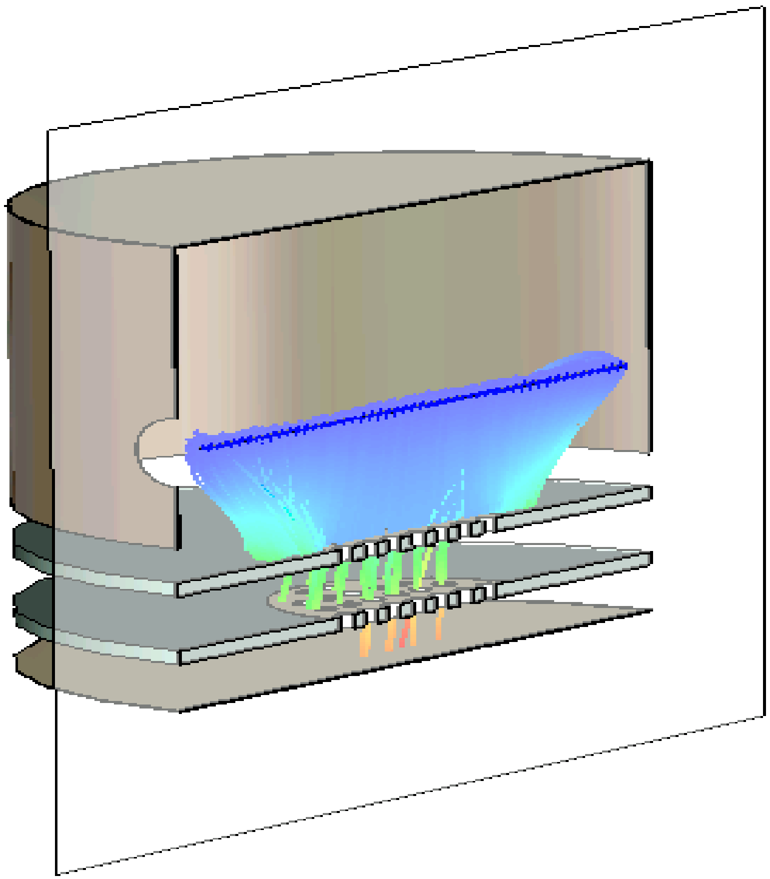


Fig.6 Charged avalanche with “field-masking cylinder”

Double-TGEM-Prototype (G10)

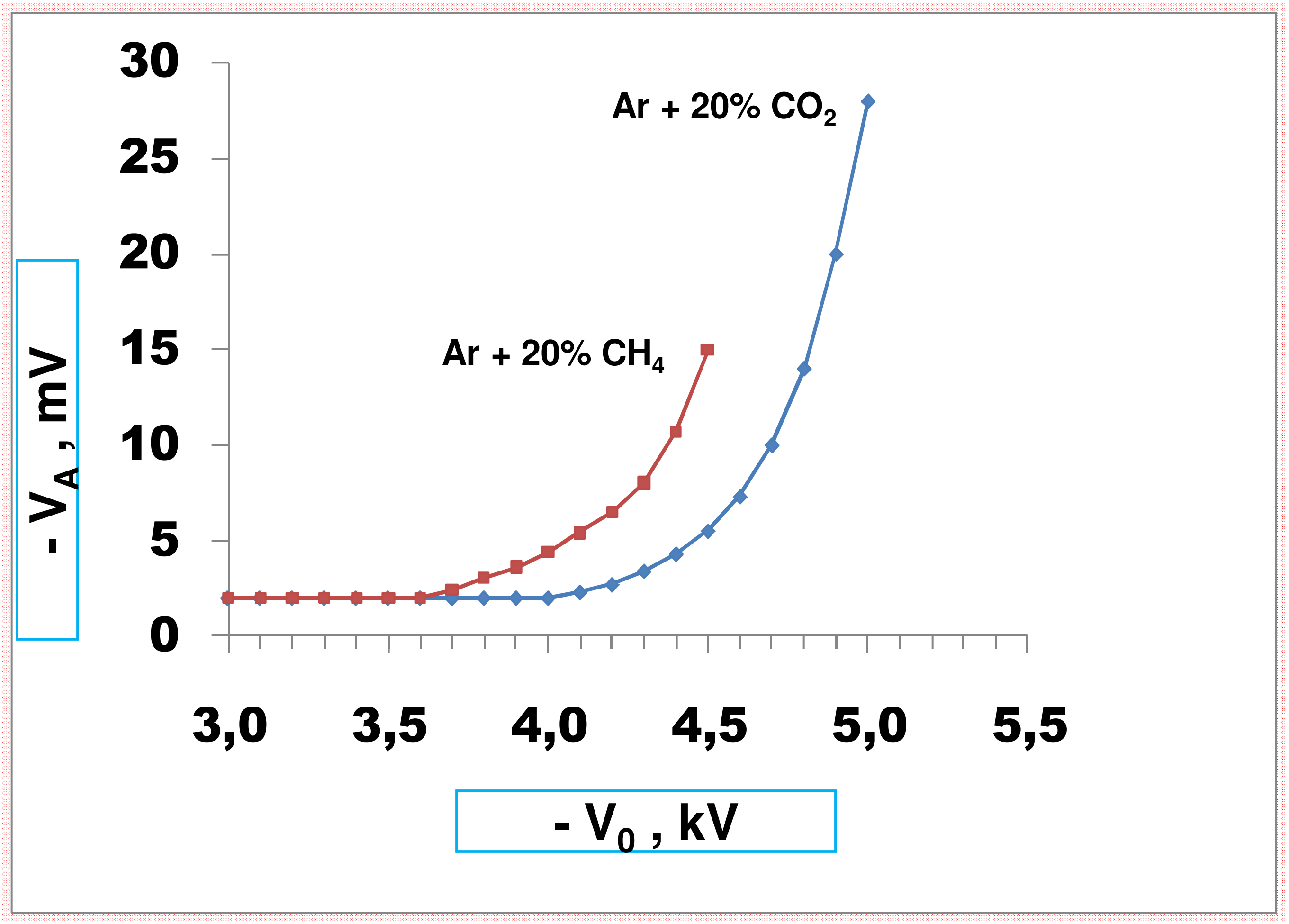
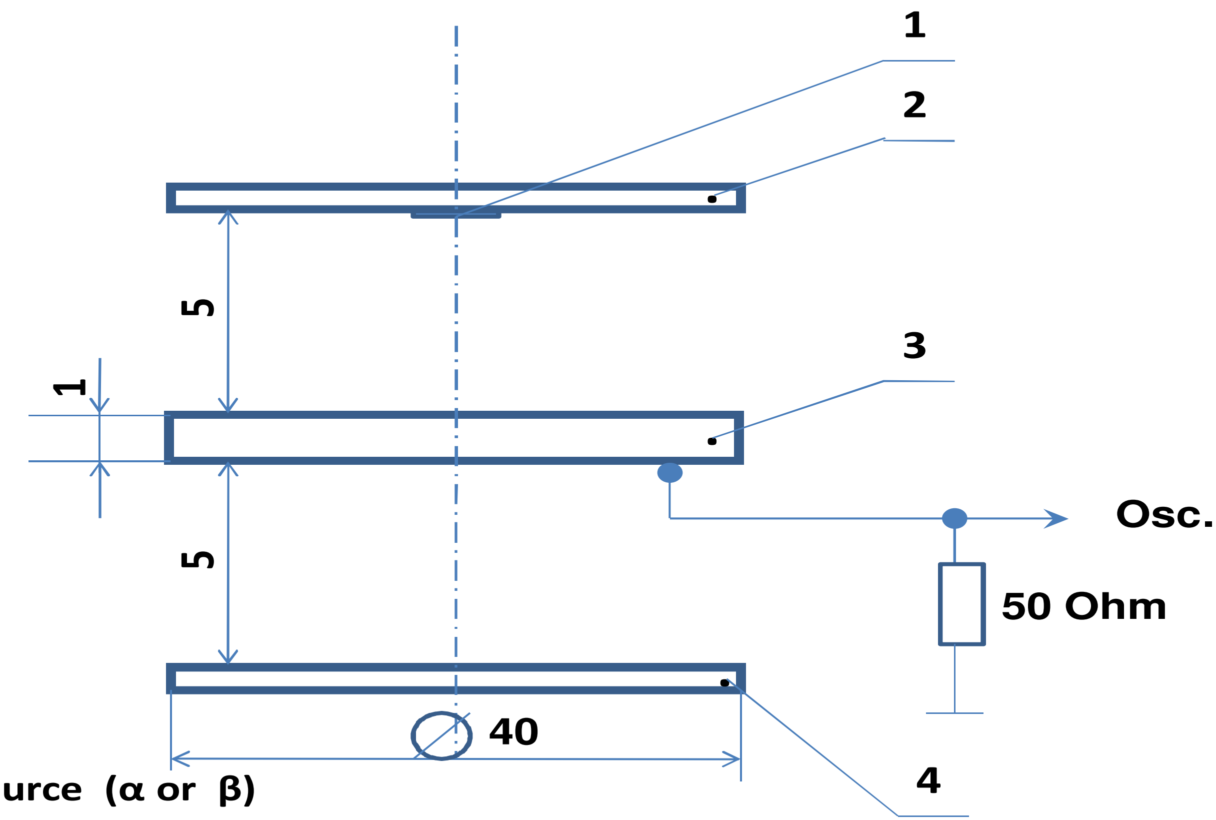


Fig.7

RETGEM-Prototype with a graphite coating and polyvinylchloride (PVC) electrodes



1 – Radioactive source (α or β)

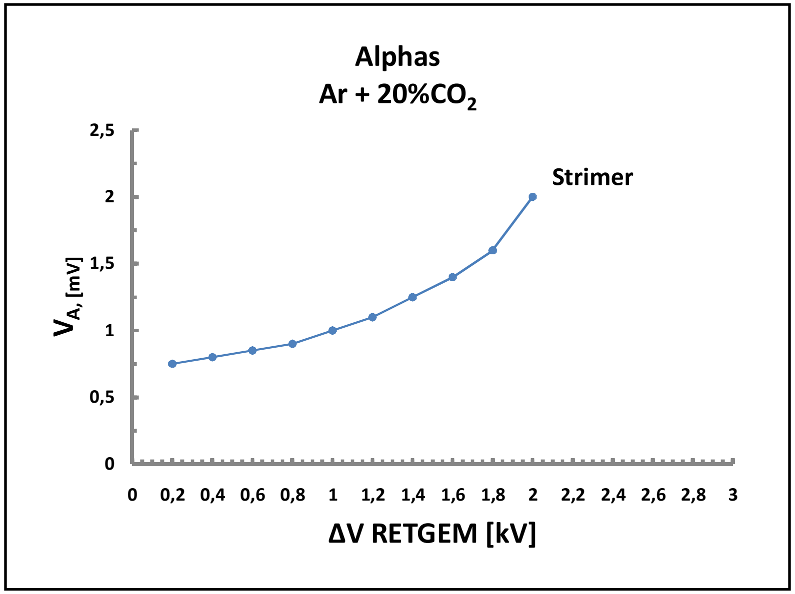
2 – Drift electrode

3 – RETGEM

4 – Collector

Fig.8 Schematic drawing of the experimental setup for testing of the RETGEM

RETGEM-Prototype with a graphite coating and polyvinylchloride (PVC) electrodes



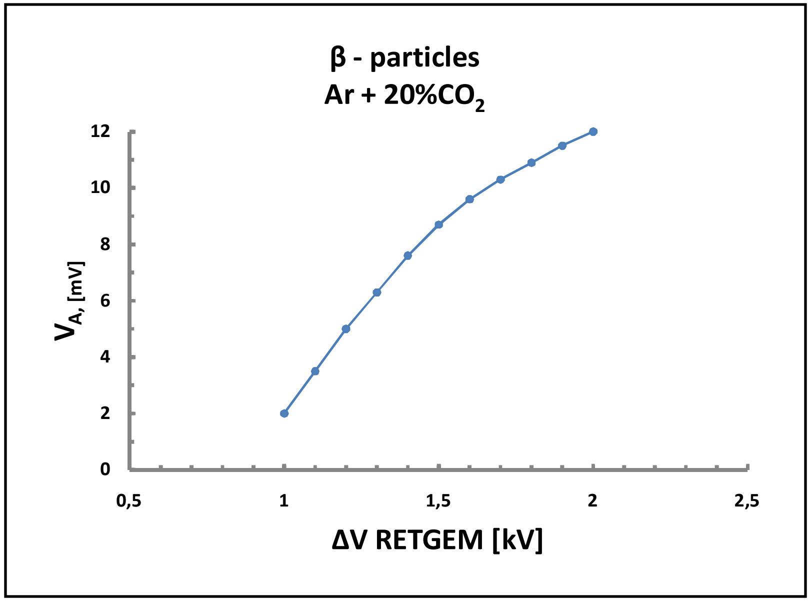


Fig.9 The amplitude of the signal v.s. voltage with the RETGEM operating in Ar + 20% CO_2 using α-source with I = 10^4 particles/s.

Fig.10 The amplitude of the signal v.s. voltage as a Fig.5 using β-source with I = 10^3 particles/s.

Construction of TGEM of a new type – Wire GEM (WGEM)

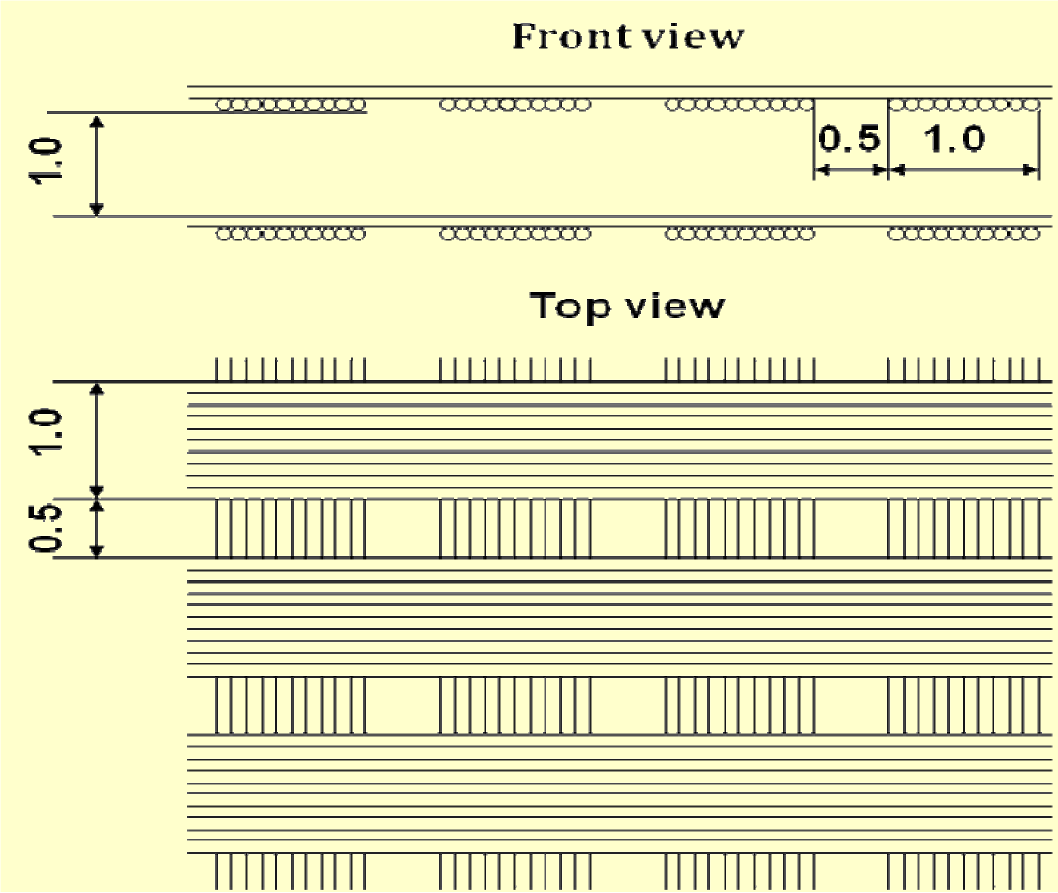


Fig.11. WGEM-detector layout

Construction of TGEM of a new type – Wire GEM (WGEM)

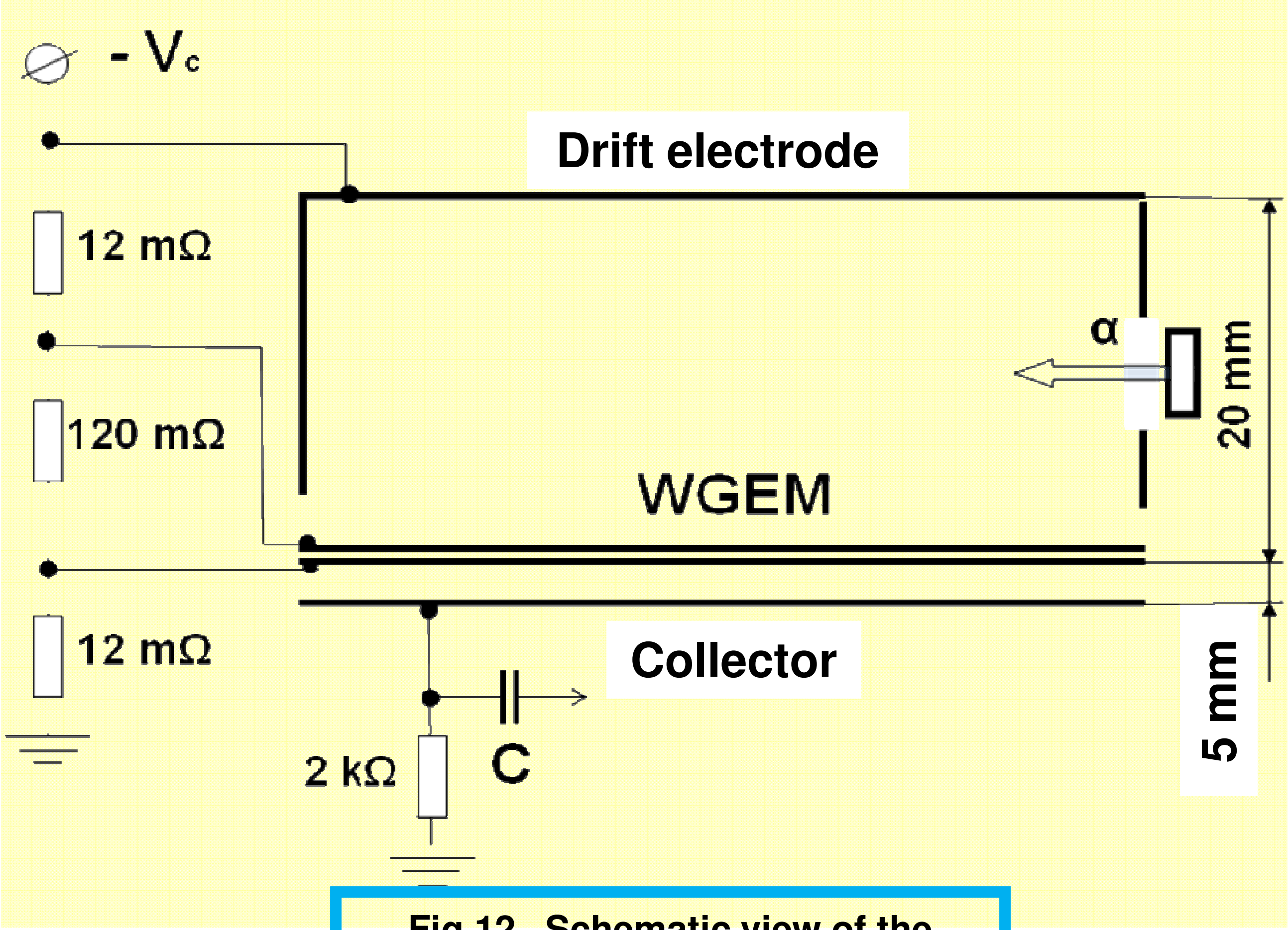


Fig.12. Schematic view of the experimental setup

Construction of TGEM of a new type – Wire GEM (WGEM)

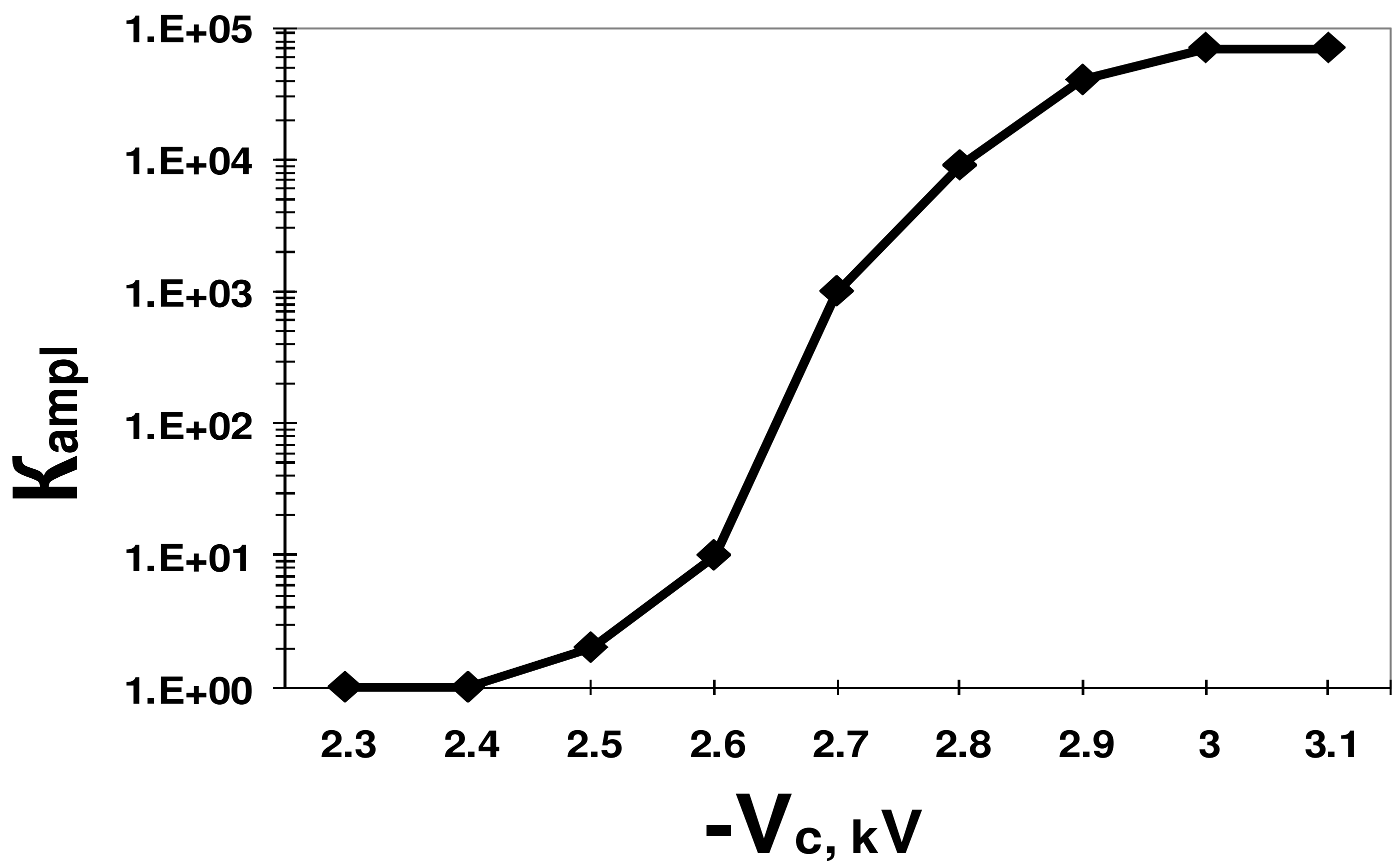


Fig.13 Gain K_{amp} vs voltage V_c

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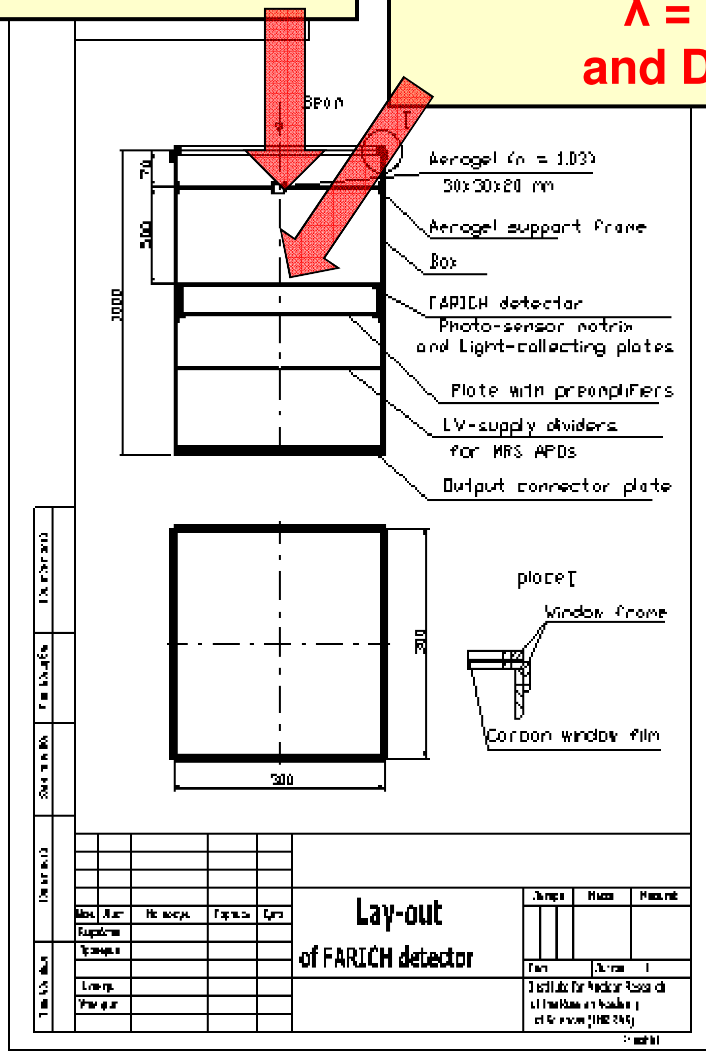
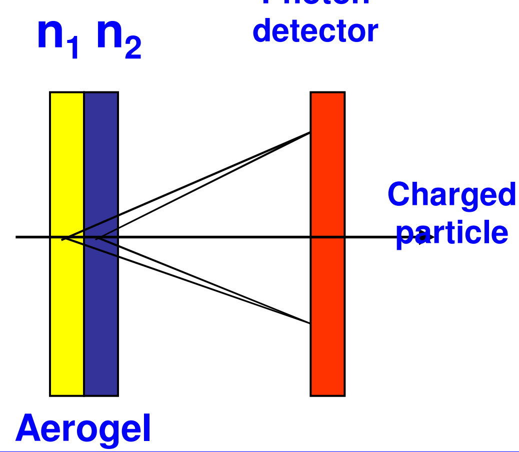
FARICH conception with the TGEM option for ALICE upgrade

AEROGEL radiator

Photo-cathode film in a range λ = 500-600 nm and Double TGEM





The main goal of the FARICH concept is

- to increase the number of photons by using thicker radiator;
- to focus Cherenkov cones on the detector sensitive plane without degrading the angle resolution.

The FARICH proximity focusing type geometry was proposed.

- the use of several layers of aerogel with gradually increasing refractive indices, n3 > n2 > n1 allows to focus Cherenkov cones of the same radius;
- refractive indices are determined by different proximity gaps.

Conclusions

1. TGEM, RETGEM and WireGEM-Prototypes were tested at INR RAS (Moscow).

2. Measurements were performed by using radioactive sources with a different directions of α and β-particles.

3. The performed computer simulation enabled to optimize the TGEM construction and generated a need of using "field-masking cylinder".

4. The development of photo-cathodes in a range λ = 500-600 nm for gas detectors (GEM) of large area will define future trends of the FARICH full-scale constructions.

5. There were strimers in TGEM and RETGEM at conditions satisfying a Rather-limit $\alpha \times M \geq 10^8$ with a discharge current < 10 mkA.

6. No sparks (spark current > 10 mA) and no equipment death was observed.

7. It was observed that the strimer is accompanied by pre-impulse (precursor) with the signal amplitude defined by a mode of limited proportionality.

8. The delay time between the strimer and precursor is always constant.

9. The drift of the electron avalanche in the double TGEM is taking place at the field 1 kV/cm – much lower than one measured for other prototypes.

10. The formation of the strimer in TGEM, RPC, MICROMEGAS etc. with gapes of 1 mm and much smaller is evidence of a unified origin of strimers in the gas medium with a uniform electrical field.

The work plan of INR-team for 2010 in the in the frame R&D51

In the frame of R&D51 we would like to work on the following problems:

1. Investigations of the nature of a strimer mode of the gas discharge.
2. Developments of photo-cathodes in a range of the light length 500 -600 nm for gas detectors of large area, in particular, for the RICH detectors with a focusing aerogel radiators.
3. Studies of the performance of TGEM detectors of the new types.
4. The computer simulation of the physical processes in gases for the optimization of the construction of GEM, TGEM, RETGEM detectors.