Proposal

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for the

Collimation Team

Basic constraints

- Have a collimation system produced and **installed for 2007**, with a **reasonable cost**.
- The system must be a **robust and flexible tool** for operation.
- **Nominal performance** must be achievable.
- The layout of cleaning **insertions must be finalized** by the end of 2003.

Guiding principles

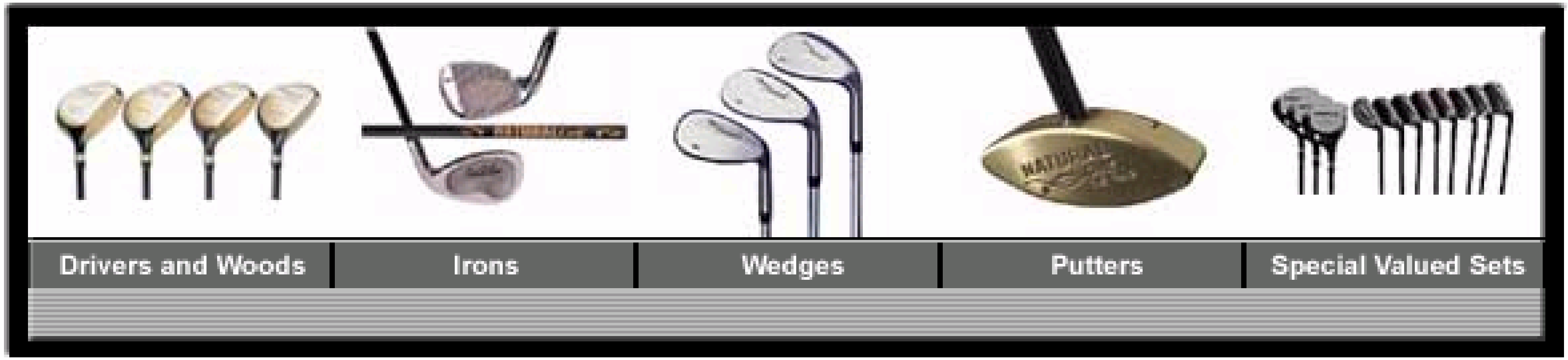
Most rapid advancement by…

- …pursuing **most simple** solutions.
- …**avoiding additional concerns** like toxic materials (at least for initial installation).
- …**minimizing changes** with respect to V6.4 collimation system.
- …selecting designs where we have **experience at CERN** (e.g. LEP).
- …introducing **flexibility** into the design (solve some problems later).

How to achieve this?

- **Specialized sub-systems** targeted at specific purposes instead of one general purpose system.
- **Stage collimation system** over 4 more years (R&D, production, installation, cost, …).
- **Minimum cost, maximum robustness** start-up systems with placeholders for upgrades (fewer components).
- Additional **upgrade phases** for nominal performance (more components).

Imagine **collimation as a game of golf**…



You can do it with one club only. However, **if you want to win you better have more than one club**:

- **Best chances to win** the "collimation game" with specially adapted, specialized sub-systems.
- **More effort to understand** what "club" to use for what.
- However, **easier and better "playing"** (operation) though there are more collimators.

The collimation "clubs"

1) **Maximum robustness, minimum cost IR3/IR7 collimation system** (C) for injection&ramping, commissioning, early physics (running at impedance limit). Thin metallic coating for going further (survival of coating unclear).

2) **"Tertiary" collimators in IR1, IR2, IR5, IR7** for local protection and cleaning at the triplets.

3) Thin targets for **beam scraping**.

Phase 1

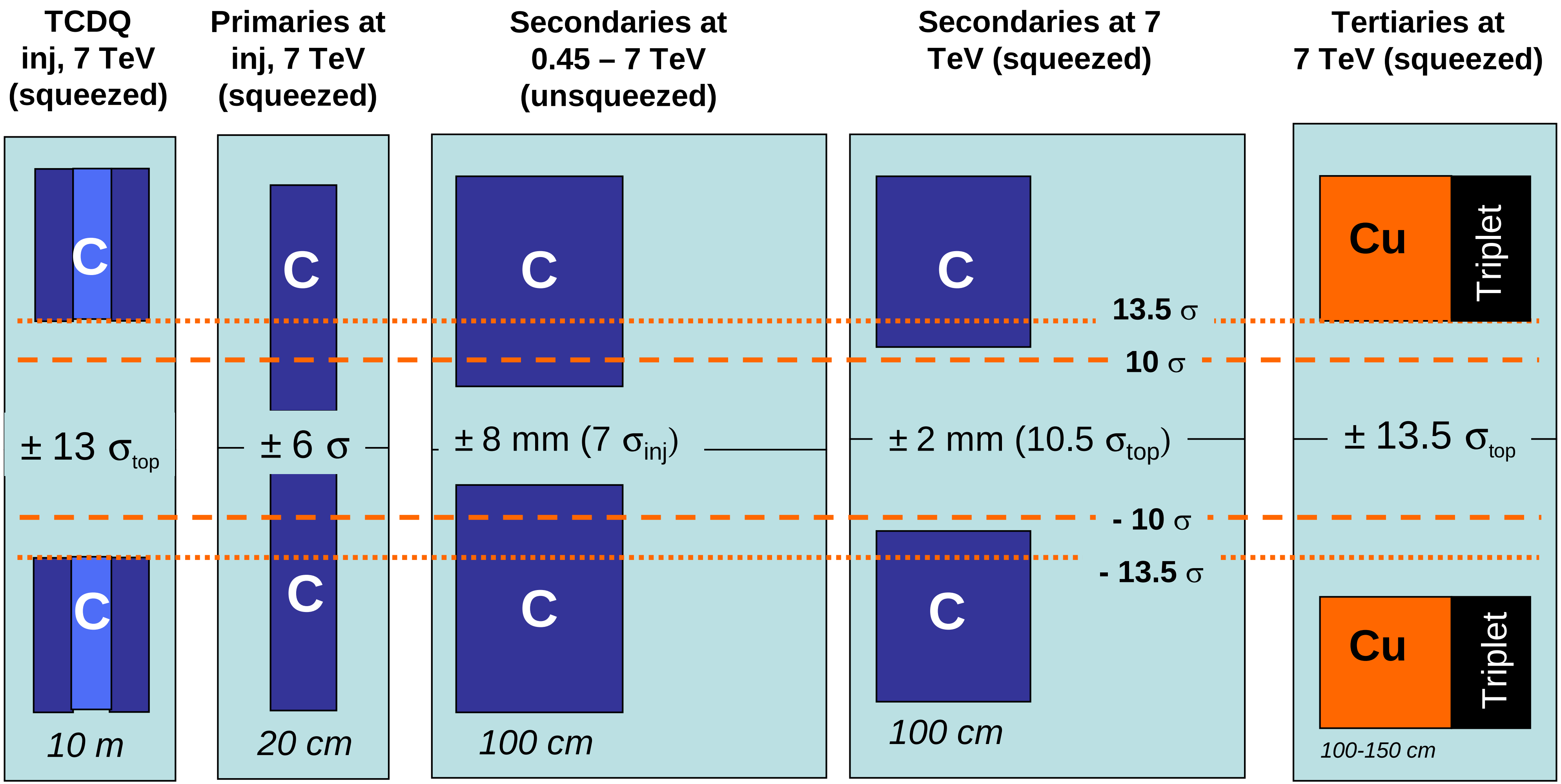
4) **Metallic "hybrid" secondary collimators in IR7** for nominal performance, used only at end of squeeze and stable physics.

Phase 2

5) **Additional placeholders** for upgrading to maximum cleaning efficiency.

Phase x

Phase 1: The robust 3-stage system for injection/ramp and early physics



Primaries very robust, robust low-Z secondaries, relaxed tolerances: mechanical and for orbit/beta beat, good efficiency.

Space allocations for phase 2 upgrade.

Triplet protection (possible later local cleaning at triplets).

Why running at the impedance limit?

We must choose:

Maximum robustness, e.g. C	or	**Low impedance, e.g. Be**
• run at impedance limit • limit beta* If limit is violated: Dump of unstable beam		• run at robustness limit • limit beam intensity If limit is violated: Damage to Be jaw, possible contamination

Our solution:

Choose a maximum robustness system (reliable and robust tool). It will last.

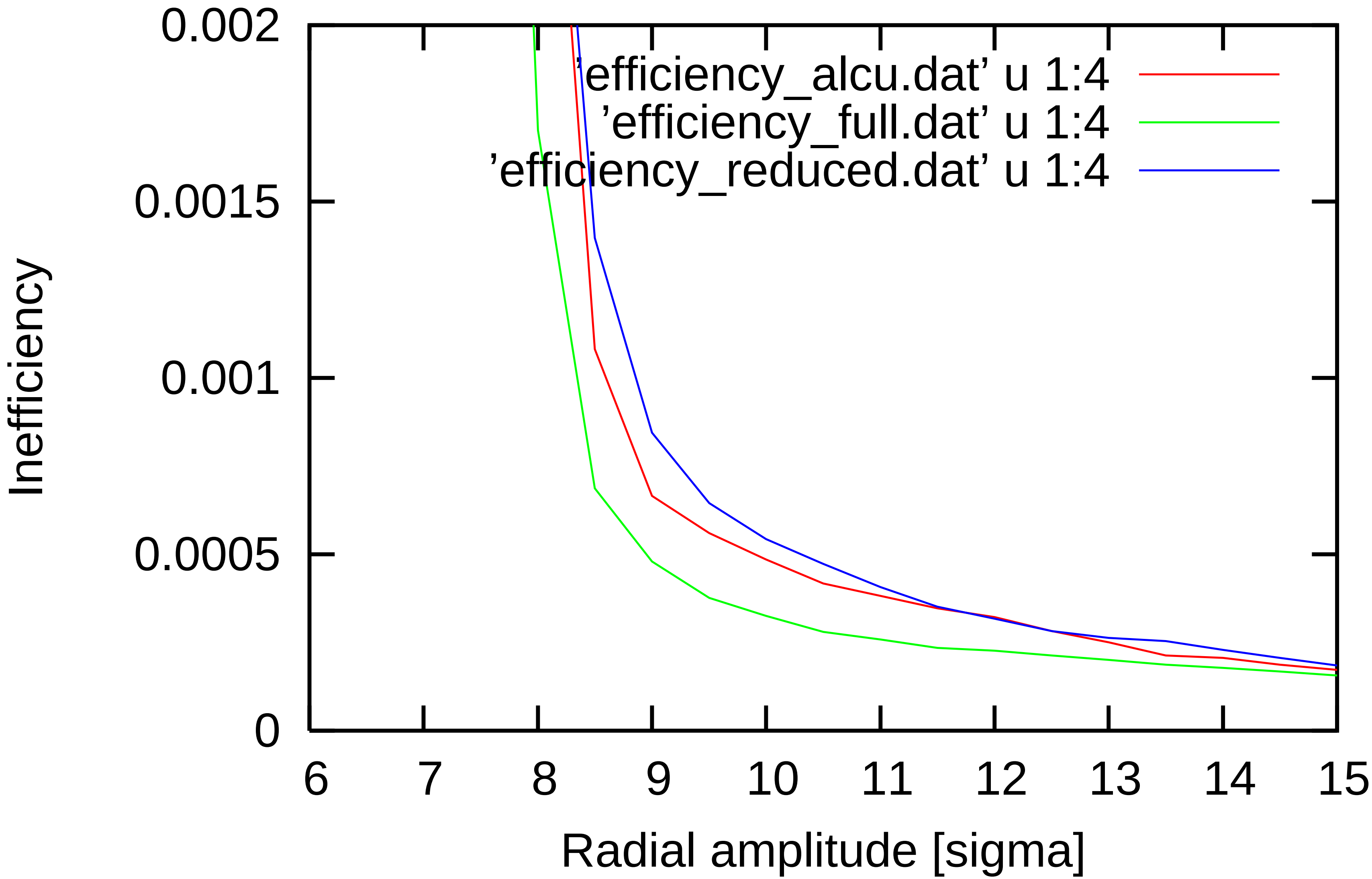
Complement with metallic triplet collimators (protection and local cleaning).
Complement with thin metallic coating.

Upgrade with “hybrid” metallic secondary jaws, only used in stable conditions.

Phase 1 for 2007

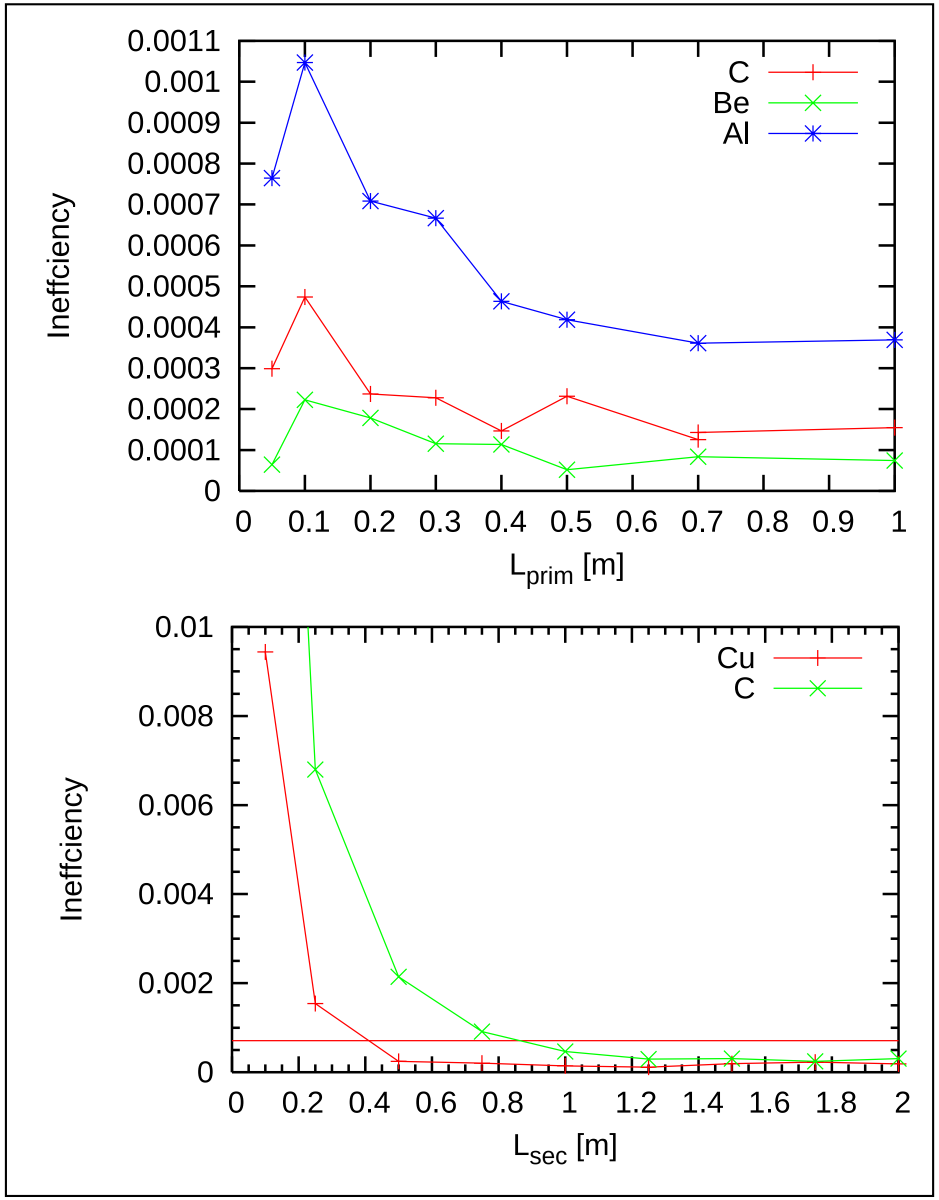
IR3/IR7 collimation	**42** components (instead of 54)	**High robustness system (fiber-reinforced graphite) for**
		* **Injection & ramping** up to nominal or even ultimate intensities
		* **Survival** of all specified beam impact cases.
*(**baseline solution** based on V6.4 collimation)*		* 7 TeV **commissioning** under easiest possible conditions.
*(**alternative solution** under study, same/fewer coll)*		* **7 TeV physics (early years)**
		* Running at the **impedance limit** (reduce imp with new optics?)
		* **Minimum beta* of ~1m.** 13.5 σ triplet aperture for 50% int.
		* Mechanical/operational **tolerances relaxed by factor 3**
		* **Minimum cost** solution (mechanical design as used for LEP)
		* Metallic coating few μm as a trial (use if it holds, no loss if not)
		* Implement a few spare locations on a jaw (1 additional motor)
		* Metallic jaws at a few "safe" locations?
Tertiary triplet coll.	**16** components (new)	**Triplet protection in phase 1, local cleaning later**
		* Not yet for cleaning of secondary halo (true tertiary collimators)
		* Further relax tolerances in physics for nominal crossing planes
TCL collimators	**8** components (unchanged)	* Used for injection & luminosity debris
Total	**66 collimators**	**(same as in V6.4 baseline)**
Absorbers	**≥ 16** components (unchanged)	* Used for damage/quench protection in IR3/7
		* Number to be verified for new system
Scrapers	**4-6?** components (new)	**Two-three one-sided scrapers per beam (H+V+momentum)**
Space allocations	**46**	for phase 2 (26), phase 3 (4)
		and possible upgrade for better cleaning efficiency (12+4 suppressed coll)
Crystals	? components (new)	* Possibly put into a primary collimator for tests

Efficiency for different solutions:



Efficiency at 10 sigma (7 TeV) roughly the same as with the Al/Cu system!
Larger impact parameters (results in larger tolerances).

Required lengths of low Z jaws:



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1) Keep secondaries (0.5 m Cu) and **vary material and length of primary collimators**!

Observations:
Win factor two for 0.2 m graphite (C)!
Stay with 0.2 m length for primary

2) Choose 0.2 m C for primary collimators and **vary material and length of secondary collimators**!

Observations:
Secondary C collimators of 1 m length will restore the cleaning efficiency of the old system.

C system: 0.2 m and 1.0 m jaws!

Phase 1 collimation system

IR	Type	Name	Plane ≈	Angle [rad]	Material	Alternative material	Length	Setting [inj σ] inj optics	Setting [top σ] squeezed	Half gap [m] inj&ramp	Half gap [m] squeezed	Betax [m]	Betay [m]	Impedance H 7TeV	Impedance V 7TeV
3	prim	TCP.6L3.B1	H	0.000	C-C	n/a	0.2 m	**8.0**	**15.0**	0.00801	0.00380	128.23	160.36	0.7	0.5
	sec	TCS.5L3.B1	H	0.000	C-C	Al/Ti/C+Cu	1.0 m	**9.3**	**18.0**	0.00586	0.00287	50.79	336.44	3.4	11.3
	sec	TCS.A4R3.B1	H	3.063	C-C	Al/Ti/C+Cu	1.0 m	9.3	18.0	0.00425	0.00208	26.67	362.83	4.5	**30.2**
	sec	TCS.B4R3.B1	H	0.078	C-C	Al/Ti/C+Cu	1.0 m	9.3	18.0	0.00426	0.00209	26.84	359.91	4.5	**29.7**
	sec	TCS.A5R3.B1	H	0.155	C-C	Al/Ti/C+Cu	1.0 m	9.3	18.0	0.00493	0.00241	35.91	304.93	4.0	16.8
	sec	TCS.B5R3.B1	H	2.972	C-C	Al/Ti/C+Cu	1.0 m	9.3	18.0	0.00550	0.00269	44.76	275.83	3.6	11.1
	sec	TCS.C5R3.B1	H	0.156	C-C	Al/Ti/C+Cu	1.0 m	9.3	18.0	0.00610	0.00299	55.01	251.09	3.3	7.5
	Total:		**7** comp/beam			before: **7**		Study:		Reduce by **2** collimators?					
7	prim	TCP.D6L7.B1	V	1.571	C-C	n/a	0.2 m	**6.0**	**6.0**	0.00664	0.00168	90.45	156.44	2.7	9.5
	prim	TCP.C6L7.B1	H	0.000	C-C	n/a	0.2 m	6.0	6.0	0.00501	0.00127	89.13	158.74	11.7	10.4
	prim	TCP.B6L7.B1	S	2.410	C-C	n/a	0.2 m	6.0	6.0	0.00582	0.00148	87.83	161.07	2.8	5.2
	sec	TCS.A6L7.B1	H	2.919	C-C	n/a	1.0 m	**7.0**	**10.5**	0.00486	0.00185	48.45	320.00	11.1	**37.1**
	sec	TCS.B5L7.B1	S	2.593	C-C	Al/Ti/C+Cu	1.0 m	7.0	10.5	0.00782	0.00298	126.54	248.46	2.8	5.5
	sec	TCS.A5L7.B1	S	0.550	C-C	Al/Ti/C+Cu	1.0 m	7.0	10.5	0.00787	0.00299	131.25	241.96	2.9	5.4
	sec	TCS.A4L7.B1	V	1.570	C-C	n/a	1.0 m	7.0	10.5	0.00515	0.00196	303.53	69.28	29.9	13.6
	sec	TCS.A4R7.B1	H	0.371	C-C	n/a	1.0 m	7.0	10.5	0.00568	0.00216	66.92	198.29	10.1	14.9
	sec	TCS.B4R7.B1	H	3.118	C-C	n/a	1.0 m	7.0	10.5	0.00496	0.00189	64.21	204.36	14.0	22.3
	sec	TCS.C4R7.B1	V	1.381	C-C	n/a	1.0 m	7.0	10.5	0.00880	0.00335	63.01	207.27	1.4	8.9
	sec	TCS.F4R7.B1	S	0.592	C-C	Al/Ti/C+Cu	1.0 m	7.0	10.5	0.00746	0.00284	66.17	319.92	1.7	8.3
	sec	TCS.G4R7.B1	H	2.701	C-C	n/a	1.0 m	7.0	10.5	0.00660	0.00251	68.39	316.97	6.7	15.6
	sec	TCS.A5R7.B1	V	1.611	C-C	n/a	1.0 m	7.0	10.5	0.00440	0.00168	362.63	50.10	**54.9**	15.2
	sec	TCS.B5R7.B1	V	1.530	C-C	n/a	1.0 m	7.0	10.5	0.00442	0.00168	356.63	50.40	**55.5**	15.2
	Total:		**14** comp/beam			before: **20**									

Horizontal impedances [MΩ/m]:	(7 TeV target 220-330 MΩ/m)	11-15	**232**	**C**	**14 Ωμm**
		13-20	290	C-C	25 Ωμm
Vertical impedances [MΩ/m]:	(7 TeV target 220-330 MΩ/m)	17-23	**294**	**C**	**14 Ωμm**
		22-29	370	C-C	25 Ωμm

Total IR3 and IR7 for two beams: **42** before: **54**

Note: n1 at 7TeV can in principle be as high as 30 σ. Open at 7 TeV if required. Check abort gap cleaning.
Close betatron and TCDQ somewhat during ramp to protect momentum collimators.

450 GeV running with nominal/ultimate intensity?
7 TeV running with 50% intensity max

C+Cu = 10 µm Cu coating on C-C

Tolerances: Relaxed by factor of at least **3** compared to nominal retraction of 1 σ.

Required physical **aperture in triplet** at 7 TeV:	**15.0** σ	no loss in cleaning efficiency
	13.5 σ	accept factor 2 loss in efficiency for 50% of total intensity
Allowable beta* for this aperture:	**~1.0 m**	

Efficiency at 15 σ:	0.05%	(with primary collimators at 7 σ)
Efficiency at 13.5 σ:	0.11%	
Efficiency at 10 σ:	3.00%	use tertiary collimators to catch this for small beta*
Efficiency at 9 σ:	5.00%	

TCDQ Set to protect physical aperture in triplet (13.5/15 σ, see above)

Tertiary collimators: 16 components

IR1	2 vertical, 2 horizontal collimators
IR2	2 vertical, 2 horizontal collimators
IR5	2 vertical, 2 horizontal collimators
IR8	2 vertical, 2 horizontal collimators (reduce by 2 jaws?)

H, V collimators (elliptical?) close to D1's, used for both beams.
Required for machine protection and local cleaning.

TCL collimators:	**8**	(4 more TCL's after 3 years)	
Absorbers:	**16**	or more?	Required for quench and damage protection.
Scrapers:	**4-6?**	Use for scraping Thin targets or just like primary collimators?	

Phase 1b **for 2008**

Push system performance to limit, relying on…

...optional Cu coating…

...and/or tertiary triplet collimators!

No installation of additional hardware!

Phase 2 **for 2008 or 2009**

IR7 collimation	**22 collimators**	**Low impedance hybrid secondary system in IR7:**

- Only used in **stable physics and towards end of squeeze**
- 7 TeV physics: **nominal and ultimate** luminosities
- **Tight tolerances**
- **Nominal beta***
- Rely on **TCDQ shadow** at 10 σ for ~2-4 H collimators
- Rely on **cleaning from tertiary triplet collimators**
- Conventional coll in safe position or innovative "consumable" collimator?

Phase 3 **for 2010**

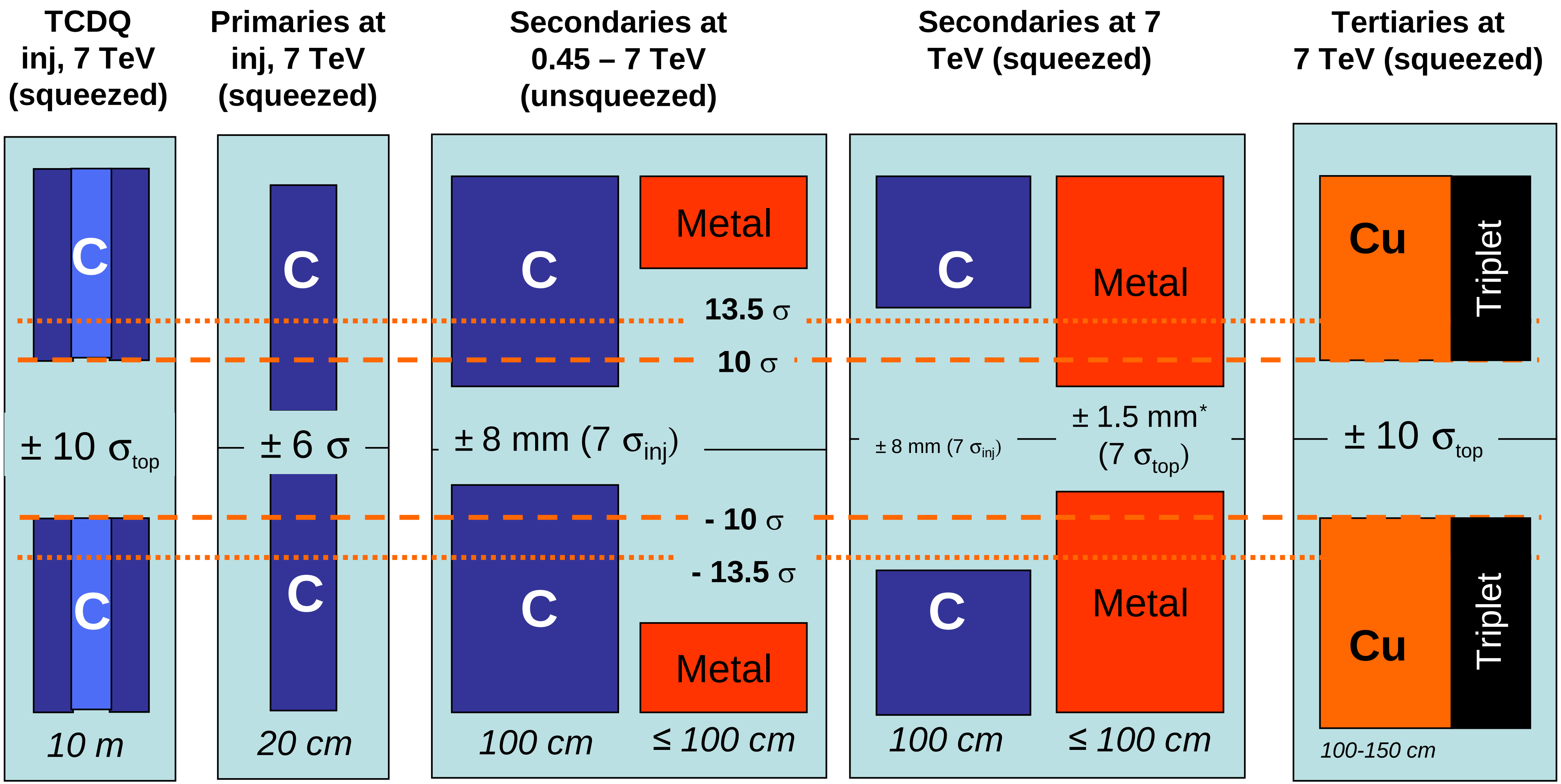
TCL collimators	**4 collimators**	**High luminosity operation**

- Intercept IP debris

All phases

Total number of collimators:	**92**	(26 more than in present baseline, however, spread over 4 years)

Phase 2: The robust 3-stage system plus low impedance hybrids



*A few hybrid collimators (1-2) might be retracted to 10.5 σ (into shadow of TCDQ). Take into account known phase advances for any given configuration.

Hybrid secondaries with metallic surface, only used towards end of squeeze and in stable physics (only dump failure relevant for H collimators in phase).

Rely on local triplet cleaning for these few collimators.

Phase 2 collimation system in IR7

IR	Type	Name	Orientation (appro	Angle [rad]	Material	Alternative material	Length	Setting [inj σ] inj optics	Setting [top σ] squeezed	Half gap [m inj&ramp	Half gap [m 7 TeV squeezed	Betax [m]	Betay [m]
7	prim	TCP.D6L7.B1	V	1.571	C-C	n/a	0.2 m	6.0	6.0	0.00664	0.00168	90.45	156.44
	prim	TCP.C6L7.B1	H	0.000	C-C	n/a	0.2 m	6.0	6.0	0.00501	0.00127	89.13	158.74
	prim	TCP.B6L7.B1	S	2.410	C-C	n/a	0.2 m	6.0	6.0	0.00582	0.00148	87.83	161.07
	sec	TCS.A6L7.B1	H	2.919	C-C	n/a	1.0 m	7.0	28.0	0.00486	0.00486	48.45	320.00
	sec hyb		**H**		**metallic**		**1.0 m**	**open**	**10.5**	**open**	**0.00185**		
	sec	TCS.B5L7.B1	S	2.593	C-C	Al/Ti/C+Cu	1.0 m	7.0	28.0	0.00782	0.00782	126.54	248.46
	sec hyb		**S**		**metallic**		**1.0 m**	**open**	**7.0**	**open**	**0.00198**		
	sec	TCS.A5L7.B1	S	0.550	C-C	Al/Ti/C+Cu	1.0 m	7.0	28.0	0.00787	0.00787	131.25	241.96
	sec hyb		**S**		**metallic**		**1.0 m**	**open**	**7.0**	**open**	**0.00200**		
	sec	TCS.A4L7.B1	V	1.570	C-C	n/a	1.0 m	7.0	28.0	0.00515	0.00515	303.53	69.28
	sec hyb		**V**		**metallic**		**1.0 m**	**open**	**7.0**	**open**	**0.00131**		
	sec	TCS.A4R7.B1	H	0.371	C-C	n/a	1.0 m	7.0	28.0	0.00568	0.00568	66.92	198.29
	sec hyb		**H**		**metallic**		**1.0 m**	**open**	**10.5**	**open**	**0.00216**		
	sec	TCS.B4R7.B1	H	3.118	C-C	n/a	1.0 m	7.0	28.0	0.00496	0.00496	64.21	204.36
	sec hyb		**H**		**metallic**		**1.0 m**	**open**	**10.5**	**open**	**0.00189**		
	sec	TCS.C4R7.B1	V	1.381	C-C	n/a	1.0 m	7.0	28.0	0.00880	0.00880	63.01	207.27
	sec hyb		**V**		**metallic**		**1.0 m**	**open**	**7.0**	**open**	**0.00223**		
	sec	TCS.F4R7.B1	S	0.592	C-C	Al/Ti/C+Cu	1.0 m	7.0	28.0	0.00746	0.00746	66.17	319.92
	sec hyb		**S**		**metallic**		**1.0 m**	**open**	**7.0**	**open**	**0.00189**		
	sec	TCS.G4R7.B1	H	2.701	C-C	n/a	1.0 m	7.0	28.0	0.00660	0.00660	68.39	316.97
	sec hyb		**H**		**metallic**		**1.0 m**	**open**	**10.5**	**open**	**0.00251**		
	sec	TCS.A5R7.B1	V	1.611	C-C	n/a	1.0 m	7.0	28.0	0.00440	0.00440	362.63	50.10
	sec hyb		**V**		**metallic**		**1.0 m**	**open**	**7.0**	**open**	**0.00112**		
	sec	TCS.B5R7.B1	V	1.530	C-C	n/a	1.0 m	7.0	28.0	0.00442	0.00442	356.63	50.40
	sec hyb		**V**		**metallic**		**1.0 m**	**open**	**7.0**	**open**	**0.00112**		
	Total:		25 components/beam				Phase 1: 14			before: 20			
	Total IR3 and IR7 for two beams:					**64**		Phase 1:		**42**		before:	**54**

Phase 2: **22 additional** low-impedance, low robustness secondary collimators for both beams.

TCDQ: 10 σ H with 0.5 σ tolerance

Note: For **known phase advance** close some H collimators more, if irregular dumped beam cannot hit.

This keeps the **freedom of LHC tune** and phase advance.

If irregular dumps are very seldom: Choose **more risky closure**, e.g. full 6/7 σ coverage.

Hybrid phase only for stable physics with reduced number of irregularities. **Afford delicate technology**.

Tertiary collimators at D1's for cleaning of additional halo.

Mechanical and operational tolerances for hybrid secondaries **very demanding**.

Technology candidates for hybrid secondary collimators:

(a) Conventional technology: (with some spare surface)

Beryllium   C-C with few μm Cu coating   Aluminium   Titanium   Cu doped C

(b) Advanced technology:

1) Rotary metallic, consumable collimator for risky operation with regular failures and damage

2) Metallic stripes/tapes on conventional jaw

Phase X: Possible upgrade for cleaning efficiency

Proposal optimized to provide a similar cleaning efficiency as V6.4 system (sufficient efficiency shown for ideal system).

Risks in cleaning efficiency:

Linear tracking **underestimates inefficiency** by factor 2-3.

Dilution of losses around the ring could be below 50 m.

Problems with **off-momentum beta beat** might prevent small collimator gaps?

Cleaning efficiency for ions has never been estimated for any machine!?

The **LHC lifetime** might drop below allowed 0.2/1.0 hours.

Quench limits in magnets are less favourable than assumed.

Operational tolerances on transient changes might be tough to be met.

Extrapolation by 3 orders of magnitude is too far to exclude surprises.

Better cleaning efficiency:

Two possibilities: **More collimators and/or longer jaws.**

- Gain factor 2 by re-adding the 12 suppressed collimators (use space allocations).
- Upgrade during LHC running: Propose solutions targeted to observed problems.

Further work in LHC collimation, if approved *(2nd half 2003& first half 2004)*

Jul-03	Start of **detailed design work** for the LHC collimators, required to ensure schedule. (AB/ATB, EST)
Jul-03	Complete **space budget** for cleaning insertions (collimators, vacuum components, magnets, instrumentation, …) (AB/ABP, AB/ATB, AB/BDI, AT/VAC, TIS/RP, AT/MS, …)
Sep-03	Finalize **new optics** design and achievable cleaning efficiency. (AB/ABP, TRIUMF)
Sep-03	Test results for collimator jaws with chosen material. (AB/ATB)
Sep-03	**3D impedance simulations** for LHC collimators and tanks. (AB/ABP)
Sep-03	**Impedance handling** with octupole excitation and damper. Strategy of usage. (AB/ABP, AB/RF, AB/CO)
Sep-03	More detailed estimate of **personnel exposure** due to collimator maintenance. (TIS/RP, AB/ATB, AT/VAC)
Sep-03	Complete **specification of BLM's, other BI** at collimators, for set-up/optimization of collimation. (AB/ABP, AB/OP, AB/BDI)
Nov-03	Results of a **robustness test** with beam of collimator material. (AB/ABP, AB/ATB)
Dec-03	Complete energy deposition in cleaning insertions and **decision on required absorbers**. (AB/ATB, IHEP)
Dec-03	Complete radiation studies in cleaning insertions. Final **decision on handling/shielding**. (TIS/RP, IHEP)
Dec-03	Complete **loss distribution around the ring** (local cleaning efficiency and loss rates). (AB/ABP, AB/CO)
Dec-03	Complete review of impact of tertiary collimators on **experimental background**. (AB/ATB, FNAL)
Dec-03	Complete review of **cleaning efficiency for ions**. (AB/ABP)
Dec-03	Decision on any measures against local electron cloud. (AT/VAC, AB/ABP, AB/ATB)
Dec-03	**Freeze cleaning insertions.**

Jan-04	Experimental results on collimator impedance and effect of coating. (AB/ABP)
Jan-04	Start of detailed studies on set-up and optimization of LHC collimation system. (AB/ABP)
Apr-04	**First prototype collimator produced.** (AB/ATB)
Apr-04	Final budget estimate.
Jul-04	Laboratory tests of collimator prototype completed. (AB/ATB)
Jul-04	Prediction of cleaning performance with measured prototype characteristics. (AB/ABP)
Summer 04	LHC collimation fully under control. No further basic surprises expected. **Ready for production.**

Testing possibilities

Location	Hardware	Purpose	Date
CERN lab	Jaw materials.	**Vacuum** and outgassing tests.	ongoing
RHIC	RHIC copper jaw.	Understanding of **showering and cleaning efficiency for ions**.	to be started
CERN lab	Prototype jaw.	Tests on **material properties** (mechanical, electrical, tolerances, ...)	Sep-03
Sandia?	Collimator jaw without (and with) eventual coating.	Test of **robustness** with beam impact (LHC MAC).	Oct-03
SLAC	Collimator jaw without (and with) eventual coating.	Test of **robustness** with beam impact of high density electron beam (LHC MAC). Measurement of **impedance**.	Jan-04
CERN lab	Prototype collimator with jaws, tanks, motors, electronics.	Test of **vacuum tightness, outbaking procedure, mechanical tolerances** on jaws in tank, **functionality, reliability**.	Apr-04
RHIC	Prototype secondary collimator including all motors and control.	Test of functionality, reliability, cleaning efficiency with beam in **regular RHIC operation**. Cleaning efficiency with **ions**.	Oct-04
SPS	Prototype secondary collimator (hybrid?) including all motors and control. **Too late for phase 1 collimators!?**	Test of functionality, reliability, and **robustness** with the injection LHC beam. Test for **local electron cloud**?	2006

System summary

Phase 1 (2007-2008)

- Injection optics: Settings **6/7 σ**.
- Squeezed optics: Settings **7/10.5 σ**.
- Tightest tolerances at collimators **relaxed by a factor ~3**.
- Impedance OK for 50% nominal intensity.
- **Minimum beta* = 0.85 m.** (loose factor 0.85/0.55 ≈ 1.6)
- **Maximum luminosity reach: 16% (25 ns)** (with factor 4 from half bunch intensity)
- Hope to gain further on impedance: Modified optics.

Options to go beyond

- Use **10 μm Cu coating** if still existing (gain factor 5 in impedance, go to nominal 6/7 σ settings). Problem: Coating might not survive (further studies)!
- Use **local cleaning at triplets** for smaller beta*. Problem: Generation of background in the experiments.
- Use **metallic hybrid collimators** of phase 2. Likely need to rely on this.

Far future, if required

- Upgrade for best possible cleaning efficiency, using placeholders in optics.

Our proposal

- Consider **phase 1 collimation as new baseline** for all further work.
- Start **detailed engineering** of Phase 1 and **finalization of LHC optics and layout** now.
- Rely on LEP experience for the mechanical design choices.
- Start **detailed studies** on efficiency, machine protection, beam loss, radiation, operational studies for the new baseline **in September 2003**.
- **Authorize R&D for phase 2** collimation to support a later decision on implementations beyond Phase 1.

Questions

- Is this staging concept **reasonable and should be pursued**?
- Are all the components for phase 1 accepted (IR3/IR7 collimation, tertiary collimators, scrapers)?
- Is the reduction in number of components in IR7 accepted, reducing the cleaning efficiency to that of V6.4 collimation?
- Are the **imposed limitations acceptable** for the LHC commissioning and early running?
- Can we start the further work with the proposed schedule?

Major milestones in LHC collimation

Sep-01	Start of Beam Cleaning Study Group/Collimation WG (AP/OP issues)
Jan-02	**CERN meeting on collimators: Foreseen materials do not withstand LHC operation.**
Jun-02	Consensus on detailed requirements.
Oct-02	LHC collimation project started. ATB group founded. (new hardware responsibility, project set-up)
Dec-02	**Installation in IR3 and IR7 delayed to provide time for finalizing the insertion design (LHC project)**
Jan-03	**Review of impedance: Collimator impedance of C jaws is way too large for nominal settings (AB/ABP)**
Feb-03	Simulation chain set-up: Beam tracking - FLUKA - ANSYS. (AB/ABP + AB/ATB + AT)
Mar-03	LTC review on impedance limitation from collimators. First short discussion of "three-stage hybrid" system.
Mar-03	**Graphite jaws can be accepted in LHC ultra-high vacuum if precautions are met (AT/VAC)**
Apr-03	**Sufficient optics flexibility for meter movements in IR7 (TRIUMF).**
Apr-03	**Beam impact from irregular dumps reduced from ~20 bunches to ~8 bunches (AB/BT)**
May-03	**Efficiency results cross-checked: factor 2-3 uncertainty in inefficiency. (AB/ABP, TRIUMF, IHEP)**
May-03	**Fiber-reinforced graphite withstands all specified beam impact cases. (AB/ATB + AT)**
May-03	**Dose rate for 1.5 h intervention is high but not prohibitive: 1-2 mSv. (TIS/RP)**
May-03	**Installed collimator length in IR7 can be reduced by 40%, IR3 collimators opened at 7 TeV. (AB/ABP)**
May-03	**Some first estimates of slow loss impact indicate that C can resist low lifetimes. (AB/ATB + AT)**
Jun-03	**A thin few micron coating can reduce impedance on average by factor 5. (AB/ABP)**
25-Jun-03	**Proposal of a staged system with tertiary collimators and hybrid phase to the LTC:** * Accept basic strategy and connected constraints? * Freeze types of collimators and lengths? * Freeze basic functionality, tolerances for different stages, conventional design choice?