



# Report from WG 3:

## Cryomodules

*(design & integration, construction, assembly)*

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With contributions from O.Capatina, CERN, EN-MME



# Goals & Motivation

## Goal:

- Design and construct a full-scale cryomodule prototype (Part of the **SPL Design Study** for a Project Proposal in 2011-2012)

## Motivation:

- Demonstrate the **construction capability**, CM with  **$\beta=1$  cavities** and **SC quadrupoles**;
- **Validate** and **improve design** and **construction features**
- Learning of the **critical assembly phases**
- **Enable RF testing** on a **multi-cavity** assembly in real operating conditions
- Validate operation issues **cryogenic cooling principles** and **acquire experience**
- Support **cost estimates**



# Agreed external contributions for cryomodules

Institute	Responsible person	Description of contribution
CEA – Saclay (F)	S. Chel	<ul style="list-style-type: none"><li>• Design &amp; construction of 2 <math>\beta=1</math> cavities (EuCARD task 10.2.2)</li><li>• a) Design &amp; construction of helium vessels for 2 cavities; b) tools for cryomodule assembly (French in-kind contribution)</li><li>• Tuner and RF coupler existing designs to be adapted to SPL needs (not formally agreed)</li></ul>
CNRS - IPN – Orsay (F)	P. Duthil	<ul style="list-style-type: none"><li>• Design and construction of prototype cryomodule (French in-kind contribution)</li><li>• Design &amp; construction of 1 <math>\beta=0.65</math> cavity (EuCARD task 10.2.1)</li></ul>



# Follow-up of issues from 1<sup>st</sup> collaboration meeting

Issue	Recommendation	Main contributors
<b>SPL general issues with impact on WG3 work</b>		
Test an adequate quantity of cavities (~ 12 $\beta=1$ + 2-4 $\beta=0.65$ ) and prepare 8 $\beta=1$ cavities for installation in full-size cryostat	Build and test more cavities "plug-in compatibility?"	<ul style="list-style-type: none"> <li>Stony Brook – BNL – AES (<math>\beta=1</math>)</li> <li>TRIUMF (<math>\beta=0.65</math>)</li> <li>CERN (<math>\beta=1</math>)</li> </ul>
Adapt CEA designs for RF coupler and tuner to the SPL	Study / build / test devices and their integration TBD	<ul style="list-style-type: none"> <li>?</li> </ul>
HOM dampers	Design / build / test devices and their integration Workshop coming up	<ul style="list-style-type: none"> <li>?</li> </ul>
Define longitudinal layout of the SPL (lattice including beam instrumentation and extraction devices)	Design In progress	<ul style="list-style-type: none"> <li>CERN, WG2,3,4</li> </ul>
<b>WG3 specific issues</b>		
Identification of integration needs: components type, interfaces, functional needs.	set-up a Product Break-down Structure (PBS) and interface specifications. pending	<ul style="list-style-type: none"> <li>WG3</li> </ul>
Cryo-module functional specification: alignment requirements, thermal budgets (static+dynamic), mechanical requirements	Produce a functional specification for the cryomodules. pending	<ul style="list-style-type: none"> <li>WG3</li> </ul>
Cryo-module conceptual layout (X section, longitudinal view)	Elaborate conceptual layouts, based on the longitudinal layout of the SPL. In progress	<ul style="list-style-type: none"> <li>WP2,3,4</li> </ul>
Cryogenic operating modes	Produce a specification of cryogenic conditions, pressures and temperatures pending	<ul style="list-style-type: none"> <li>CERN, WG3</li> </ul>
Quadrupole magnets and powering schemes.	set up a baseline specification for the quads lattice. In progress. June	<ul style="list-style-type: none"> <li>CERN, WG4</li> </ul>
work organization structure	set-up of a cryomodule design working group steered by CERN. done	<ul style="list-style-type: none"> <li>CERN, WG3</li> </ul>



# Work organisation plan

- **Working group** composed of:
  - System responsible representatives (see table, next slide)
  - Integration responsible (S.Weisz)
  - representatives of collaborating institutes (CNRS/CEA so far)
- Regular (monthly) **Working Group meetings** at CERN, starting from June next
- **Reporting** to SPL management:
  - 1 progress report every 6 months (July/December);
  - regular progress reporting presentations in SPL steering group meetings
- Strong interaction with other working groups

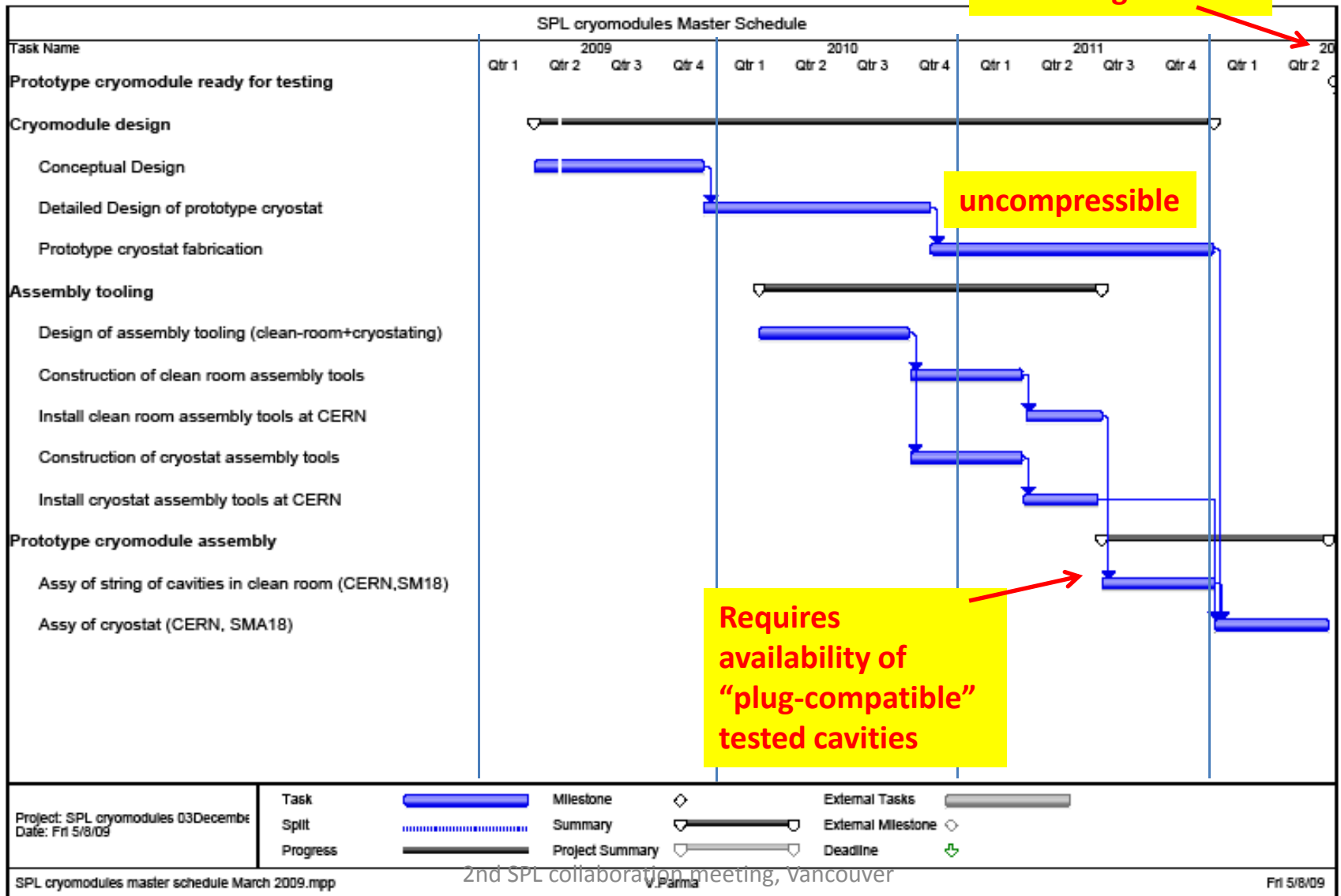


# Working group members

System/Activity	Responsible	Lab
Machine parameters and layout	F.Gerigk	CERN, BE/RF
WG3 coordination	V.Parma (O.Capatina)	CERN, TE/MSC, EN/MME
Cryostat design & Integration	P.Duthil	CNRS/IN2P3-Orsay
Cryostat assembly tooling	TBD	CEA-Saclay
RF cavities in vessel/ancillaries	W.Weingarten/S.Chel	BE/RF, CEA-Saclay
Vacuum systems	S.Calatroni	TE/VSC
Quad.doublet	D.Tommasini	TE/MSC
Magnet powering/protection	A.Ballarino	TE/MSC
Cryogenics	U.Wagner	TE/CRG
Survey	D.Missiaen	BE/ABP
SPL integration	S.Weisz	DG/PRJ

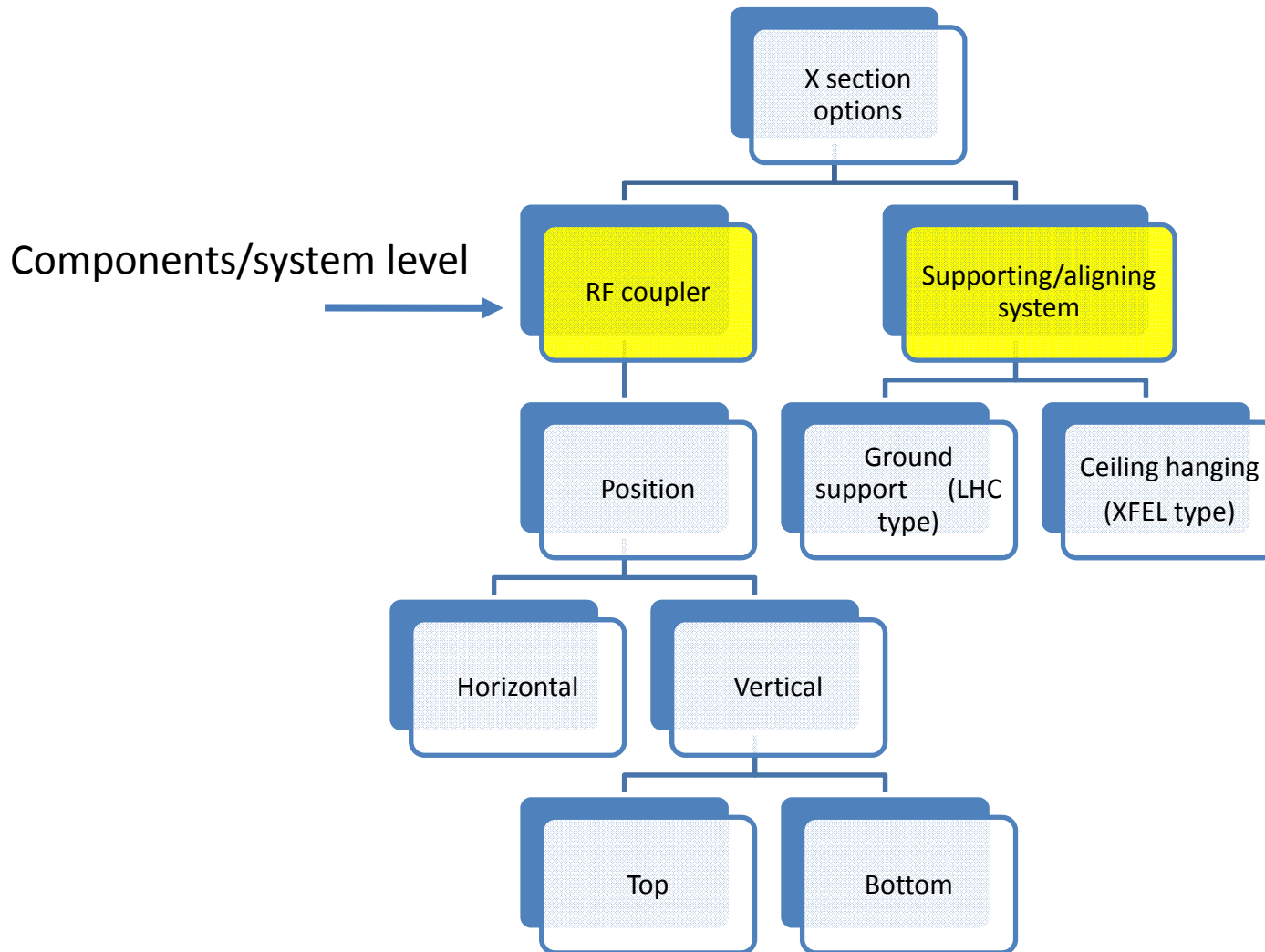


# Schedule for SPL prototype





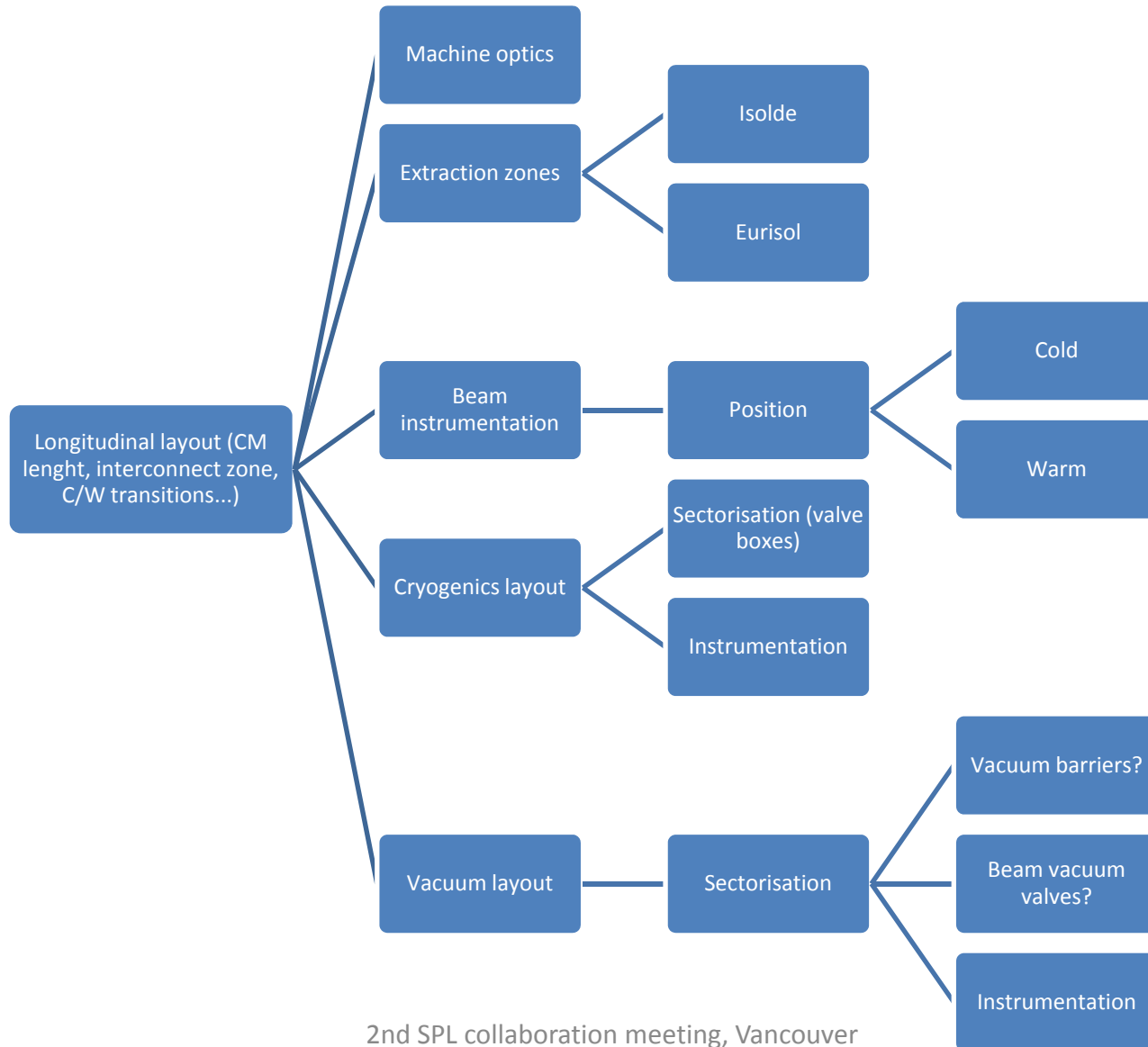
# Conceptual design: example of X section options under study







# Conceptual design: some ingredients towards a longitudinal layout






# Milestones 2009...

## Main technical milestones for WG3 in 2009:

- Accelerator layout with intermediate energy ejections: 05/2009
- HOM damper specifications (?): 06/2009  
[dedicated workshop on June 25-26, 2009 at CERN  
(<http://indico.cern.ch/conferenceDisplay.py?confId=57247> )]
- Location of beam instrumentation: 06/2009
- Orientation of RF coupler: 09/2009
- Coordination of sc cavities development: 09/2009  
[dedicated meeting in September 2009 at CERN – before SRF09]
- Decision on supporting of cryomodules: 10/2009
- **Dedicated workshop on sectorization of cryogenics: October 2009 at CERN**
  - Invitation to be sent in coming weeks.



## Work plan for WG3 this year...

- By June - July
    - Analysis of options for transversal layout (X section)
  - By July - August
    - Input from HOM work shop, optics and instrumentation requirements => analysis of options for longitudinal layout
  - October
    - Workshop on sectorization of cryogenics will be organized at CERN
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- By November => conceptual design and detailed specification for detailed design to start