SC Cavities for Proton Linacs

EuCARD

WP10: SRF

Task 10.2: SC Cavities for proton Linacs

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Participants in the task: CEA/Saclay
CERN
IN2P3/IPN-Orsay

Objective:
Demonstrate the feasibility of 704.4 MHz sc cavities <u>at the specified performances</u>

- IPN/Orsay: Design and fabrication of beta=0.65 704 MHz 5-cells elliptical cavity equipped with a Titanium helium reservoir.
Preparation and assembly in clean room and test in vertical cryostat.

- CEA-Saclay: Design and fabrication of beta=1 704 MHz 5-cells elliptical cavity.
Preparation of the cavity and assembly in clean room and test in vertical cryostat.
Development of a vertical EP station and new HPR station.
Upgrade of field-flatness set-up suited to the cavity size and weight

- CERN : Study of interfaces between the cavity and the cryomodule.

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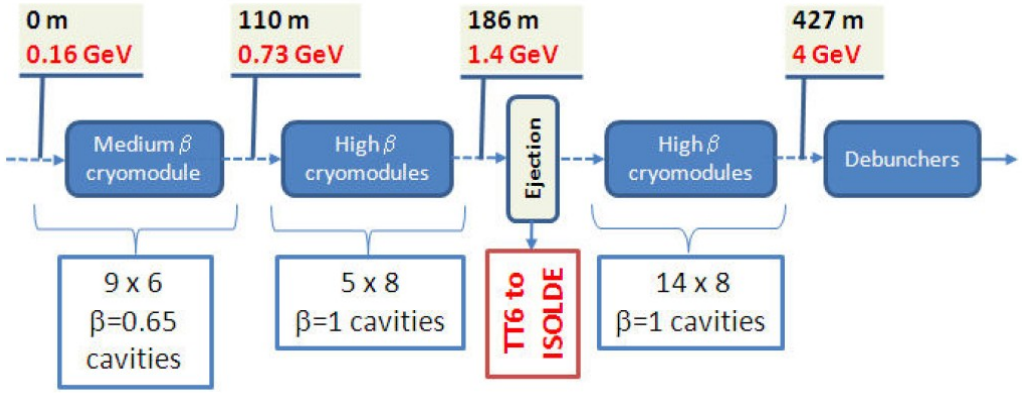
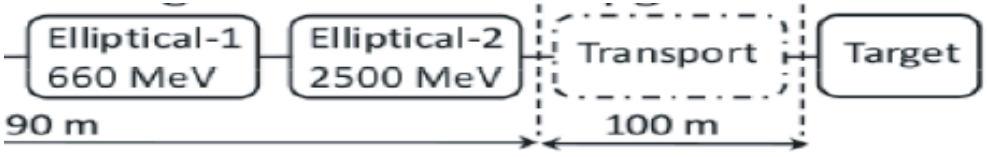
- in this program, we have to design β=0.65 and β=1.0 704 MHz sc elliptical cavities able to reach high accelerating gradients (resp. 19 and 25 MV/m)
- we aim to push the studies far enough to allow a full compatibility with already qualified components as tuner, power coupler, …

These developments are clearly essential for designing complete cryomodules for SPL and ESS whose machine parameters are very similar



sc linac - elliptical cavities - 704 MHz -



SPL		ESS
2.5	Energy (GeV)	2.5
4	Beam power (MW)	5
50	Rep. frequency (Hz)	20
40	Av. Pulse current (mA)	50
0.8	Pulse duration (ms)	2
704.4	RF frequency (MHz)	***704.4***
1.0	Peak RF power (MW)	***1.0***

Set of parameters used in yr 2010

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Meetings organized between the laboratories participating in the task:

1st July 2010 : Dedicated meeting CEA-CERN-IPNO at Lund (meeting SPL/ESS)

30 September 2010 : technical meeting on cavity and Helium tank between CEA-Saclay and IPN-Orsay at Saclay

15 October 2010 : meeting on cavity and He tank interfaces between CEA, CERN and IPN at Orsay

17 January 2011 : technical meeting on cavity and Helium tank between CEA-Saclay and IPN-Orsay at Orsay

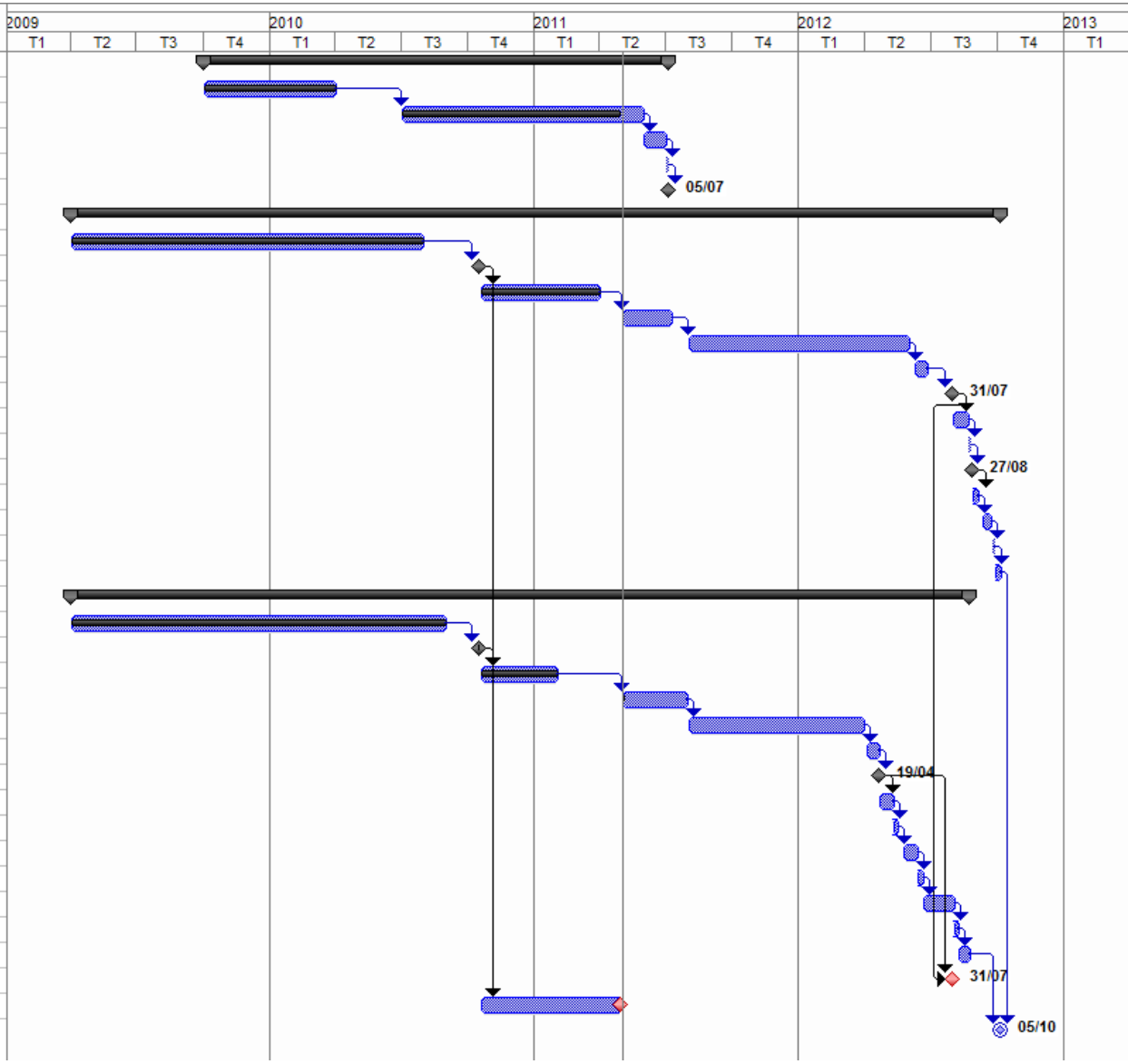
Several exchanges of 3D models via dedicated electronic plateforms

Achievements

- RF and mechanical designs of beta=0.65 and beta=1.0 cavities completed
- Mechanical designs of both cavities use common features (coupler flanges, end tubes, tuner interfaces)
- Both cavities are designed to be compatible could be tested in horizontal cryostat CryHoLab (modifications should be needed for assembly and test in the CERN-SPL 'short' cryomodule – to be assessed)
- Niobium material is available for fabrication of beta=0.65 cavity at IPNO
- Fabrication of Vertical EP station at Saclay is almost finished and first tests at Saclay (with water) are scheduled for June 2011

Schedule

N°	Nom
1	**Vertical EP station**
2	Design, Study
3	Order, Fabrication
4	Firsts tests with water at Saclay
5	Qualification and Agreement from Safety group
6	Vertical EP operational
7	**Cavity Beta=0.65**
8	Design (RF & mechanical)
9	Cryostat Interfaces
10	Drawings & Specs
11	Call for offers & Order
12	Fabrication
13	Field flatness & Frequency tuning
14	Cavity fabrication completed
15	Dummy assembly before inner chemichal treatment
16	Chemical treatment or Vertical EP
17	UHV Annealing (650°C - 800°C)
18	Preparation of antennas for vert. Test
19	Last Chemical treatment (EP or BCP) + HPR + CR assembly
20	Assembly in vertical cryostat
21	Tests in Vertical Cryostat
22	**Cavity Beta=1.0**
23	Design (RF & mechanical)
24	Cryostat Interfaces
25	Drawings & Specs
26	Call for offers & Order
27	Fabrication
28	Field flatness & Frequency tuning
29	Cavity fabrication completed
30	Dummy assembly before inner chemichal treatment
31	Chemical treatment or Vertical EP
32	UHV Annealing (650°C - 800°C)
33	Preparation of antennas for vert. Test
34	Last Chemical treatment (EP or BCP) + HPR + CR assembly
35	Assembly in vertical cryostat
36	Tests in Vertical Cryostat
37	Milestone 10.2.1: Cavity fabrication (proton linac)
38	Milestone 10.2.2: Definition of cryomodule interface
39	DELIVERABLE 10.2.1: Results of SC proton cavity tests (β=1 and β=0.65)



Milestones

Milestones #1: Definition of cryomodule interface (R – M24)

Interface between cavity and SPL cryo-module

These interfaces are identified by a) interfaces between cavity and titanium helium vessel; b) RF coupler connection to the cavity port; c) cryogenic lines ports; d) interfaces for cavity supporting in the cryo-module; e) supporting interfaces for the magnetic shielding on the helium vessel.

The design of the SPL cryo-module features the use of the RF coupler as main support of the cavities within the cryostat and defines their fixed point; in addition, an inter-cavity sliding support allows relative sliding between adjacent cavities, not to hinder thermal contraction movements, and provides complementary vertical supporting. The mechanical calculations, proving the viability of this innovative concept, were made with the participation of a fellow financed by Eucard at CERN, are available in a dedicated report (CERN EDMS No. 1102764).

…

The SPL interface drawings will be available by the end of 2010.

Milestones #2: Fabrication of cavities (P – M40)

Deliverable #1: Results of SC proton cavity tests (R – M42)

Session programme

Task 10.2 “SRF Cavities for proton drivers" Reports		
(5’)	Introduction and Task Report	Stéphane CHEL (*CEA*)
(15')	Status of the beta=0.65 cavity	Guillaume OLRY (*IN2P3*)
(15')	Status of the beta=1.0 cavity	Juliette PLOUIN (*CEA*)
(20')	Study of the vertical EP station at CEA-Saclay	Fabien EOZENOU (*CEA*)
(20')	Study of the SPL ‘short’ cryomodule	Duthil PATXI (*IN2P3*) *Including status of CERN activities*