

Status 24/Sep/2022

- refurbished J0 is fully equipped except one APV card (first in middle-left-rigid-backplane), there is still an issue about “light” spikes in middle module which mainly interfere with the middle-left-rigid-backplane and in particular with the first card (removed after two replacements). It could be either internal discharge involving a sector connected to the left side or an external discharge between divider – left backplane and carbon fiber frame. The shielding of middle and top module has been removed to understand the noisy discharges, in fact related to a trivial mistake.
- Running DAQ (with 4 MPDs connected to J0)
- Module M04 fixed
- Module M16 seems ok in terms of HV

- HV and LV off (not sure about PMT HV)
- Ar/CO2 closed
- N2 flushes on all modules

TO DO:

Possibly fix issue of J0 middle module discharge (possibly improving insulation in the left side of the module) than take cosmic data; if issue cannot be fixed, reduce HV of middle module (likely ≤ 3900 V) to avoid spikes that compromise APV/MPD configuration and then take cosmics; for the moment do not reinstall the missing shielding.

In the meanwhile in Italy we will try to define/implement a way to connect the floating HV to the GEM. Possibly test some alternative, less invasive, shielding based on metalized plastic foils.

When we will be back (November likely) we will try to refurbish the J2 layer.

Details

Refurbishing and start testing J0

M15 (this was the middle module in layer J0 – expected to have a shorted sector since BB commissioning):

- this has been confirmed by multimeter: remove divider and measure resistance between the pins of the divider connector on the GEM (one every three pins is connected to a GEM layer and last to the drift); resistance between the two side of readout-GEM (GEM closest to readout) is 2 MOhm (sum of two protective resistors), it should be ideally infinite (out of range for the multimeter);
- use thermocamera to localize the resistor connected to the shorted sector: power up the compromised foil with 120-150 V; the current flows into the resistors of the shorted sector and generates heat; thermocamera is sensitive to the heat. Identified resistor near (behind) the divider terminals.
- resistor removed: now shorted sector is isolated (from external HV serving the other sectors of the same GEM)
- due to the low sensitivity of the thermocamera, initially we erroneously located a wrong resistor, removed it and then resoldered once realized it was not the right one
- module M15 moved into the J0 top position so that the shorted sector is near the corner of the layer

- module tested with N2 up to 4000 V for about one hour – normal current consumption
- during test of next day one resistor near the lower left edge was visibly sparking; it has been removed and replaced by conductive glue (no possibility to solder a new resistor due to the very tiny HV path left connecting to the internal sector)

M25 (this was the bottom module in layer J0 – from BB commissioning: the HV current was below nominal value):

- the divider alone drains less current than expected (about 20% less of nominal value)
- divider replaced
- module tested with N2 up to 4000 V for about one hour – normal current consumption
- module installed in middle position of J0

M18 (this was the bottom module in layer J2 – no specific issue addressed):

- module installed in bottom position of J0
- module tested with N2 up to 4000 V for about 1 hour – normal current consumption

on 20/Sep/2022

the assembled J0 with M15-TOP, M20-Middle, M18-BOT moved in the cosmic tower, cabled with 2+10m analog-HDMI and 3+10m digital-HDMI connected to:

MPD8 – rigid-left-backplanes

MPD9 – two flex and one rigid with digital lines on the right side

MPD10 - rigid-right-backplanes

MPD11 – one rigid and two flex, with digital lines on the left side

all layer tested with N2 up to 4000 V for a whole night; top module tripped once during the night

on 21/Sep/2022

spent ~0.5 day to fix various electronics issues using the low level test program essentially in histo mode:

```
./mpdLibTestINFN_TestLab ./cfg/config_apv_test.txt ./prova.txt 4 5 0x0
```

some file saved as histo_j0_2209 ...

most of the issue were either sparse unconfigured cards or double peak in histo of all cards of an MPD. In the first case either the HDMI or the cards were not properly plugged, couple of cards replaced; the double histo peak are caused by a single card either not properly connected or damaged: first one disconnect the backplanes one by one, as soon as the backplane with bad card is disconnected, the histos of all other cards become normal; once the backplane has been identified, one proceed to unplug, one by one, the single cards: when the “bad” card is disconnected all others look normal: most of the cards have been re-plugged properly; couple of them have been replaced.

when histo test passed by all cards, a sample test has been run:

```
./mpdLibTestINFN_TestLab ./cfg/config_apv_test.txt ./prova.txt 2 0 50 2
```

on 22/Sep/2022:

spent (wasted) ~2 days trying mainly to debug continuous noisy internal discharges of middle and top modules and electronics somehow suffered of that, being quite unstable; to understand these discharges we removed the shielding on both modules.

While doing attempts to fix the above issue, we realized that the external shielding of HV channels power supply are floating and this causes a floating potential between backplane GND and HV GND; we run a pedestal (2634) connecting the HV-GND to the MPD-GND and noise was slightly lower (than without connection (run 2630); this connection should be considered and investigate further: it may possible mitigate the common noise

24/Sep/2022:

in the afternoon we finally realized that we made a terrific trivial mistake in HV polarity of the TOP and Middle GEM dividers! GND and HV channels were inverted!!!

fixed this stupid mistake and tested HV up to 4000 V (in ArCO₂) for about 1 hour; noticed one “light” discharge in middle module but situation was much better than before.

Low level histo test worked correctly → histo_j0_220923 ...

Around 5PM we tried to run coda for new pedestal and then cosmic, it gives timeout error on SSP; we did not realized immediately that there was a problem in MPD 8; it was fine in low level test and actually got configured in CODA

After dinner we observed some HV interference by the middle module and its left rigid backplane (and relative cards) connected to MPD8.

Noticed monitored current value (file mon_220923.txt) some perturbation (“light” spikes) on middle module during the afternoon/evening; not clear if coming from inside or outside the GEM

After a while since configuration, all cards on MPD8 show double peaks in histo test (all cards in the left rigid backplane of the layer), likely due to the “light” spikes which have a frequency of about 1/min.

The first card in left rigid backplane of middle module (above divider) is the cause of the histo double peaks of all cards in MPD8; the card looks damaged and has been replaced.

Improved isolation between readout fingers and the rest of the GEM and carbon frame.

Middle module continue to have some “light” spikes which misconfigure the APV of MPD8 that in turn produces timeout on CODA; again the source of trouble is the first card in middle rigid left backplane. Card is removed (not replaced!)

Middle module HV reduced by 50 V (from 4000 V to 3950 V), but some light spikes still occur during the night and interfere with electronics that loose configuration and cause CODA timeout (the LV current drops from about 8 A to 3.2 A)

24/Sep/2022: before leaving:

- switched off HV and LV,
- closed Ar/CO₂,
- now N₂ flushes on all modules;
- J0 is fully equipped except one APV card (first in middle-left-rigid-backplane), and issue on “light” spike which interfere with the middle-left-rigid-backplane

TO DO: try to identify the cause of “light” spikes in middle module of J0; improve isolation of divider and electronics in the left side; the affected cards seem to be always the ones on the middle-left-rigid backplane.

Work on other modules:

M04 (was TOP of J2 with HV issues):

- found a broken HV terminal (top of readout GEM) below the divider board
- resoldered
- tested with HV at 4000 and N2 gas – normal current observed

M16 (spare module):

- no shorts detected; tested HV up to 4000 V with N2 for about 2 hours – no issue arised

We also familiarized a little bit with the CAEN floating HV power supply; we began to think on how to connect to the GEM.

Essential Runlog:

Data	Time Start	Time Stop	Run Type	Run	Rate [Hz]	Number	EverHV (V)	Gas Flow	Gas Flow Sta	HV File	Comment
22/09/2022	01:02:00 PM	01:04:00 PM	Pedestal		2617	25000	0	ArCO2 – 60 units			first runs with installed coda test cosmic trigger
22/09/2022	01:29:00 PM	01:30:00 PM	Cosmic		2618						
22/09/2022	01:41:00 PM	01:42:00 PM	Pedestal		2620	10000	0				
23/09/2022	12:31:00 PM	12:32:00 PM	Pedestal		2630	10000	0				
23/09/2022	03:20:00 PM	03:21:00 PM	Pedestal		2634	10000	0 (bottom probably at 4000 V)			mon_220923.txt	GND of HV VME module connected to GND of MPD modules
	10:15:00 PM		Pedestal		2661	5000	4000 V for TOP and BOT; 0	ArCO2			Coda gets timeout; probably configuration of some APV lost due to new spike in middle module (but not noticeable in HV current monitor)
	10:27:00 PM		Pedestal		2663	8000	4000				Probably APV configuration problem due to HV interference; the low voltage current drop from about 8 A to 3.2 A
	10:30:00 PM		Pedestal		2664	10000	4000				again run stop getting events due to timeout; apv configuration issue
	10:34:00 PM	11:08:00 PM	Cosmic		2665	5.0	1965	4000	ArCO2 – 60 unit		
24/09/2022	12:57:00 AM		Cosmic		2673	2074	4000 TOP, 3950 Middle, 40	ArcO2 – 30 unit			
							reconfigured electronics after power cycle Low Voltage				
	09:35:00 AM		Cosmic		2677	111					limited due again configuration can