JRA on Sc cavities and Cryomodule for a Pulsed proton Linac

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- Motivation
- Work Packages
- Partners & resources

Motivation

- A superconducting linac represents today the best solution for the acceleration of high intensity, high brightness and high beam power proton beams up to a few GeV [Foreseen European projects planning to use a superconducting linac for accelerating protons: EURISOL, ESS, ADS, LPSPL/SPL at CERN].
- Based on the results of the HIPPI JRA inside CARE which has studied the low energy part of pulsed proton linacs (up to ~200 MeV) and using extensively the technology developed for the ILC, the proposal is to extend the development to the acceleration system above 200 MeV for a pulsed proton linac, using superconducting elliptic multi-cell cavities.
- One important goal is to prepare for a start of construction of the LPSPL at CERN in 2012, as part of the planned overall refurbishment of the injector complex of LHC.

WP2: Studies & computations

Subjects:

- HOM in cavities:
  - analysis of the effect on the beam,
  - study of the possible means of compensation,
  - specification of solution (e.g. HOM dampers).

- Study of the propagation in the high energy sections of the beam mismatch induced by transient neutralization at low energy:
  - simulation of the neutralization in the front-end (steady state and transient),
  - simulation of the transport of this transverse modulated beam pulse in the rest of the accelerator,
  - analysis of possible corrective actions.

- Study of beam centering and matching in the high energy sections using BPMs and/or dipolar modes in the cavity:
  - development of a centering correction method using the dipolar moment,
  - development of a matching method using the quadrupolar moment.

WP3: Superconducting cavities

- **Goal:**
- **development of superconducting elliptic multi-cell cavities meeting the SPL specifications for β=1 (25 MV/m). [The high power tests will be made at the CEA-Saclay using CRYHOLAB and the 704 MHz RF system installed in the frame of HIPPI.]**

- **Design phase:**
- **optimization of cavity shape,**
- **optimization of geometrical beta (usually the optimum $\beta_{geom} < \beta_{particle}$),**

- **Hardware tests (Cryholab - Saclay):**
- **measurement of each cavity in a test cryostat (Q as a function of temperature (2 K, 4.5 K) and electric gradient)**
- **measurements with a matched power source (low-power) and high-power tests (up to 1 MW),**
- **determination of the maximum gradient as a function of repetition rate (duty cycle).**

WP4: Multi-cavity cryostat

- **<u>Goals</u>:**

- **design of the complete multi-cavity cryostat for the SPL,**
- **construction of a prototype housing the 2 cavities built in WP2 and tuners equipped with fast piezo devices as developed in the frame of HIPPI,**
- **characterization of the ensemble in the new multi-purpose test place for sc modules at CERN (SRA "SuRFTeC").**

SUPPRESSED TO REDUCE TOTAL BUDGET

WP4: Multi-cavity cryostat

- **Design phase:**
- design of the full 8-cell SPL cryo-module for the SPL, adapting the TESLA/ILC cryo-modules to 704 MHz,
- adaptation of the design of the cryo-module to the construction of the prototype hosting 2 cavities,
- assessment of the effect of the cavities on the magnetic stray fields of the sc quadrupole doublet,
- stiffness simulations, vibrational analysis

- **Hardware tests (CERN):**
- pulsed high power tests with up to 1 MW per cavity: Q, gradients
- measurement of the static and dynamic cryogenic losses,
- test of the RF set-up needed for the SPL: 4 or 5 MW klystrons (prototypes from industry), high-power circulators, splitters, phase shifters, etc,
- pulsed operation of multiple cavities driven by a single RF source: implementation and test of a 2 cavities version of the RF architecture recommended after the study in the CNI for SLHC.

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