The LHC Ring Collimation System

Presented by O.Aberle
AB/ATB Targets & Dumps Section

Outline

1. Specifications
2. Design
3. Prototype testing
4. Integration
5. Outlook

Specifications

	TCP	TCS	TCT
Numbers	11	33	18
Jaw length:	20 cm	100 cm	100 cm
Jaw tapering:	20 cm	20 cm	20 cm
Jaw material:	C	C	Cu (high Z)
Jaw dimensions:	80x25mm	80x25mm	65x50 mm
Jaw coating:	~ µm Cu	~ µm Cu	
Jaw orientations:	any	any	H / V
Jaw resistivity	minimal	minimal	
Max. opening	60 mm	60 mm	60 mm
Minimum full gap:	0.5 mm	0.5 mm	20 mm
Knowledge of gap:	50 µm	50 µm	250 µm
Flatness:	25 µm	25 µm	125 µm
Surface roughness:	< 1 µm	1.6 µm	1.6 µm
Jaw position control:	10 µm	10 µm	10 µm
Jaw angle control:	15 µrad	15 µrad	15 µrad
Reproducibility:	20 µm	20 µm	100 µm
Heat load:	3 kW	10 kW	
Annually dose rate	1 MGy	1 MGy	
Max. oper. temperature:	50°C	50°C	
Outbaking temperature:	250°C	250°C	250°C

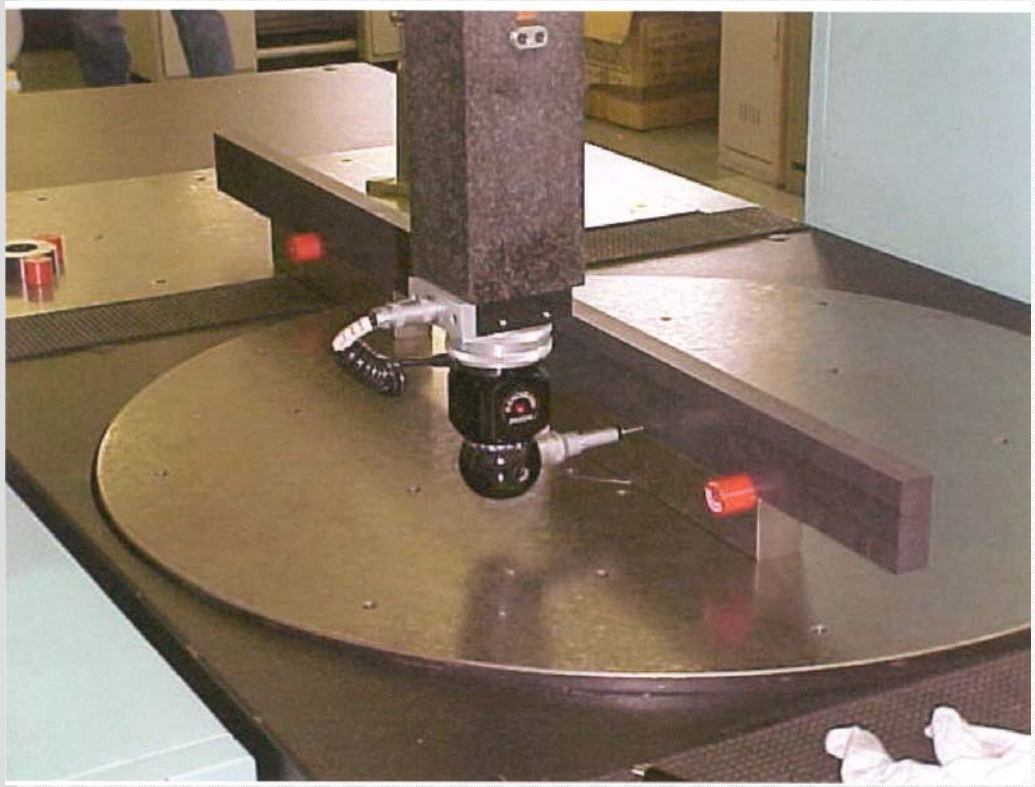
Jaw material

Graphite		Size	Orientation	Resistivity [$\mu\Omega$ m] bakeout (1000°C for 2 h)	known values
SGL	R 4550	Prim.	iso	15	13
		Sec.	iso		
	R8650	Prim.	iso	15	14
	R8710	sample	iso	16	14
	R8710Cu	sample	iso	6	3
	Sigrasic	sample	iso	375	-
Poco	ZEE	sample	iso	44	-
	PLS	Prim.	iso	-	12.2
	FM	Sec.	iso	-	12.4
	DFP	Sec.	iso	-	15
CFC					
Tatsuno	AC100	Prim.	x-y	11-12.5	7
	AC200	Prim.	x	13.5-18	7
		Sec.	x-y	14	7
	AC150		x-y	10	7
SGL	1001Z	sample	x-y	-	6
	1501Z	sample	x-y	-	6
Snecma	N11	"Prim."	x-y	6	-
	NB31	samples	x-y-z	9	-

Base for calculations: 14 $\mu\Omega$m

Resistivity Measurements CFC with as low as 6 $\mu\Omega$m found

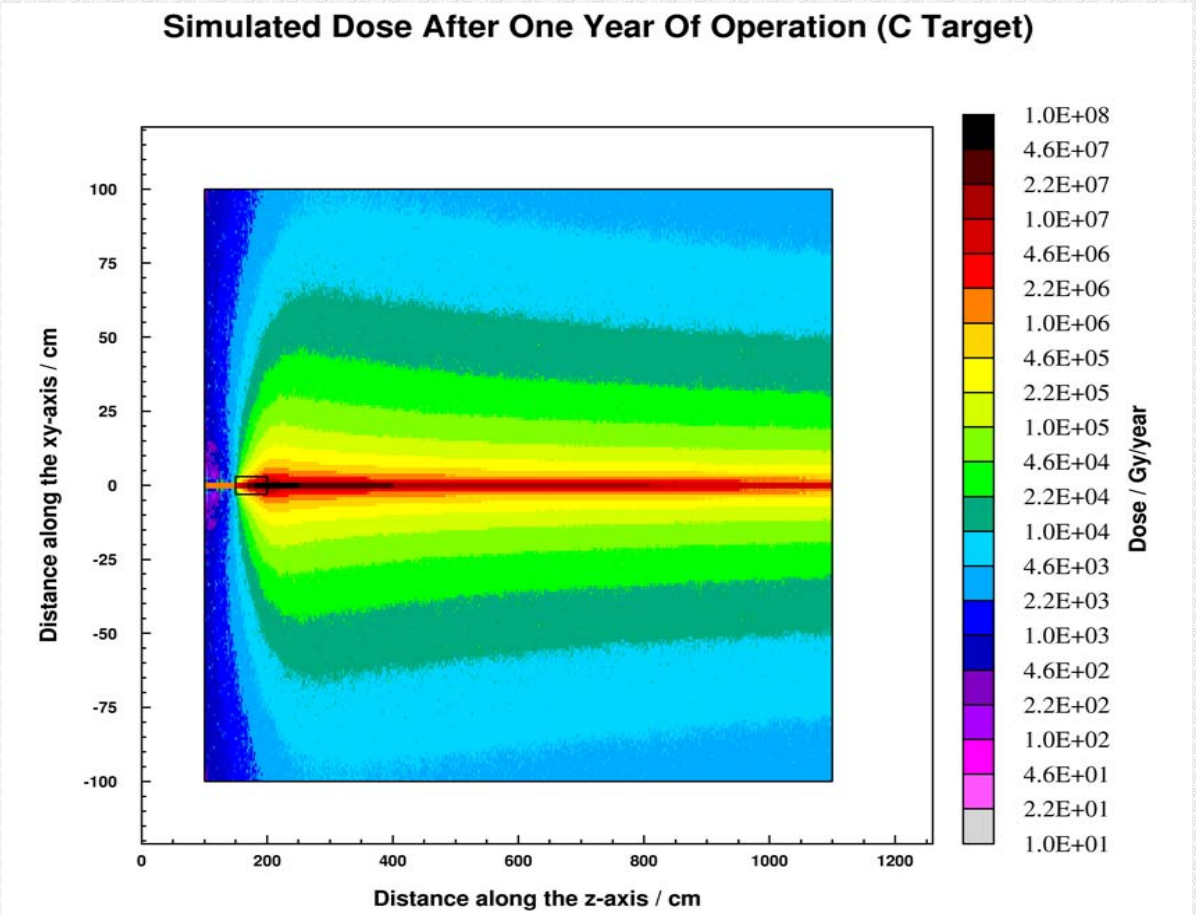
Jaw material



Flatness

Graphite		Size	Flatness bake out (1000°C for 2 h) before	after
SGL	R 4550	Sec.	0.2/0.25	
		Sec.	0.04/0.1	
		Prim.	0.05/0.01	
	R8650	Prim.	0.005/0.015	
	R8710Cu	sample		
	Sigrasic	sample		
CFC				
Tatsuno	AC100	Prim.	0.01/0.05	0.02/0.05
	AC200	Prim.	0.015/0.03	0.02/0.03
		Sec.		-
	AC150	Sec.	0.11/0.117	-
SGL	1001Z	sample		-
	1501Z	sample		-
Snecma	N11	"Prim."	0.01/0.05	0.01/0.02
	NB31	samples		

Jaw material



Motor radiation hardness For annual dose rate of 1MGy

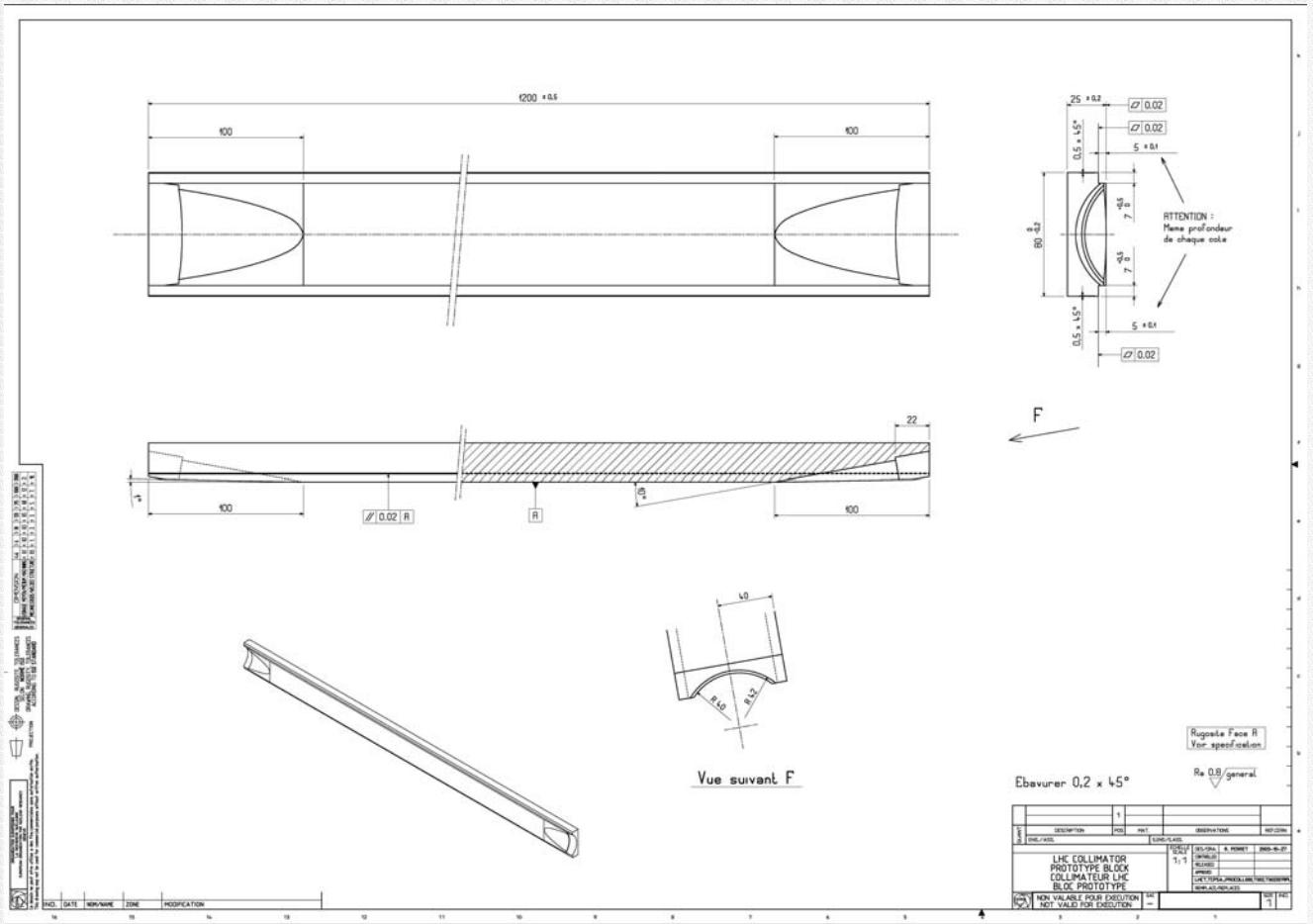
Prototype design

- For reasons of delays and budget a solution as simple and as robust as possible is envisaged.
- Experience and expertise (e.g. LEP) from different groups and divisions involved.
- A team in EST (A. Bertarelli, R. Perret, M. Mayer) is in charge to design and produce the different collimator prototypes,
  the first TCS for May 2004.

Prototype design

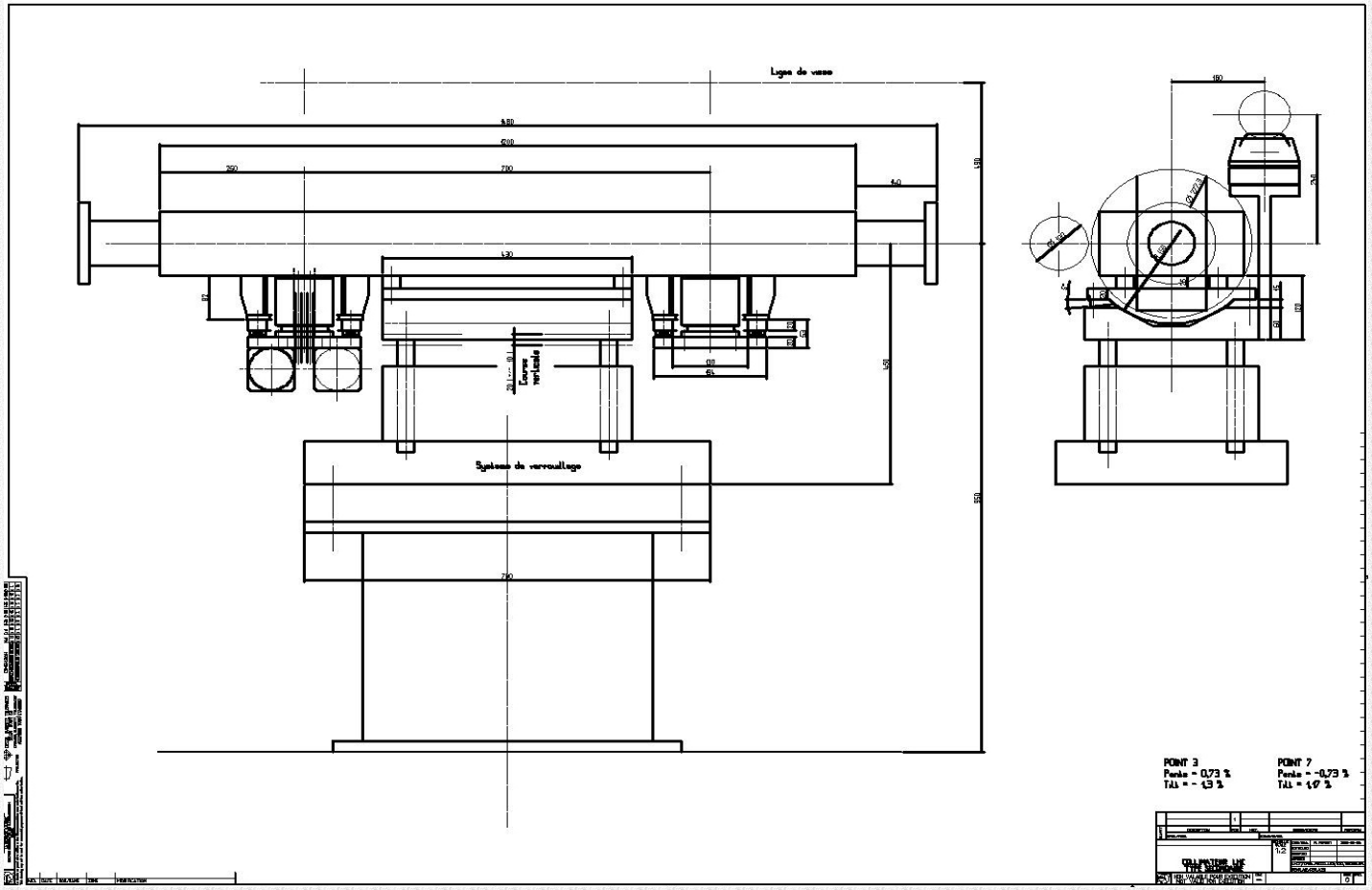
- Jaw: Two carbon collimator jaws (secondary collimator, length = 1.2 m). The active length is 1 m, parts of the tapering are machined on each side of the block.
- Motion: The required high precision is transmitted via stepping motors through a pair of bellows from outside of the vacuum.
- Cooling: Separate cooling circuit. Local cooling units

Prototype jaw (TCS)



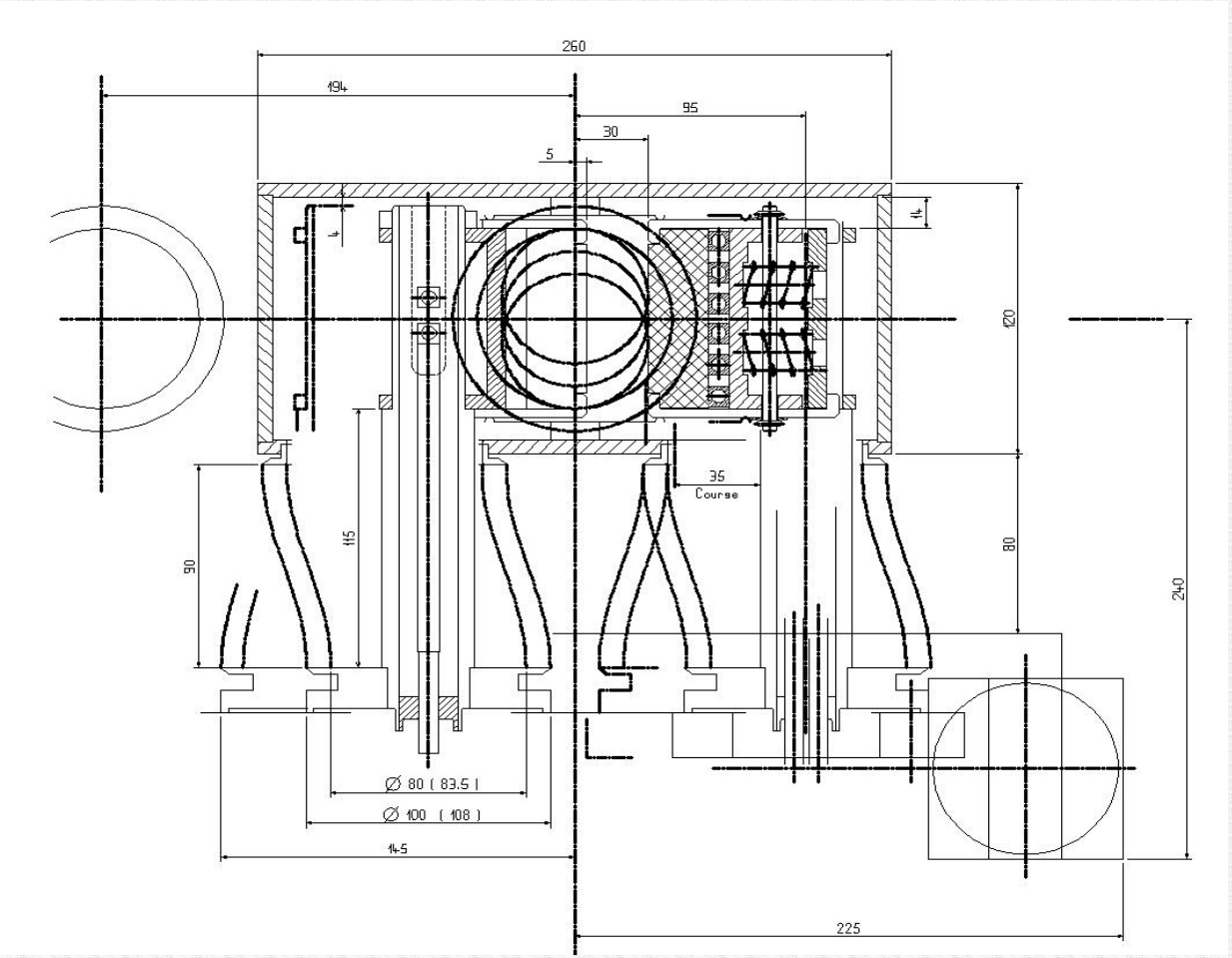
Collimator jaw with tapering

Prototype (TCS)



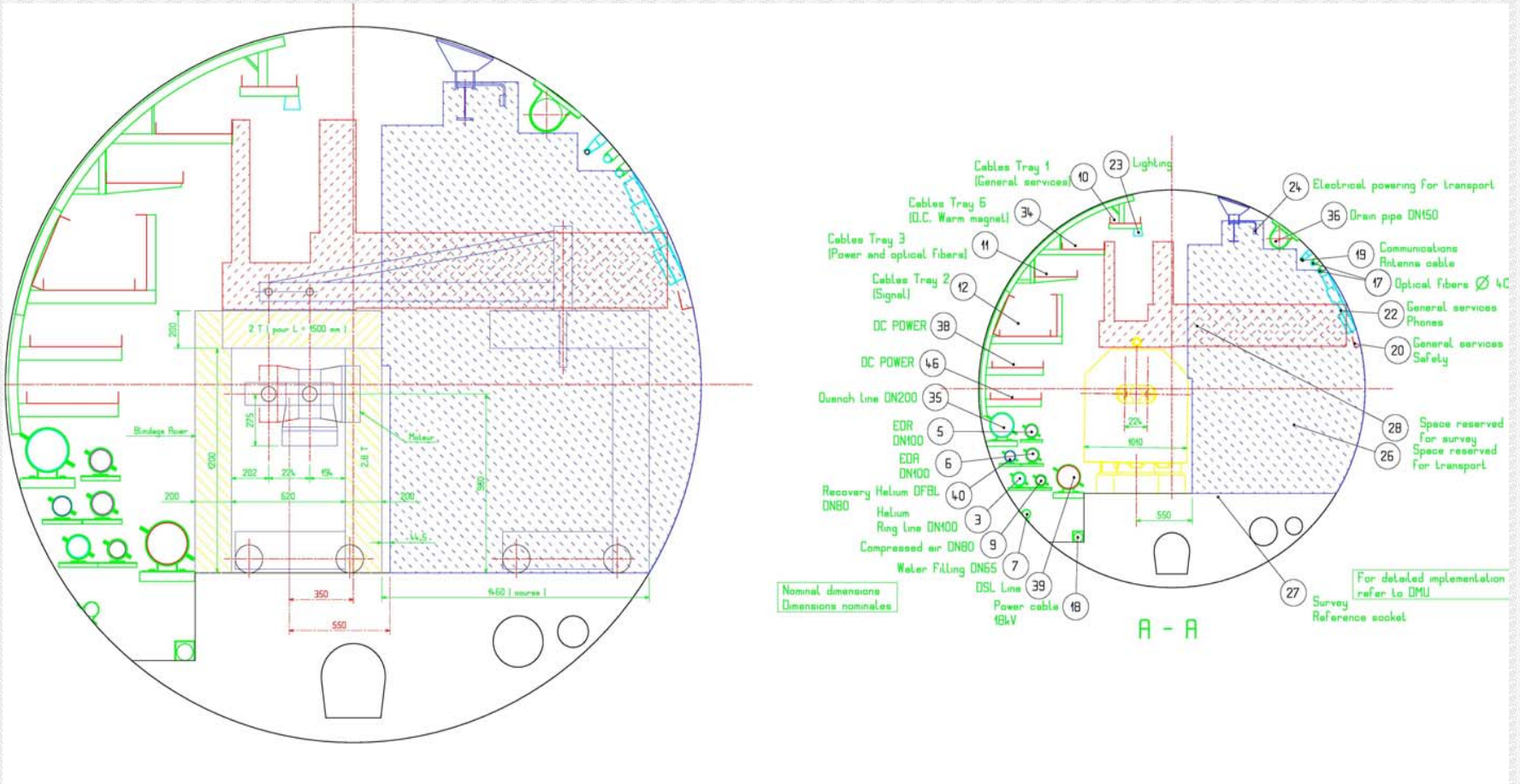
Collimator on it's support unit

Prototype cross section

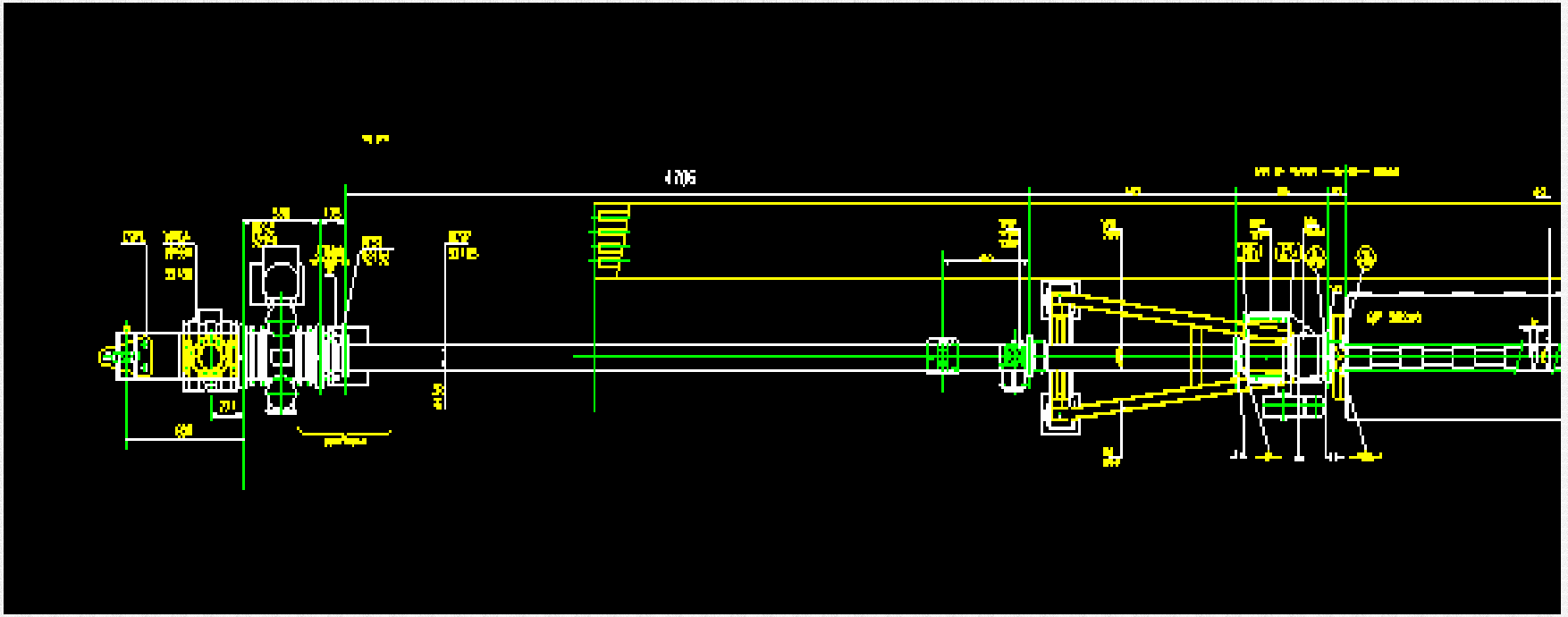


Collimator cross section with spare surface and motorisation.
Outer envelope: 450 x 350 mm

Tunnel space constraints



Collimator test

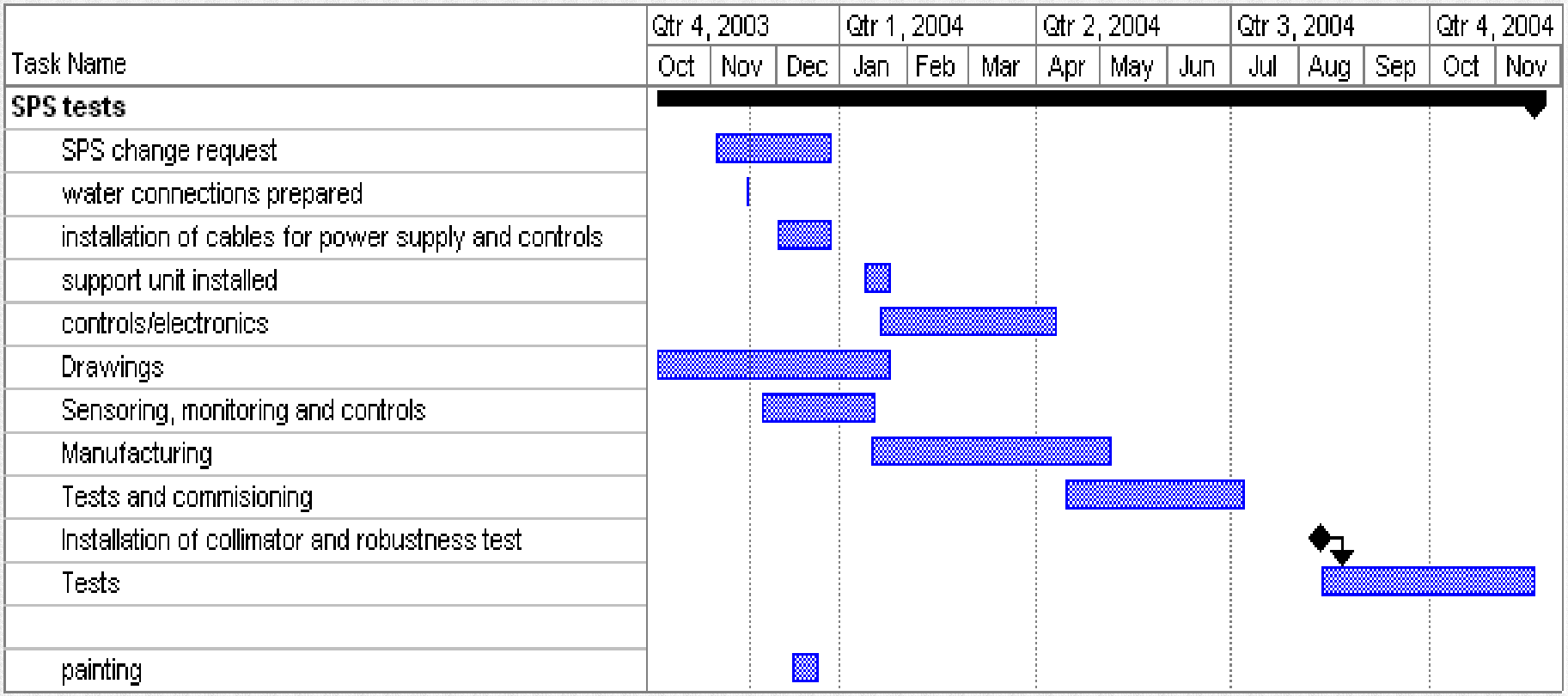


Location at UF 522: Space available: 4.7 m

Robustness test

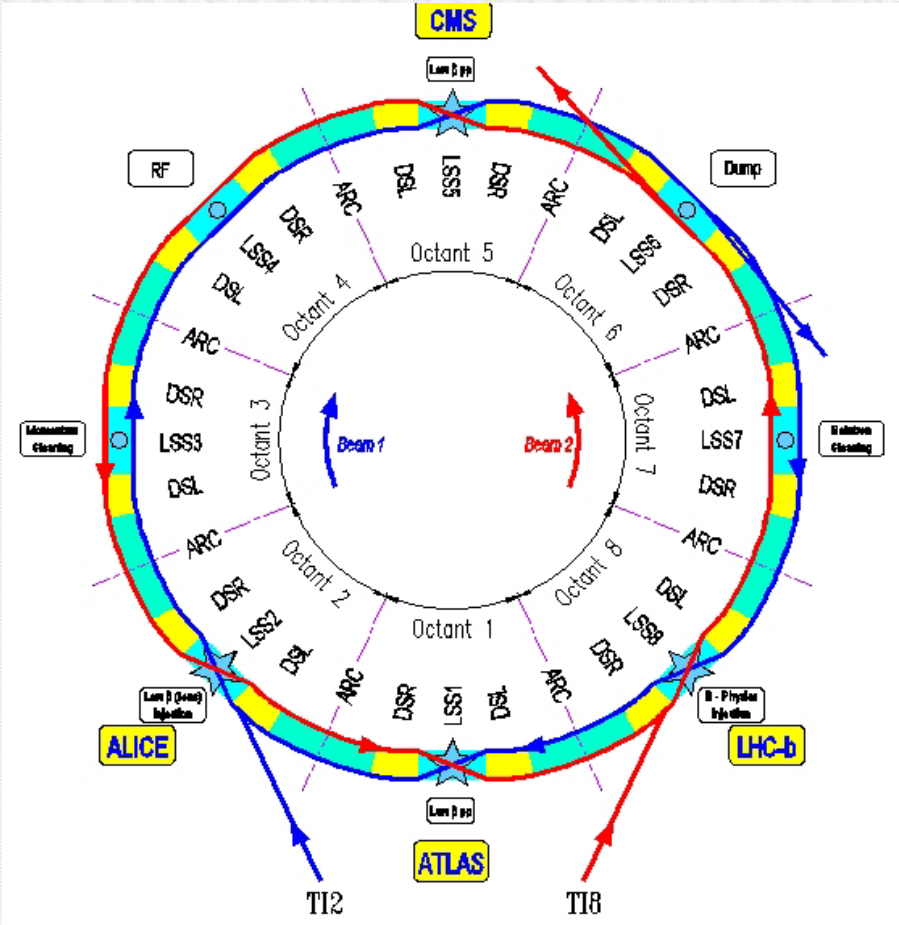
Location in TT40 in front of the TED

Planning SPS tests

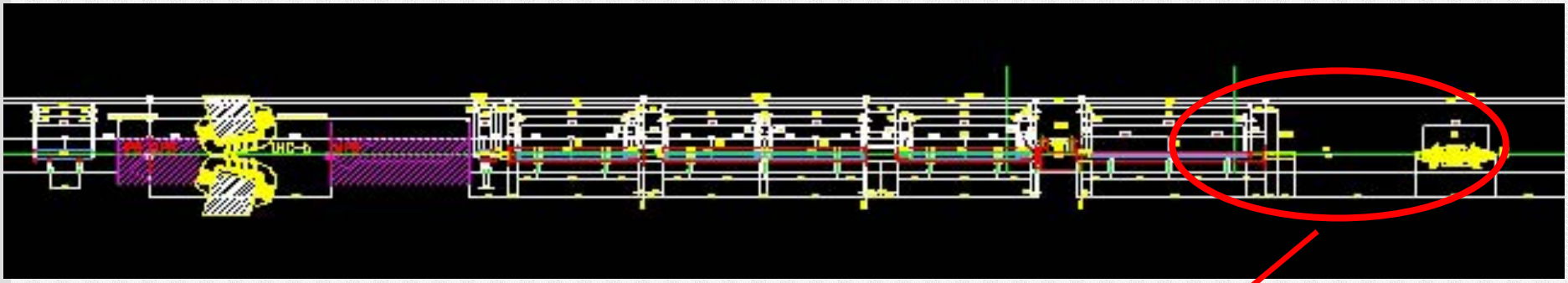


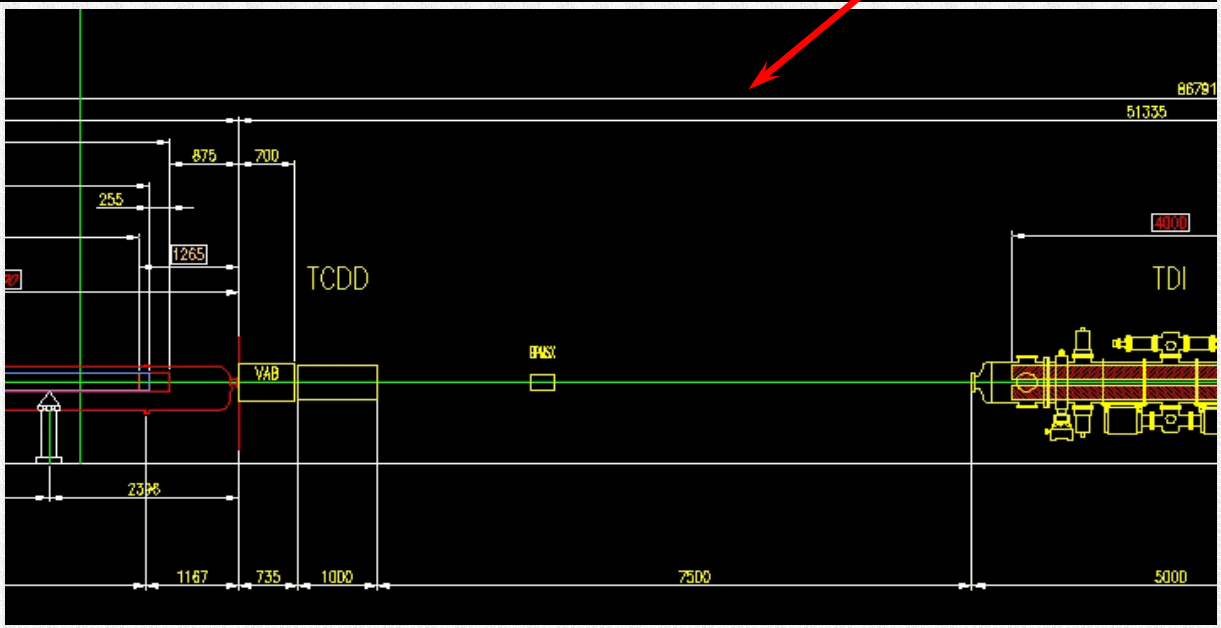
Positions

TCP and TCS are grouped in IR 3 and IR 7.



Positions





TCT collimators around the IP 1, 2, 5 and 8.

All positions are ok with two exceptions in IP2 and IP8

Outlook

Series production:

- Final assembly foreseen at CERN (B252)
  -space for testing and storage needed (100m^2).
- A quality control system and the critical acceptance points will be defined as a result of the prototype tests.
- Interferences for installation and integration have to be checked.
- The services for installation as well as space requirements have to be done.