

# Review of SPL short Cryomodule

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### -CERN-

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# Context and goal

- The SPL R & D is aimed since 2010 at a high power linac.
- Present goal is to assemble and test a short cryomodule equipped with 4 cavities and their RF accessories (RF couplers, tuners, HOMs (2<sup>nd</sup> phase) before the end of 2014.
- The main choices have been made for the design of the prototype cryomodule.
- The purpose of this review is to analyse these design choices

# Preliminary comments

- The Committee appreciated the good preparation of the meeting and congratulates the speakers for the quality of the work and of the talks. However, time was very short for the work of the Committee itself...
- It is understood that this R & D had to pursue a moving target during the past years.
- New solutions are being attempted which will not only help the SPL but also be of high value to the accelerator community in general.

# Subject 1: Cavity helium tank concept and interfaces to cryo-module

- New and creative concept
  - Advantages in terms of heat losses
  - Transfer of loads through vacuum flanges is critical: to be thoroughly tested
  - Inter-tank support: complex, compatible with bellows?
- Mechanical analyses:
  - Is the He tank rigid enough for the tuning system to work correctly?
  - Not always easy to understand. Clarify BCs.
  - Choice to use simplified models (intertank) or FEM detailed models (couplers) not understood; to be completed.
  - Transport analysis helium tank: 0.5g OK but what about first eigenmodes?
  - Transient analyses under thermal loads needed

## **Subject 2: Supporting system concept for the cavities in the cryo-module;**

- Courageous innovating approach of interest for the whole community.
- Importance of mock-up(s) to validate crucial concepts (alignment at cold, intercavity connection...).
- No data about leak and mechanical robustness at the level of coupler support flange on vacuum vessel: design is in initial stage.
- Vibration analysis required.

# **Subject 3: Vacuum vessel concept and choice of the associated assembly tooling; possibility of extending the concepts to a full size 8-cavity cryo-module**

- Removable top cover vacuum vessel
  - Concept with priority on quality of positioning
  - Interesting choice, simplifying the integration of the helium vessel inside the vacuum vessel
- Design at the initial stage
  - Critical flanges: dimensions, special treatment of the corners (large radii), flexibility, machining tolerances (to be done after welding), type of joint ( O or X-rings), costs, extrapolation to 13 meters(?)
  - Cover to be rigidified in the axial direction
  - Need for transient FEM analyses

# Subject 4: Cryostat thermal design concept

- Lack of a unique database for inputs (heat loads, pressure, temperature,...)
- Cooldown / warm-up requirements / constraints to be specified.
  - Check the deformations (screens, shields,...) during these transient modes
  - Check the compatibility with SM18 cryogenic infrastructure
- 2 K cooling loop:
  - Unbalance of subcooling heat exchanger to be assessed
  - Phase separator for coupler supply: Real need? What happens if we cool the couplers directly with 2.2 K, 1.3 bar subcooled liquid?
  - Check the size of the interface valve at the outlet of the sub-cooling heat exchanger to avoid 2 JT valves in series.
  - Robustness of the 2 K He level controls (RF transients) ? Need for preliminary modelling.

# **Subject 5: Cryogenic scheme, control and diagnostic devices**

- Safety: Incomplete cryogenic risk analysis for the final sizing of safety relief system on the He circuits and on the vacuum vessels
- List of additional instrumentation for prototype validation to be finalized and added on the P&I diagram.
- Study alternative for instrumentation feedthroughs without cold ceramic insulators.
- Leak-tightness issue of the top-cover vacuum vessel. Impacts on series production (cost, commissioning, operation...).



## Other subjects

- Lack of a consistent up-to-date set of parameters continuously available to all contributors.
- Need for clarification of the potential of the short cryomodule for extension to full size.
- Discussions were lively and showed the dynamism and inventiveness of the actors. However it also illustrated that many questions still deserves more work before concluding...