DQW_SPS_001
Partially Dressed Cavity Cold Test

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on behalf of

SRF Cavity Testing Team

Cold Test of Partially Dressed cavity: EDMS=1807930

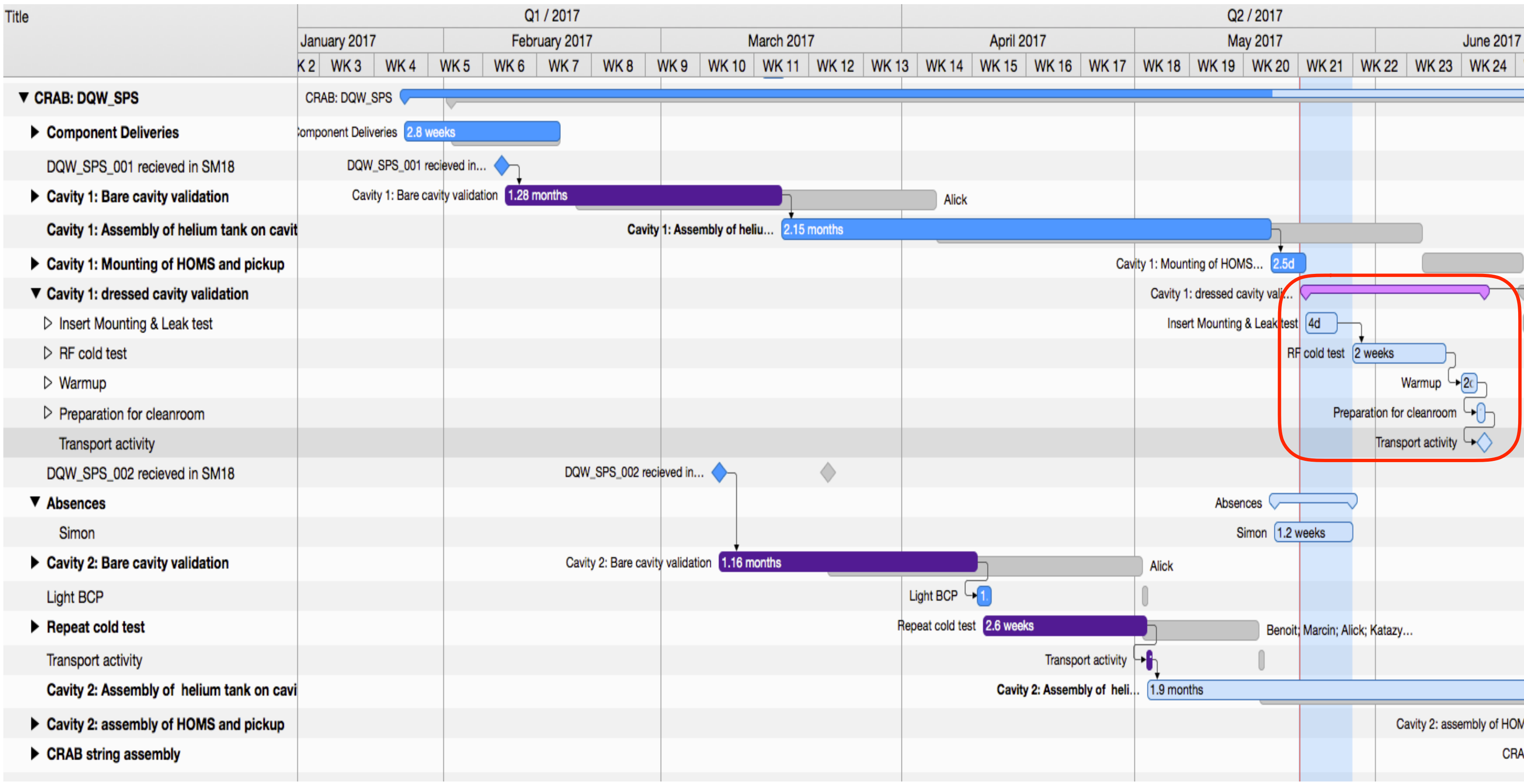
Objectives

- **Validate Cavity RF Performance**
  - Freq shift & RF performance after helium tank assembly.
- **HOMS Measurements:**
  - Measure cross coupling and behaviour of HOMS
  - Assess cavity/HOMS susceptibility to quenching
- **Schedule:** Ensure completion on schedule

Entry/Exit Conditions

- Entry: cavity under vacuum
- Exit: Cavity vented to 1 Bar with clean N2

Schedule


Title
Q1 / 2017
Q2 / 2017
January 2017
February 2017
March 2017
April 2017
May 2017
June 2017
WK 3 WK 4 WK 5 WK 6 WK 7 WK 8 WK 9 WK 10 WK 11 WK 12 WK 13 WK 14 WK 15 WK 16 WK 17 WK 18 WK 19 WK 20 WK 21 WK 22 WK 23 WK 24
CRAB: DQW_SPS
Component Deliveries
2.8 weeks
DQW_SPS_001 recieved in SM18
Cavity 1: Bare cavity validation
1.28 months
Alick
Cavity 1: Assembly of helium tank on cavit
2.15 months
Cavity 1: Mounting of HOMS and pickup
2.5d
Cavity 1: dressed cavity validation
Insert Mounting & Leak test
4d
RF cold test
2 weeks
Warmup
Preparation for cleanroom
Transport activity
DQW_SPS_002 recieved in SM18
Absences
Simon
1.2 weeks
Cavity 2: Bare cavity validation
1.16 months
Alick
Light BCP
Repeat cold test
2.6 weeks
Benoit; Marcin; Alick; Katazy...
Transport activity
Cavity 2: Assembly of helium tank on cavi
1.9 months
Cavity 2: assembly of HOMS and pickup
CRAB string assembly

Preparation of cavity for test

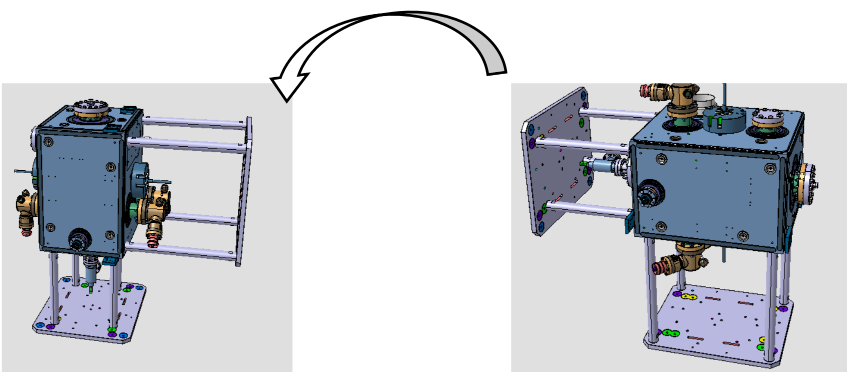
- **Handling done with crane and rotation table in SM18**
  - Cavity handling choreography in EDMS 1807930
  - Cavity handling tooling same as in workshop
  - Cavity manipulations done with transport team

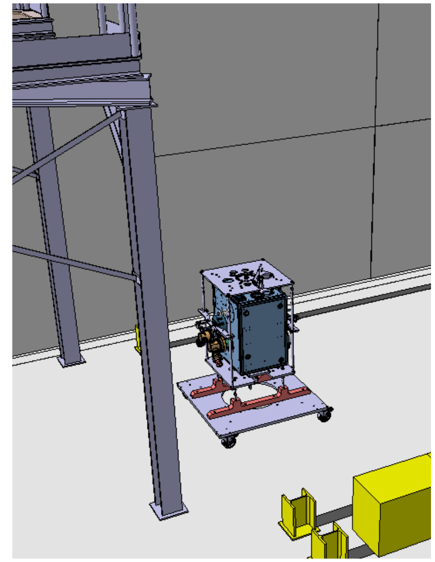
- **Mechanical Constraint**
  - Struts proposed to insert frame for coping with weight

- **No cavity bakeout:**
  - Just standard connection of pumping line

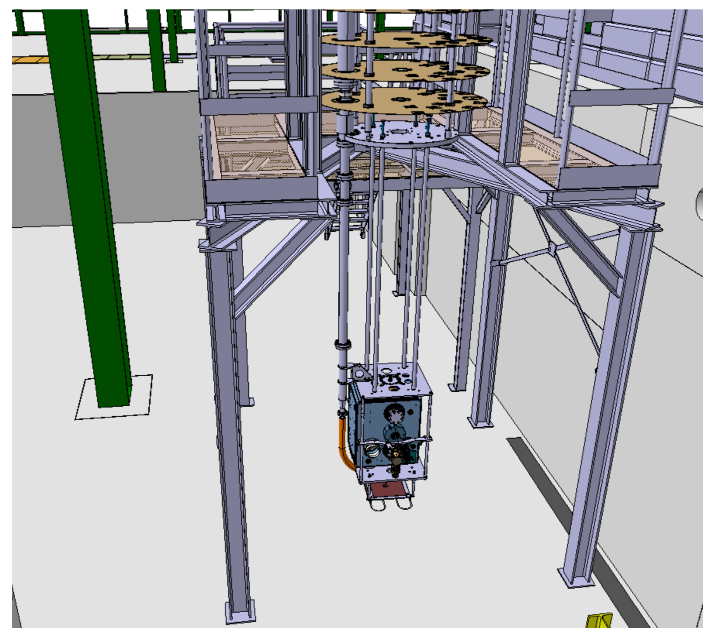
- **Insert instrumentation**
  - Temperature, B-field, cavity vacuum cryostat pressure
  - RF Power (PF, PR, PT) + Power on HOMS lines
  - Quench detection systems: OST + TES (new)
  - Pickup dark current + HOMS 800MHz components

Cavity Handling

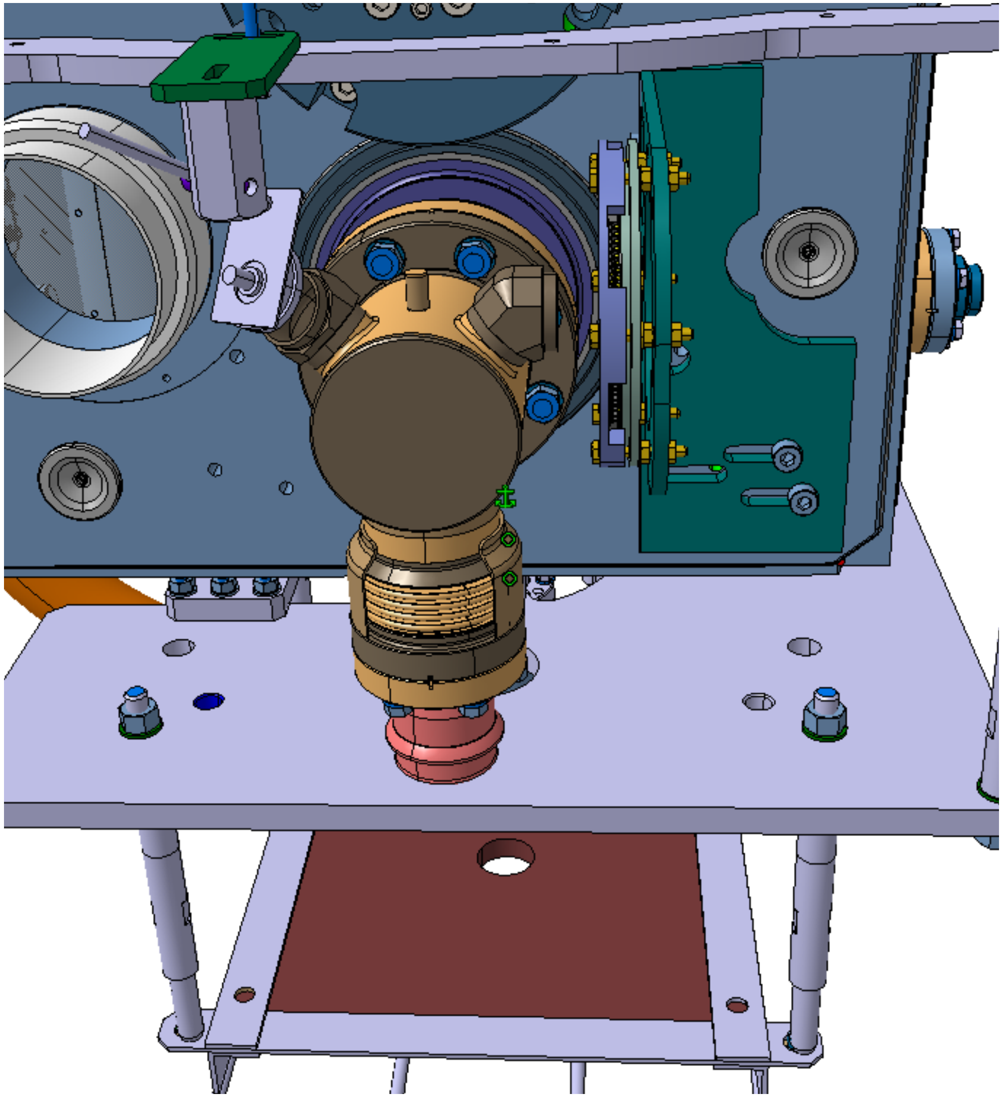


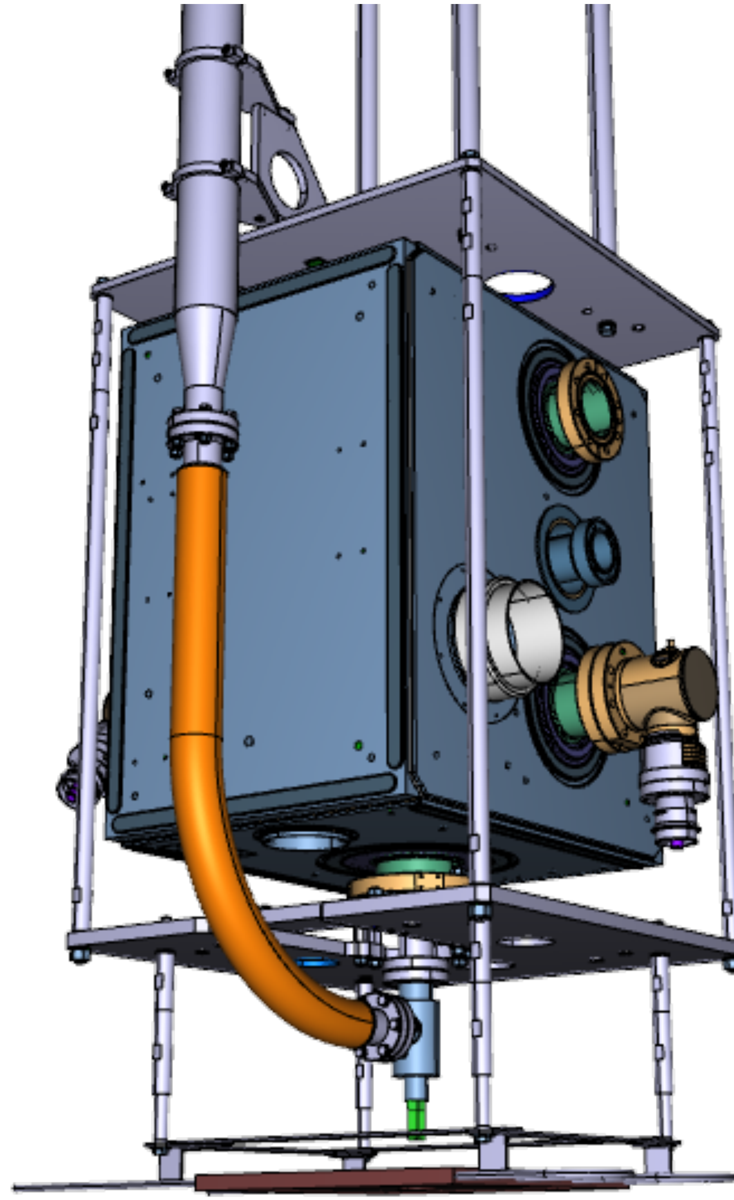


Cavity + insert frame is 293 kg



Mounting Issues



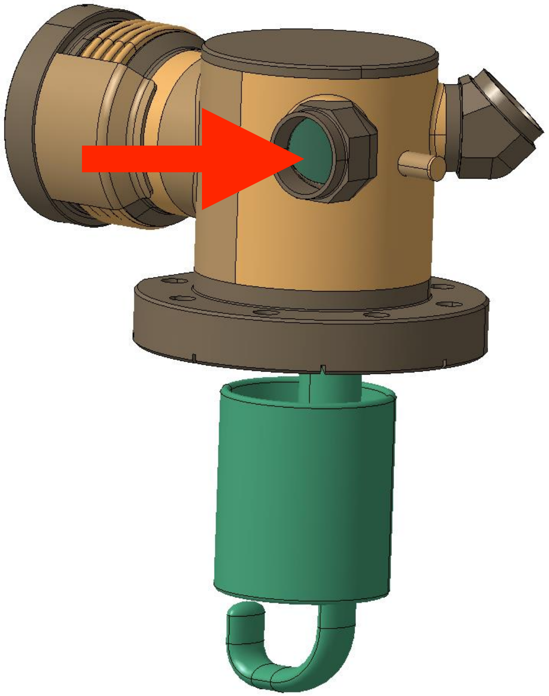


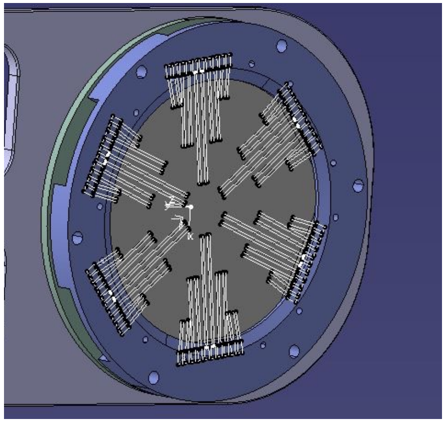
HOMS Instrumentation

- **Temperature sensor**
  - mounted directly on Nb body of HOMS
  - Contact sensor => no glue or adhesive

- **Quench detection**
  - Baseline = OST sensors
  - FPC-side HOMS fitted with 6 **T**ransition **E**dge **S**ensors
    - May give additional quench dynamics data

- **Cavity Vacuum activity**
  - Measured at top of cryostat
    - Typical level = 1 e-9 mBar





TES

Constraints

- **Requirement:**
  - Temperature, power, quench monitoring on each HOMS
- **Cool down Limitations**
  - Cavity spatial temperature thermal gradient: $\Delta T < 50$ K
    - Avoid mechanical stress from thermal contractions
- **Powering limitations:**
  - No powering above V_T = 3.4 *1.05 = 3.6MV
    - Avoid risk to HOMS ceramics from electron impacts
  - No RF powering above superfluid transition
    - Avoid trapped He gas in HOMS cans

Measurement Plan

- **Cooldown**
  - Track set of frequencies during cool down
    - **Frequencies**: 400, 586, 963, 1299, 1843 MHz
  - Discrete temperature steps (50K) measure HOMS Couplings
    - S-Parameters for set of modes
      - **Frequencies** : 746.622, 926.750, 1638.624, 1659.614, 1746.077, 1754.382, 1840.934, 1856.187, 1856.722, 1921.395 MHz

- **At 4.5 K: No RF Powering**
  - Avoid risk of trapped Helium gas damaging HOMS

- **At 2 K:**
  - S-parameter measurements with VNA
  - Pulse mode power scans up to 3.6MV
    - Power scans with (new) Self Excited Loop LLRF

RF powering at 2k

- **Initial powering**
  - Pulse mode with long pulse period + low duty factor
    - Monitor cavity vacuum: Activity => conditioning/ multipacting
    - Monitor Pickup dark current for electron loading
  - Increase input power as conditioning allows

- **RF performance scan in pulse mode**
  - Transition to pulse periods of ~5s with 50% duty factor
    - Filling time: tau ~ 0.7s
  - Monitor HOMS: look for multipacting at harmonics of 400MHz
  - Temperature monitors on individual HOMS+ beam ports
  - Quench detector on individual HOMS

- **RF performance scan in CW mode**
  - Repeat powering scan in CW
  - Includes heat run to get a heat load estimate

Warmup

- **Cryostat empty of liquid: No significant spatial ΔT**
  - **Warmup will take ~4 days**
    - Track set of frequencies during cool down
      - Frequencies: 400, 586, 963, 1299, 1843 MHz
    - At discrete temperature steps measure HOMS Couplings
      - S-Parameters for set of modes

Executive summary

- **Cavity Handling Baseline:**
  - **Cavity handling done entirely in SM18**
- **Cooldown:**
  - $\Delta T \leq 50K$ will significantly extend cooldown time
- **RF Tests**
  - First: VNA measurements of couplings
  - Second: Power scans for cavity + HOMS performance
- **Power Scans**
  - Limited to a maximum of 3.6MV
  - Pulse mode operation with SEL LLRF
- **Risk Mitigation**
  - Numerous cross-checks to protect cavity & identify multipacting