



News on Crab Cavities

HL-LHC WP4



18.06.2024

News on RFD-CM

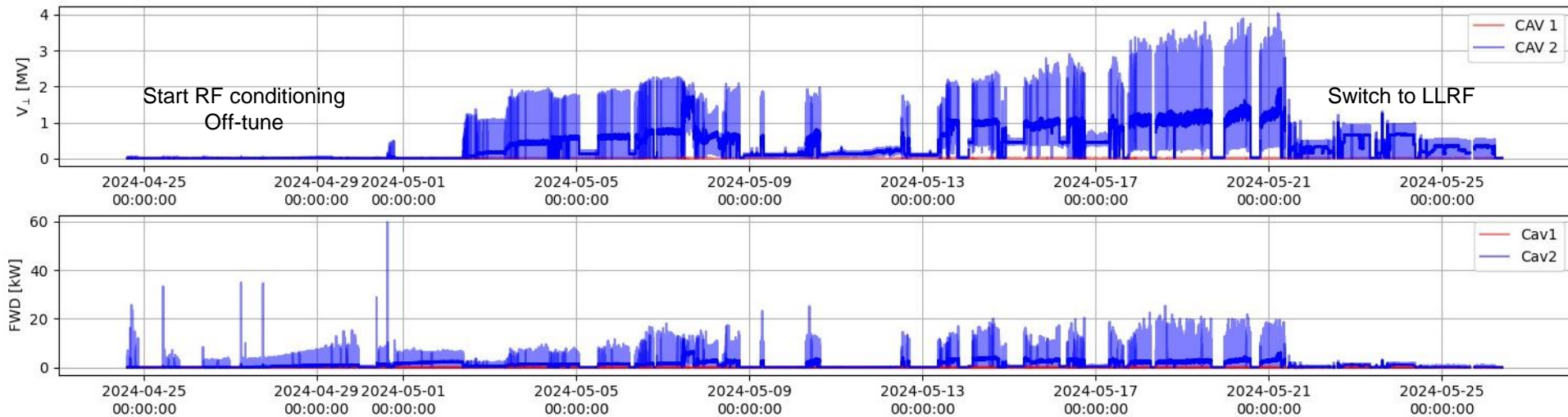
- Vacuum repair on Cav #2 successful, cavity at 2K since mid-April
- Cavities aligned after repair (transverse < 0.1 mm w.r.t nominal, longitudinal ~ 3.5 mm)
- Frequency tuning at 2K – linear. Small steps show some drifts (~ 50 Hz)
- HOM measurements confirm damping below thresholds
- RF conditioning (~ 1 month) & LLRF commissioning (~ 1 month)

Technical results, see TCC talk:
<https://indico.cern.ch/event/1421141/>

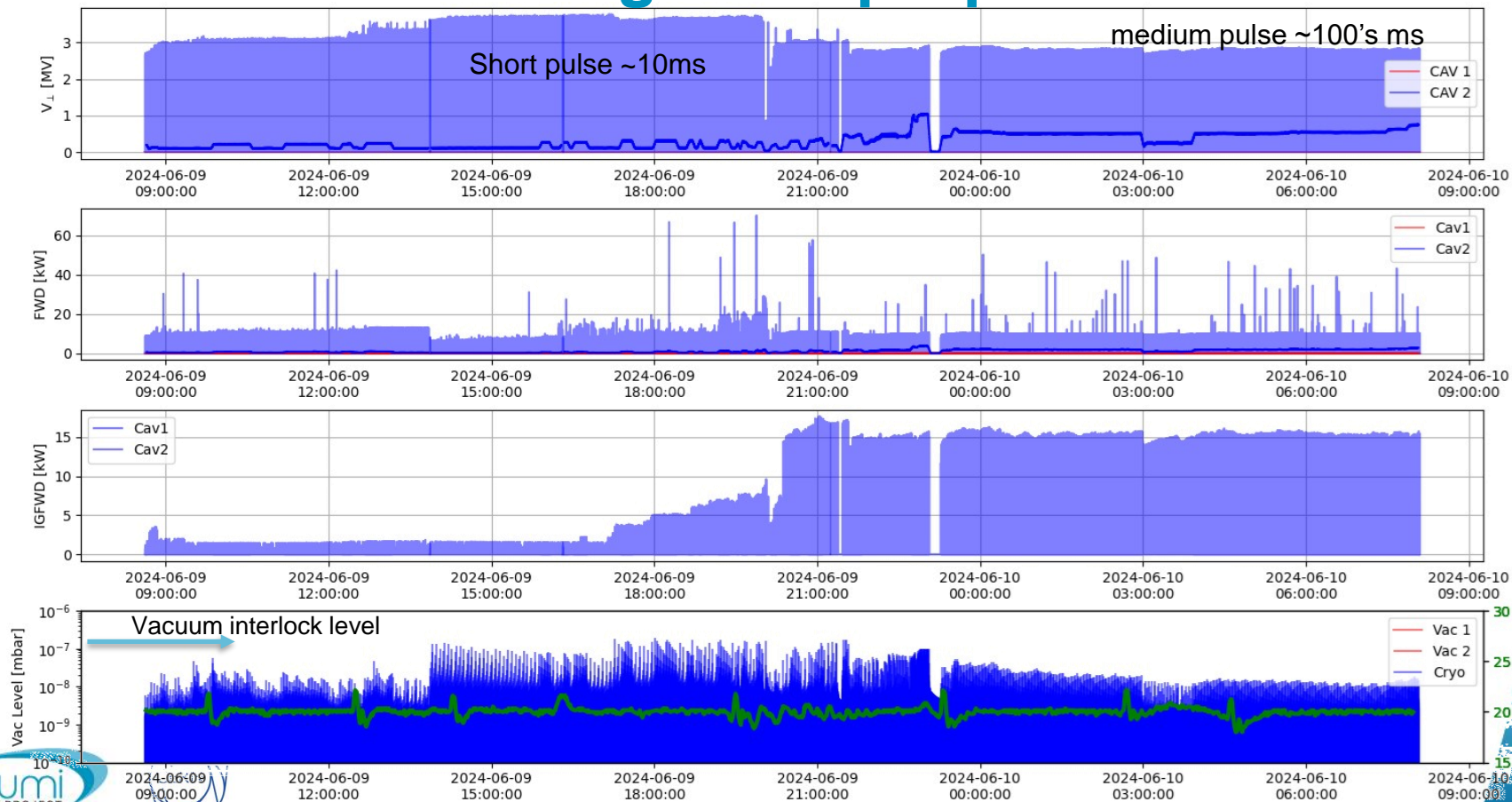


RF Conditioning Overview

- RF conditioning of the main coupler and then move cavity frequency (on-tune)
- Good progress in ~4 weeks. Installation of LHC spare circulator was necessary to progress further



Voltage Ramp Up



Next Steps, RFD

- Repair of cavity 1 in June 2024. Cool-down expected after SM18 cryo-shutdown
 - WP4 request for a high priority for the cool-down after cryo shutdown for final validation
- Qualify both cavities to nominal voltage (3.4 MV+). Up to 2 MV CW on cavity 2 looks relatively straight forward to reach
- Installation into the SPS Jan 2025. Full voltage ramp up may only be feasible in SPS

Comb Filter “Update”

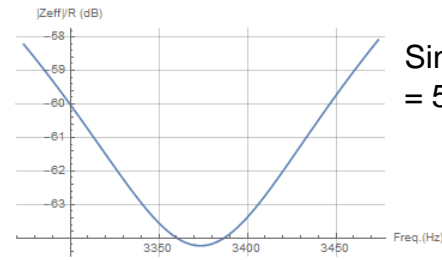
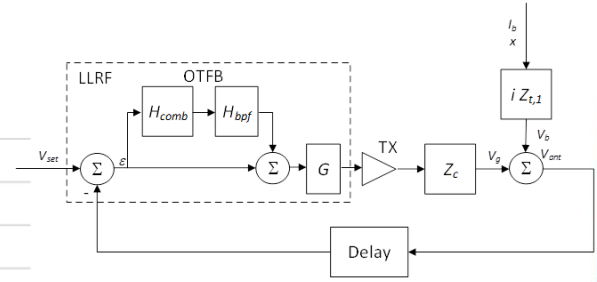
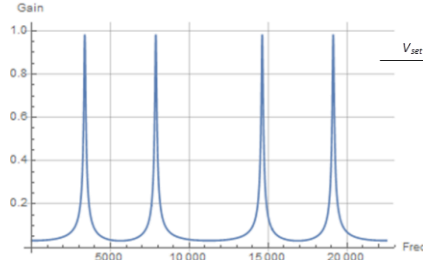
Baudrenghien et al.

- High gain at β -sideband and low gain elsewhere

$$H_{BB}(\omega) = K(1-a) \left[\frac{e^{i 2\pi Q} e^{-i T_{rev} \omega}}{1-a e^{i 2\pi Q} e^{-i T_{rev} \omega}} + \frac{e^{-i 2\pi Q} e^{-i T_{rev} \omega}}{1-a e^{-i 2\pi Q} e^{-i T_{rev} \omega}} \right]$$

- The filter gain (K=10) and bandwidth (a=31/32)

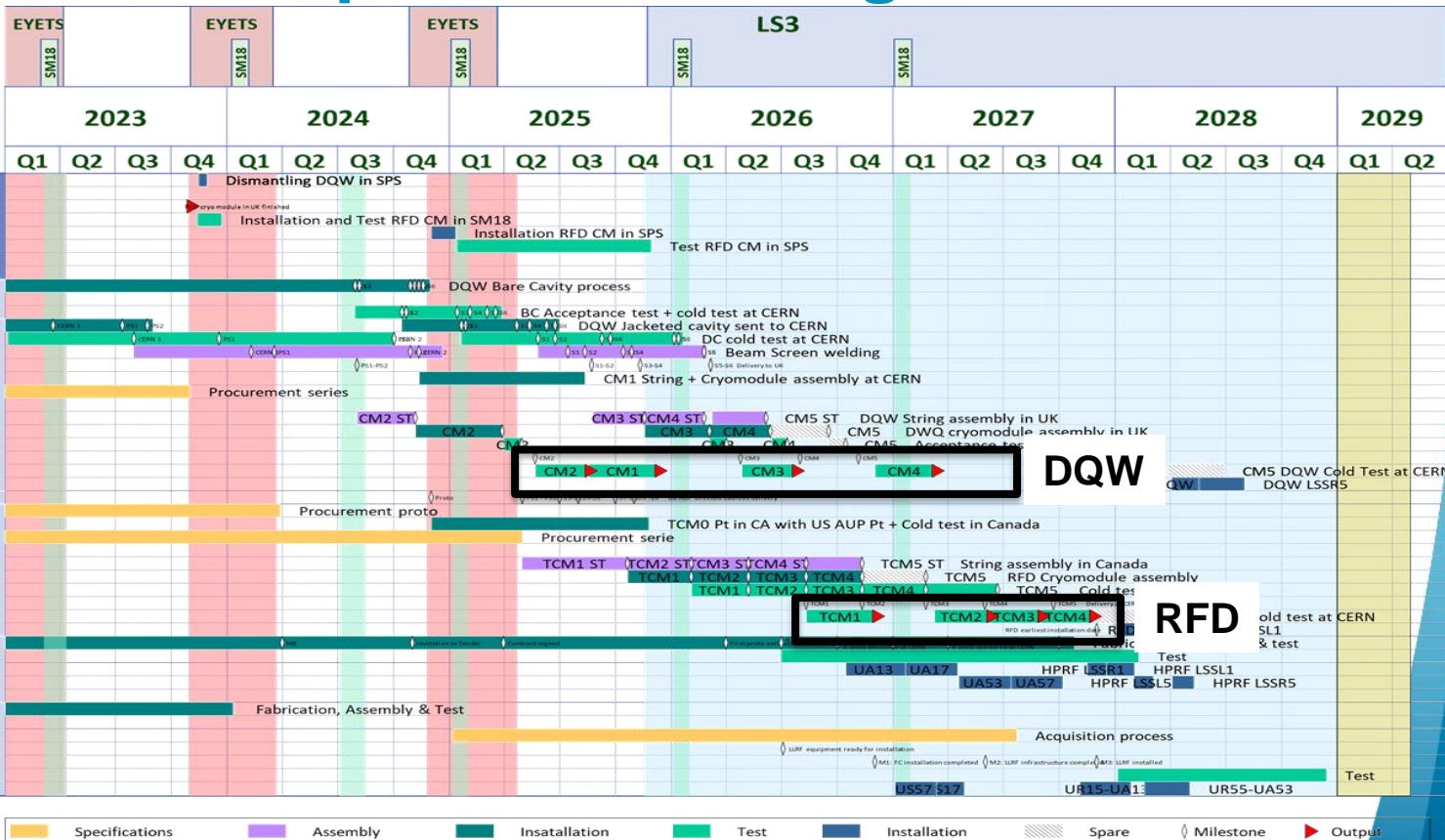
$$K \frac{\Delta f_{-3dB}}{f_{rev}} \approx \frac{0.3}{2\pi}$$



Single sided BW @-3db = 50 Hz

CC Updated Planning

WP4 - In work 23rd May



CC Planning & Commissioning

- But according to the installation planning, RFD should be installed first near ATLAS
 - We should anticipate for a back up plan in case of RFD-CM 3&4 not ready (cool-down in HL Q4-2028)
- Assuming all CMs are installed on time, the RF conditioning time (Mar-Jun 2029)
 - 1st year to be used with moderate voltage (assume 1 MV, counter-phased). We could possibly accept ~ 1 mm beam offsets at this voltage
 - Impedance & noise aspects will almost be parasitically obtained
 - Will need a few MDs (or beam commissioning) to test full RF-ON sequence to nominal voltage, phasing, beam centering