BDS Vacuum System

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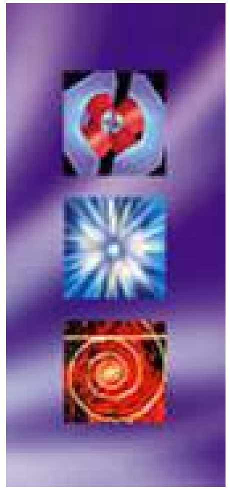

BDS Vacuum system work package

- Physics
  - Material science (ougasing, coatings) – laboratory studies
  - E-cloud
  - Gas dynamics modelling – gas density profiles and pumping optimisation
  - Impedance of vacuum chamber, BPM, pumping and gauge ports
- Practical vacuum science
  - Choice of valves, pumps, gauges, controllers, racks, leak detectors
  - Power consumption for bakeout and operation
  - Services: electricity, water cooling, gases, remote control, cables
  - Cost estimations
- Engineering
  - Integrated design
    - 2D layout: all elements a part of a beam chamber, connected to or near the vacuum chamber – fist check that there are no overlaps for different components
    - 3D design of vacuum chamber with a simplified view of other components (vacuum chamber inside magnets)
  - Detailed design of IR vacuum chamber
  - Conceptual design of BPM, RF shielded bellows, optic insert.
  - SR power deposition – SR power absorbers of needed
  - Pumping ports, valves, bellows, tapers position
  - Vacuum elements mechanical support

BDS Vacuum system work package – what is needed

Physics

- Material science (outgassing, coatings) – laboratory studies
  - Choice of material for vacuum chamber (SS, Al, Cu, …)
  - Inner coatings: Cu, Au, TiZrV?
  - New data for photon stimulated desorption at the critical energy as high as possible (20-100 keV), the BDS there will be ε_c > 1 MeV
  - Compatibility to bakeout (180°-250°C)
- Provide the necessary input for the gas dynamic model

BDS Vacuum system work package – what is needed

Physics

- E-cloud
  - If there is any e0cloud related problems
  - E-cloud power in cryogenic elements
  - Electron multipacting intensity (rate and electron energies) onto vacuum chamber

- Outcome:
  - If e-cloud should be considered in vacuum design to suppres it
  - Provide the necessary input for the gas dynamic model

BDS Vacuum system work package – what is needed

Physics

- Gas density profiles and pumping optimisation:
  - gas dynamics modelling is based on experimental input for known materials
  - Needs apertures and lengths of all elements
  - Needs SR photon fluxes and energy along the BDS
  - Need to know required pressure (gas density) **after given time/dose** for pumping and conditionning (ex.: 100 Ah or 1 year at I=?? mA)

- Outcome:
  - recommended pumping scheme:
    - positions of pumps,
    - distributed or/and lumped
    - Options
    - How it may change with time

BDS Vacuum system work package – what is needed

Physics

- Impedance of
  - Vacuum chamber,
  - BPM,
  - Pumping and gauge ports
  - Valves, Flanges, Bellows
  - TiZrV coating
  - Absorbers and spoilers
  - Tapers
- Outcome:
  - Provide recommendation to the mechanical design of these elements

BDS Vacuum system work package – what is needed

Practical vacuum science:

- Choice of valves, pumps, gauges, controllers, racks, leak detectors
- Power consumption for bakeout and operation
- Services: electricity, water cooling, gases, remote control, cables
- Practical experience vs. vacuum modelling

- Outcome:
  - Practical recommendation for vacuum design
  - Cost estimations

BDS Vacuum system work package

- Engineering
  - Integrated design
    - 2D layout: all elements a part of a beam chamber, connected to or near the vacuum chamber – fist check that there are no overlaps for different components
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  - Pumping ports, valves, bellows, tapers position
  - Vacuum elements mechanical support

What is needed as an input for mechanical design of BDS vacuum chamber:

- Apertures, collimators, spoilers along the BDS
  - Aperture meanings:
    - free space for a beam or mechanical size of the vacuum chamber
    - Tolerances for apperture, straightness, mechanical position
- Gaps between vacuum chamber and outer devices (ex.: dipole, quadrupole)
- Vacuum chamber support
- Acceptable angle for tapers
- Special vacuum chambers
  - BPMs (design and locations, fixed to quadrupoles or standing alone)
  - …
- Material for vacuum chamber (SS, Al, Cu):
  - Wall thickness – mechanical stability
- Coatings and thickness (Cu, Au, TiZrV)?
- Compatibility to bakeout (180°-250°C)
- Bellows (type, travel, RF fingers, possible locations)
- SR power
  - distributed along vacuum chamber and on
  - SR absorbers and spoilers
- Lost particles power, if large power deposited
- Flanges (gaps, special gaskets)
- Sectorisation and sector valves (location, SR shield and RF smoothness)
- Everything that can affect vacuum chamber and not mentioned above.

Work fields for Daresbury Laboratory, ASTeC and CI

- Theoretical calculation for variety of pumping layout and vacuum chamber proceedings
  - Calculate the average pressure and pressure profiles in the BDS and the extraction lines
  - Decide on the choice of material for the BDS vacuum systems
  - Recommend the BDS pumping philosophy (coatings, pumping, sectorisation, gauges, etc.)
- Reference mechanical design of BSD vacuum chamber
  - Collecting the necessary information and production of technical designs for first vacuum chamber components, based on preliminary specifications
  - Key components design
  - Reference mechanical design
  - Iterations and revisions as necessary

Relation between Vacuum system design and other task

- Optics –
  - position of optic components vs. position of vacuum components
  - Beam chamber alignment
- BPM – position, fixing to magnets or flow, connecting to vacuum chambers
- IR optimisation
  - Integrated vacuum system to meet specifications
- Crab cavity – position, valves, vacuum requirements.
- Collimators
  - position and apperture
  - Needs in TiZrV coating
- Magnets:
  - Available space between poles
  - common girder?

What resources are needed

- Physics
  - Material science (ougasing, coatings) – laboratory studies: SR beamline and volunteers to perform the experiments
  - E-cloud – modelling expert
  - Gas dynamics modelling – gas density profiles and pumping optimisation (1 vacuum scientist)
  - Impedance of vacuum chamber, BPM, pumping and gauge ports (1 expert in impedance study)
- Practical vacuum science
  - At least one practical vacuum scientist is essential (Dr. Suetsugu?) preferably 2 or 3 to present wider experience
- Engineering
  - At least 3 mechanical designer (BDS beamline, IR, dumps), the less people the less could be done