# Summary of Cavity Preparation&Testing Discussion

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- Focus on most critical preparation steps
- Give some idea on what should be done as R&D
  - Some kind of priorisation by BCD/ACD
    - There are a lot (!) of red bullets
- Can we say who's doing what on which time schedule?

# BCD/ACD developments for Cavities

- Several improvements are needed on both BCD/ACD
- A significant amount of R&D work is needed to resolve issues
  - Quality control of the processes of cavity preparation needs improvement

# Processing BCD/ACD developments - 1

- BCD=EP, 6-800°C & EP
  - Need to confirm the amount for damage removal.
- ACD
  1. Centrifugal barrel polishing 40 µm  BCP 10 µm + 750°C & EP 50µm to 75 µm
     - Is Mechanical better alternative?
       - Good for defect removal
       - Good initial surface roughness
       - Environmentally friendly
       - Q disease issue
  2. BCP & EP ????

# Processing BCD/ACD developments - 2

- Electropolish improvements:
  - Control of HF concentrations during processing (sulphur)
  - Control of Nb content during processing other contaminants?
  - Are we working in the right part of the I-V curve?
    - dc
    - pulsed
  - Can we get the right current distributions for uniform etching?
  - Measure surface roughness as process QA - can we do it?
  - Orientation? Horizontal vs. vertical
  - Other acid compositions (buffering); add water plus HF? Nitric acid?
  - Develop a technique to EP cavities in helium vessels (understand and minimize voltage drop along cavity)
  - Mass production
    - Acid recycling
      - Cost and environmental issues

# Processing BCD/ACD developments - 3

- Determination of optimum post-etching rinse processes
  - Rinse fluid
    - Water
      - Output water quality parameters?
    - Hydrogen peroxide
    - Ozonated water
    - Alcohol
  - Duration?
  - Rinse & dump?  Steady flow?
- Post-rinse handling
  - Manipulation
    - Cleaning of the outside of the cavity
      - Ultra-sound
      - HPR
  - Storage until HPR
    - baseline is to keep it full of water
    - air, vacuum, clean nitrogen, argon, ????

# Processing BCD/ACD developments - 4

- Ultra-pure high-pressure water rinsing
  - Improve water quality with additional/better monitoring
    - Particulates - both input and output streams
    - Total oxidizable carbon
    - Dissolved solids
    - Resistivity
  - Improve cleaning power
    - Optimize nozzle material, geometry, size
    - Optimize flow rates, impact angles
    - Optimize pressure
    - Investigate electrostatic charging
      - Change of oxide structure, monitoring needed
  - Optimize duration of rinse

# Processing BCD/ACD developments - 5

- Post-HPR handling:
  - Drying procedures
    - Laminar flow in clean room (DESY, KEK, JLab)
    - Vacuum (DESY, KEK, JLab)
      - Understanding of the best Vacuum system needed
        - » Oil-free
        - » No particulate contamination
    - Heating
      - With evacuated cavity (KEK): ‘In-situ’ bake
      - Air bake
    - Alcohol rinse

# Processing BCD/ACD developments - 6

- Assembly
  - Standardisation of cleaning methods for sub-components
    - Cf. Mass production
    - QA of particle counts etc.
    - Main power coupler:
      - » Can it be cleaned like the other components (before processing)?
  - Documentation of assembly procedures
    - QA of particle counts etc.
  - Training of people
- Bakeout at ~120° C
  - Optimize low-T bakeout temperature and time
    - Part of the drying process (KEK)
  - Air bakeout
- Backfill
  - Argon
    - Avoid nitride formation during tank welding
    - DESY
    - KEK: After RF test only Argon
  - Nitrogen
    - Jlab, DESY (single-cells), CEA ?
    - KEK: Before RF test

# Processing BCD/ACD developments – 7

- High-temperature heat treatments
  - Integration of furnaces into clean room?
  - 600-800°C
    - Optimise temperature and duration
    - Attach furnaces to cleanroom
    - Cavity under separate vacuum
  - 1400°C
    - High RRR needed?
      - Data analysis of cell Eacc/RRR
      - High RRR sheets from supplier

# Mass Production Issues for Preparation Process

- Simplify assembly procedures
- Reduction of hardware counts
- Minimize contact with humans
  - Tooling, Fixtures
  - Investigation of automation
- Determine processing equipment MTBF
- There is a need to develop QA processes to assess particulate contamination of the inner cavity surface

# Testing developments

- R&D phase
  - Improve cold test diagnostics
    - Extend thermometry to all tests
    - Visible light monitoring of helium boiling
  - We need to do more post-test forensics
  - All passband modes measured
  - Data on dark current
    - VT:
      - Relation of X-rays to dark current???
      - Measure X-rays in all directions
    - Module test stand
      - Faraday cup

# Test Sequence BCD

- BCD:
  - Vertical low-power test of all cavities
    - Measure 8 cavities in one cooldown
      - Measure all passband modes
    - Sorting ?
    - Different manufacturers for cavities and module (interface)
  - High-power test only few single cavities
  - All sub-components tested
    - Need to improve quality control of feed throughs, couplers, tuner motors
  - Module power test
    - First X % modules, then every Y module
    - Must include dark current measurement

# Fabrication ACD developments

- EP half-cells
- Preparation of auxiliary components
  - Cleaning and handling kept consistent with cavity treatments
- Have we got the right gasket material?
- Can we improve flanges to reduce the likelihood of contamination?

# Material ACD developments

- Investigate EP with single-crystal/large-grain material
  - Phonon peak
- Optimum heat transfer by reduction of Kapitza
- Investigation on Flux trap n Nb/Cu clad