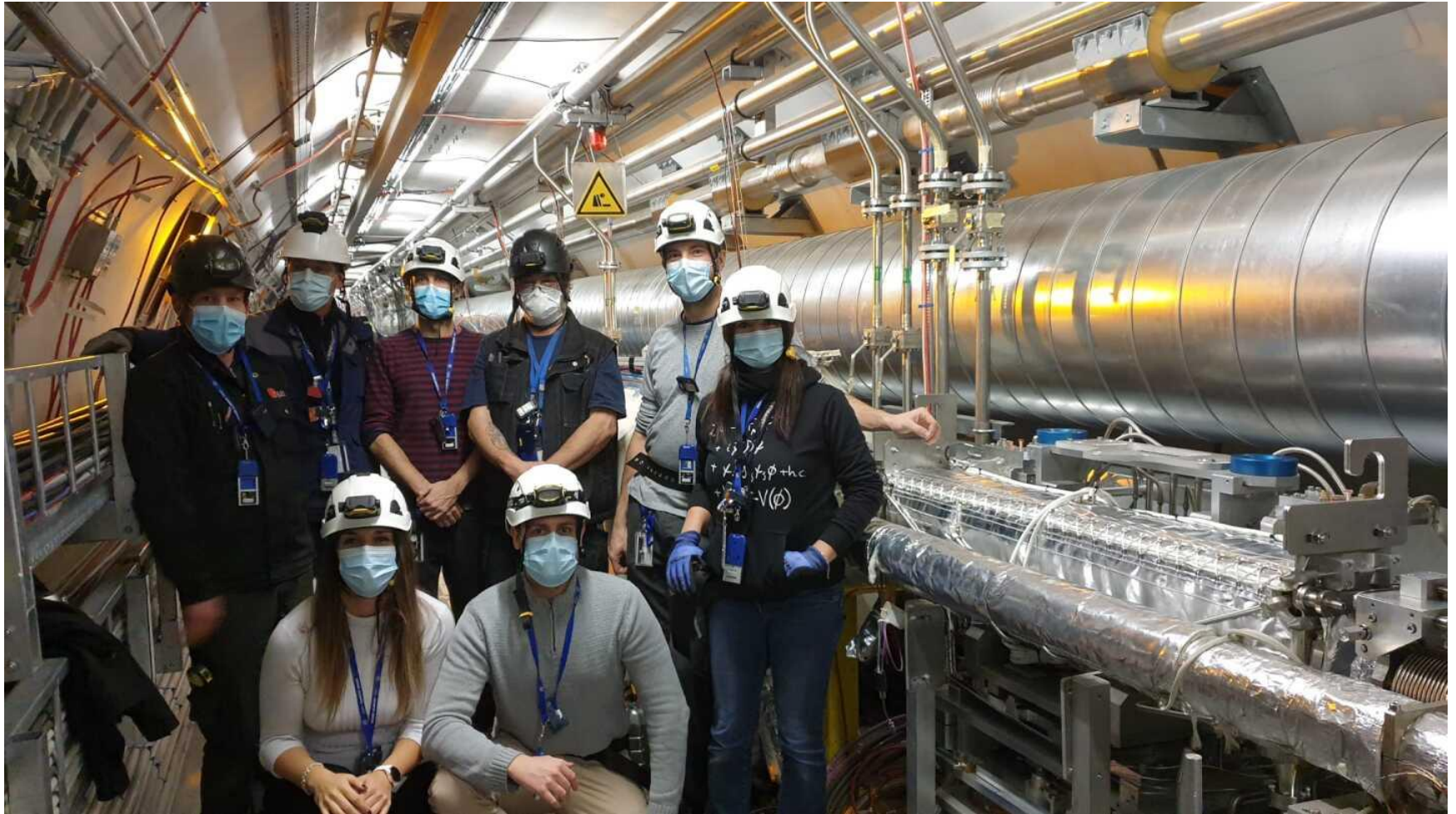


# sWP5.2 IR Cleaning (TCL, TCT) & Halo Cleaning (TCSPM)

F.-X. Nuiry  
Sept. 2021



# Big thank to the LS2 team for the excellent job



# Introduction

- Re-organization of WP5 as presented at [129th TCC](#)

## Proposed Task Management

- WP5 Leader: Stefano Redaelli (BE-ABP)
- WP5 Deputy: Antonio Perillo Marcone (SY-STI)
  
- 4 new sub-Workpackages, with leaders nominated
  - sWP5.1: Collimation Studies
    - Sub-Workpackage Leader – **Roderik Bruce** (BE-ABP)
  - sWP5.2 : IR cleaning (TCL,TCT) & Halo Cleaning (TCSPM)
    - Sub-Workpackage Leader – **Francois-Xavier Nuiry** (SY-STI)
  - sWP5.3 : Hollow Electron Lens
    - Sub-Workpackage Leader: **Adriana Rossi** (SY-BI)
  - sWP5.4 : Crystal Collimation
    - Sub-Workpackage Leader: **Mario di Castro** (BE-CEM)



# SWP5 Mandates

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- WP5.1 Beam Collimation Studies led by R. Bruce, BE-ABP – EDMS [2594117](#)
- WP5.2 Collimator Production led by F-X. Nuiiry, SY-STI – EDMS [2594114](#)
- WP5.3 Hollow e-lens led by A. Rossi, SY-BI – EDMS [2594119](#)
- WP5.4 Crystal Collimator Production led by M. Di Castro, BE-CEM – EDMS [2594112](#)



# SWP5.2 Mandate



EDMS No. 2594114

## Mandate for Sub-Workpackage Leader of the WP5 Collimator production

The role of sub-Workpackage Leader (sWPL) for the “WP5 Collimator production” is assigned to F.-X. Nuiry (SY/STI). The mandate for the sWPL is summarized below.

- The sWPL coordinates, in close conjunction with the groups responsible for the technical execution, all aspects related to the development, engineering design, prototyping, validation, production, installation and hardware commissioning of the WP5 Collimators to be installed during LS3.
- In collaboration with the CERN groups involved in WP5 collimator activities and the external collaborators involved in in-kind contributions, the sWPL
  - Liaises with groups to ensure the availability of resources needed for the execution of the task
  - Proposes/communicates to the WP5 management possible modifications to the resources allocated to groups involved, to optimise the overall resources, reduce risks, activate opportunities for savings (if possible), identify additional needs;
  - Is responsible for assuring that the adequate documentation is provided timely and archived in EDMS in accordance with the project QA guidelines;
  - Defines and coordinates the successful execution of project milestones and deliverables following the WP5 master plan;
  - Liaises with the involved technical groups and with planning, coordination and integration teams to organize the installation of the collimators during LS3;
  - Defines the project structure in EVM together with the WP5 link persons in each group involved and collects the relevant information for the EVM reporting;
  - Is responsible for defining – in collaboration with the WP5 and HL-LHC Project management – alternative procurement and validation scenarios if needed;
  - Is responsible in conjunction with the involved technical groups for the successful production and testing of the collimator prototypes (in particular, TCLPX and TCTPXH) foreseen to be built at CERN.

- The sWPL steers with the relevant groups the validation tests prior to installation (impedance measurements, control tests, functionality of all sub-components, etc.), without and with beam for the collimators and the related sub-components. This includes the definition of the validation tests (e.g. leadscrew taskforce, HiRadMat, Radiation-to-Materials and PIE) needed prior to the series production for full-collimators and sub-components (e.g. active jaw material, full jaws or full collimators, etc...).
- The sWPL is responsible for the design and production of the final assembly (i.e. collimator with its support and vacuum interconnections), and its conformity with the functional specifications/requirements, triggers possible design improvements, relevant reviews, and proposes different production schemes-
- The sWPL is responsible, in collaboration with the relevant groups, for the integration of the full remote alignment system (FRAS) and the vacuum interconnects in the overall collimator design, and guarantees that the collimators are compatible with remote handling.



EDMS No. 2594114

- The sWPL is responsible for the management of the budget (M+P) for the sWPL.
- The sWPL will organize the technical meetings required for the execution of the respective sWPL tasks with the relevant teams.
- The sWPL attends, and reports regularly at, the WP5 meetings organized by the WPL. The sWPL participates to the WP5 PSMs and other Project meetings where needed.
- The sWPL, in collaboration with the HL-LHC Safety Office and acting on behalf of the WPL, is responsible for ensuring that all relevant safety aspects are taken into account, from the design phase of the system until its operation. The sWPL liaises with the safety officers and the HSE unit to author the Safety Assessment Form and organises and facilitates the in-situ inspections where relevant.



# SWP5.2: Key activities to follow-up

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- Specifications & design follow-up

Production management

Testing, installation and commissioning

TCLPX &  
TCTPXH protos

+

51 collimators & masks

- Specific developments for collimators (materials, mech. components, R2E...);
- Specific developments of the FRAS;
- Specific developments of the vacuum interconnects;
- Surface mock up for IR collimators;
- New EVM WBS to be proposed, and related budget management;
- Documentation and integration;
- Report to WP5 and HL.

# SWP5.2: General Organization

**SWP5.2 Leader: F-X. Nuiry, deputy: F. Carra**

**Project management:** F-X Nuiry & STI team.

Compliance with specifications, EVM, resources management, planning, reporting, information management, quality, communication with WPs & HL.

**Equipment ownership:** STI.

Coll. and masks engineering design, production, qualification, installation, commissioning, maintenance, storage.

**Engineering developments:** F. Carra and MME team.

3D/2D design updates and support, core materials development and production follow-up, Multimat-2, defined prototyping activities, engineering support on collimators (simulations, engineering specifications, defined assembly and test procedures, reporting, etc.).

**Survey:** P. Bestmann & M. Sosin. Alignment proc. support and Eng. activities on FRAS.

**Impedance:** B. Salvant, N. Biancacci. Design input and qualification/validation tests.

**Vacuum:** G. Cattenoz and VSC team. Vacuum, incl. Eng. and install. of interconnects.

**Controls:** J. Lendaro and CEM team. All controls and cabling activities + FRAS controls.

**BPM:** J. Daricou and BI team. Cables, flanges, BPM selection, supply, qualification, and tests.

**Transport:** C. Bertone. Transport scheme and actual transport.

# sWP5.2 Collimators' production

- LS3 collimators' production LHC-TC-ER-0006
  - In green: to be produced

Collimator Description	Names	LS3 installation				Design	Jaw material		Functional specification status April 2021	
		Operational	Total series Production	Spares	CERN Protos					
Tertiary collimators	TCTPXH	4	4	1	1	LHCTCTPXH_0001	Two possibilities: Inermet 180 (tapering in CuCr1Zr), CuCD (tapering in MoGr) (selected for the proto)		<a href="#">EDMS 2519805</a>	
	TCTPXV	4	5	1	-	LHCTCTPXV_0001	Inermet 180 (tapering CuCr1Zr)			
	TCTPM	4	5	1	-	TCSPM Design	Two possibilities: Inermet 180 (tapering in CuCr1Zr), CuCD (tapering in MoGr)			
	(TCTP)	4 (re-used)	-	-	-	LHCTCTP_0001	Inermet 180			<a href="#">EDMS 1304880</a>
Physics debris collimators	TCLP	4	5	1	-	TCSPM design	Inermet 180 (tapering CuCr1Zr)		<a href="#">EDMS 2276600</a>	
	TCLPX	4	5	2	1	LHCTCLPX_0001	Inermet 180 (tapering CuCr1Zr)		<a href="#">EDMS 1304880</a>	
	(TCTP)	4 (re-used)	-	-	-	LHCTCTP_0001	Inermet 180		<a href="#">EDMS 1304880</a>	
Physics debris collimator Masks	TCLM	4 TCLM4 8 TCLM5/6	15	3	-	LHCTCLM_0001 and LHCTCLM_0002	Inermet 180 for TCLM4	TCLM5 & 6: Copper OFE	<a href="#">EDMS 2276600</a>	
DS collimators	TCLD	2 (point 7)?	-	-	-	LHCTCLDA0001	Inermet 180		-	
Low-Impedance secondary collimators	TCSPM	10 (point7)	12	2	-	LHCTCSPM0160	MoGr with Mo coating		Copy/paste of LS2 production	



# sWP5.2 Collimator's production. Present baseline

Addendum No. P110/A16

to

THE 2013 PROTOCOL P110  
CONCERNING SCIENTIFIC COLLABORATION

between

THE EUROPEAN ORGANIZATION  
FOR NUCLEAR RESEARCH (CERN)

and

THE BUDKER INSTITUTE OF NUCLEAR PHYSICS  
(BINP)

to

THE 1993 CO-OPERATION AGREEMENT BETWEEN  
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Collaboration in the manufacture and assembly  
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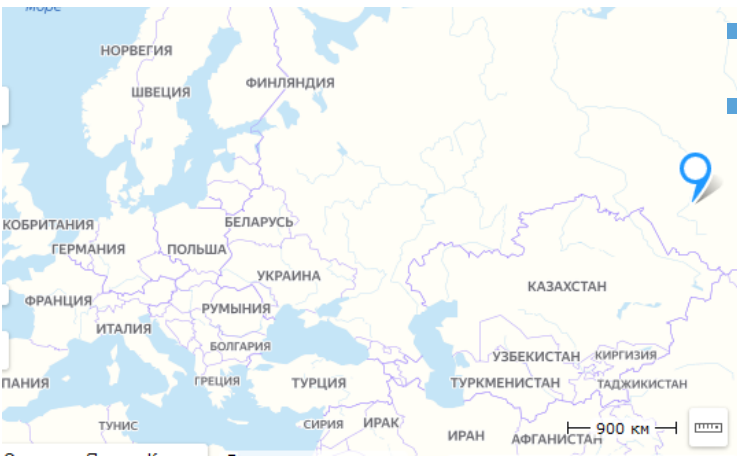
## BINP contribution

- Samples and protos (EBW, brazing, Jaw, coll.);
- 51 coll. and masks produced at BINP:
  - including metrology tests;
- Other QA tests to be defined;
- Exact deliverable “*collimator*” to be defined.

## CERN Contribution

- Design, specifications and procedures;
- Provide specific components and materials;
- Training of BINP expert on INFOR/EDMS;
- Define acceptance criteria;
- Organization of a Prod. Readiness Review.

**Coll-assembly at BINP / Final assembly at CERN**



# Functional & Engineering specs & studies

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- TCL: EDMS 2276600 being updated

Pending:

- NEG vs aC?
- BPM flange compliance with 6 PT100.
- Vacuum features to be defined for masks.
- TCT: In work
- TCSPM: Copy past of LS2 production. Updates for TCTPM and TCLP

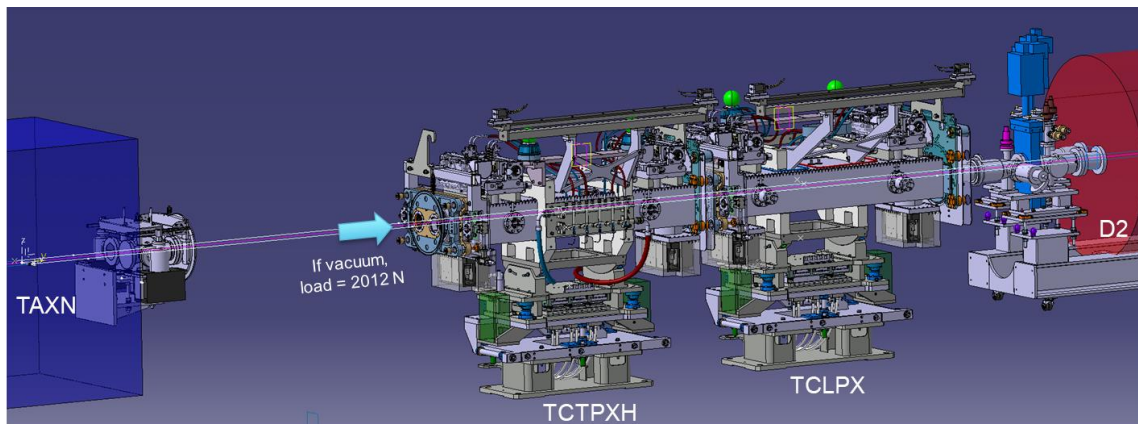
- 
- Integration & transport studies with WP15 to be done
  - Spare policy for some units to be defined

# Prototyping of TCLPX and TCTPXH

## ➤ Production:

- Functional drawings approved;
- General production plan done;
- Decisions on some key components (roller screws, etc.);

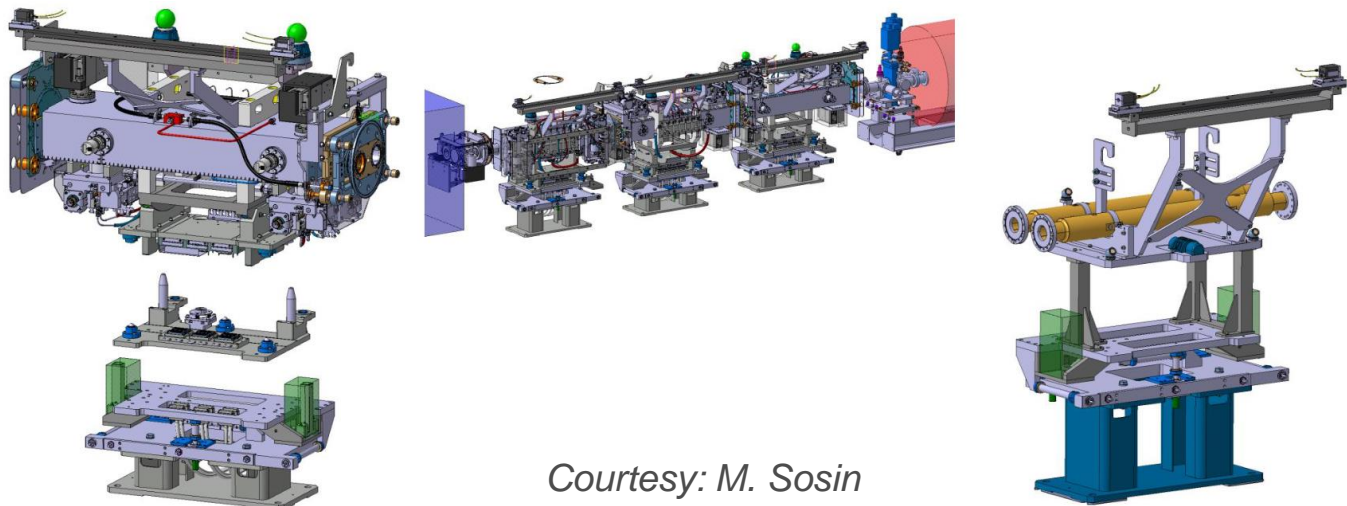
## ➤ Testing phase to be designed:



- Foot pre-alignment test;
- Handling test;
- Collimators & D2 vacuum valves alignment;
- Vacuum interconnection tests;
- Remote actions;
- Electrical continuity test;
- FRAS operational tests;
- Test of TCLPX collimator replacement.

# FRAS (AUP and WPS) for TCLPX, TCTPXH/V and TCLM

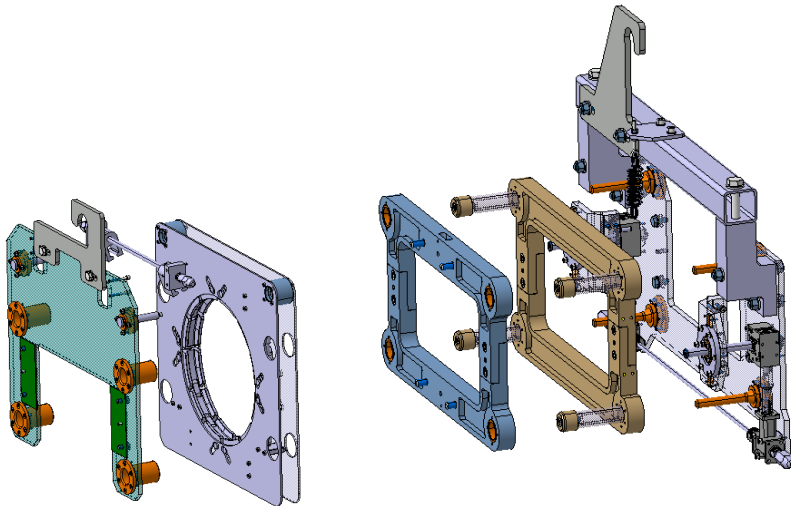
- Collimator alignment procedure in work;
- Controls (Switches/LVDTs, soft securities) to be defined & developed;
- Remote handling do be defined and developed;
- Maintenance / other design features to be studied;
- Design Review to be organized.



*Courtesy: M. Sosin*

# Vacuum interconnects for TCLPX and TCTPXH/V

- Specifications to be defined (TID to be considered);
- Vacuum and mech. developments ongoing. Risks of failure mitigations to be discussed;
- Responsibility sharing WP5/WP12 done:  
<https://edms.cern.ch/document/2609329/0.9>
- Design review to be organized.



Courtesy: J. Pascal Meignan

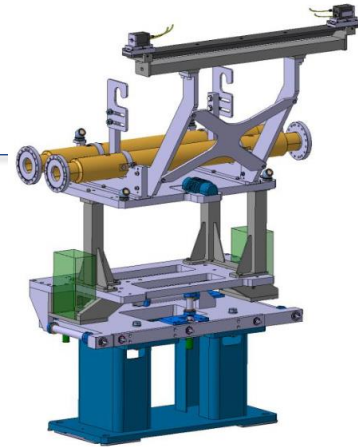
Steps	Responsibilities
Design	TE/VSC
Prototyping production & optimization	TE/VSC
Procedure for operation	TE/VSC
Procedure for production assembling	TE/VSC
Engineering specification	TE/VSC
Series production	SY/STI
Installation on the collimator tanks	SY/STI
Installation / removal in the tunnel	TE/VSC assisting the robotic team (BE/CEM) with presence of SY/STI representative
Vacuum Commissioning	TE/VSC
Leak detection	TE/VSC



# TCLM

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- In cells 4, 5 and 6;
- Baseline is Inermet & Copper;
- Design being reviewed in view of the production;
- Plug-in support to be discussed;
- Quantities to produce to be confirmed (spare policy).



# Planning (to be updated with In-Kind information not available yet)

- Series production starts after completion of the TCSPM prototype (BINP) & TCLPX/TCTPXH CERN protos;
- Proposed procurement process time of in-kind partner based on CERN expertise;
- Production rhythm based on LS2 production capacities (from a well trained industrial partner).

BINP ACTIVITIES																
Milestones		LS3														
		2022	2023		2024		2025		2026		2027		2028		2029	
		S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	S1	S2	Q1	
TCLPX TCTPXH TCTPXV	TCLPX + TCTPXH Prototypes prod. & testing	█	█													
	DESIGN READINESS Review or Milestone		★													
	Pre-series production of EB samples, brazed samples, prototype jaw	█	█													
	Pre-series production of a collimator prototype (TCSPM type)		█	█	█											
	PRODUCTION READINESS Review				★											
	Series Production including BINP procurement process					█	█	█	█	█	█	█	█	█	█	9 5 colls
	CERN final assembly and QA										█	█				
Installation												█				
TCLM	DESIGN READINESS Review or Milestone	★														
	PRODUCTION READINESS Review		★													
	Pre-series and series production			█	█	█	█	█	█	█	█	█	█	█	3 12 masks	
	QA at CERN						█	█	█							
Installation										█						
TCSPM, TCTPM, TCLP	PRODUCTION READINESS small Review		★													
	Series Prod start after BINP TCSPM proto. completion					█	█	█	█	█	█	█	█	█	16 6 colls	
	CERN final assembly and QA											█	█			
	Installation														█	

# Conclusion

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- New WP5 structure with dedicated 5.2 sub-workpackage;
- More collimators to produce than during LS2;
- In-Kind production baseline (new);
- (Very) challenging design for physics debris collimators;

# Appendix

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# sWP5.2 Collimator's production. Present baseline

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## Steering committee

Monitor the execution of the contract  
Ensure compliance with requirements

**CERN**

-Director of Acc.  
-HL-LHC PL

**BINP**

-Director of BINP  
-Deputy director

## Technical coordinators

Technical coordination of the project  
Monitor execution of the project  
Define detailed WP and schedules

**CERN**

-S. Gilardoni  
-S. Redaelli

**BINP**

-A. Krasnov

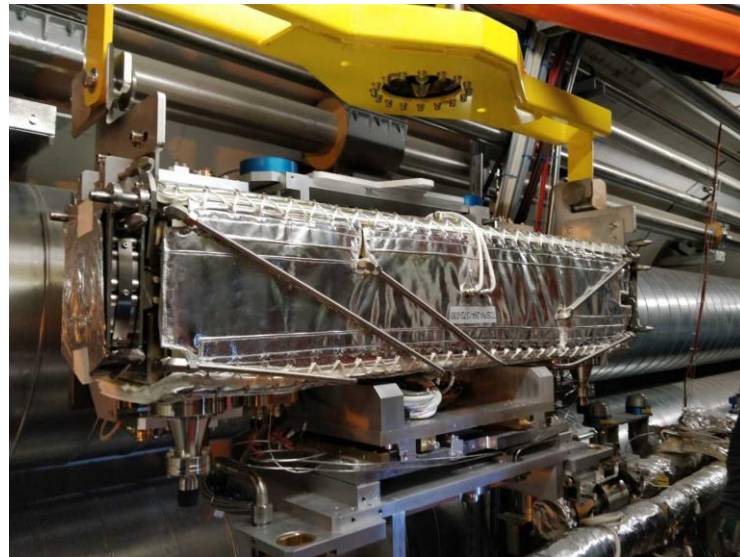




# TCSPM

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- To install 10 **at point 7?**
- *LS2 Collimators Production* is the reference folder: <https://edms.cern.ch/project/CERN-0000185864>



# TCTPM

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- Same design as TCSPM but with Inernet or CuCD;
- TCSPM functional drawings to be used;
- **Installation location:**

# TCLP

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- TCSPM design with Inermet 180 (with and CuCr1Zr tapering)
- **Installation location:**