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## MINUTE S Cryogenic RF tests of DQW cavity + HOM filter

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**Location:** Vidyo conference, <https://indico.cern.ch/event/730324/>  
**Date:** 23 May 2018  
**Time:** 12:00pm EDT / other locations  
**Sharepoint:** <https://espace.cern.ch/HiLumi/WP4/Shared%20Documents/Forms/AllItems.aspx?RootFolder=%2FHiLumi%2FWP4%2FShared%20Documents%2FDraft%20documents%20for%20discussion%2FDQW%20Cold%20Measurements&View=%7B635F3862%2D8ACC%2D47F4%2D9819%2DAA14F998E416%7D>  
**Attendees:** Ilan Ben-Zvi, Silvia Verdu-Andres, Qiong Wu (BNL), Rama Calaga (CERN), James Alexander Mitchell (CERN / Lancaster U.), Naeem Huque, HyeKyoung Park, Tom Powers (JLab), Graeme Burt (Lancaster U. / Cockcroft), Alex Ratti (SLAC).  
**Excused:** Binping Xiao (BNL)

### AGENDA AND DISCUSSION

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o) News from CERN: *first ever crabbing of proton bunches performed today in SPS*

- Rama reports on first crabbing of proton bunches in SPS in the afternoon of today. The DQW cryomodule is at 4.5 K. Cooldown to 2 K was not possible due to issues with cryogenic system. Only one cavity was powered to provide about 0.1 MV deflecting kick (take this voltage as preliminary, calibration is on-going) during single bunch operation with 26 GeV SPS beam. Data is currently being analyzed.
- Cooldown to 2 K may not happen until the end of June. Operation at 4.5 K limits the maximum voltage for operation. Large vacuum activity is detected during operation at 1 MV deflecting voltage. Trapped bubbles in the HOM filter may be the cause of such vacuum activity.
- Operation at fields near the low-voltage multipacting band (< 0.5 MV) leads to significant perturbation of pickup signal and vacuum activity. However, large power availability thanks to over-coupled FPC does not seem to pose any obstacle for cavity operation.

1) Review of May'18 cold test results and comparison to results from previous tests

- Silvia presented some slides covering the following topics:
  - i. Results from the NWV-DQW-002 cavity with a HOM filter tested in JLab on 14-15 May 2018.
  - ii. Comparison to other cavity tests (incl. CERN DQWs and RFD crab cavities) and to previous tests (with and without HOM filter) of the US DQW cavities.

- iii. CERNOX and OST signals.
  - iv. Multipacting voltages found during past and present DQW cavity tests and multipacting bands predicted by ACE3P and CST.
  - v. Coupling (input, pickup) for all SPS-series DQW cavity tests.
- Tom remarks that **maximum voltage reported for pulsed operation** is not correct. In the last test the pulse flat-top was 1-2 seconds long during “pulsed operation”. This long pulse – in comparison with the cavity’s rise time, in the order of few ms -- surely produces the same effects as operation in CW mode.
  - Rama stresses out that the **relevant performances are for CW mode**, as it is in this mode how the DQW will operate in LHC.
  - Only one **OST responded to the cavity quench**. The OST is located close to the bottom HOM ports. The delay between the response of the transmitted RF and the OST is about 9 ms, which corresponds to a distance of 0.14 m between the OST and the quench source. The 0.14-m-radius sphere envelope **lies on the highest H-field region of the cavity** and is **far away from the HOM filter**. Another OST, located on the same side of the cavity and looking into the same point but far from the region, did not record any signal.
  - Rama asks if **coupling is consistent through all the tests** performed for the DQW cavity in JLab. It seems that way from the table compiled in Silvia’s slides.
  - The **multipacting bands predicted** by ACE3P and CST **matched well the multipacting voltages found during the tests**. A hard multipacting band, related to multipacting in the cavity waist as predicted by ACE3P and CST, is found in every single test. Other multipacting bands were processed and never came back in following tests.
  - Ilan asks if **multipacting was responsible for the quench** of the cavity **in previous tests** of cavity plus filter. Silvia replied that the cavity reached 3.6 MV before quench on Oct’17, well beyond the multipacting band in 2-3 MV region.
  - Silvia remarks that we **cannot conclude that multipacting found in May’17 and Oct’17 is occurring in the HOM filter**. In both tests, multipacting was found between 2 and 3 MV. According to simulations, multipacting in this voltage region could occur in the HOM stub and/or waist and lunette.
  - Ilan asks if we can conclude that the **filter is not responsible for quench according to OST signal**. The other OST was far away from highest H-field region in cavity. Tom suggests looking at **ratio pickup over filter transmitted signals** to understand if multipacting was involved in quench.
  - Graeme highlights importance of learning about the **surface treatment followed by HOM filters installed in CERN DQW cavities** and comparing their performance to the HOM filter tested in May’18 at JLab.

## 2) Discussion on next steps

- Main focus of the **next tests**:
  - i. Verify reproducibility (→ test with another filter);
  - ii. Increase statistics (→ test with DQW-001);
  - iii. Discriminate quench location (→ test with spacer, location of OSTs);
  - iv. Performance with more than one filter (→ test with 2 filters).
- BNL will **prepare proposal** with next tests of DQW cavities with HOM filters. The proposal should define the location of planned instrumentation (CERNOX, OST).
- In preparation **for every single test**, the cavity will follow HPR prior to assembly and the filter will be manually rinsed with pressurized water. Then the assembly will be baked for at least 24h at 120C.
- In **case of a new filter**, the filter will follow the **standard surface treatment** for SRF cavities but **replacing the HPR by manual rinsing** with pressurized water (due to technical difficulties):
  - i. bulk BCP of 100 um,
  - ii. manual rinsing with pressurized water,
  - iii. 10h 600C bake,
  - iv. light BCP of 30 um,
  - v. manual rinsing with pressurized water,
  - vi. at least 24 h 120C bake.
- JLab foresees that the **next test will not happen until July**.
- Qiong asks about the legal status of the HOM filter. Rama says that the lending period was extended. The **return date** for the HOM filter has been **postponed**.
- Qiong asks when **version 2 of the HOM filter** (Jamie's design) will be **fabricated**. Rama does not expect the first prototype before **Spring 2019**.

## **ACTIONS REQUIRED**

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RESPONSIBLE	ACTION
HyeKyoung	Review calibration for CERNOX #7 and #8.
Jamie	Retrieve information about surface treatment followed by HOM filters installed in DQW cryomodule in SPS.
Silvia	Circulate updated slides and meeting minutes.
Silvia	Analysis of time domain data from pickup and HOM signals.

BNL                      Prepare proposal of next tests of DQW with HOM filters, including guidelines for OST locations.

**UPCOMING EVENTS WITH RELEVANCE TO THE PROJECT**

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N/A.

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*Minutes taken by Silvia Verdu-Andres (BNL)*