



*HL-TCC Technical Coordination Committee
47th meeting, March 8th, 2018
CERN, Geneva, CH*



Cost and manpower estimate for the hollow electron lenses for collimation

O. Bruning and S. Redaelli



The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404.





Introduction



- 2016: Spring meeting of US-LARP
Estimates of full cost by Fermilab: 13.6 M\$
- 2016: Review on needs
Initial estimates for hardware costs at CERN, but no complete assessment of all components.
No commitment from CERN groups in charge of HW
- 2017: Review on readiness
Full complete assessment involving the CERN groups!
Triggered iteration to assess also personnel resources
↳ first version already available for Chamonix!
*Assess possibilities for **in-kind contributions***
- Now (pre-C&S review)
Additional iteration involving department heads.



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Present here the budget table version
circulated to the ATS department heads.



Acknowledgements



Special thanks: Diego Perini and Adriana Rossi

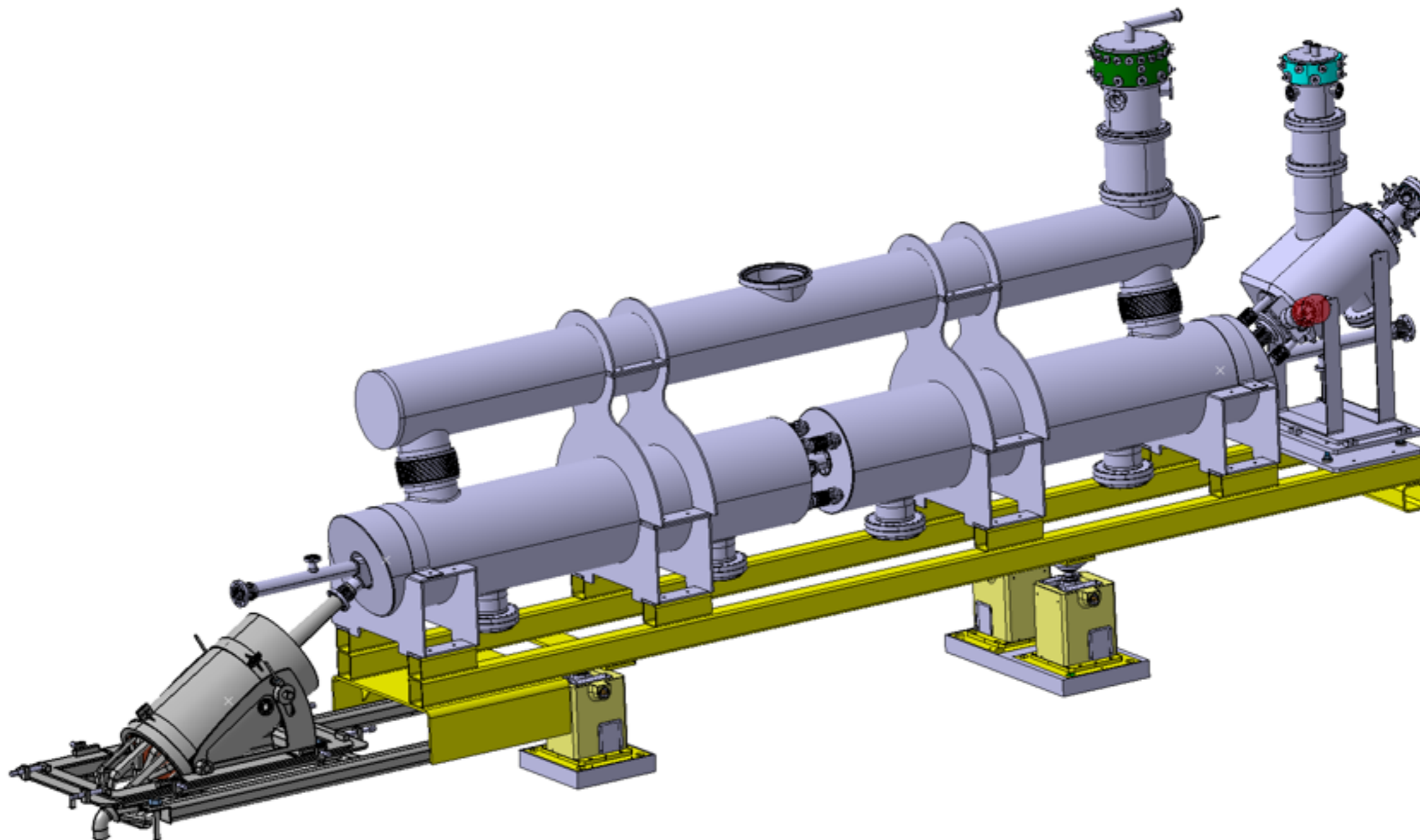
Links for key sub-systems:

Michele Martino, Serge Claudet, Diego Perini, Adriana Rossi, Glyn Kirby, Gijs De Rijk, Vincent Baglin, Paolo Fessia, Daniel Wollmann, Markus Zerlauth, Gianluigi Arduini, Stefano Redaelli

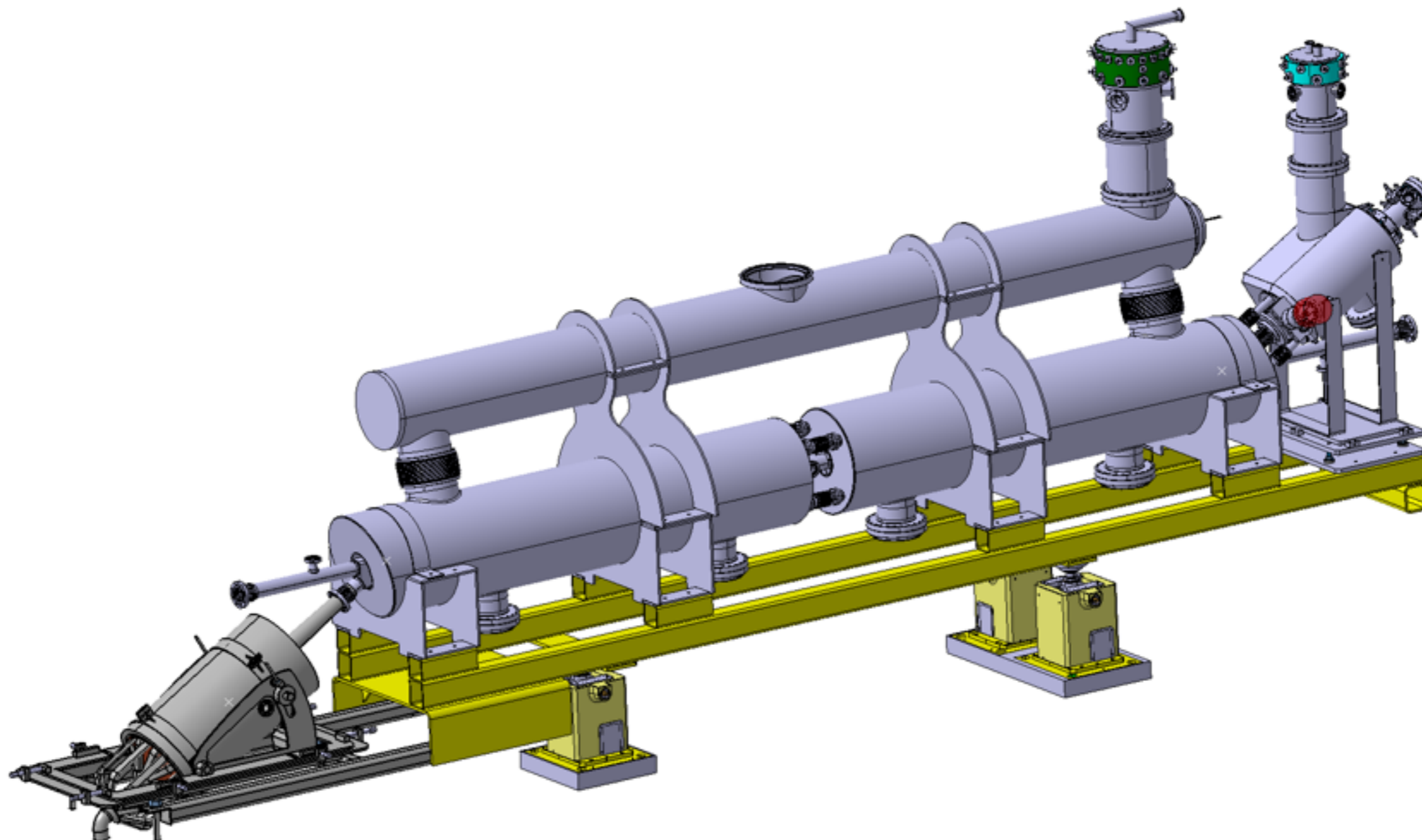
Information and request of feedback was distributed to all work package leader and group leaders involved:

Luca Bottura, Paolo Chiggiato, Dimitri Delikaris, Francesco Bertinelli, Andrzej Siemko, Brennan Goddard, Jean-Paul Burnet, Gianluigi Arduini, Rhodri Jones, Eugenia Hatziangeli, Erk Jensen

Present design



Present design



Design is evolving. Important major changes triggered by the review in Oct. 2017!
Will need an iteration on budget figures for final design (magnetic system!)



Budget table



System	Cost [kCHF] for 2 units	Cost [kCHF] spares	Personnel [kCHF]	Material [kCHF]	TOTAL [kCHF]	CERN personel [MY]	Availability of Staff @ CERN	Option for Inkind?
Magnets systems (solenoid, correctors, cryostats, leads)	2100	700	0	2800	2800	5.1	YES	YES
Beam instrumentation: gas jet monitor	200	50	0	250	250	1.5	YES	YES
Gun and collector	240	30	10	270	280		YES	YES
Supports and feet	200	0	0	200	200	0.5	YES	YES
Vacuum systems	730	0	200	730	930	0.1	YES	YES
Beam instrumentation: BPM, BLM	320	30	0	350	350	1	YES	YES
Power converters (with HV cables)	1190	109	220	1299	1519	1	YES	NO
Anode Electron beam modulators	240	120	0	360	360	3	YES	NO
Cabling, integration, transport, cooling, alignment	450	0	50	450	500		YES	NO
Cryogenics system	2000	0	150	2000	2150	2.25	YES	NO
Powering Interlock controllers	60	0	20	60	80	0.3	YES	NO
Quench detection	65	0	50	65	115	0.3	YES	NO
Energy Extraction system (switch + dump resistor)	300	0	50	300	350	0.5	YES	NO
Validation of design	0	0	400	0	400	2	YES	NO
Development for inkind contributions/outsourcing	0	0	175	0	175	0.2	YES	NO
TOTALS	8095	1039	1325	9134	10459	17.75		
Required Core CERN investment					5649			
Total for in-kind					4810			
Additional Options not yet in the baseline design								
Dipole correctors for tilted solenoid compensation	?	?			0		YES	YES
Additional BI: YAG + back-scattered electron detection	240	0	0	240	240		YES	YES
Finalization of guns and BI (test facility)	150	0	0	150	150	1.3	YES	YES



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This is still a bottom-up approach without optimisation!

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Update: +50kCHF for BI spares + 350kCHF for test facility "option"

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- With the latest iteration we exceeded the threshold of 10MCHF that we had set as a target!
This is before any top-bottom iterations to optimise figures received.
- We are working on finding possibilities for in-kind contributions and all groups/teams are encouraged to support this approach. Only < half of the cost is now considered as suitable for outsourcing.
- Can we get a full HE built outside and integrate it into the LHC?

- We already working on identifying possible saving/ optimizations!
- Possibly reduce cryogenics costs by up to 650kCHF if synergy is found with other RF works in P4.
- Vacuum sectorization in point 4 possibly done in LS3 could save up to ~300kCHF
- Smart design of self-protected magnets could save up to 365kCHF for QPS and energy extraction.
- Magnetic system design, with lower aperture (80mm \mapsto 60mm), to be assessed.
- 10-15% for the modulators \mapsto ~50kCHF
- “M” resources estimated as follows: -30% less if PJAS.