Updates from the SoLID-GEM Chinese Collaboration

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SoLID Collaboration Meeting June 9, 2020 JLab

SoLID-GEM Chinese Collaboration

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China Institute of Atomic Energy



• Development of APV25 readout electronics and DAQ



APV25 Electronic and DAQ System

The APV25 Electronic and DAQ System uses *APV25* electronics front-end card, *APVDS* electronic digital system and newly developed data acquisition software *GeoAPV*. Both APVDS and GeoAPV are developed by CIAE.

Testing in the configuration of 1,024 channels, internal trigger mode while monitoring the sampling waveform, the transmission rate can stably maintain 715 Mbps

Developed by CIAE







Development of APVDS

Electronic Digital System at CIAE

- ADC (ADS5242) +FPGA (Spartan 6)
- In 128-channel configuration, the system trigger rate can reach 285 kHz - the upper limit of APV25





Hardware Integration

Each APVDS digitalization board is capable of processing 512 channels' input. The whole system uses multiple APVDS board to expand the capacity of the system. (4 APVDS boards designed; 2 APVDS boards tested)





Every APVDS has an independent IP address and shares a common external clock signal from APVTTS board.



Data Acquisition Software at CIAE

GeoAPV is developed for APV25 frontend card and APVDS board



Mainly improved in usability, scalability, and modularity.

It performs intuitive operations, monitors input waveform in real time, and will integrate more functions in the future



LZU

Lanzhou University



• Development of a MPGD anode PCB and APV25 readout

The anode PCB

• Pad readout PCB with 1664 channels in total

Pad size in inner ring : 2mm*6.25mm Pad size in outer ring: 4mm*6.25mm Pad gap: 0.2mm





APV25 readout

• Each mother board can connect 4 backplanes



Testing and Debugging



Modified version of the readout system





The system undergoing testing





- Optimization of 2-D readout DLC-µRWELL
- Going for High-rate and large area

➢ Optimization of 2-D readout DLC-µRWELL

Going for High-rate and large area

DLC-µRWELL with 2-D Readout



• Top layer induced charge is 1.9 times of Bottom layer

Optimization of 2-D readout strip



Insulator layer between DLC and readout strip: 50um Prepreg+12um Kapton+10um epoxy glue

Signal amplitude

gain

 10^{4}

103

440

460

480



Ar/CO2=70/30 8 keV copper X-rays



	Bottom/Top Copper/Botto		
Sector 1	1.09	2.03	
Sector 2	1.11	1.95	
Sector 3	1.14	2.06	
Sector 4	1.11	1.95	

Signal amplitude ratio in different sector

The signal amplitude of top layer is almost same with bottom layer.

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> Optimization of 2-D readout DLC-µRWELL

Going for high-rate and large area

Current status of high-rate µRWELL

Two different high-rate µRWELL have been fabricated based on Copper/DLC/APICAL substrate material.

- 1-DLC layer μRWELL with fast grounding lines (SG2++)
- 2-DLC layers µRWELL by Sequential Build Up method (SBU)

These two detector were tested with 8-keV copper X-rays, the highest gain is about 1000 and then a discharge shows.

- A high pressure of 20 kg/cm² was applied in order to glue DLC/APICAL substrate and PCB board.
- > The resistivity of DLC is several $M\Omega/\Box$, much less than the expected value (before fabrication: 50 $M\Omega/\Box$).

We guess that the resistivity of DLC coating decreased a lot after copper coating and gluing process, which results to the lower gain.





Problems with large area µRWELL







Large area APICAL may have a large deformation



For SG2++, after gluing onto the readout PCB, it is impossible to see the fast grounding lines, so it is impossible to align the mask for APICAL etching.

For SBU, still have alignment problems

Novel idea for high-rate µRWELL



Step1: Copper & APICAL etching, to make a big hole, with DLC on bottom.



Step3: Use silver glue to connect the DLC to readout pad.

Advantages:

- No alignment problems even goes to large area;
- No DLC+Cu needed, better resistivity control;



Cu Apical DLC Prepreg



Step2: Drill a small hole, make the copper of the readout pad expose to air.



Step4: Make µRWELL structure and remove the copper around silver glue.

Detector plan:

- A small-pad μRWELL with sensitive area of 5cm X 5cm was designed;
- If it is OK for small pad, then we will use this method to make a large area μRWELL;

R&D on large area DLC samples

A batch of large area $(1.2m \times 0.6m)$ DLC sample have been made by using Hauzer 850 sputtering system.





- The resistivity shows a large value on the top and bottom side due to the limitation of target size.
- For 1.2m × 0.4m, the resistivity uniformity is 25% (sigma/mean).

The resistivity repeatability and uniformity should be improved in the next step.

Resistivity map									
ity	580	550	480	400	430	450	430		
	270	260	210	210	200	200	220)	
	210	185	150	160	150	155	160		
60 cm	180	180	165	165	170	165	180		
	270	260	260	300	320	300	320		
	800	940	850	850	1000	1050	1000	_	

≻ 40 cm