FP420 provisional Mechanical Thermal Interface Definition – Shopping list

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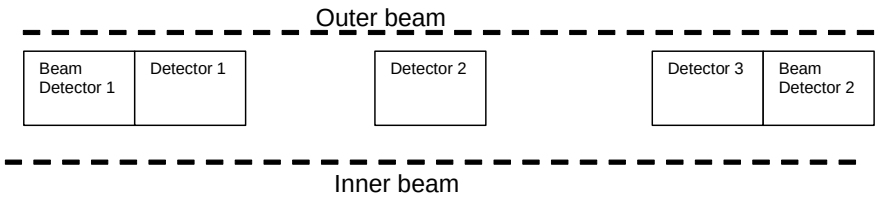
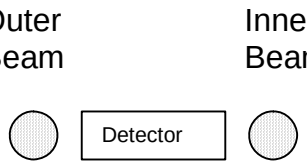
System Schematic

Top View



Side View



- Basic overview
  - There could be 3 or 4 detectors
  - Not clearly specified redundancy yet
  - The beam detectors are limited to 50 micron accuracy (due to the config of the beam)
  - There is a bake out (reminder)
  - Operational the detectors warm up need cooling

The beam

- The beam is generated every day
  - Requires tuning at the start
    - Focussing
    - Synchronisation
  - At the start at can wander between -4 and +4 mm (horizontal)

Alignment Reference

- Primary alignment reference
  1. The outer shell
  2. The beam tube (holding the primary vacuum)
  3. The beam (itself)

Alignment: Outer shell

- The outer shell holds the secondary vacuum (TBC)
- Relying on alignment mounted on outer tube:
  - Susceptible to variation in temperature and thermal gradients between ambient (cold) and operational (Warm)
  - Susceptible to variation in pressure
  - Variation in location of the tunnel (geology)
  - Co-alignment between detectors?

Alignment: Beam tube

- The beam tube holds the primary vacuum
- Relying on alignment via beam tube
  - Less susceptible to variation in temperature and thermal gradients between ambient (cold) and operational (warm)
  - Less susceptible to variation in pressure
  - Variation in location of the tunnel (geology)
  - Co-alignment between detectors?

Alignment: The beam itself

- Relying on the beam itself is relying on the beam detector
  - Position accuracy 50 micron
- Influenced by:
  - Temperature changes between non operating (cold) and operating (warm)
  - Co-alignment between detectors?

Thermal

- We need to specify cold (ambient)
  - 20 °C (TBC)
- We need to specify warm (operational)
- We need to specify hot (bakeout)
- This requires a thermal analysis
  - Detector and cooling
  - Vacuum chamber interfacing cryostat
- Cooling will have a transient effect on the co-alignment of the detectors!!!! Co-alignment after stabilisation

Impact of misalignment

- Is a required input which has not been specified sofar sensitivity analysis is underway
- We need alignment budgets
- Minimum (fundamental) seems:
  - Position of the beam is only known within 50 micron (TBC)
  - Therefore the tilt between the outer detectors is known up to 1 micro-arc (8 meter spread)
- On top of this:
  - Assembly tolerances
  - Thermal deformation
  - Difference between ambient and vacuum

Proposal (draft)

- Co-alignment (for starters)
  - 50 micron for uncertainty of beam position (TBC)
  - 25 micron on top of that as budget (TBC)
    - 20 micron for assembly misalignment (including translation) (TBC)
    - 3 micron for thermal loads (TBC)
    - 2 micron for vacuum (TBC)
- Goal:
  - Limit misalignment within
    - 50 micron for beam (TBC)
    - 12.5 micron for the rest combined (TBC)

Design Guide

- Keep it symmetrical ☺
- Detectors produce 0.5 W per active plane
- 10 planes per detector
- 24x8 mm² and 5 mm thick
- Retract heat on both long sides (shortest distance, smallest gradients)
- Detectors need to be cooled down to -20 °C
- They require a dry environment (Ice….)
  - Vacuum
  - Purged with dry nitrogen
- Cold link to detectors needs to be flexible (translation of 8 mm) (TBC)
- Cooling detectors with heath link of 0.5 W/K (could be too optimistic):
  - Would mean a 10 W heat sink at -40 °C (TBC)