PROTOTYPE TPC FOR THE MEASUREMENT OF COSMIC MUON FLUX

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OBJECTIVE

Study the integrated muon flux in different directions at different latitude, altitudes and underground and that can be included in neutrino event generators to reduce the uncertainty of neutrino flux.

DETECTOR

For this the most suitable detector is a Time Projection Chamber(TPC), which provides position resolution in millimeter range and better rate capability compared to atmospheric muon rate. Also the electronics required is minimal compared to other detectors and transportation easier.



BOTTLENECKS



No multiple pulses are observed in the anode(RED) with a muon trigger.



Reflection in the readout channel.

GAS COMPOSITION

• The selection of gas is made on the basis of position resolution and other secondary effects.

 $\sigma_x^2 = \left(\frac{1}{64N^2}\right) \cdot \frac{1}{x^2} + \frac{2D}{v_d} \cdot x + \sigma_{const}^2$



TPC DESIGN

- Drift Length 14 cm.
- Gas used P10, Argon- $CO_2(80\% 20\%)$.
- Readout used Tried Thick GEM, but due to fabrication issues followed by discharges, using MWPC now.
- Anode Wire Material- Gold plated tungsten.
- Anode wire dia 25 μ m.
- Voltage divider Twenty 5 M Ω resistors making a total of 100 M Ω .
- Applied Drift Field for Ar- $CO_2(80\% 20\%)$ 400 V/cm.
- Applied Drift Field for P10 150 V/cm.
- Drift Velocity for Ar- $CO_2(80\% 20\%)$ at 400 V/cm is 1.2 cm/ μs corresponds to a total drift time of 11.6 μs .
- Drift Velocity for P10 at 150 V/cm is 5 cm/ μs corresponds to a total drift time of 2.8 μs .
- HV on Anode wires for Ar- $CO_2(80\% 20\%)$ is 2900 V.
- HV on Anode wires for P10 is 2500 V

MWPC DESIGN



DESIGN CONSIDERATION

Fractions of charge flowing to the various electrodes in the readout chamber depends on various features such as the angle under which the ions leave the anode wire.



The anode wire has to be of small dia, and should be able to withstand more tension.

- x (mm)
- If the size of detector is big, the non satureated drift velocity will also deteriorate the rate capability and localization accuracy of the detector.
- Standard argon-methane 90-10 (P10) mixture satisfies the requirements of a high drift velocity and low diffusion at moderate drift field values, and has been the preferred choice for the first generation of TPCs.
- For P10 peak drift velocity is around 150 V/cm at STP.
- A replacement of methane with carbon-dioxide satisfies the diffusion requirements despite a lower drift velocity.

Drift Velocity



Longitudinal Diffusion Constant



New Pickup Pannel





DISCHARGES





References

[1] F. Sauli. Principles of operation of multiwire proportional and drift chambers In *CERN* 77-09
[2] D. R. Nygren, J. N. Marx The Time Projection Chamber In *Physics Today* 31 (101978), pp 46-53.

A FUTURE DIRECTION

- Solve the problems reflection in the signal.
- Modify the anode plane with seprate current limiting resistor for each wire.
- Make Feedthroughs for bigger TPC.
- Develop the electronics for the readout.



