

RD-51CM





Advances in the study of electro luminscence induced by high electric fields outside GEMs

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CYGNO

• CYGNO is the project of a directional detector, whose main goal is the direct detection of Dark Matter





MANGO & LEMON

Lenses





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55 Fe Expected Signal

• 5.9 keV X-ray emission is expected to be contained in few hundreds micrometers

• The diffusion (especially in GEMs) spreads the electrons to a round blob of 2-3 mm



LEMON

NEW LEMON SETTINGS



EL: LEMON CHARGE MEASUREMENTS

• Exploiting Lemon prototype all GEM currents were read in continous way.

16/06/2021



G.Dho, *Electro-luminescence*

- All GEM electrodes are read
- Sum of II currents is consistent with zero
- Between the last GEM and the mesh there is some extra charge produced only above 13/14 kV/cm

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EL: LEMON LIGHT AND CHARGE MEASUREMENTS



EL: LEMON LIGHT AND CHARGE MEASUREMENTS

• Simply modelling the electric field in the GEM holes the behaviour in two different conditions can be tested:

Varying the GEM voltage

Varying the field in the gap



EL: LEMON LIGHT MEASUREMENTS WITH ITO

• An ITO glass mesh was also installed on LEMON.

 \cdot With 60/40 He–CF $_{\!_4}$ and triple thin GEM structure the same light and charge behavour



EL: LEMON LIGHT MEASUREMENTS WITH ITO

• An ITO glass mesh was also installed on LEMON.



MANGO

NEW MANGO SETTINGS

GAS Flow: 180 cc/min 1 atm He:CF₄ 60/40 and 70/30

125um GEM , 175um holes 350um pitch



50um GEM , 70um holes 140um pitch

LIGHT MEASUREMENTS

• Three configurations studied Triple thin, mixture 60/40



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G.Dho, Electro-luminescence

LIGHT MEASUREMENTS

• We looked at the gain moving the voltages across the GEM to find working points



 \bullet Intense increase in light production was visible at high $\mathsf{E}_{_{\mathrm{mesh}}}.$ Double thick configuration especially.



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EL: TRIPLE THIN



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• Energy resolution is pretty stable given a configuration.

• Double thick configuration has a strong degradation of resolution at higher Emesh



- Energy resolution has a peculiar behaviour
- TT configuration has a strong degradation of resolution at higher E_{mesh}



- Energy resolution has a peculiar behaviour
- TT configuration has a strong degradation of resolution at higher E_{mesh}



- Also the size of the spots tends to become large
- Double thick configuration has a stronger degradation also of the spatial resolution



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CONCLUSIONS

• In the context of a DM directional detector, based on gaseous TPC optically readout, it is of relevant importance to study the behaviour of light yield in different configurations.

- With MANGO and LEMON protoypes we continued studies on the performances after the addition of a electric field underneath the bottom GEM.
- The application of intense electric field toward the mesh produced a visible increase in the light output without an equal increase in charge due to electron multiplication suggesting that a form of electro– luminescence in a He:CF₄ mixture is still taking place.
- The studies will continue to assess still unclear and possible effects of the geometry structure and of this intense electric field.

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BACKUP

LUMINESCENCE IN HE:CF₄

• The light emission from CF_4 , also in mixture with He, was studied in the past [1-2]



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G.Dho, Electro-luminescence

ELECTRO-LUMINESCENCE



- The very intense electric field in GEM holes ionizes the gas and produce multiplication of
- During the ionization process also neutral fragment of CF₄ are produce with consequent emission of light
- ► 0,07 ph/el Increasing the amount of light would improve
 - It could be useful to generate more photons, drifting the electrons at lower field for longer, enhancing excitation of the gas without any

SIZE MEASUREMENT

• To quantify the dimension of the spots, trying to be independent from the light output, all

the spots are centred and summed and the sigma of the shape is fitted with a gaussian

