



The development of novel high-efficiency fast neutron detector based on triple GEM

WANG Xiaodong^{1,3}

HU Bitao¹, DUAN LiMin², YANG Herun,

ZHANG Junwei², LU Chengui², HU Rongjiang², Wu Huiyin¹

1 School of Nuclear Science and Technology, Lanzhou University

2 Institute of Modern Physics, Chinese Academy of Sciences

3 School of Nuclear Science and Technology, University of South China

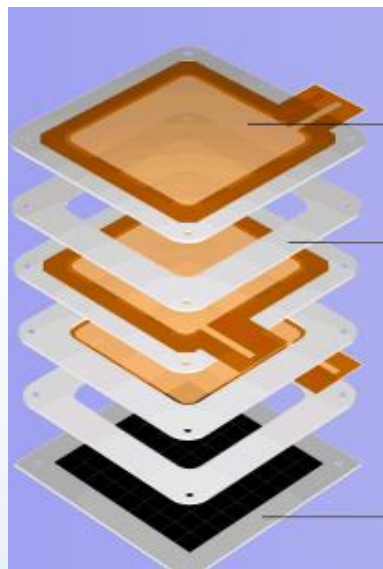


Outline

- Design, assembly and test of Triple GEM
- The preliminary results of the high-efficiency fast neutron detector based on Triple GEM
- Conclusion



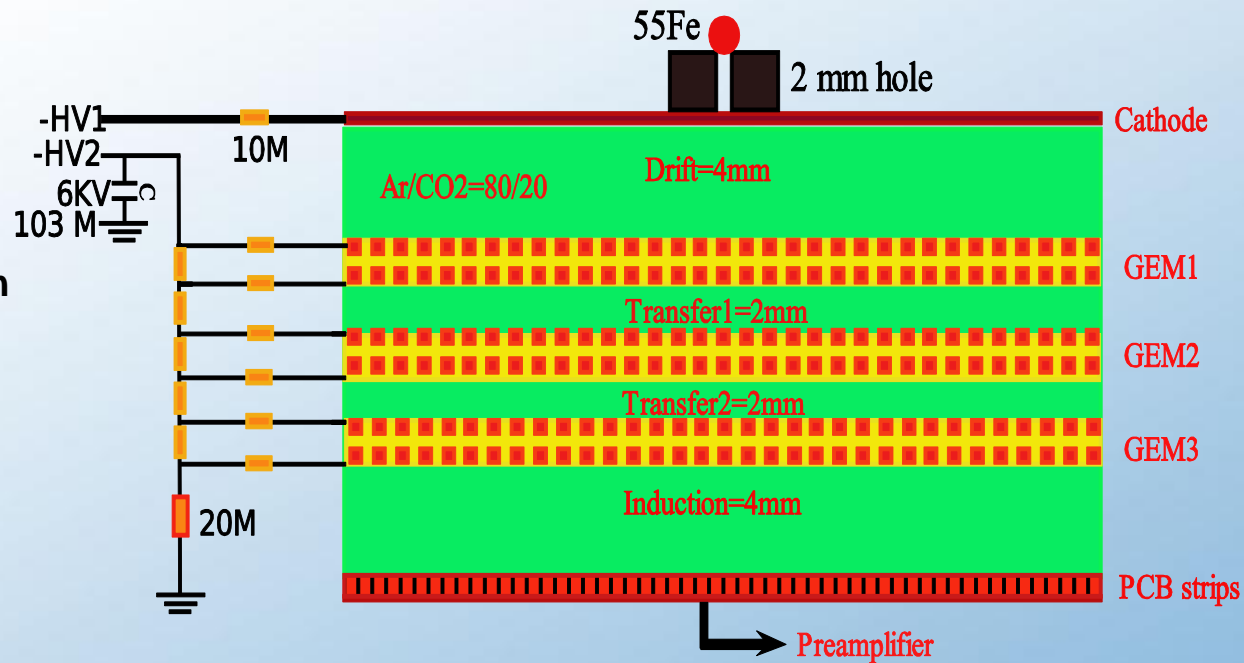
Design, assembly and test of Triple GEM



gem

partition

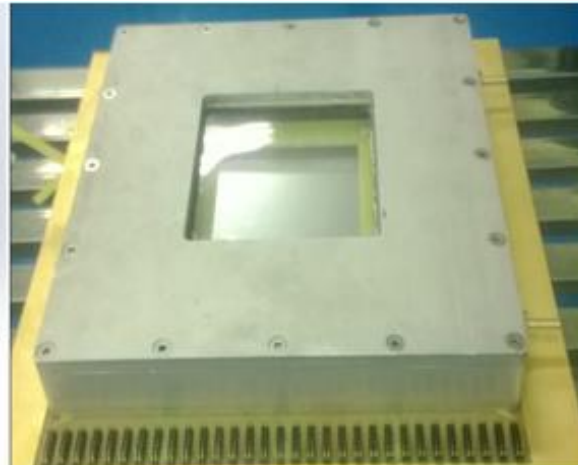
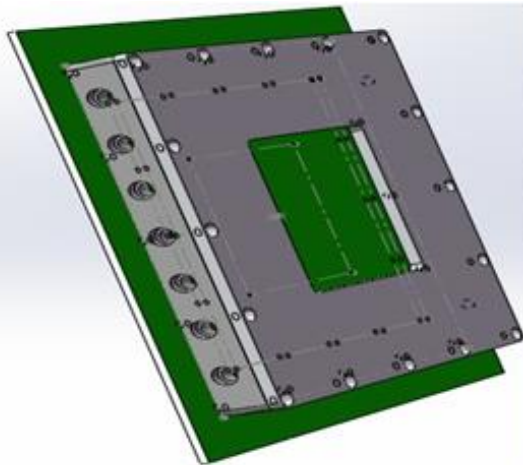
PCB



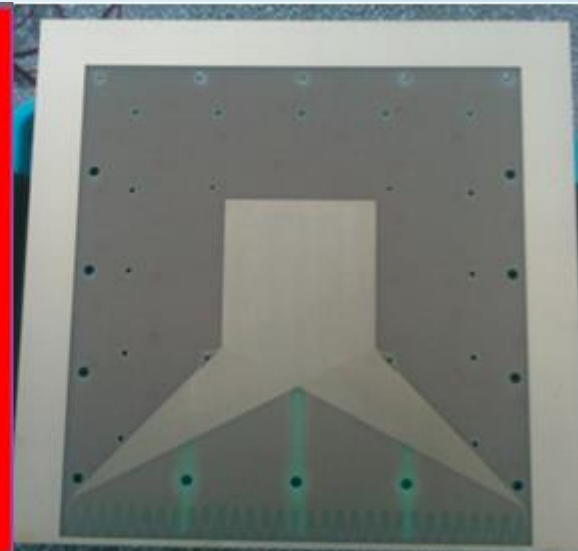
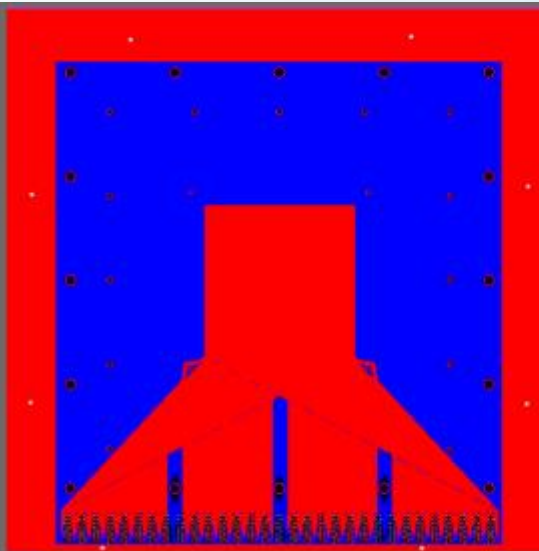
Triple GEM detector



Design, assembly and test of Triple GEM



dimension: 290X290X56 mm³
Volume: 256.5X256.5X33 mm³
High voltage: seven
Inlet and outlet : the same side
by SolidWork



Dimension: 360X360 mm²
Readout way: strips
width: 110 um
interval: 80 um
Sensitive rane : 100X100 mm²
Number: 496
by AutoCad and AltiumDesigner



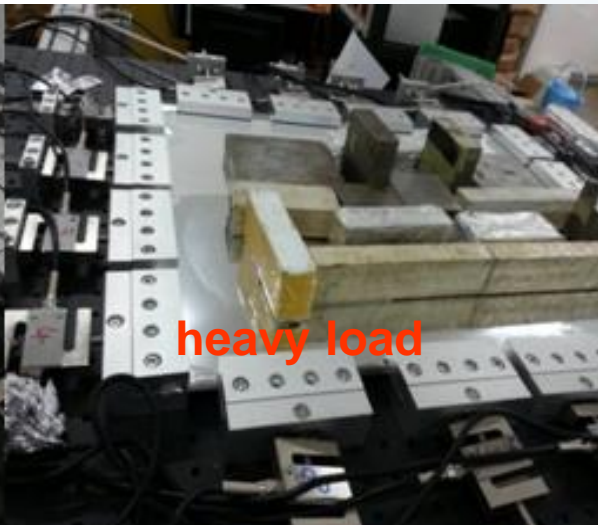
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Design, assembly and test of Triple GEM

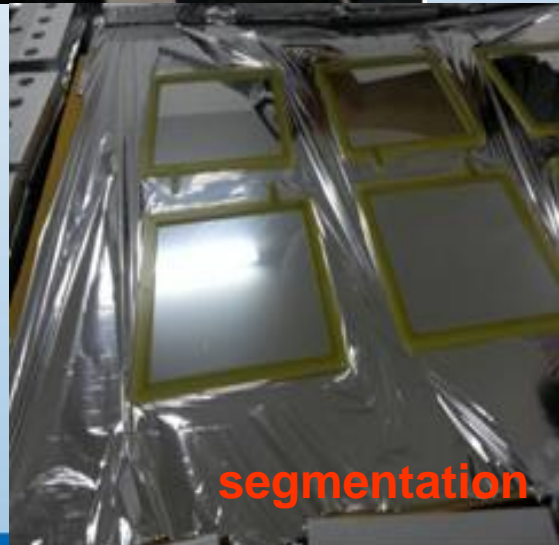
The drift electrode



stretching



heavy load



segmentation

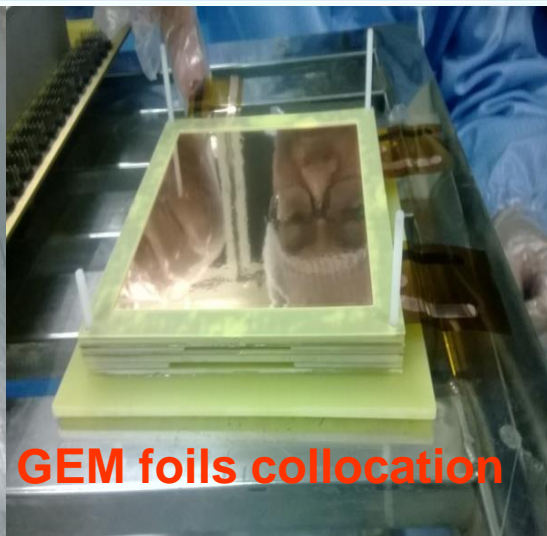


Drift electrode

Design, assembly and test of Triple GEM



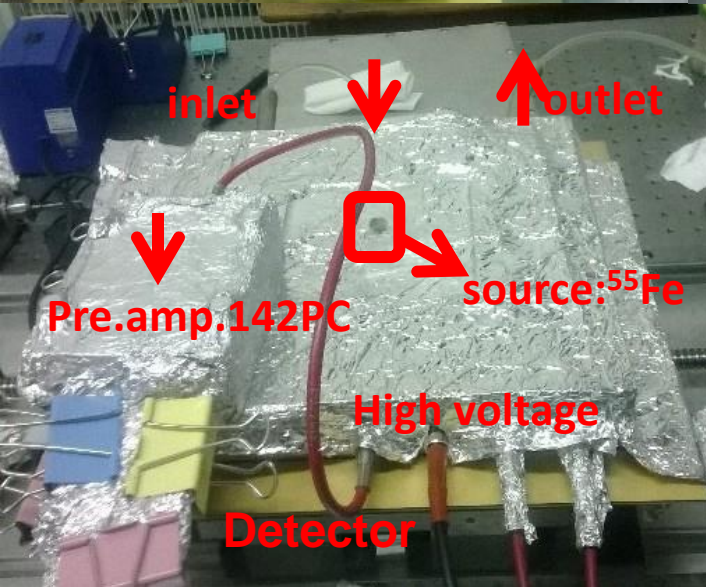
Gas leak test



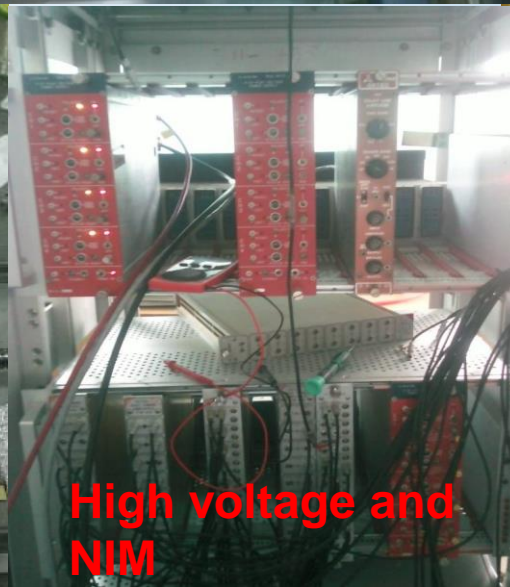
GEM foils collocation



Work gas: Ar: CO₂=80:20



inlet
outlet
Pre.amp.142PC
source: ⁵⁵Fe
High voltage
Detector



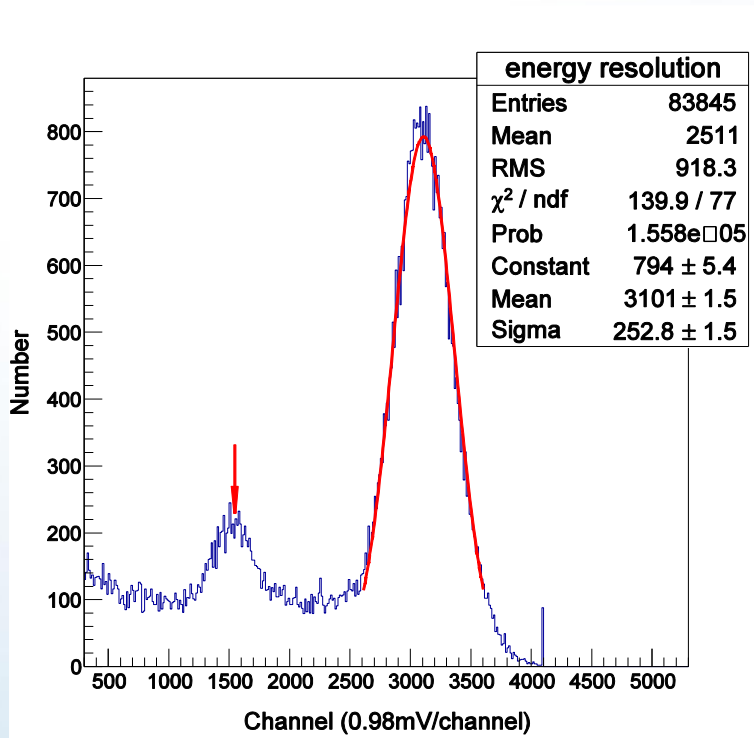
High voltage and NIM



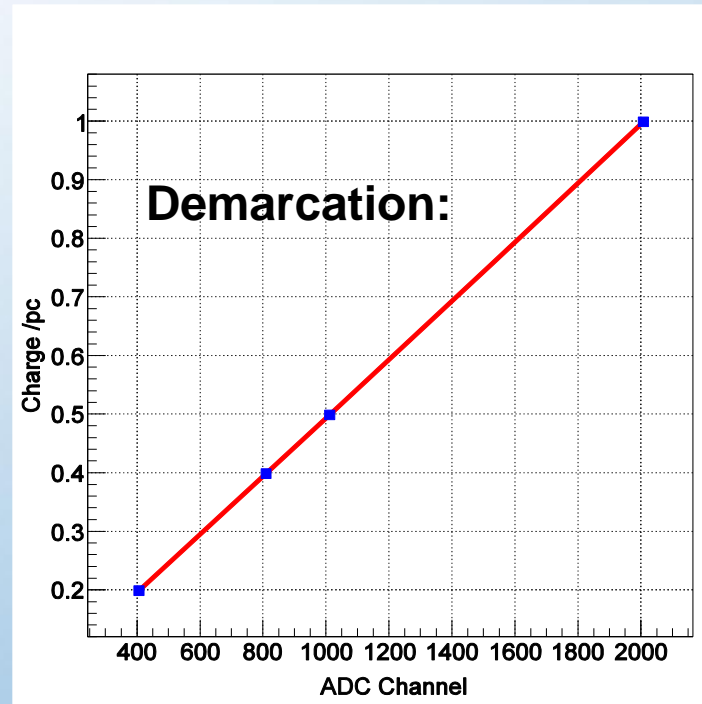
DAQ system



Triple GEM detector basic performances test



The ratio of two peaks: 2

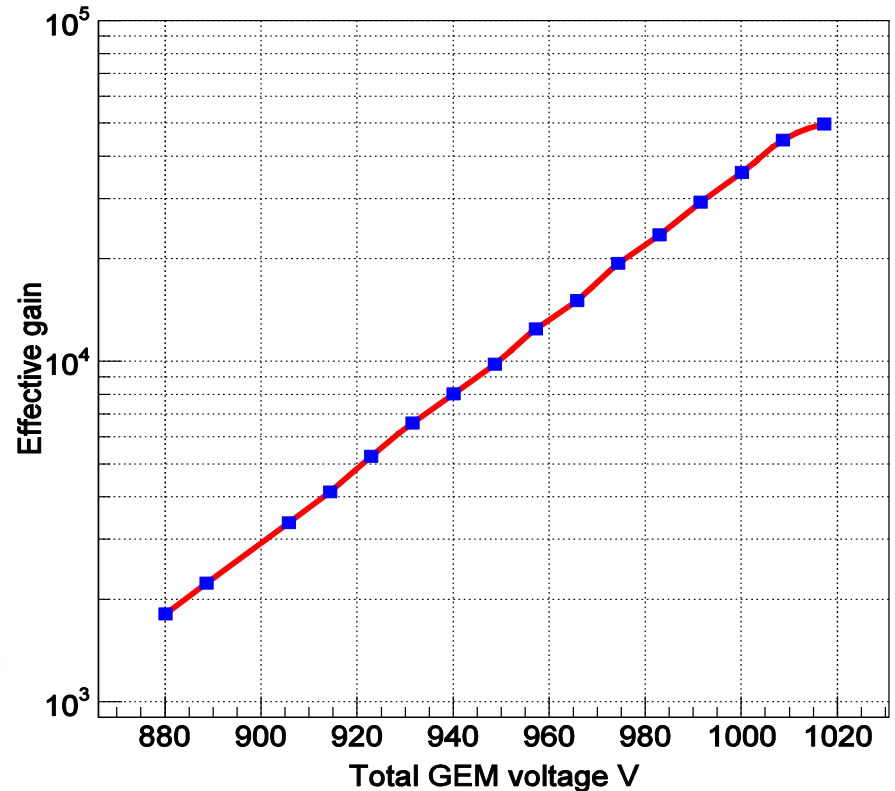
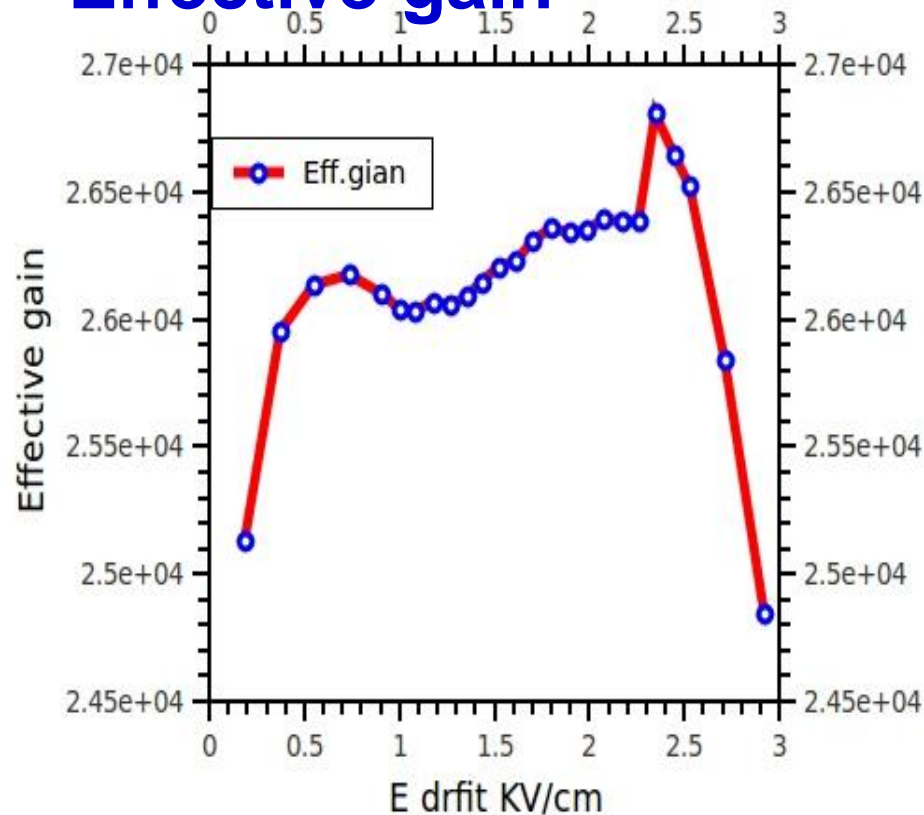


$$Q(\text{pc}) = 0.000499\text{Ch} - 0.0019$$



Triple GEM detector basic performances test

Effective gain

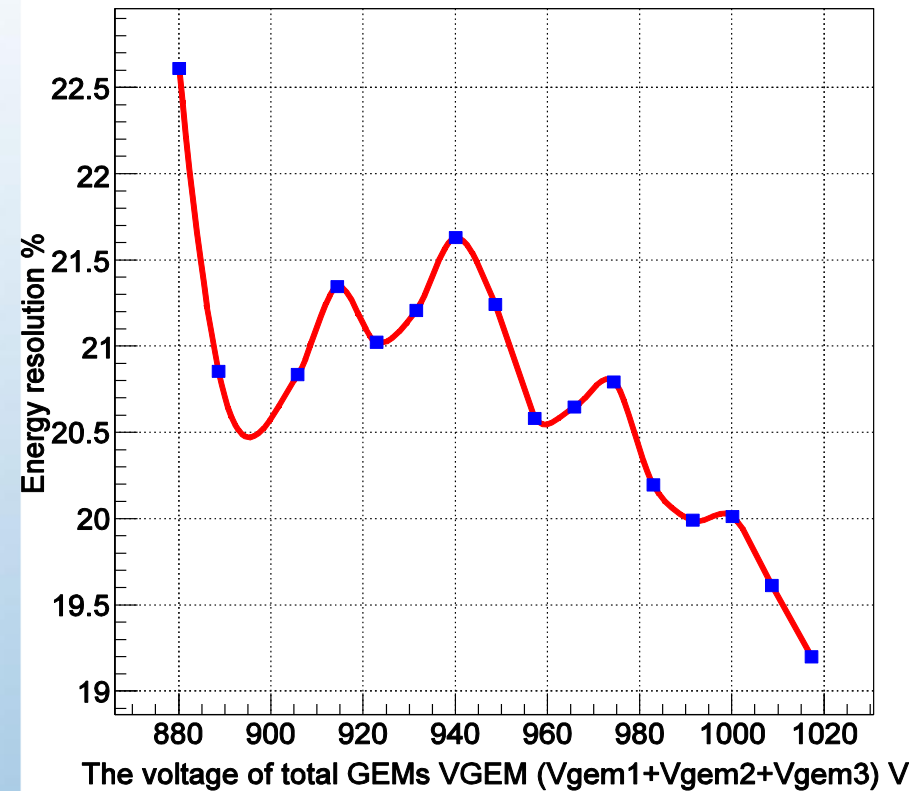
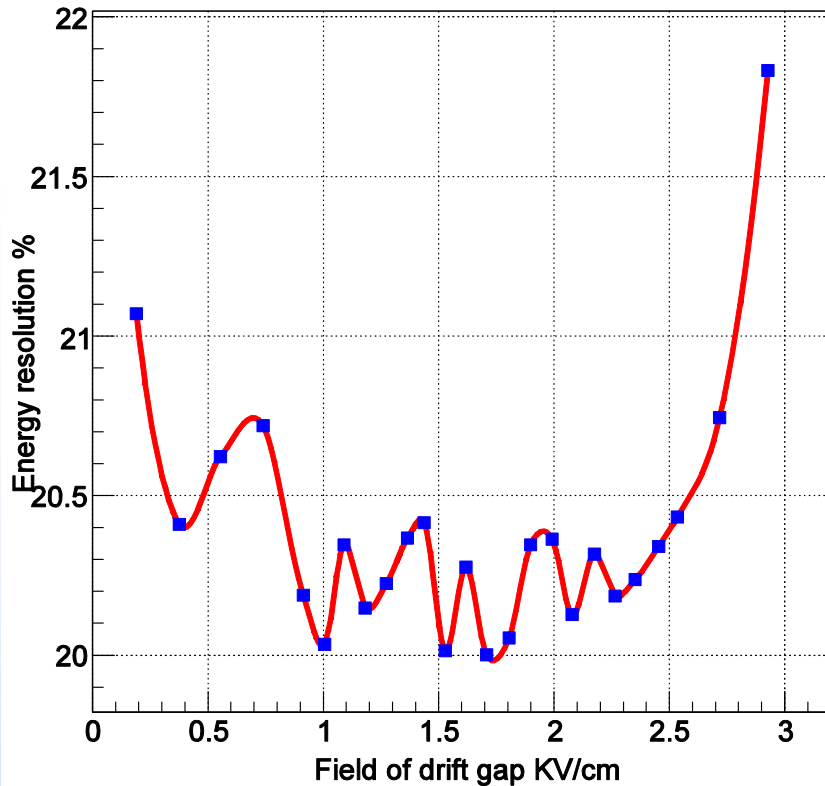


Effective gain of the triple gem detector as function of Ed and total gem voltage.

Preliminary result: effective gain is 5.0×10^4



Energy resolution

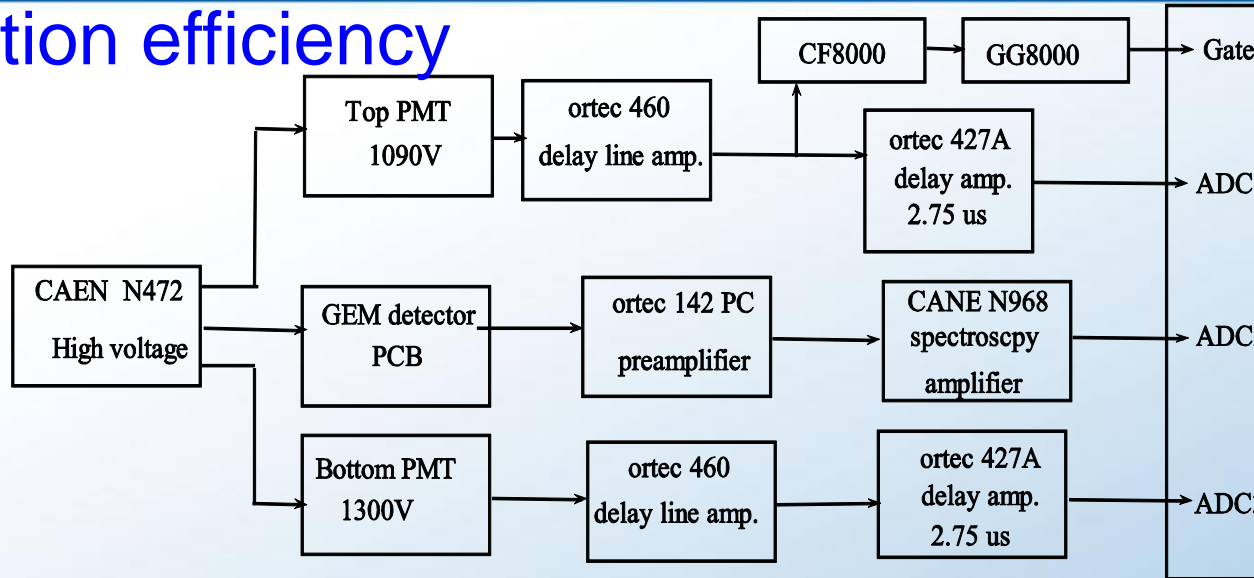


Preliminary result: energy resolution is 19.2%.

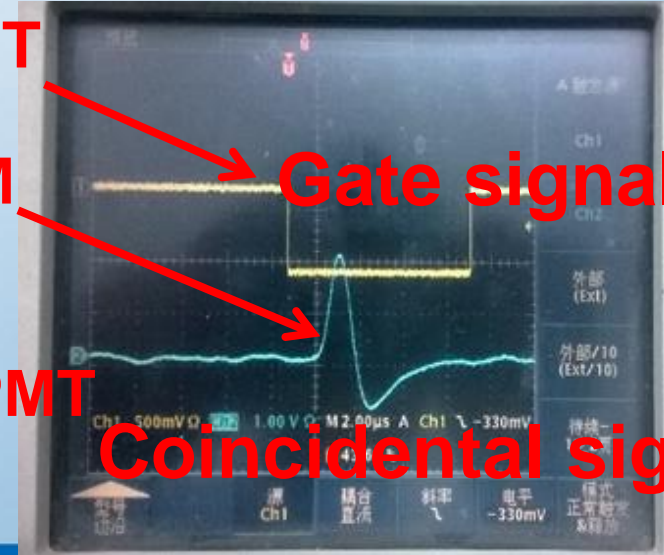
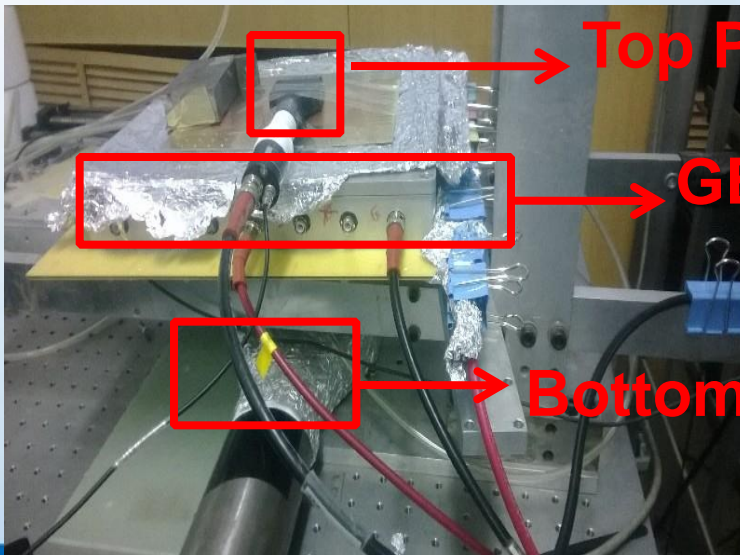


Triple GEM detector basic performances test

Detection efficiency



Electronic system
of detection
efficiency

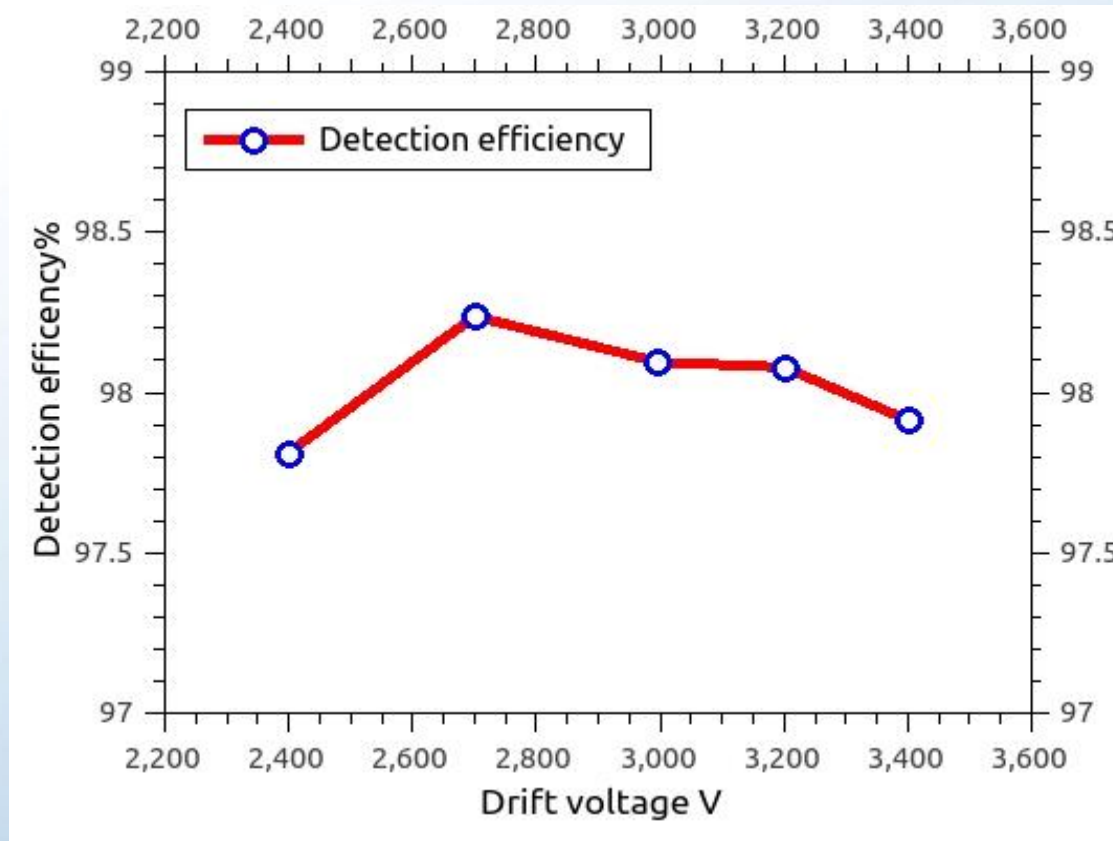


Experiment
test



Triple GEM detector basic performances test

Detection efficiency



Preliminary result: Detection efficiency is 98%.



Triple GEM detector basic performances test

Time resolution



scintillation t_{start}

GEM t_{end}

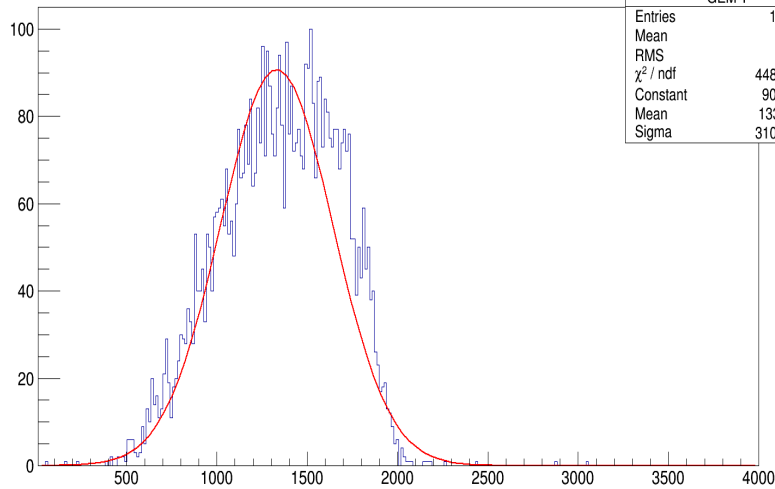
pre.amp. 142B





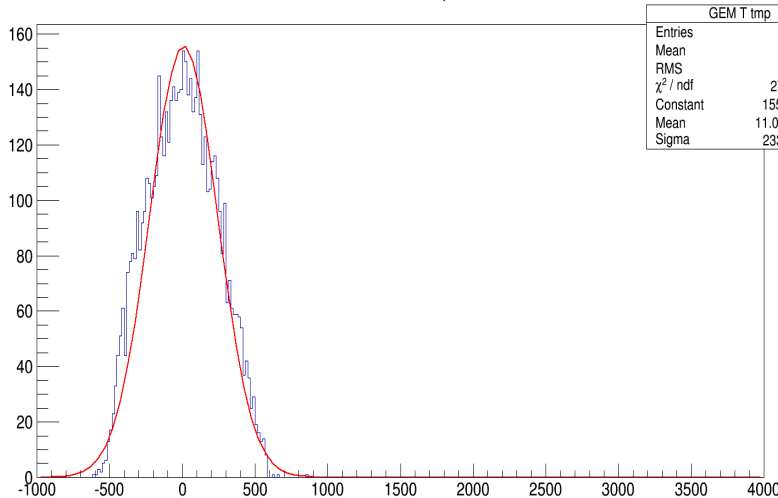
Triple GEM detector basic performances test

GEM T



The time resolution is 31 .4 ns

GEM T tmp



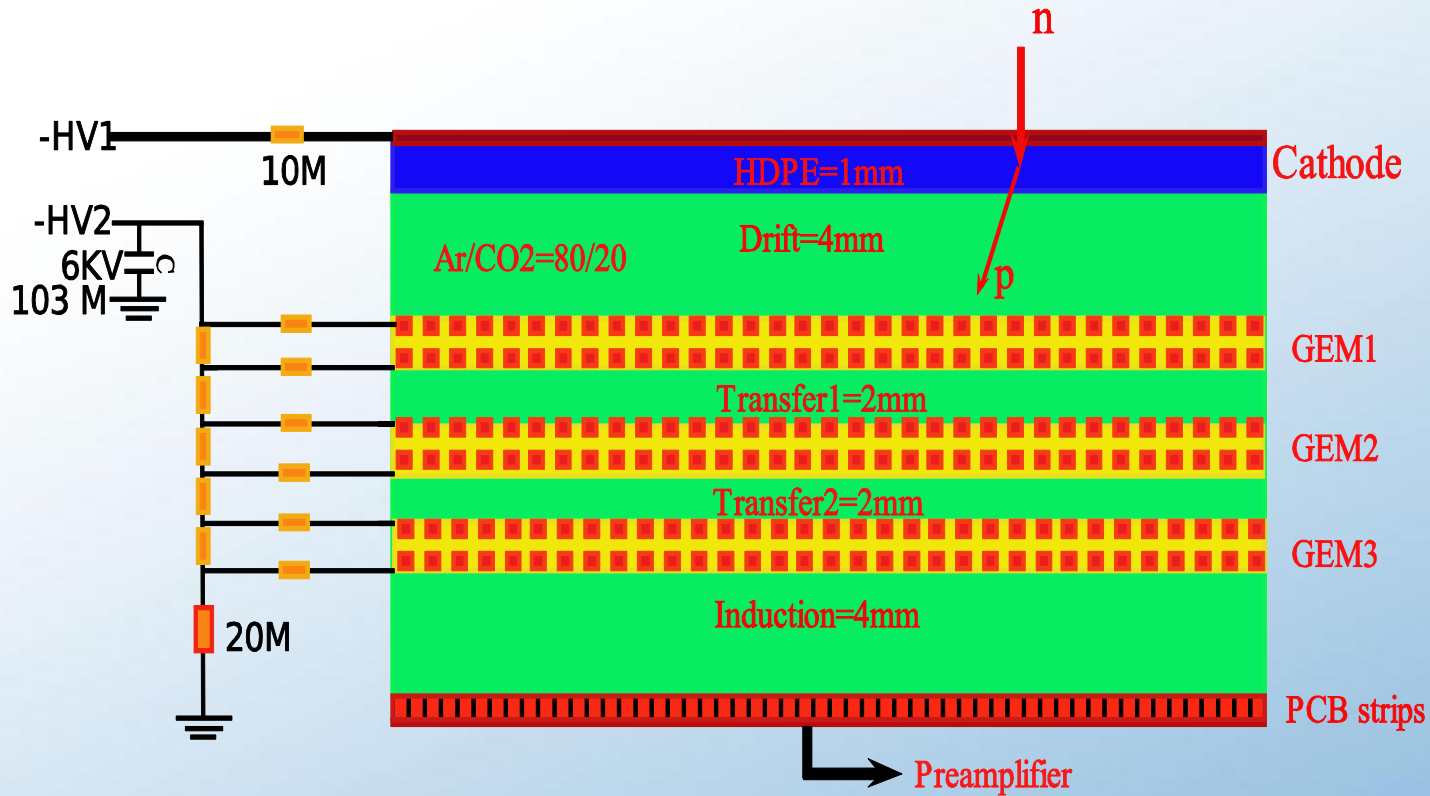
Time-amplitude correct

$$T = T_{test} - Ae^{-\frac{E}{t_0} + B}$$

The time resolution is 22.6 ns after correct

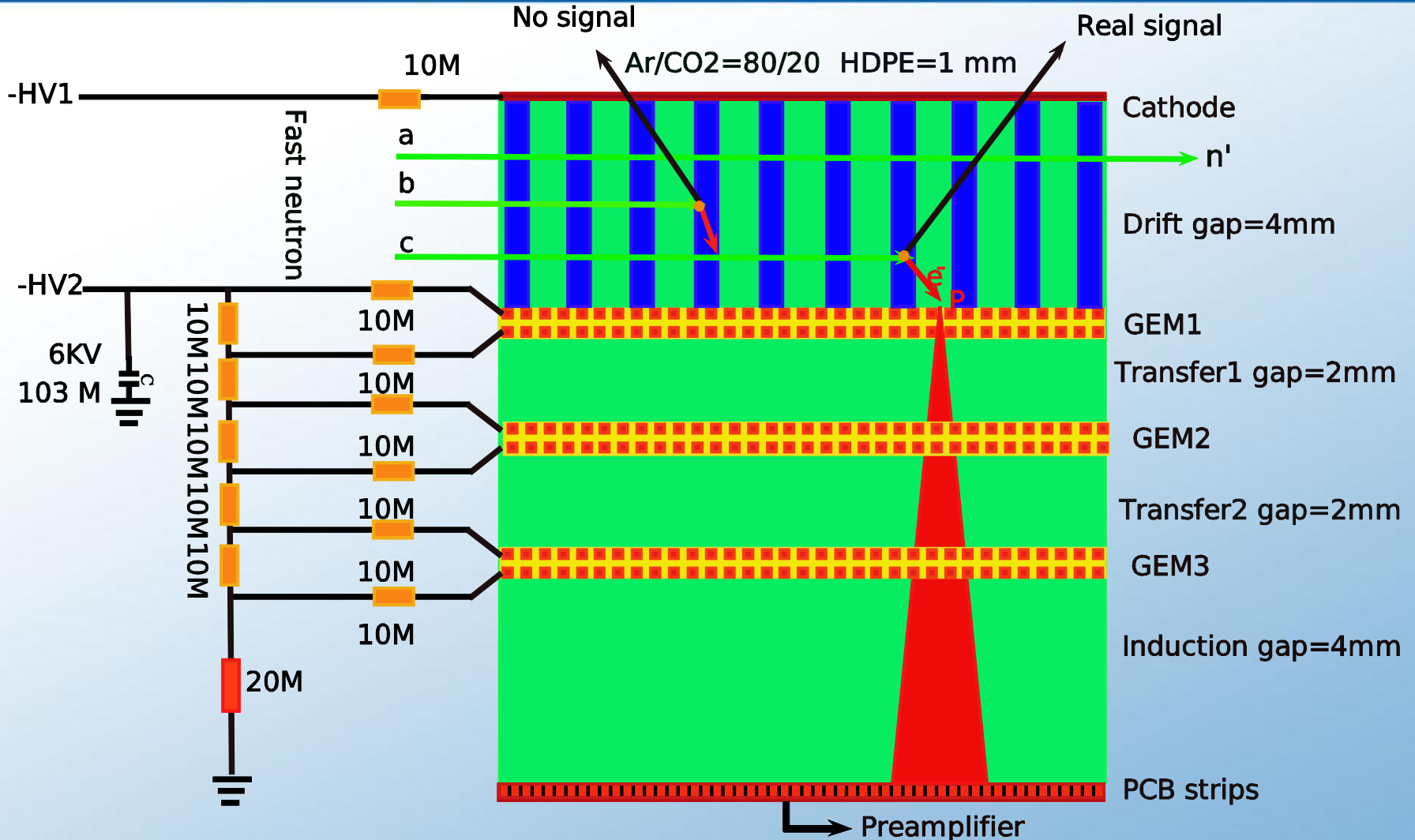


Single layer HDPE converter





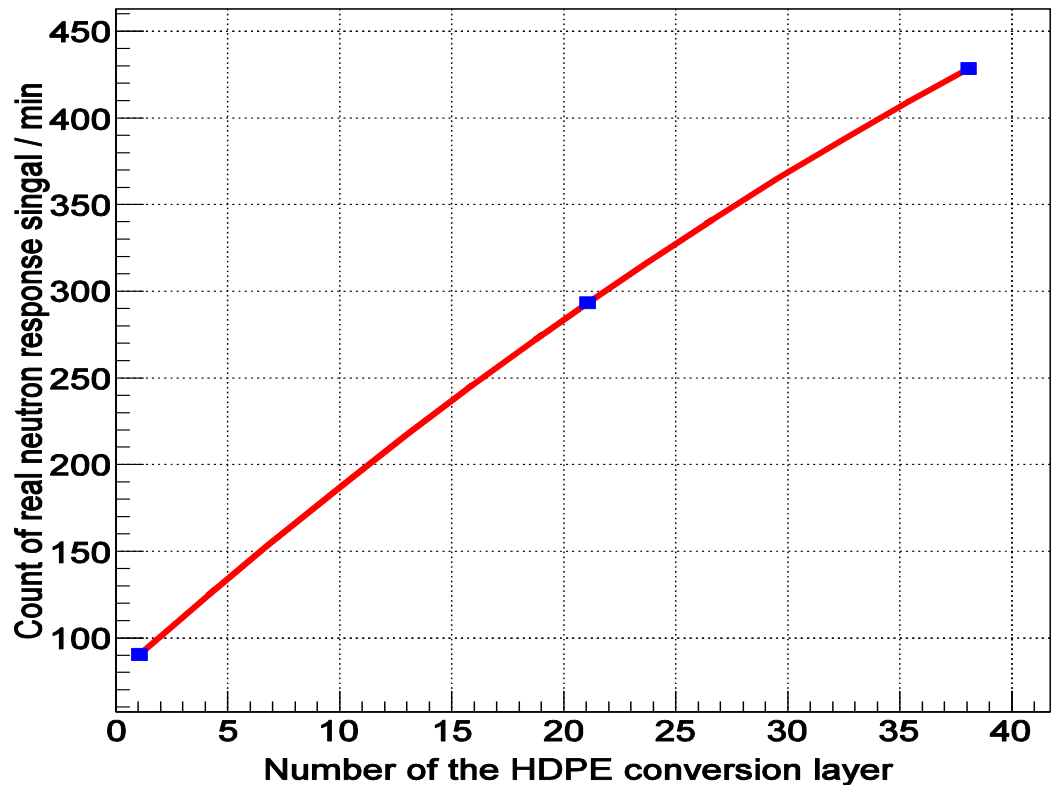
Novel multi-layers HDPE converter



The experimental setup of the neutron detector based on the Triple GEM



Novel multi-layers HDPE converter



The count of real neutron response events as a function of the number of converter layer, the number of the converter layer is 1,21 and 38, layers, respectively.



Conclusion

1, The basic performances of triple GEM is tested. When the bias divider voltage is 2373 V, its energy resolution and the effective gain is respectively about **19.2%** with 2 mm hole collimator and around of **5.0E4**. Its detection efficiency and the time resolution is **98%** and **22.6 ns**, respectively.

2, The design of multi layers HDPE conversion, processing and combining it with a Triple GEM to form a novel high efficiency fast neutron detector is completed. Experimental results show that, when the number of conversion layer is 38, its effective neutron response **is more than four times higher** than that of single layer conversion technique.



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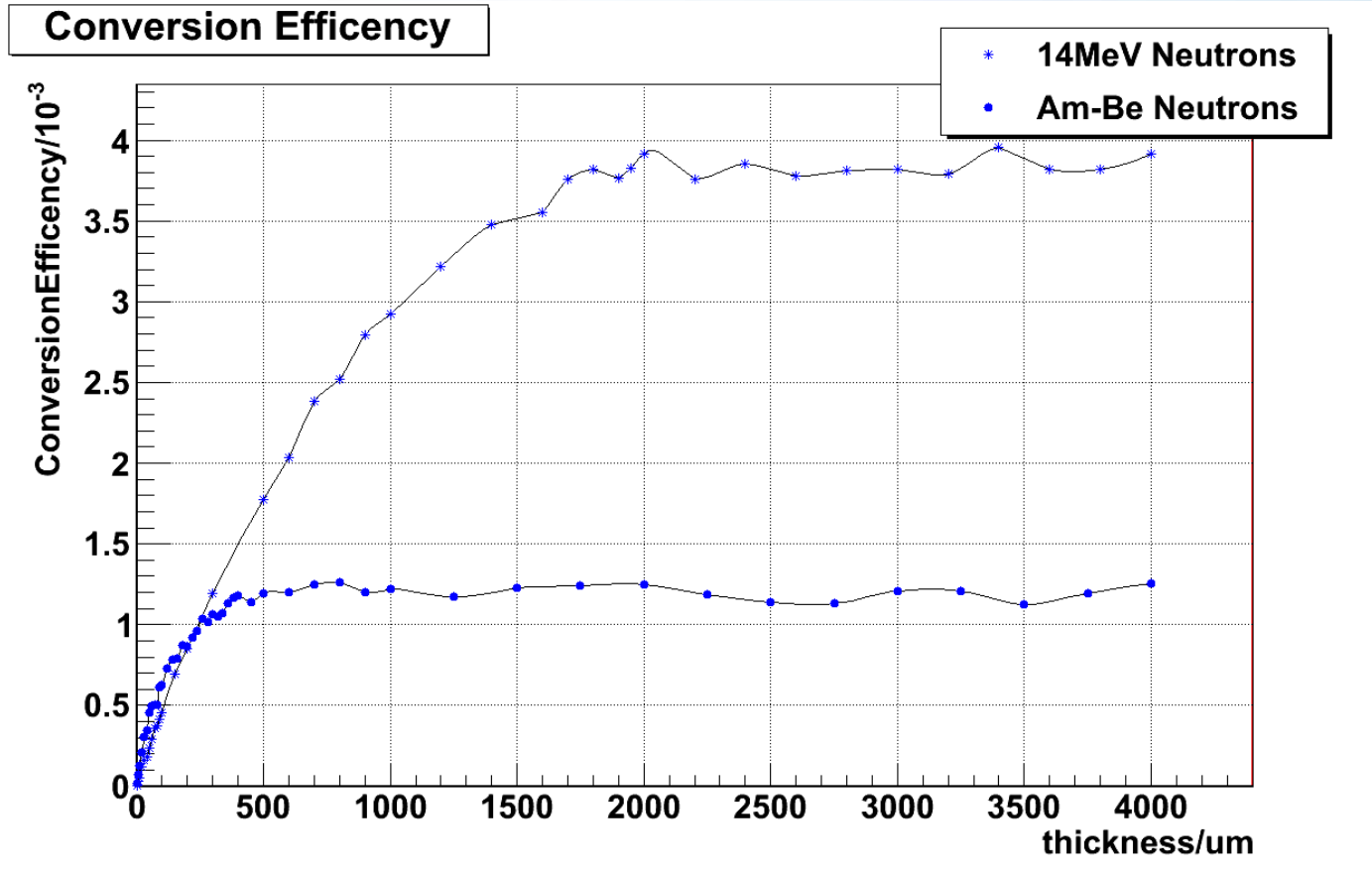
**Thanks for your attention
!**

wangxd11@lzu.edu.cn



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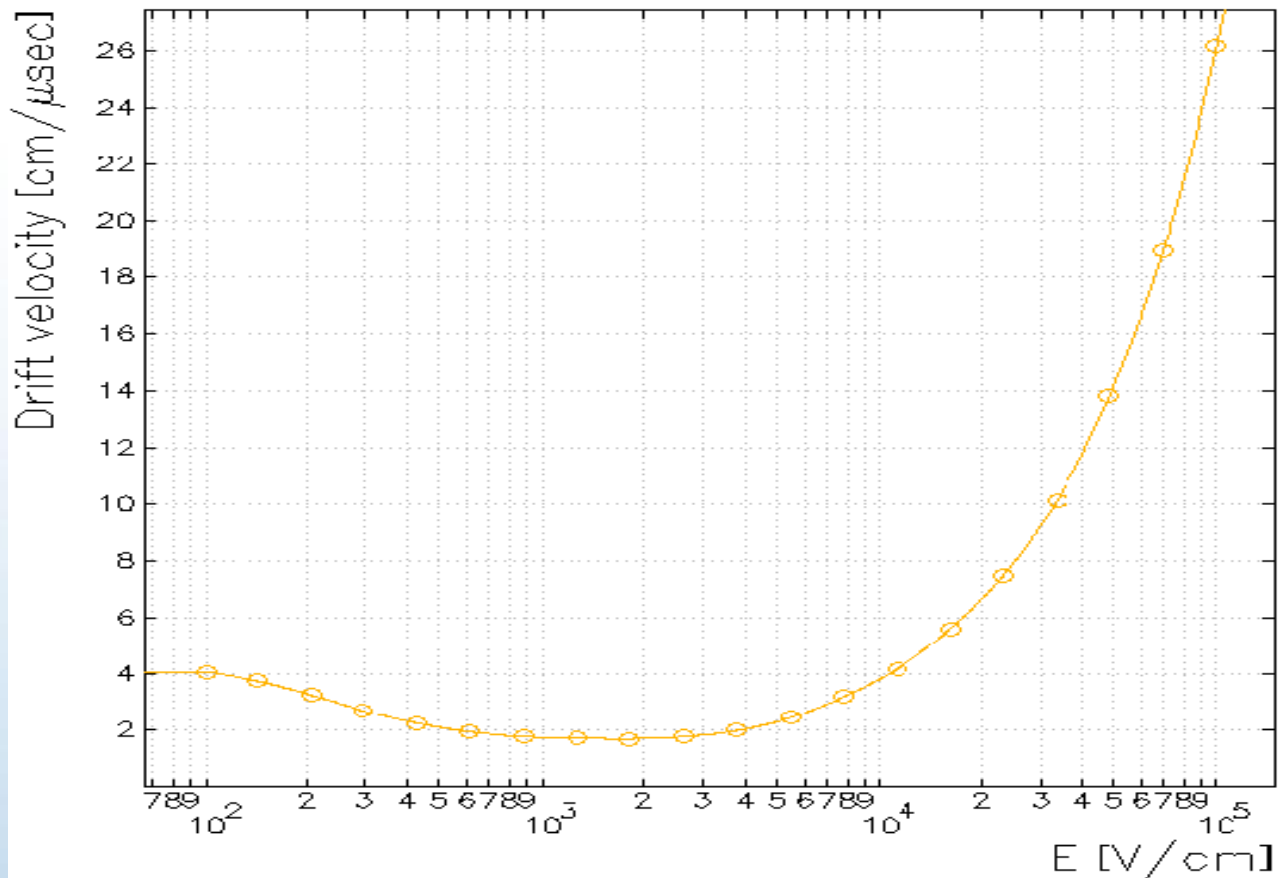






Drift velocity vs E

Gas: CH₄ 5%, Ar 95%, T=300 K, p=1 atm



Plotted at 14:15:33 on 19/09/12 with GraphPad version 7.14.