Time/resources of an intervention on continuous cryostat for cryo-collimators

Outline (10 min.)

- Introduction
- Baseline / Alternatives
- FP420 Connection Cryostats for collimators (V Parma)
- Installation schedule
- Budget estimate
- Planning : With splices or later ?
- Closing remarks

Introduction (R Assmann)

❖ Present configuration (Phase I collimation) does not allow safe operation at nominal intensity and energy

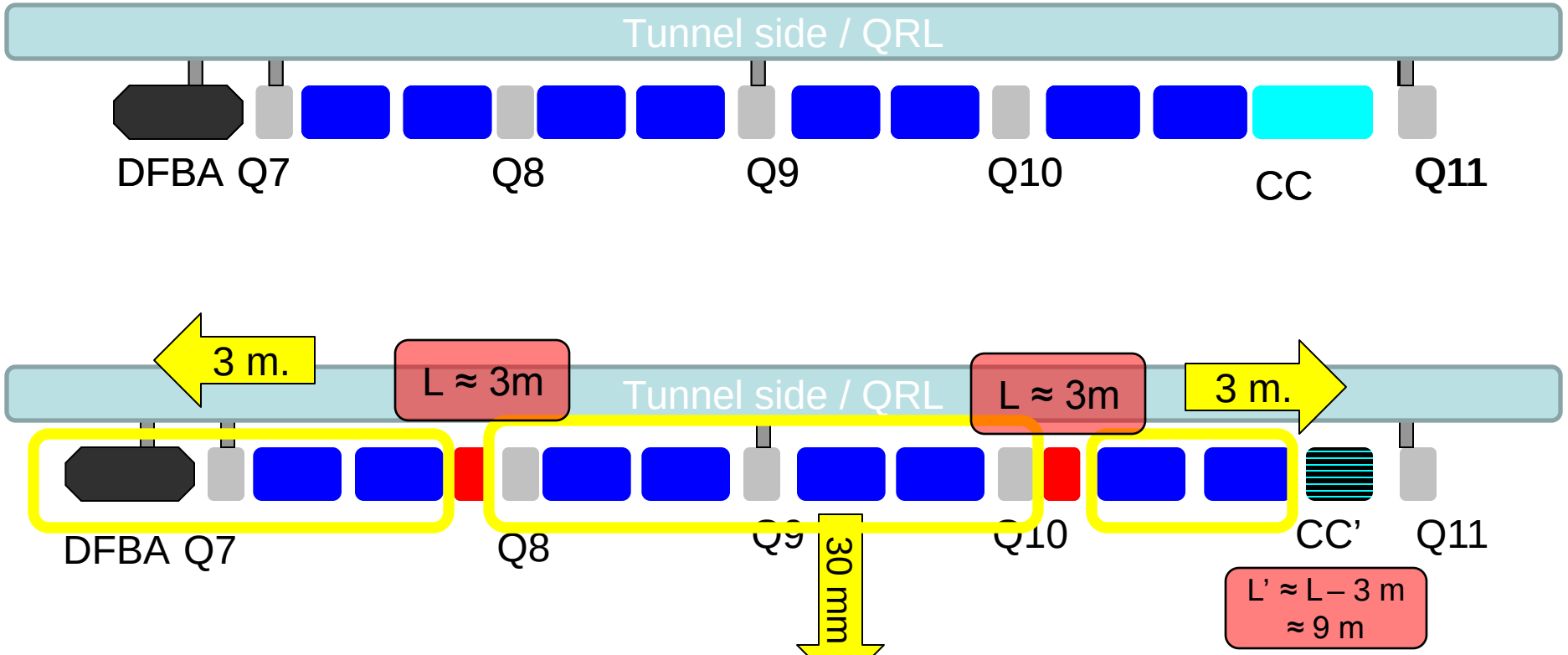
Phase 1 provides optimum robustness but ideal performance limited to ~40% of nominal intensity, less with imperfections. Phase 2 is prepared to maximum and allows nominal and ultimate intensities!

❖ Phase II collimation includes many interventions : cryo collimators at P3/P7 (P2)

4(6) DS zones concerned : L3, R3, L7, R7, (L2,R2)
[P2 not studied here]
4 sectors to be warmed-up : 23,34,67,78

IR	Hardwar		
1	TCLP instal TCTH, TCT TCT (new t		
2	TCTH installed	2	Improve **signal acceptance in ZDC**
	TCRYO installed	2	Remove limit on **ion luminosity**
3	TCSM installed	8	**Lower impedance (1/2), faster setup (h → s), longer lifetime LSS3 (x 3)**
	Shift positions of 24 SC magnets by 3m, 3cm		Space for collimators at critical loss locations
	TCRYO installed	4	**Better efficiency (x 15-90)** with collimators in SC dispersion suppressor
5	TCLP installed	2	Interaction debris for **nominal luminosity** (after removal of Roman Pots)
	TCTH, TCTVA moved	4	Phase 1 IR upgrade (if change in D2-D1 region)
	TCT (new type?) installed	4	Phase 1 IR upgrade (reduced aperture in matching section)
6	TCLA installed	2	**Reduce quench risk** after TCDQ
7	TCSM	22	**Lower impedance (1/2), faster setup (h → s), longer lifetime (x 3), lower R2E (1/6 – 1/2)**
	Shift positions of 24 SC magnets by 3m, 3cm		Space for collimators at critical loss locations
	TCRYO installed	4	**Better efficiency (x 15-90)** with collimators in SC dispersion suppressor

DSR_: Baseline (The only studied)



IC to cut	# 14	Some special ones (DS)
Jumpers to cut	# 3	5 to reconnect (Cryoextensions)
Cryostats to move	# 13	6 Longitudinally / 7 Radially
DFBA to move	# 1	Affect also warm region
CTW Modules	# 4	Cold To Warm : 2 per collimator
New cryostats	# 3	1 CC' of ≈ 9 m length and 2 CColl
Jumper longi motion	# 2	DFBA & Q7: Not standard
Modif line N	# 1 (2)	

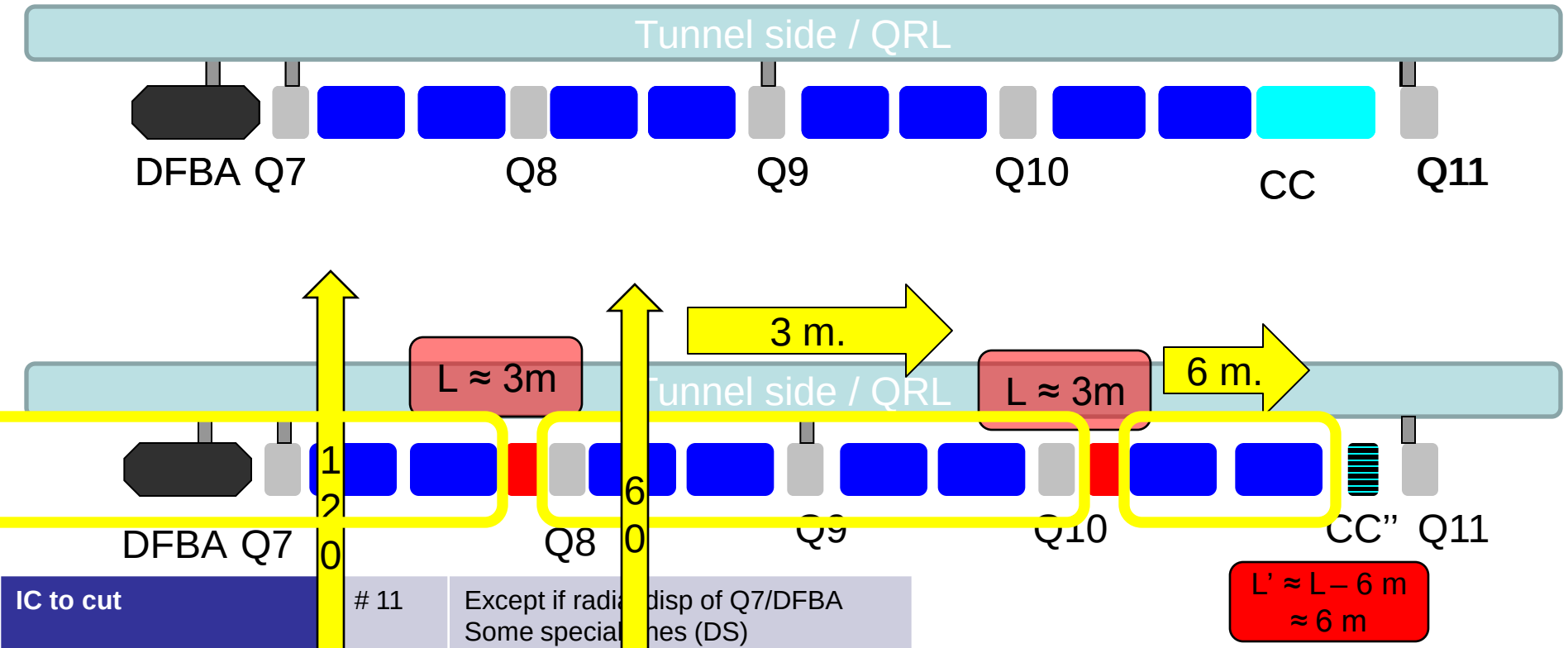
Cryo collimators (EN-MME)

- Interfaces are of the magnet type
- Length of 3 meters

Impact of increasing it slightly (+≈ 1.5 m) is limited except for transport zone

[If 6 m, then 60 mm radial displacement]

DSR_: “Alternative 1”



IC to cut	# 11	Except if radial disp of Q7/DFBA Some special lines (DS)
Jumpers to cut	# 1	
Cryostats to move	# 9	9 Longitudinally & Radially Except if radial disp of Q7/DFBA
DFBA to move	# 0	No (Limited) impact on warm region
CTW Modules	# 4	Cold To Warm : 2 per collimator
New cryostats	# 3	1 CC’ of ≈ 6 m length + 2 CColl
Jumper longi motion	# 1	Q9
Modif line N	# 1 (2)	

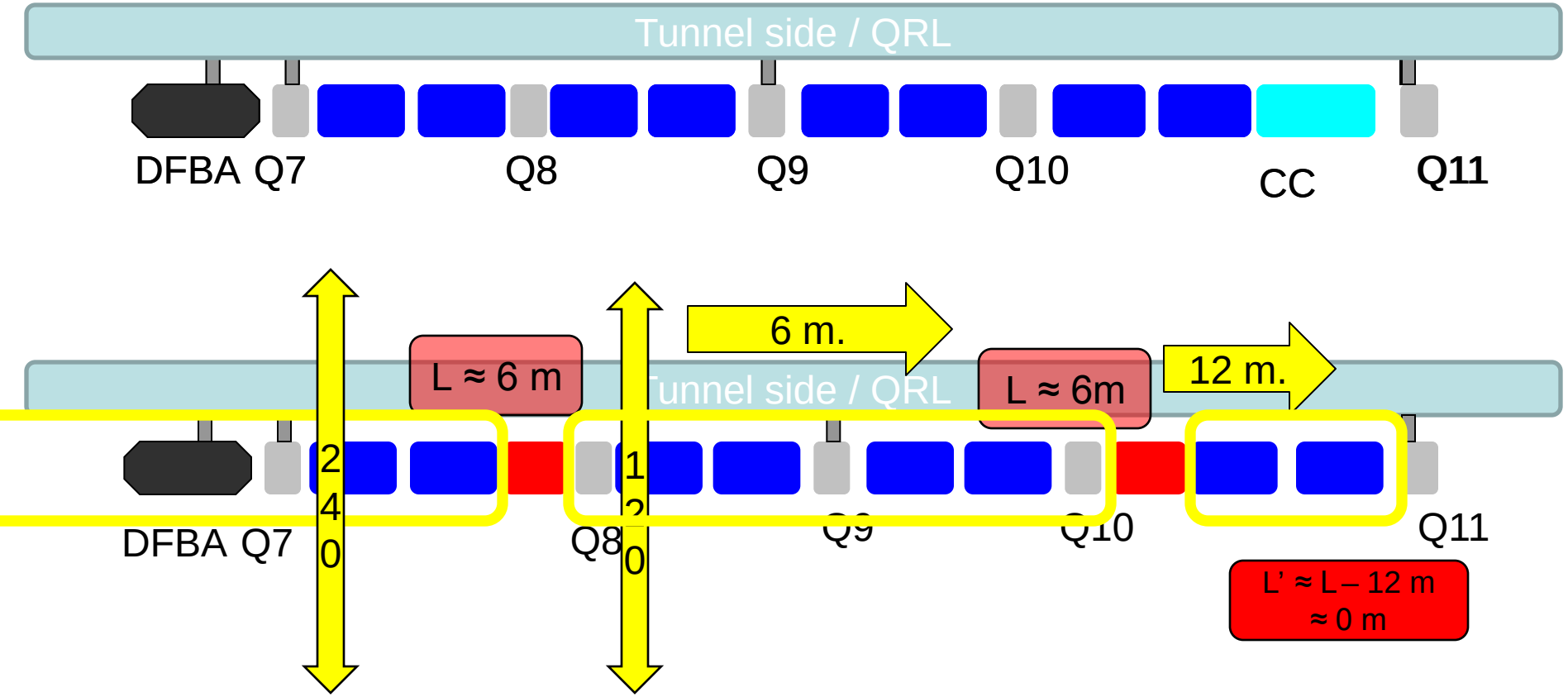
Difficult due to lateral space limitations

Comparison baseline and alternative

Parameter	Baseline	Alternative	Comment
IC to cut	14	11	
Jumpers to cut	3	1	DFBA & Q7
Cryostats to move	13 (6/7)	9	
DFBA to move	1	0	Affects warm regions
CTW Modules	4	4	
New cryostat	1	1 sh	Length: 9 m/ 6m (TBC)
Jumper longi motion	2	2	Cryogenics extension
Modif line N	1-2	1-2	

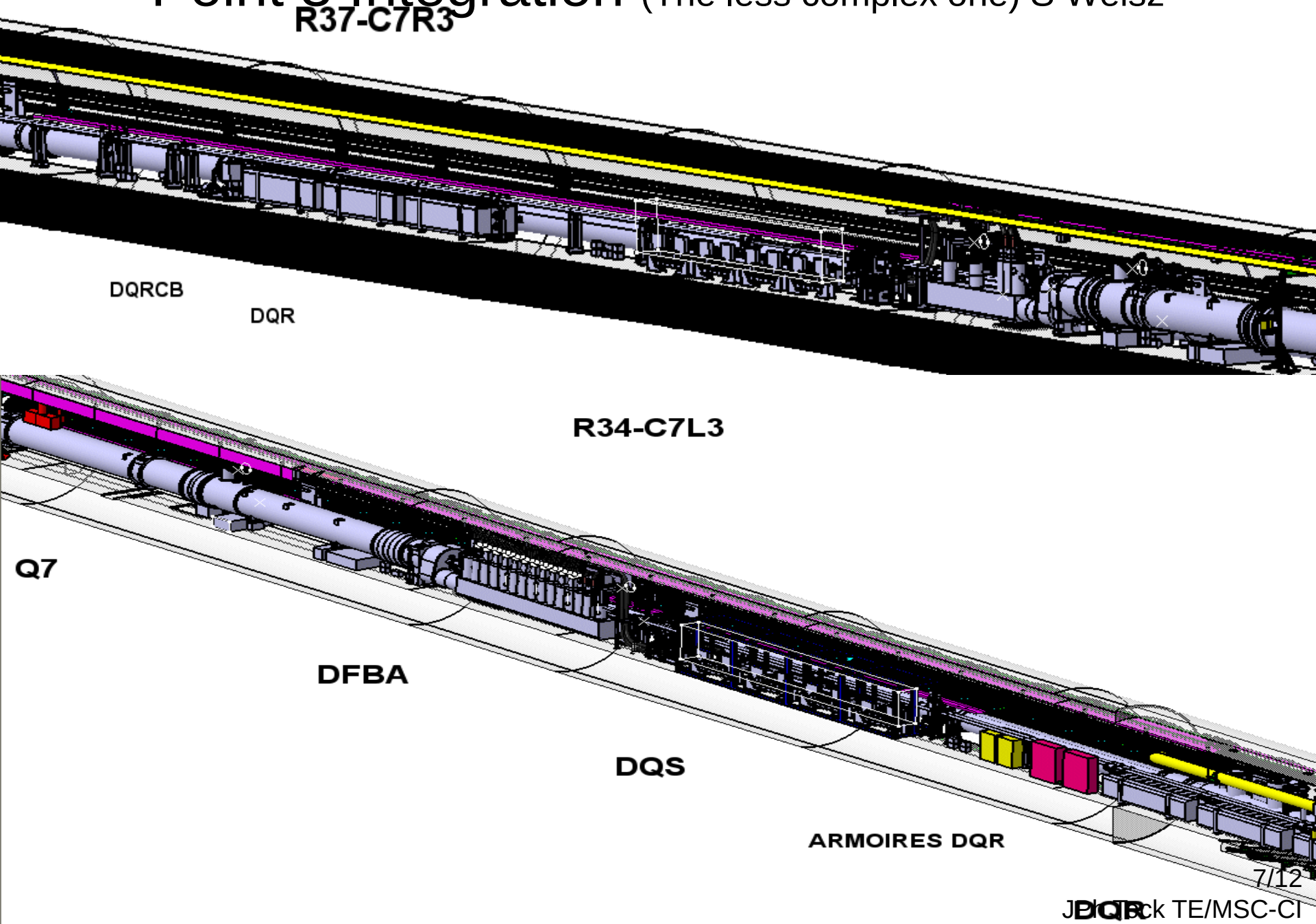
Not studied for integration reasons and the difficulty of this alternative is increasing with the length of the cryogenics collimators

DSR_: “Alternative 2”

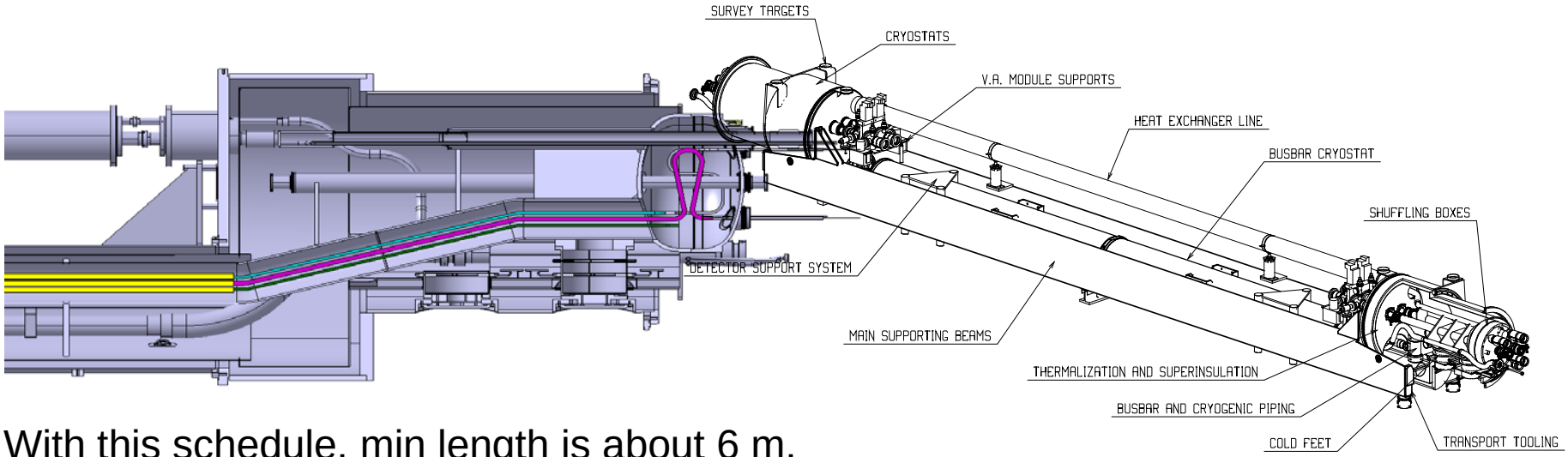


VERY difficult due to lateral space limitations

Point 3 Integration (The less complex one) S Weisz



FP420 CC for CryoCollimators (V Parma)



With this schedule, min length is about 6 m.
Hard limit with more time is to be assessed

Busbars are the critical component for the schedule.

	2010				2011				2012				2013			
Activity	**1st QTR**	**2nd QTR**	**3rd QTR**	**4th QTR**	**1st QTR**	**2nd QTR**	**3rd QTR**	**4th QTR**	**1st QTR**	**2nd QTR**	**3rd QTR**	**4th QTR**	**1st QTR**	**2nd QTR**	**3rd QTR**	**4th QTR**
Design/drafting																
Engineering																
Components production				Critical path defined by bus-bars: 1y production												
Construction of 1st CC																
Construction of 2nd CC																
Construction of 3rd CC																
Construction of 4th CC																

Same is true for the new CC (In parallel)
(Same resources partially)

Ready for one IR at 4th QTR 2012
(No cold test planned but recommended)

Simplified schedule (one side of IR)

+ Total : 5 months per side of IR but partial parallelism possible
+ Second front (2nd side of same IR) : Extra 4 weeks
+ 2 shifts of 12-15 persons each (excluding transport)
+ Transport during the night
+ No cold test of cryomagnets before lowering
+ Assumes that trained resources are available
+ DFBA in parallel
+ Cryogenics extensions integrated

+ Can fit in a 6 months shutdown
+ If in parallel with splices, resources availability will be critical

Material budget estimate (Preliminary)
Per side of IR [To be X 4 (6)]

Activity	[kCHF] FSU + comp.	Remark
Interconnection	493	64 for splices
DFBA	164	
Cryoextensions	88	
nCC	400	Not cryocollimators
TOTAL	1145	*4 = 4.6 MCHF *6 = 6.9 MCHF

Not considered :

- Warm-up, cooldown, recommissioning costs
- Integration studies
- Modifications of environment
- Impact of working in a radioactive environment
- Optimised for cryocollimators schedule (Neither for money nor for production efficiency)

In parallel with splices ?

If yes, implies “warm” cryo collimators for schedule reasons

	With splices	Few months later	2-3 years later	Remark
Trained resources	Critical	OK		Later will smooth the workload
ALARA	+	+	- -	Really critical ?
Budget	+ / -	+ / -	+ / -	Limited impact (5%)
Preparation	-	+ /-	+ +	Cold CColl could be envisaged later
Physics (Luminosity)	+ +	+ +	- -	When will it limit LHC?

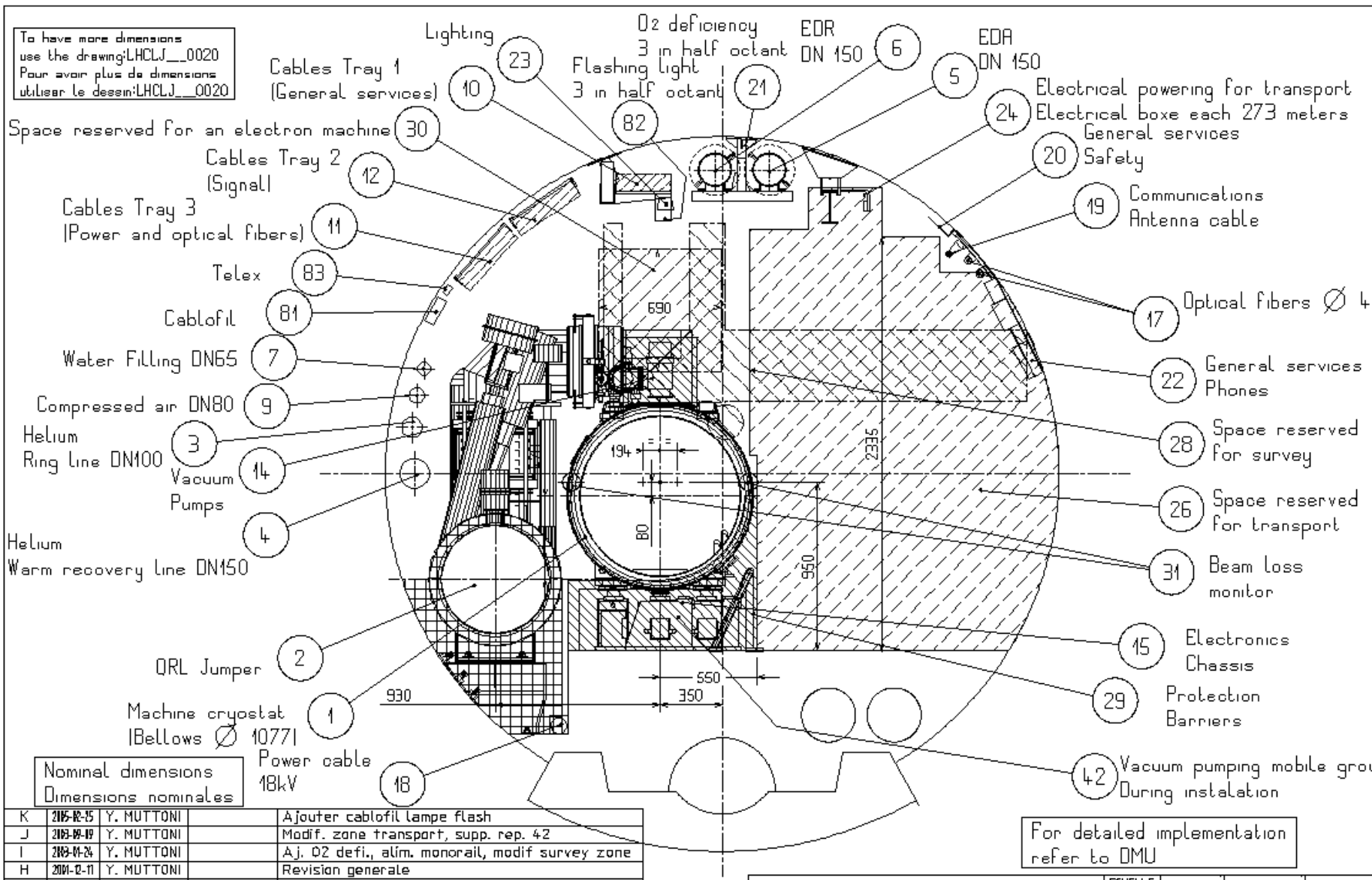
Closing remarks

- Not necessary to decide NOW on the installation time
- But design and study for “warm” cryo-collimators shall start/continue/increase
- The situation could be reviewed in 6 months
  - More info on actual LHC limitations due to collimation
  - Integration can be studied in more details
  - Production(CC and Ccollimators) schedule can be refined

- Can the splices consolidation be delayed to give more time for CC production?

- Availability of experienced resources is a key & critical parameter
- Implications of working in radioactive environment have to be assessed

Thanks to A Bertarelli, F Bertinelli, R Folch, V Parma, A Perin, S Weisz



IND.	DATE	NOM/NAME	ZONE	MODIFICATION
K	2005-02-15	Y. MUTTONI		Ajouter cablofil lampe flash
J	2003-09-19	Y. MUTTONI		Modif. zone transport, supp. rep. 42
I	2003-01-24	Y. MUTTONI		Aj. 02 defi., alim. monorail, modif survey zone
H	2001-12-11	Y. MUTTONI		Revision generale
G	2001-07-03	Y.MUTTONI		Revision generale
F	2000-06-22	Y.MUTTONI		MODIFICATION ZONE TRANSPORT ET PROFIL TUNNEL
E	2000-06-07	Y.MUTTONI		REVISER TCC 19/05/00
D	1997-08-05	G.PERRIER		MISE A JOUR (TCC 1/8/97)
C	1997-06-16	G.PERRIER		MISE A JOUR HT FAISCEAU : 950MM + SERVICES
B	1997-02-10	G.PERRIER		AJOUT RES.VISEE GEOMETRE
A	1996-11-28	G.PERRIER		VERIF.COTES + TXT FRANCAIS/ENGLISH