BNL-CERN-UK collaboration meeting on DQW Crab Cavity - June 29, 2015

Minutes prepared by: Silvia Verdú-Andrés and reviewed by: Carlo Zanoni

Attendees:

- BNL: Qiong Wu, Sergey Belomestnykh, John Skaritka, Ilan Ben-Zvi, Silvia Verdú-Andrés.
- CERN: Ofelia Capatina, Rama Calaga, Carlo Zanoni, Marco Garlaschè, Kurt Artoos, Norbert Kuder, Raphael Leuxe, Teddy Capelli, Mateus Sosin, Alexandre Amorim Carvalho. Laurene Giordanino.
- LBNL: Alex Ratti.
- UK: Graeme Burt, Nik Templeton, Tom Jones.

Indico event:

https://indico.cern.ch/event/396882/

Agenda and discussion:

1 – Helium Vessel Design & Answer to BNL Comments (Norbert Kuder, Carlo Zanoni, Kurt Artoos)

- ANSYS calculations of mechanical stresses in vessel show that the design fulfils pressurized vessel normative and VDI guidelines for bolts (which are not included in the pressurized vessel standards)
- Latest vessel design includes additional venting hole to improve vacuum pumping.
- Planned tests on mechanical properties of bolts.
- Intersecting weldings at the vessel corners have been tested at CERN, however Ofelia explains that the dummy vessel should show if those are a critical part of the design also in the full real conditions.
- The bolts of the vessel may unscrew due to thermal cycle. John Skaritka proposed using bi-metal washers (assuming that bolts are not made of the same material as the vessel in titanium) to avoid losing torque. One side of the washer could be tagged to the SS bolt head and the other side of the washer could be tagged to the Ti vessel surface. Ofelia says that she would rather prefer to simplify vessel assembly and reduce welding steps. Therefore, CERN is considering using non-return washers to prevent bolt unscrewing during thermal cycles.
- Sergey comments that bolts would better made of other material rather than titanium to avoid seizing bolts and vessel up. Marco comments that they are considering different types of coating for the titanium bolts such molybdenum disulphide coating (aka moly coating).
- Ofelia comments that welding lips have not been implemented in the vessel design because they rather prefer to weld over larger areas. Welding over larger areas will provide a robust vessel compatible with pressurized vessel normative. In case that a weld must be repeated, common practice is to machine the area and weld again. Sometimes, the weld is not performed on the same place, but somewhere else previously prepared. Ofelia comments that second weld lines have not been planned because the design aimed at being as compact as possible. However, Marco explains that enough material on vessel top-plate to

cut (as it has an L-shape profile) in case that weld is not satisfactory and area must be machined and welded again.

- Current planning foresees to test response of welds and bolts in dummy vessel during thermal cycle from ambient temperature to 80K, not down to 2K.
- The 4-rod cavity was leak-proved with liquid nitrogen but did show leaks with liquid helium. John Skaritka says that usually if leak test is passed with liquid nitrogen, then it also passes the test with liquid helium. But Ofelia reminds that for difficult leaks such those in materials, the liquid nitrogen leak test may not be conclusive.
- Current planning only foresees leak tests for the dummy vessel at warm. John Skaritka mentions an interesting **test setup** used in the past **to identify leaks** in an aluminium vessel **at cryogenic temperatures**. The vessel was enclosed in a Teflon bag (Teflon bag is used as it does not crack at cryo temperature) and immersed in a bath of liquid nitrogen. The vessel was then pumped down. When satisfactory vacuum level was reached, the Teflon bag was filled with helium gas to identify possible leaks in the cold vessel. A sketch of the test setup can be found in Indico.
- Kurt recalls that the tuner in manufacturing stage corresponds to the 1st version of the tuner presented in previous meetings and will be tested in SM18 on the PoP DQW cavity.
- As the cavities will be operated in CW and the tuner will only need to act when the cavity is switched on and off, the wearing of the components of the tuner is not a major concern.
- When an alternative design of the tuner based on a wedge-type system is mentioned, Kurt recalls the tuner designed by CEA Saclay for the SPL cavities (see Fig. 1 and 2) based on an eccentric cam with rollerbearing. It is a wedge-type actuator with no sliding friction, only rolling friction.

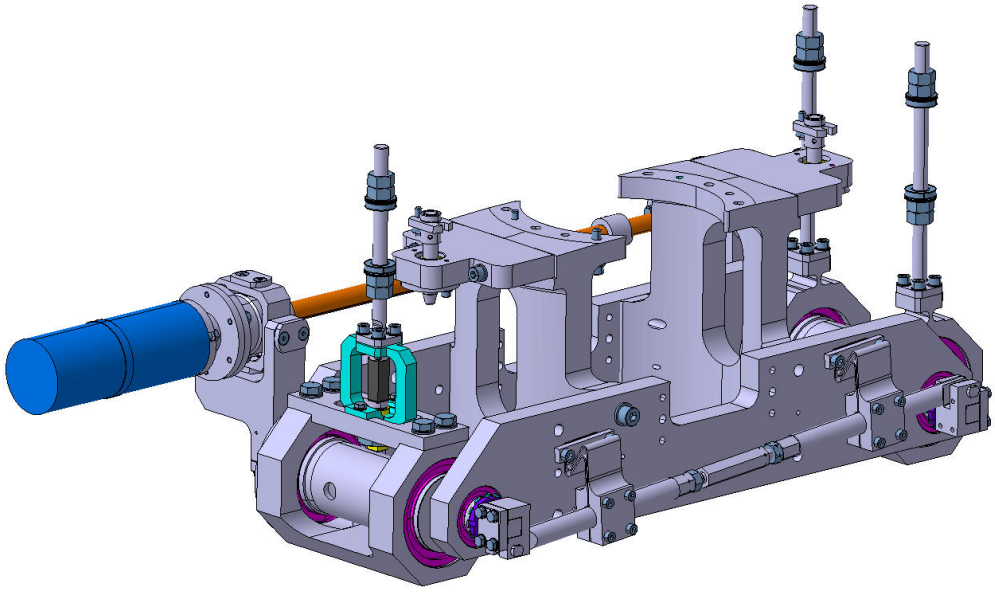

Figure 1. SPL tuner design by CEA Saclay based on eccentric cam with rollerbearing.

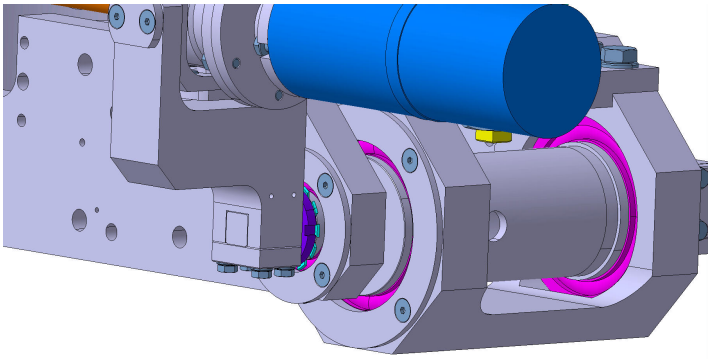

Figure 2. Detail of eccentric cam with rollerbearing for SPL tuner.

2 – <u>Magnetic Shielding</u> (Nik Templeton)

- No comments for magnetic shielding. If no major showstoppers are found, the magnetic shielding will be sent to production.

3 – <u>HOM Filter Fabrication</u> (Marco Garlaschè)

- Reported promising advances on the HOM filter fabrication at CERN workshop.
- Two prototypes of the **main hook body** have been manufactured. BCP methodology is currently under qualification on one of the two prototypes. Manufacturing has been successfully qualified on the second prototype (manufactured dimensions within ±0.01mm of ideal dimensions from drawing).
- Reported challenging weld between **capacitive collar piece** and first inductive rod of filter due to non-homogeneous thickness along weld line. Performed several trials.
- On process to qualify machining strategy for **filter cap**. Qualification performed on aluminium prototype. The main body is wire cut from bulk aluminium. The internal surface will be shaped by specifically designed milling tool. The internal blending seems pretty challenging. Checked assembly procedure: enough clearance to insert main body hook into filter cap.
- **Bellow**: manufacturing has been subcontracted. Expected delivery by September.
- Manufacturing qualification of **second inductive rod end** is on going.

4 – <u>HOM Damping Update</u> (Qiong Wu on behalf of Binping Xiao)

- **New PU coupler RF design**: Reviewers encouraged the team to reduce the impedance for the 1.75 GHz HOM. This mode weakly couples to the HOM filters as can be observed from the field distribution and the port location. The main cavity geometry was fixed more than one year ago and is currently under manufacturing. The HOM filter design was also fixed some months ago and is currently under manufacturing qualification. However, some power reaches the PU tube. Therefore, the PU coupler design has been modified to extract more power from 1.75 GHz HOM by adding a capacitive plate at the end of the coupler. The coupling to the fundamental mode increased by the addition of this capacitive plate, so the hook used to couple to the fundamental mode was retracted to reduce the coupling to the fundamental mode.
- **Materials for new PU coupler**: PU coupler to be made of bulk niobium or Nb-coated copper in order to reduce thermal loss. Ofelia raised a concern for the manufacturing of an RF

feedthrough for this coupler. If the PU coupler is made of niobium, there might be some challenges to braze the feedthrough ceramics to the rod in niobium. Qiong informed that the main losses are located at the other end of the PU coupler, in the plate and the hook. Therefore, the PU coupler can be made of two different material pieces: niobium for the part with high surface currents and copper for the part that inserts into the feedthrough.

- Next actions:
    - Design of **RF feedthrough for PU port** with enough bandwidth to extract 400 MHz and 1.75 GHz modes.
    - Define RF system to **separate 400 MHz and 1.75 GHz mode signals**.