

AGATA PROJECT

**AGATA Week Virtual Feb. 2021
EMC Requirements @ Leganro**

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outline

- EMC meetings prior to Installation
- EMC requirements
- EMC Qualification procedures
- Test examples from GANIL Campaign
- Test phases @Legnaro
- Conclusion and perspectives

LNL EMC Meetings

- First meeting held with the mechanical team on 28/10/2020
 - LNL setup has been briefly described to NK.
 - The project step file sent on 19/10/2020 by NB.
 - The Mechanical project is finished and being ordered.
 - NK informed that all paintings should be removed between mechanical pieces prior to mounting
 - Structures are planned to be mounted in March-April 2021.
 - NK suggests to go to LNL and make the first EMC qualification process.
 - NK Presented EMC of AGATA @ GANIL (Hall overview, tests zones, tests types etc...)
 - NK To write a preliminary requirement document and distribute it before the next meeting

LNL EMC Meetings

- Second meeting held with the mechanical team on 24/11/2020
 - Design is completed and company is starting the work.
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 - A detailed study of the mechanical design was done prior to the meeting,(large surface area contact without painting to optimize grounding).
 - First list of possible critical points:
 - Triple cluster honeycomb and shaft
 - Shaft and its support
 - Shaft support, its rails and the platform
 - Shaft support and shaft cable grid
 - various pieces of the platforms
 - racks and platform
 - racks, rack cable grid, cable tray
 - As an example, RM shows NK slides from the AGATA Demonstrator phase @ LNL about how groundings were modified after the first EMC qualification in 2009.
 - NK to send an EMC requirements working document for the LNL campaign including critical points, measurement procedures photos or pictures of EMC items that could be used to optimize the grounding etc..)

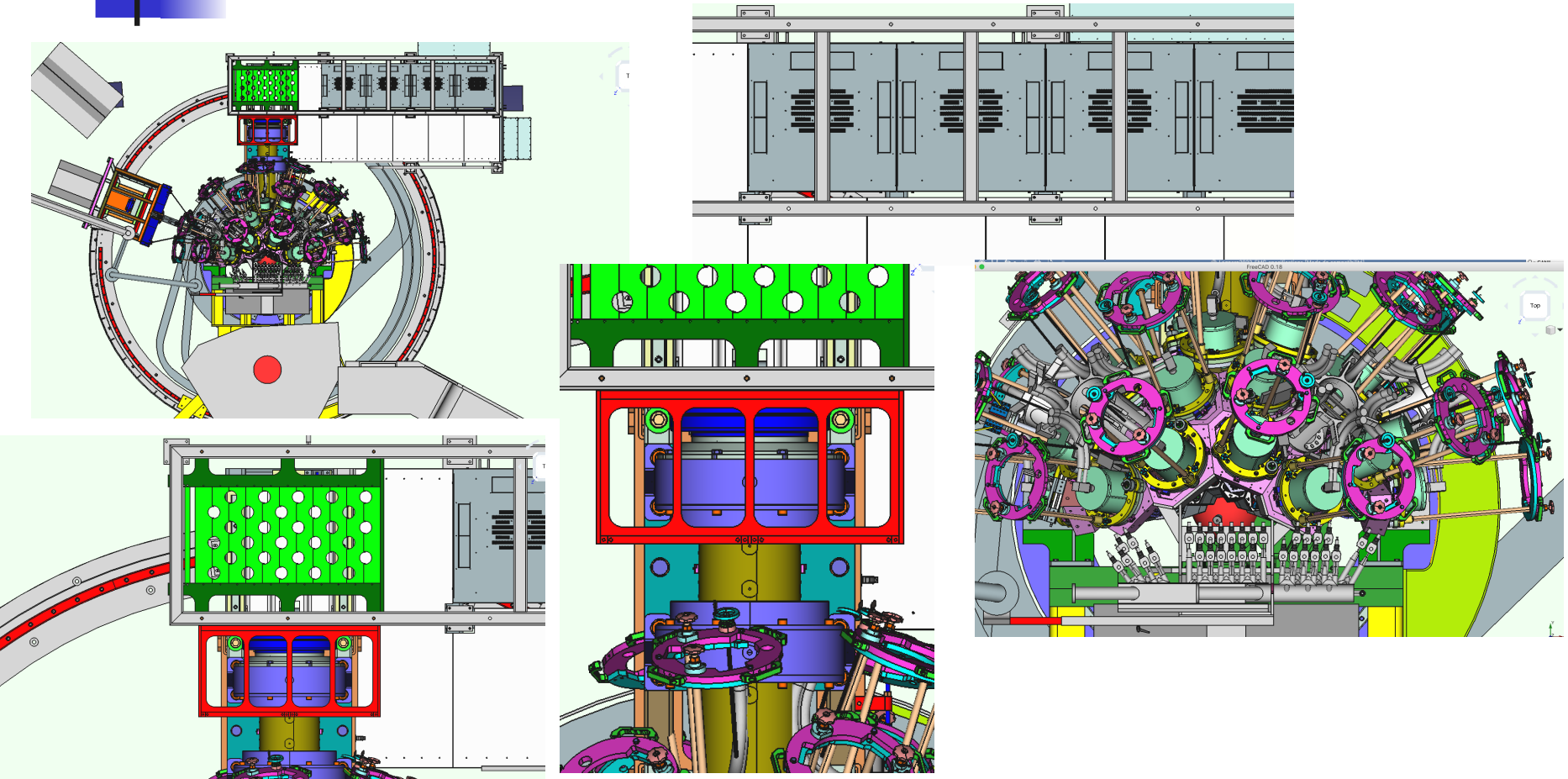
LNL EMC Meetings

- Third meeting held with the mechanical team on 15/12/2020
 - first draft of EMC specifications was distributed prior to the meeting as expected (*Legnaro2022_EMC_specifications.docx*)
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 - RM shows the distribution of the AGATA electronics (HV LV) dispatched to different zones close to the array and on the PRISMA racks. (care should be taken here)
 - On the PRISMA racks: PRISMA electronics, Autofill, HV AGATA, Ancillaries, Trigger;
 - On the AGATA racks: AGATA digitisers and LVPS.
 - NK goes through the document:
 - For good EMC, cables will be supported on a cable tray over the AGATA racks.
 - Cables perforated plates include plastic clamps for each cable bunch.
 - Need to connect fixed parts to moving parts,
 - Never get painting on surfaces that need to be in contact,
 - Green cable tray placed on grey support which is fixed on the ground should be connected to PRISMA rail,
 - All shielding of cables should be connected together,
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LNL EMC Meetings

- Third meeting held with the mechanical team on 15/12/2020 (cont.)
 - Document to be updated:
 - fixing of the detector to the honeycomb,
 - Include PRISMA racks,
 - measurement is not difficult but very tricky as every piece of instrumentation may give an error of the order magnitude of 1 of the expected resistivity: 220 mOhms for 8-14 mOhms.
 - VC call as soon as some parts are mounted to check the situation:
 - platforms mounting,
 - shaft and support,
 - all the rest.
 - Plan visit to LNL

EMC Requirements



EMC Requirements

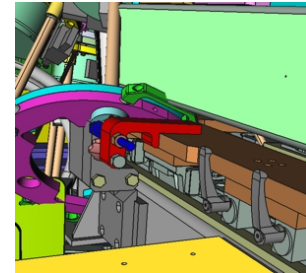
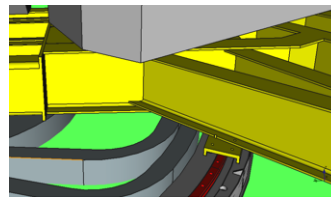
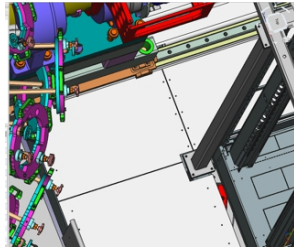
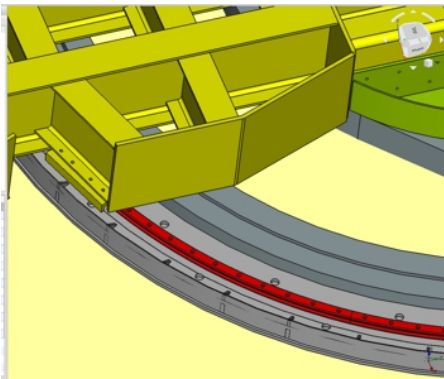
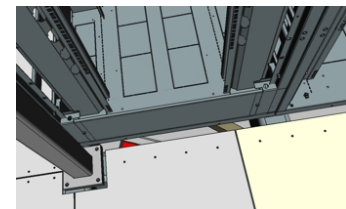
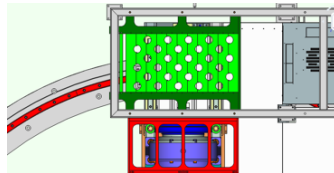
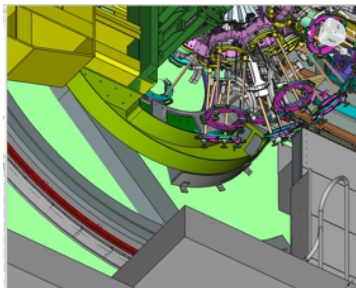
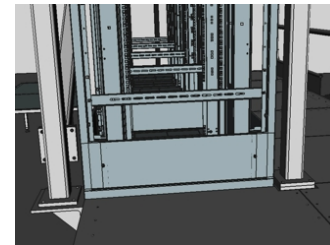
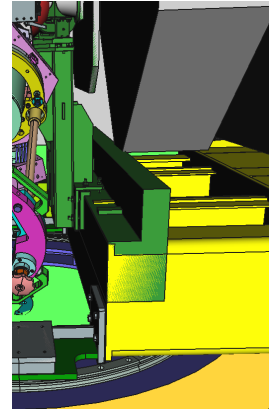
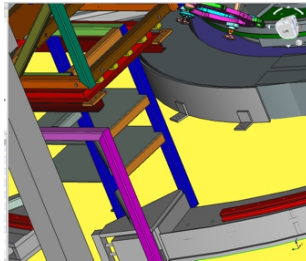


FIGURE3. Copper foils to improve grounding on the mechanics

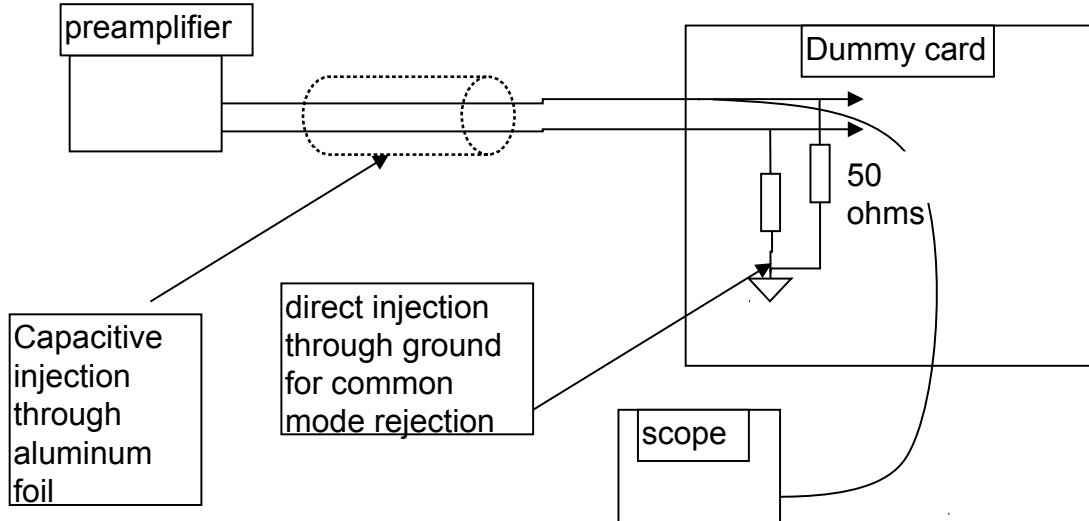




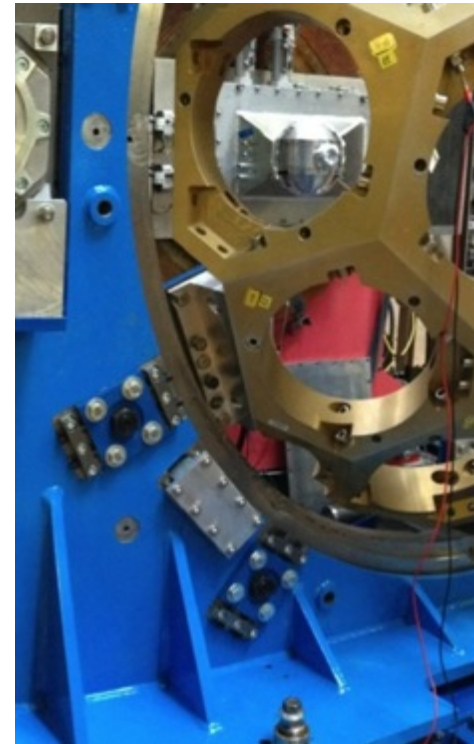
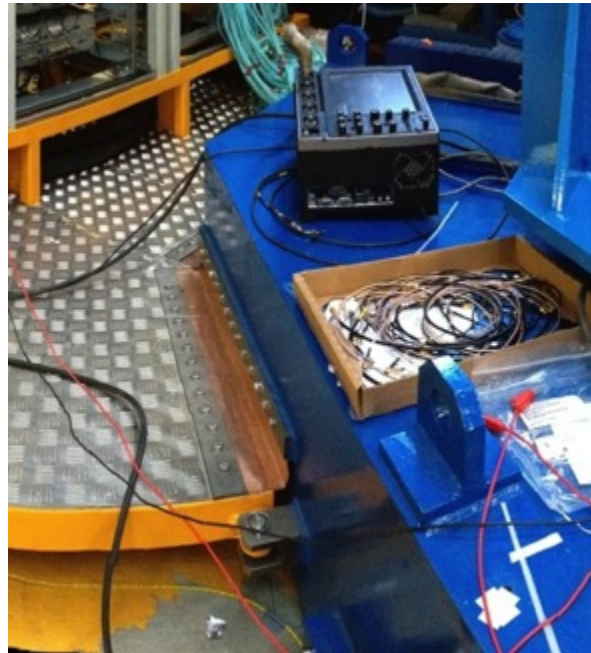
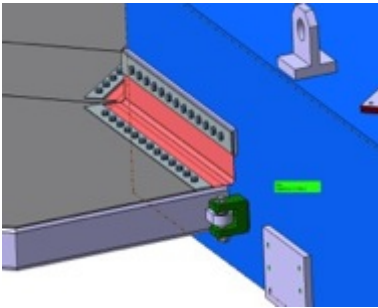
Qualification Procedure

- 4 wire resistance calculations (mechanics)
- Direct Injection to the ground (4 kV)
- Capacitive Injection to the cable (4 kV)

Cabling scheme for the qualification

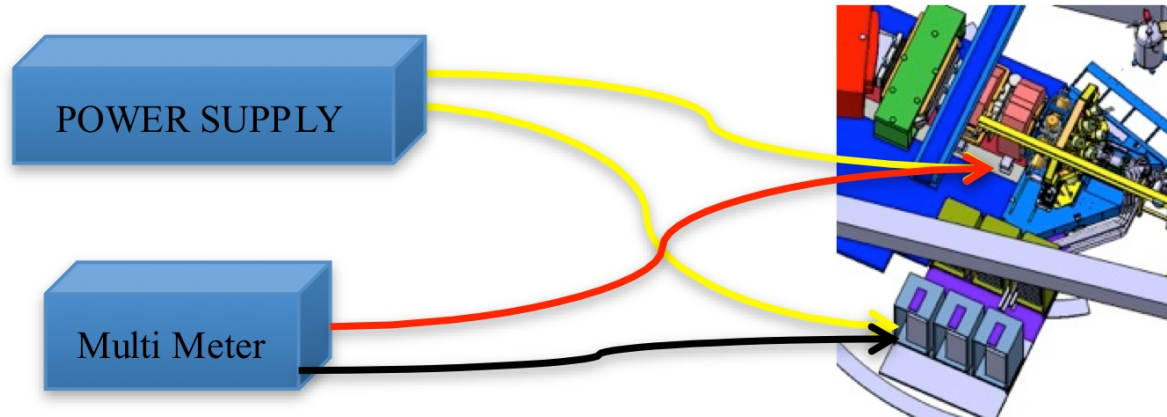


Recommendation on the design and what was done

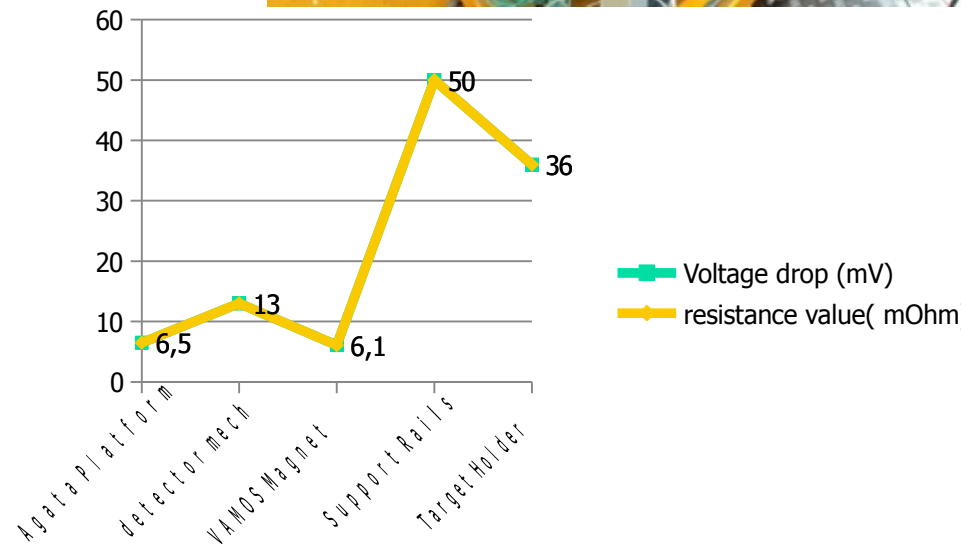
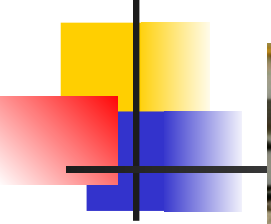


4 wire resistance calculation

- The 4 wire resistance measurement is a very accurate way to measure the resistivity between different mechanics in the same array.
- It requires 2 wires to inject a known DC current between two points.
- Measure the voltage drop between the contact points.
- The resistance value of the structure = the voltage drop by the current. $R_{mec} = DV/I_{amps}$.



4 wire measurements example



Conclusion: a crocodile clip was the cause of the bad contact

Direct Injection example

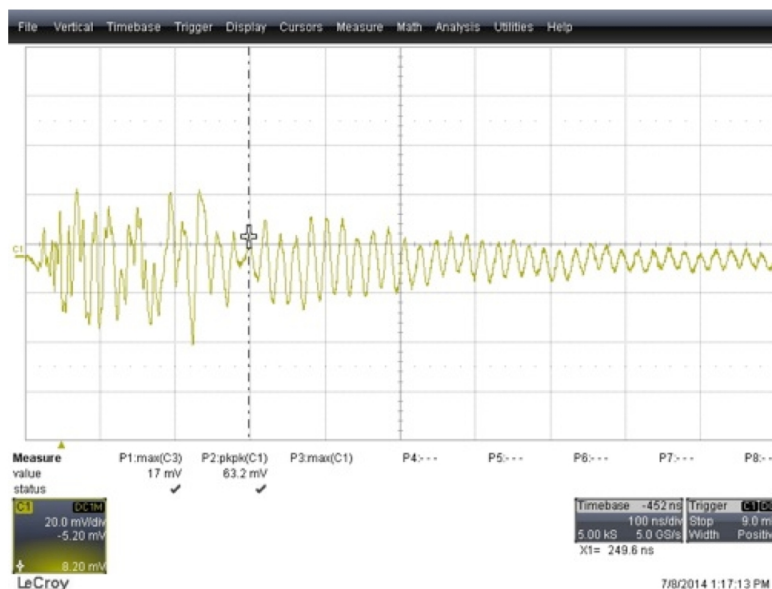


FIGURE1. This figure show 63 mV Voltage difference on the point B of the electronics Bay
 the SNR = - 96,0 dB

Direct Injection example

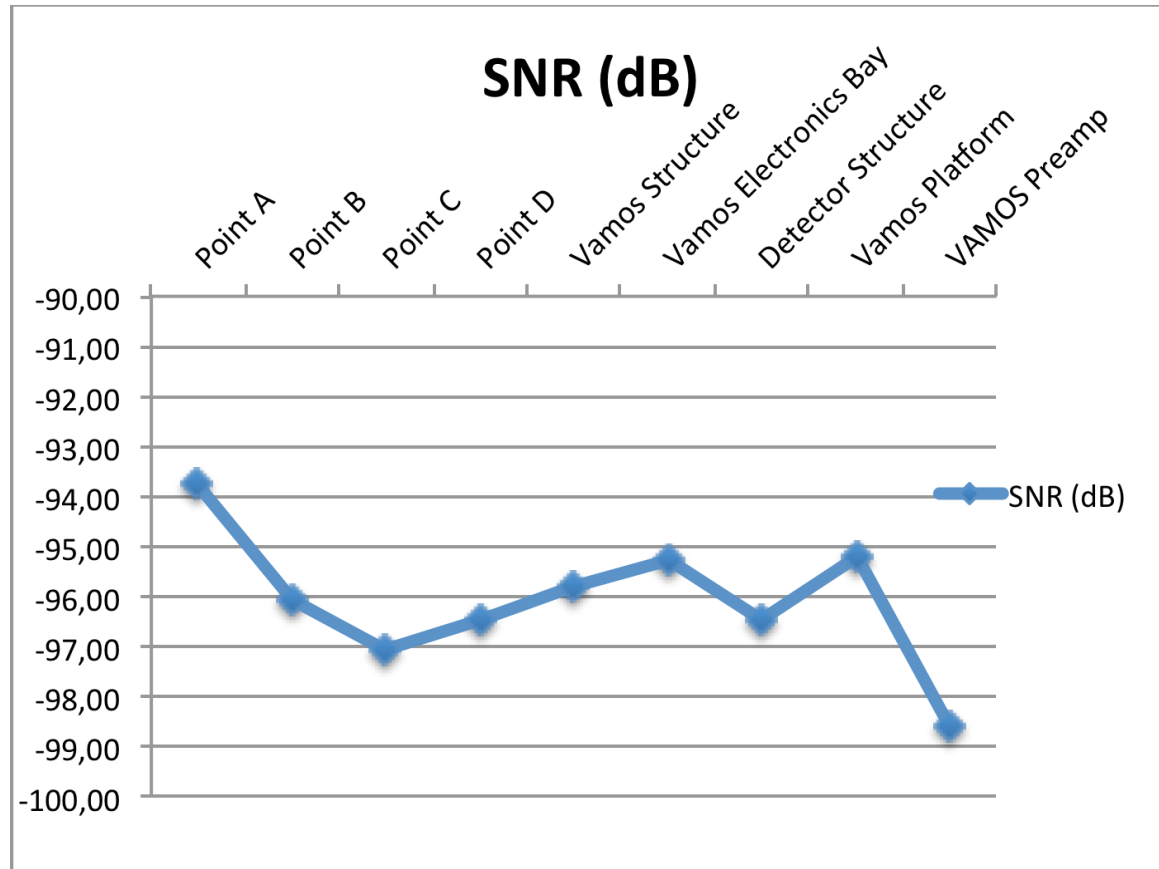
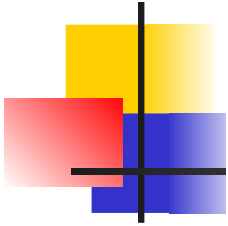


FIGURE1. Graphics showing the SNR value of each measured point in direct injection

Test phases for LNL campaign

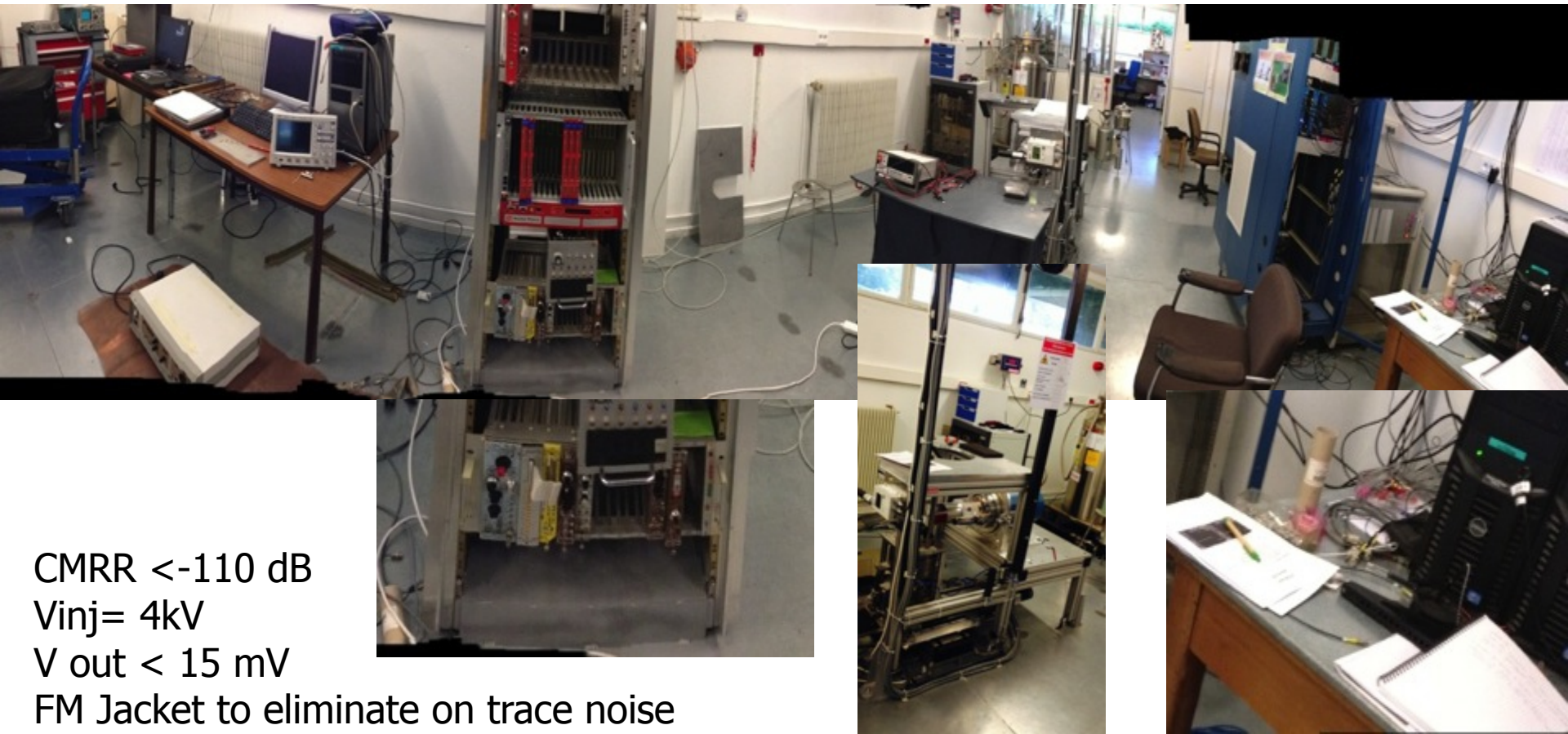
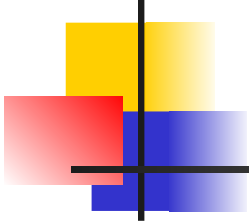
- Three or more EMC qualification phases to be done @ Legnaro.
 - Preliminary Mechanics
 - First infrastructure (honey comb shaft racks etc..)
 - First detector installations
 - Other measurements
- Three measurements during installation are extremely important. It gives time to mechanical modifications if needed.
- Other measurements can be made after adding more detectors or if there are any noise on detectors. Don't hesitate.
- Direct injection 4 kV signal peak to observe noise effect
- Capacitive injection rejection is made with detectors mounted.



Conclusions and Perspectives

- EMC requirements (RevB now) document to be finished.
- Discussions with Richard about detailed shaft mechanics .
- Discussion with LNL local staff when mechanics arrives.
- Program EMC qualification visits
- Generate EMC qualification report.

Mesures CEM à l'IPHC Exemple à suivre



CMRR < -110 dB

$V_{inj} = 4\text{ kV}$

$V_{out} < 15\text{ mV}$

FM Jacket to eliminate on trace noise