4th Joint HiLumi-LARP Annual Meeting
November 21st, 2014
KEK, Tsukuba, Japan

Summary of WP5

Stefano Redaelli, CERN, BE-ABP
Material from WP5, WP7, WP10, WP14

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

Plenary on IR1/5 layouts

Crab Cavities: progress towards SPS - 25' + 5' — *Dr. Graeme BURT*
Kobayashi Hall, 1F, Kenkyu-Honkan Bldg., KEK 09:00 - 09:30

Collimation status and layout for IR1 and IR5 - 25' + 5' — *Dr. Roderik BRUCE*
Kobayashi Hall, 1F, Kenkyu-Honkan Bldg., KEK 09:30 - 10:00

R2E and Availability workshop report and upgrade plans for injection protection devices - 25' + 5' — *Dr. Daniel WOLLMANN*

IR collimation and energy deposition

KEK

Collimation IR layout for the incoming beam
Kobayashi Hall, 1F, Kenkyu-Honkan Bldg., KEK

Energy deposition for HL-LHC v1.1: TAS/Triplet/D1, update with latest design of beam screen, correctors and TAS aperture impact, impact of possible levelling at ...

Energy deposition for HL-LHC v1.1: TAN/D2/Matching Section and crab cavities, effectiveness of masks and integration issues, impact of a movable TAN, impact of possib...

Collimation impedance

Honkan Bldg.

00 **Wake fields and impedances of LHC collimators - 15' + 5'**

Updated impedance model - 20' + 5'

Machine settings and operational scenario from stab... — *Dr. Elias METRAL*

00 **Status of R&D and beam plans for low impedance...** — *Federico CARRA*

Lunch Break

Advanced designs, halo excitation methods

KEK

Update on the beam-beam effects for HL-LHC (DA, stability considerations, PACMAN effects) — *Dr. Tatiana PIELONI*

Beam -beam effects for round and flat optics: DA simulations

Beam-beam long range compensation for HL-LHC

BBLR tests in the LHC: possible set-up and what can we learn

Coffee Break
Lounge, 1F, Kenkyu-Honkan Bldg., KEK

Beam monitoring for BBLR tests and commissio... — *Dr. Rhodri JONES*

MD plans for active halo control — *Dr. Roderik BRUCE*

Advanced collimation design studies (TCT with wire, ... — *Dr. Diego PERINI*

MQXF quench protection analysis

MQXF magnet assembly
Room A: Seminar Hall, 1F, Yon Go-Kan Bldg., KEK

MQXF cold-mass assembly and cryostating
Room A: Seminar Hall, 1F, Yon Go-Kan Bldg., KEK

Collaboration Board
Andrzej Wolski

Joint discussion with machine protection and inj&dump WP's

WP14 overview

Protection studies of SC elements in the case of inject...

Status of MP studies

Planned HiRadMat beam tests on collimation materials

Discussion
Room A: Seminar Hall, 1F, Yon-Go-Kan Bldg., KEK

Internal WP5 discussion: simulation news and work ahead

12:30 - 14:00

Introduction

Simulation priorities until end of 2015 (task 5.2) — *Dr. Roderik BRUCE*

Simulation priorities until end of 2015 (task 5.3)

Status of TCLD design and integration (task 5.4)

Status of BDSIM developments at RHUL — *Dr. Laurie NEVAY*

WP3 QXF (cost & schedule) Session Thursday PM (by invitation only)
Dr. Paolo Ferracin
Room A: Seminar Hall, 1F, Yon-Go-Kan Bldg., KEK

Status of Merlin simulations: 4 TeV cases and new scattering — *Dr. Sam TYGIER*

Updated on US-LARP collimation activities — *Dr. Tom MARKIEWICZ*

Outline

- Introduction
- FP7 HiLumi-WP5 status
- Collimation design activities
  - WP5 / 7 / 14
  - Collimation in LARP
- Conclusions

FP7 Hi-Lumi WP5: IR collimation

WP5.1: Coordination & Communication

WP5.2: IR Simulations of Halo Loss

– Assess locations and magnitudes of halo loss in the IR's for various upgrade scenarios (includes crab cavities, ATS, ...).

– Assess impact of imperfections.

WP5.3: IR Simulations of Energy Deposition

– Assess locations and magnitudes of energy deposition in the IR's for various upgrade scenarios.

– Assess impact of imperfections.

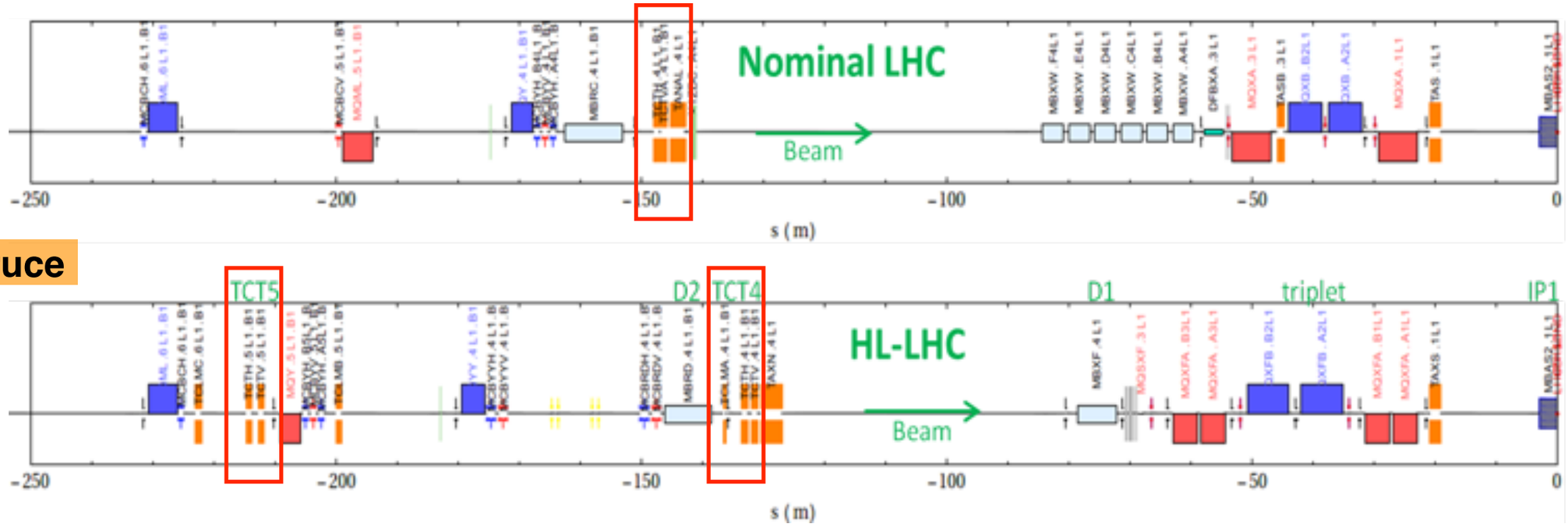
WP5.4: Design of IR Collimation

– Study required collimation to keep losses at the same level or below before the upgrade.

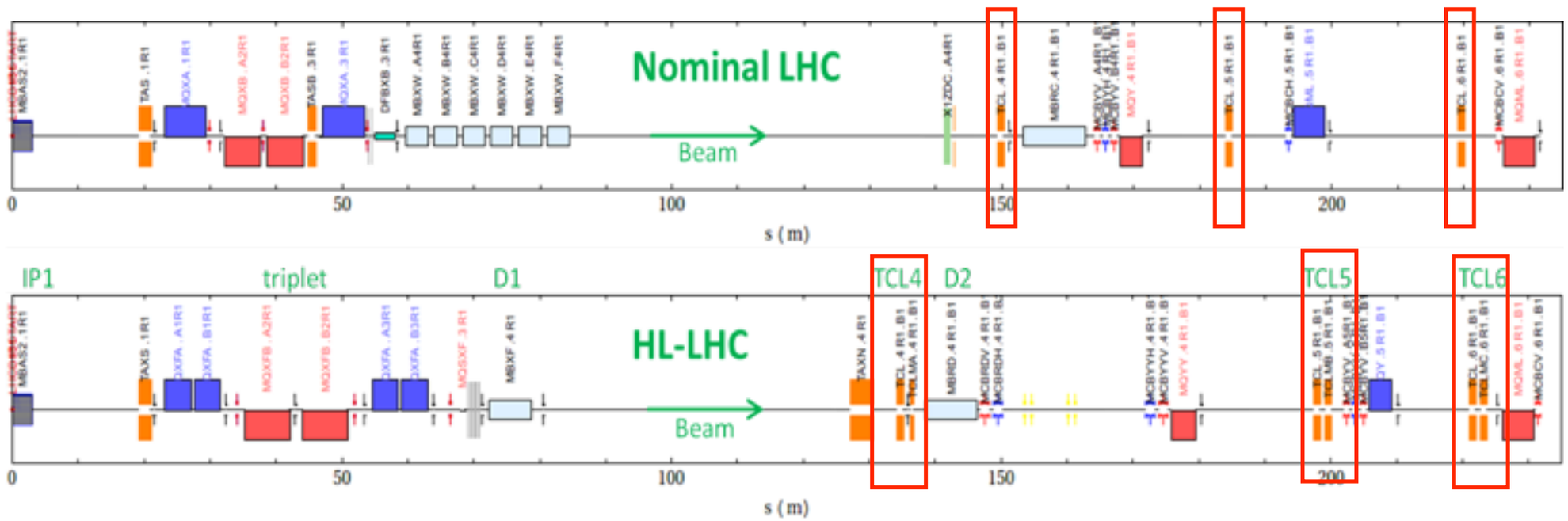
– Integration of collimators, new layout and optics.

– Feed-forward to simulation WP's.

IR1/5 collimation layouts

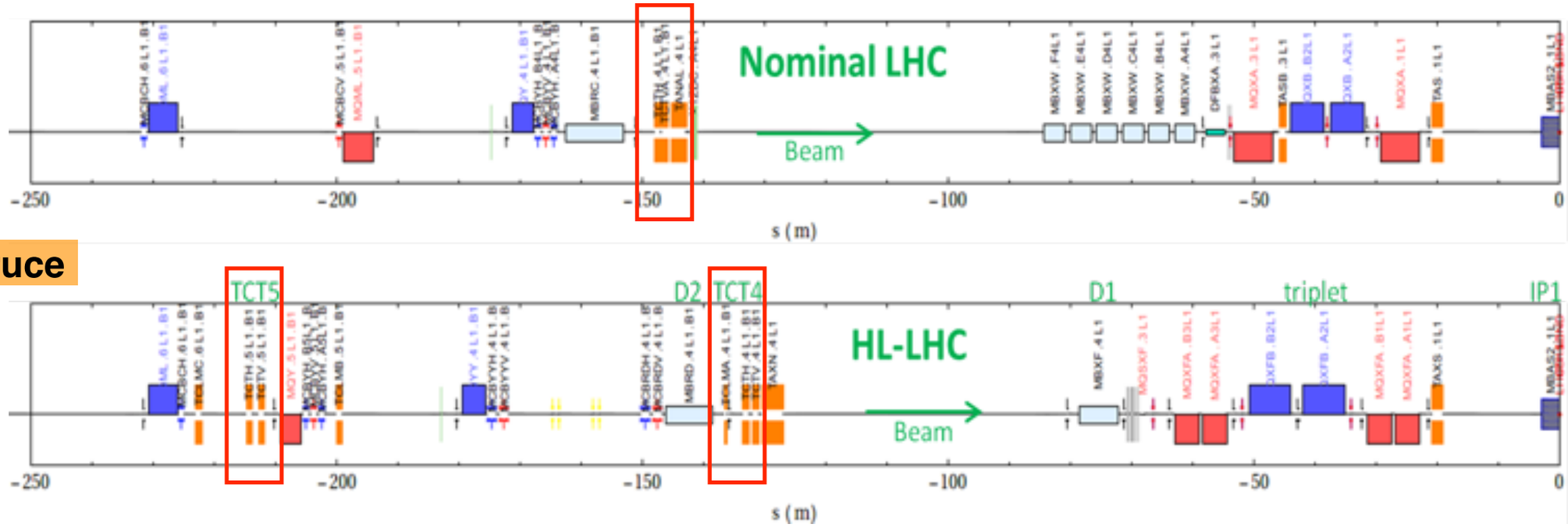


*Additional H/V tertiary collimators protect the Q5 aperture from **incoming beam** losses.*

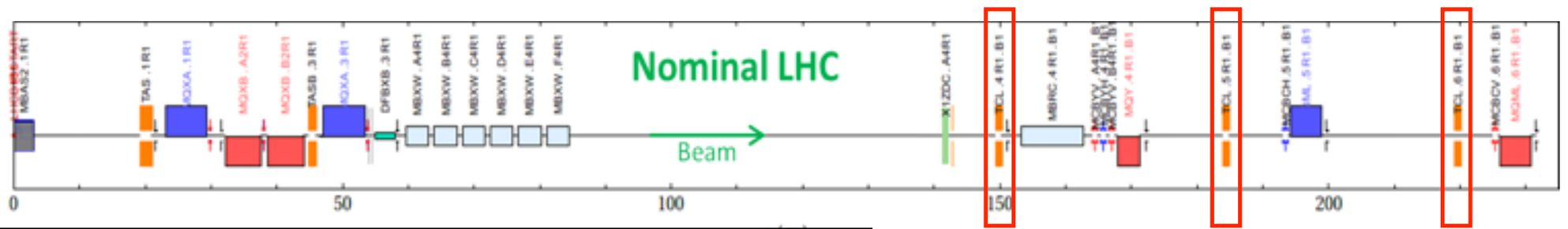


*Standard TCL layout complemented by fixed mask for **outgoing beam** cleaning.*

IR1/5 collimation layouts



*Additional H/V tertiary collimators protect the Q5 aperture from **incoming beam** losses.*

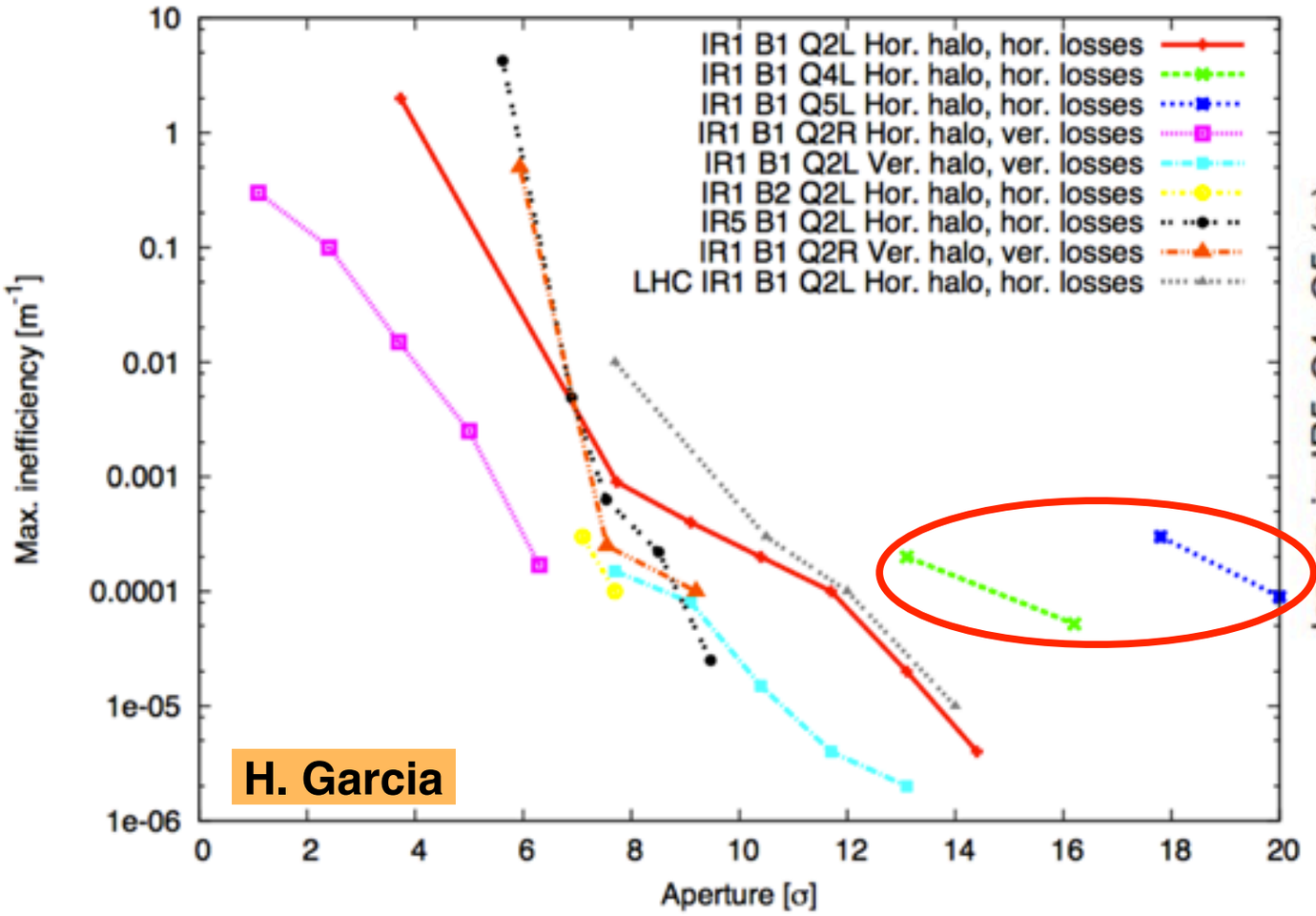


*First complete conceptual layouts in IR1/5, integrated into the HL-LHC optics version. Performance estimates addressed in 2 detailed talks by **H. Garcia** and **L. Esposito**.*

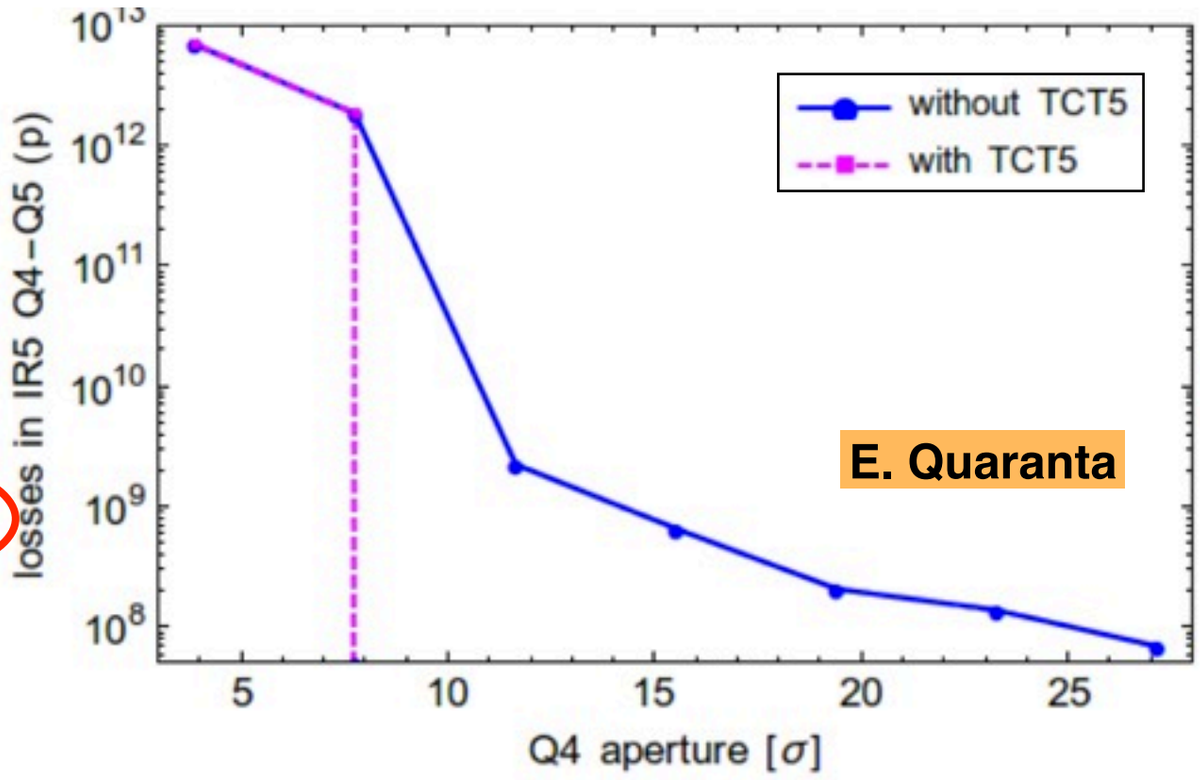
*Standard TCL layout complemented by fixed mask for **outgoing beam** cleaning.*

IR1/5: incoming beam

Collimation cleaning



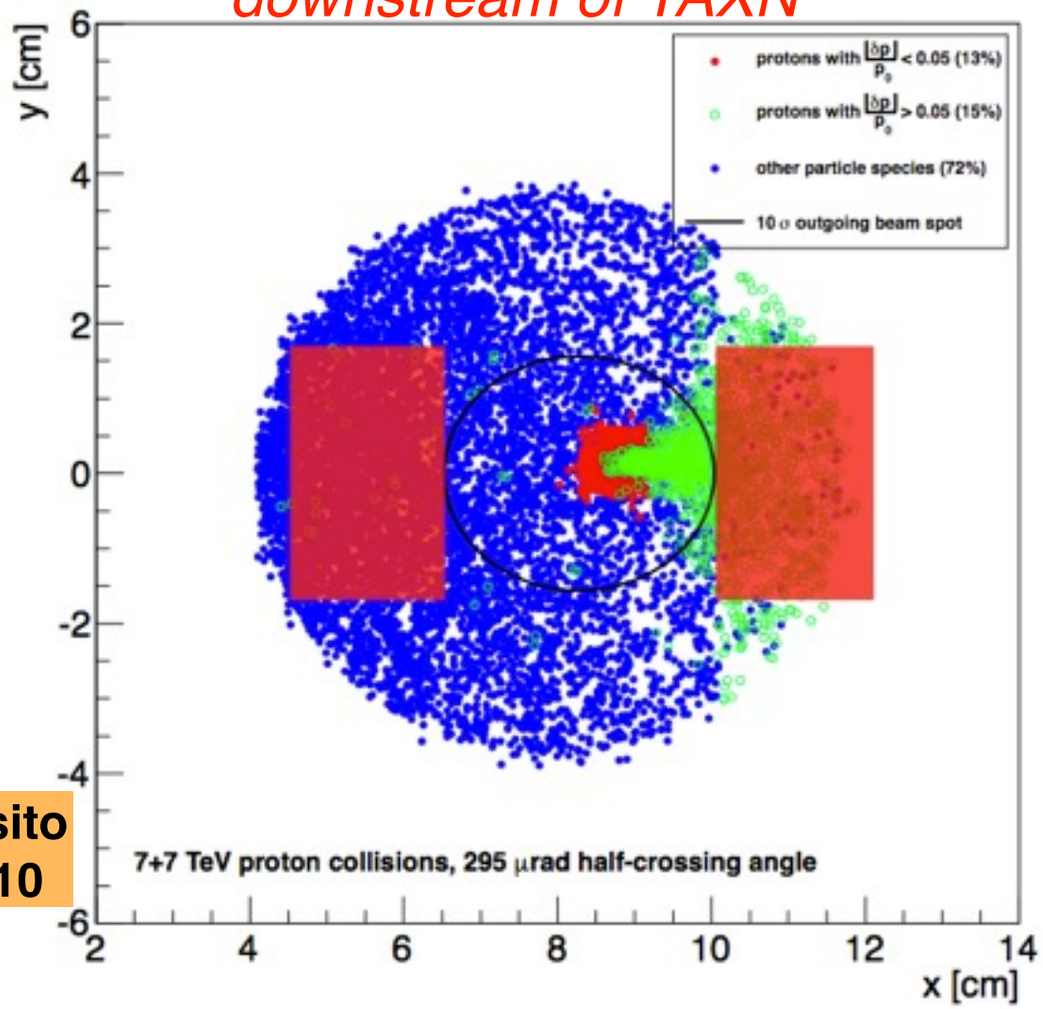
Protection against fast failures



- ☑ An additional pair of TCT's in front of Q5 cures potential issues from losses in standard operation (cleaning) and during fast failures (protection).
- ☑ It comes at a [moderate] cost (existing collimators might be re-used for HL!)
- ☑ Impact on the machine impedance needs to be studied.

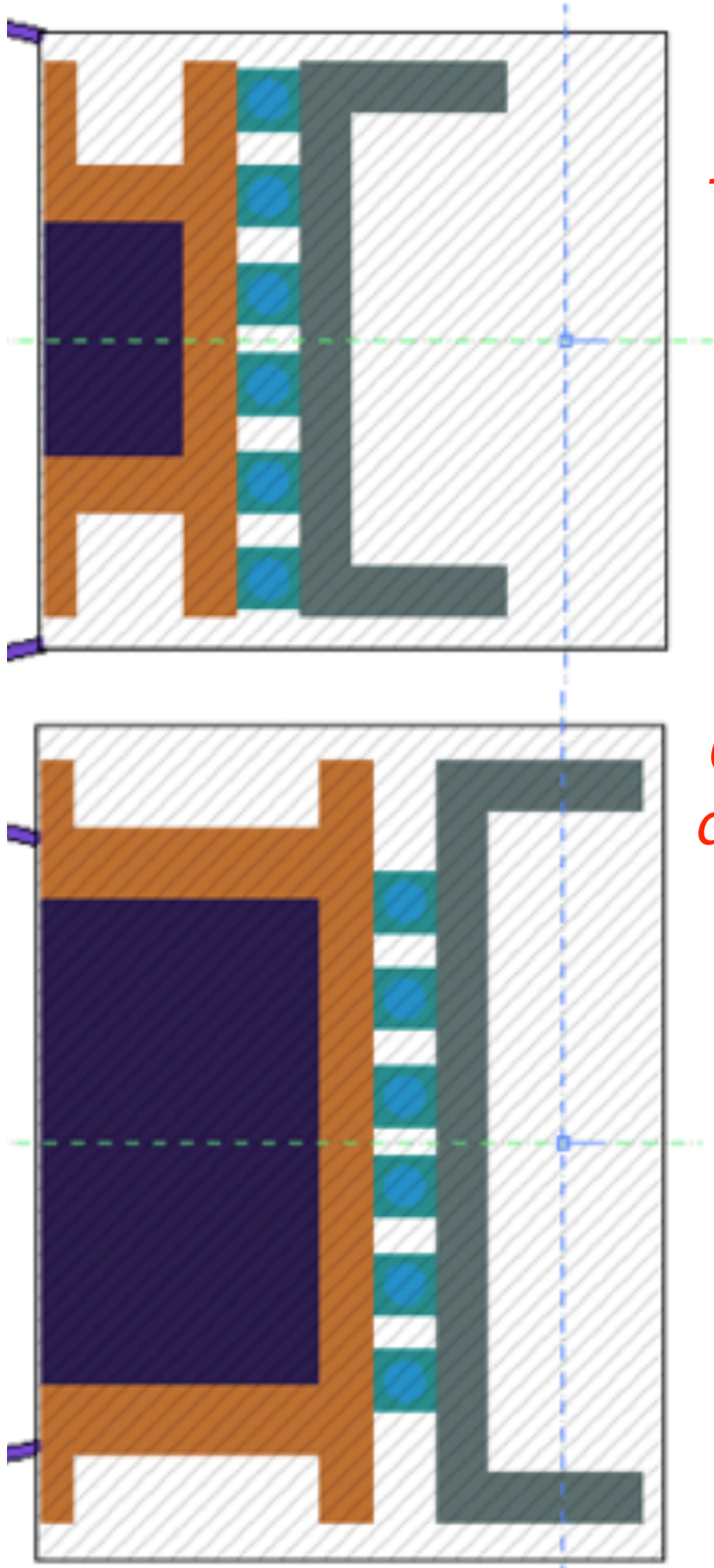
IR1/5: outgoing beam

Physics debris products downstream of TAXN



L. Esposito for WP10

- ☑ New design of the present TCL collimators improved cleaning downstream of the TAXN
  → remove a D2 mask (less integration issues)
  → more flexibility versus optics choices
- ☑ Clearly, this conceptual solution requires now a detailed design and integration work.



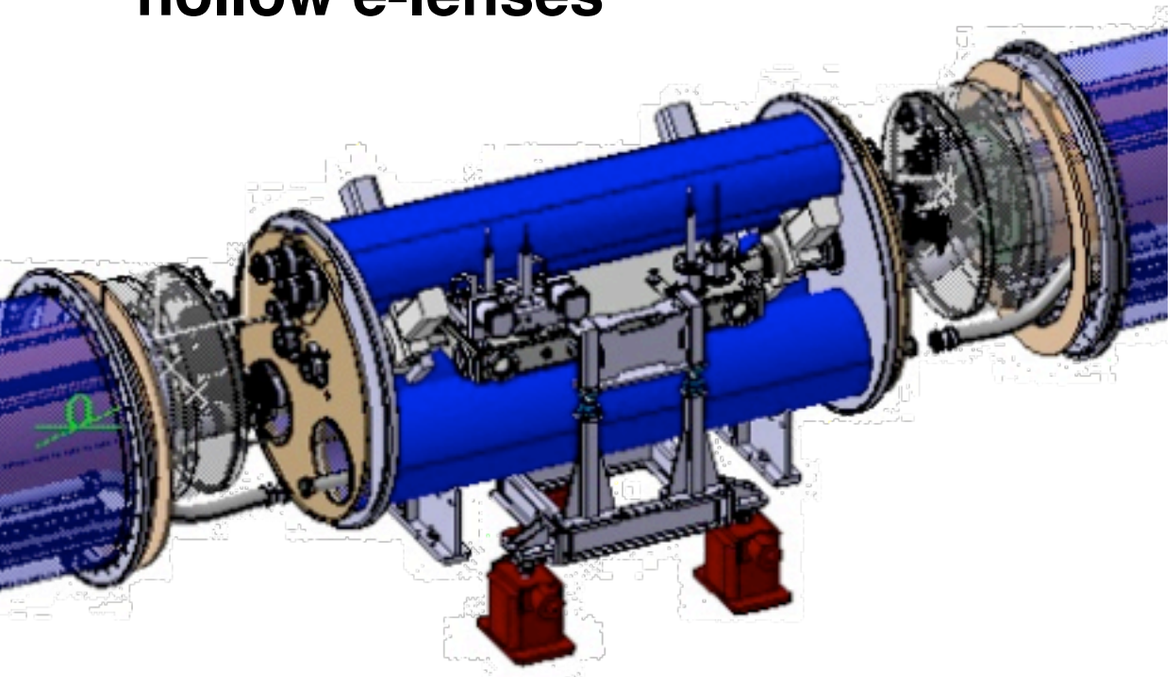
Present jaw design

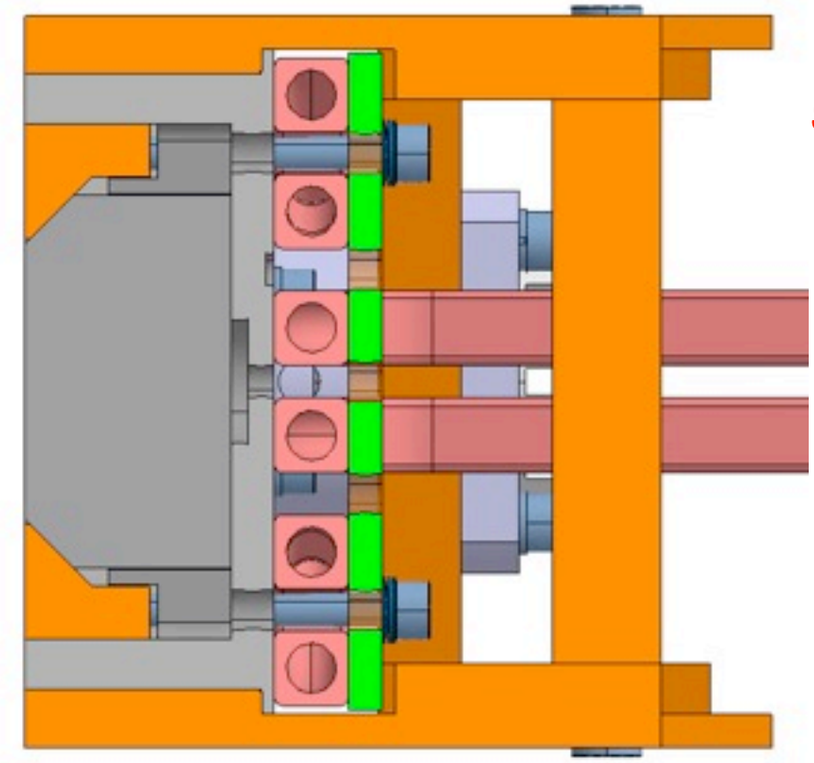
Conceptual design of an improved jaw.

Collimation design activities

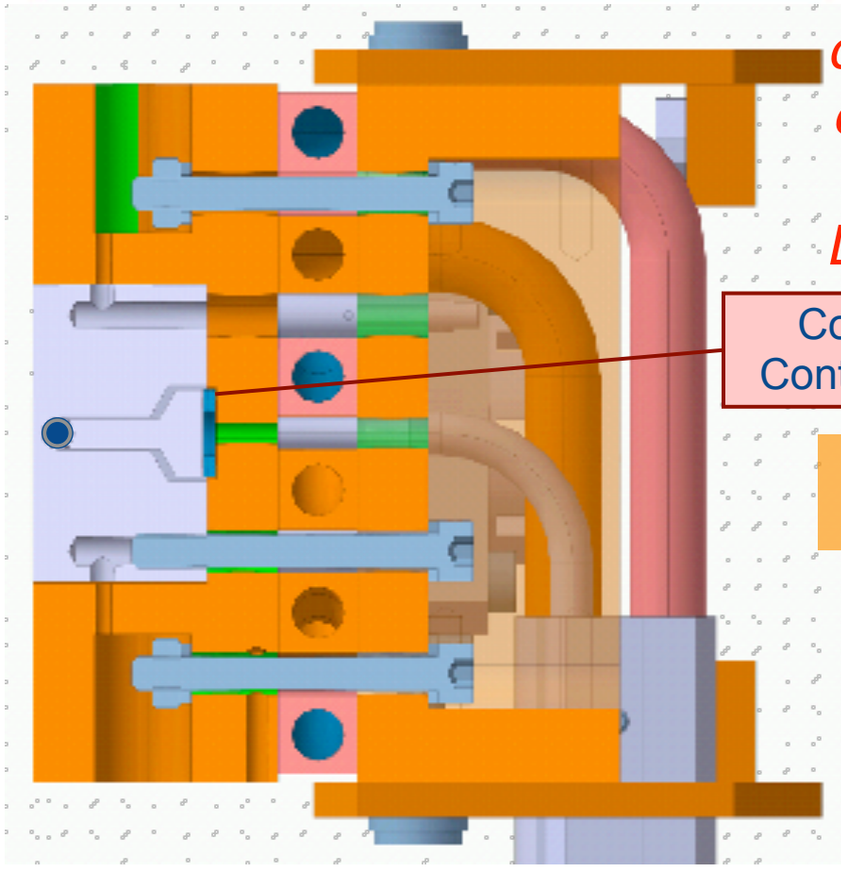
Impressive amount of new results in 2014:

- ☑ New generation of **secondary collimators** (low-impedance) nearly ready for prototyping
  - → *Two single full jaws for HRM in 2015;*
  - → *Aim: 1 collimator for IR7 by end of 2015.*
- ☑ Collimators with **embedded wire** (LRBB)
  - → *still pending feasibility issues!*
- ☑ In addition: on-going **major revision** of the TCLD collimator for the 11T dipoles
- ☑ Design of **HiRadMat collimation tests**
- ☑ Preliminary but advanced technical design of **hollow e-lenses**





New secondary collimator in MoGR or CuCD



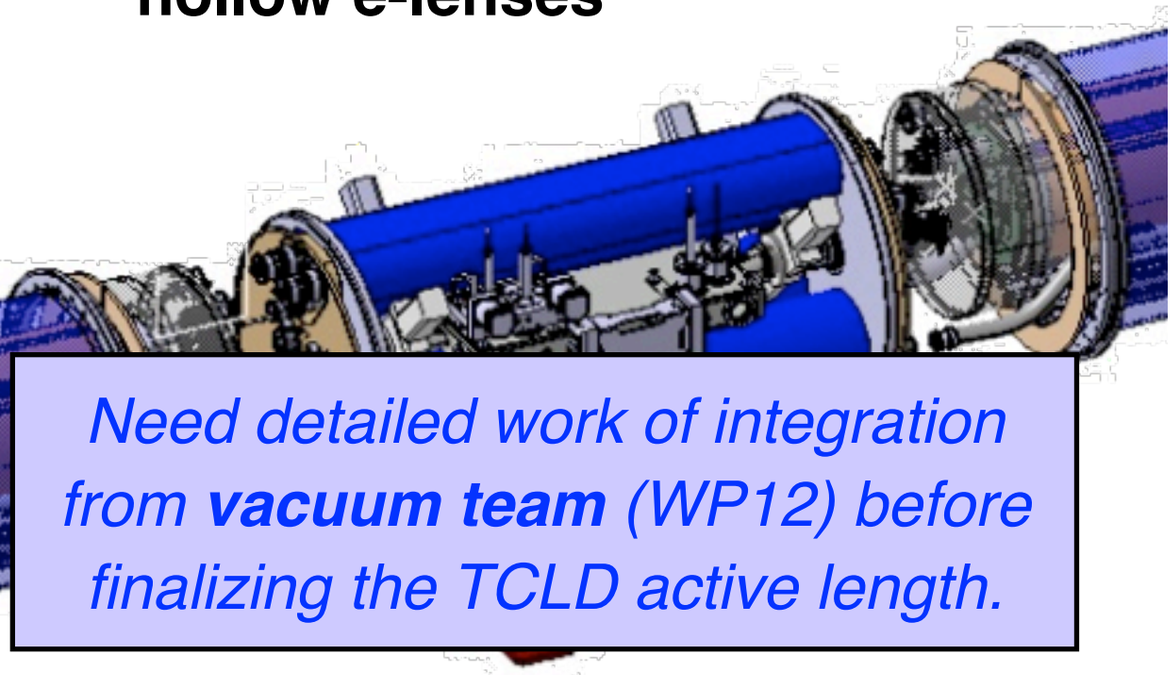
Tertiary collim. with embedded wire for LRBB MDs

D. Perini
F. Carra

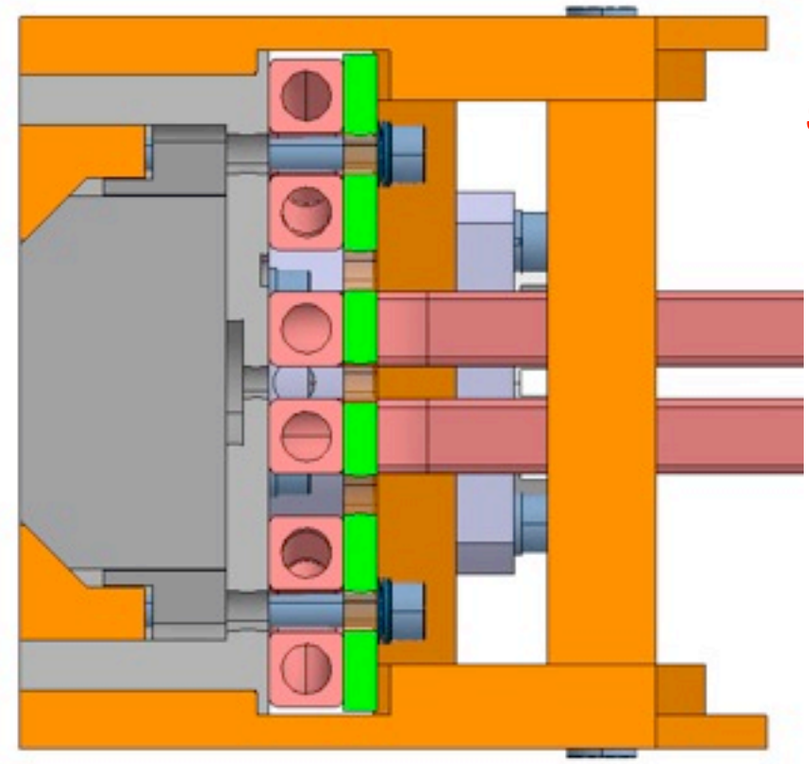
Collimation design activities

Impressive amount of new results in 2014:

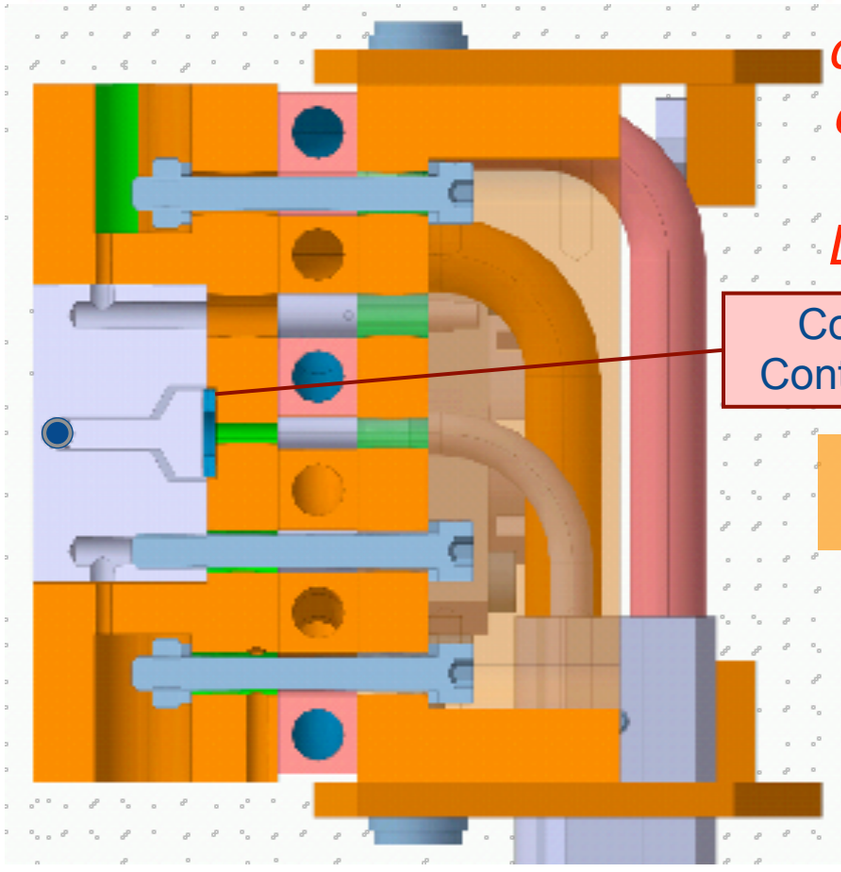
- ☑ New generation of **secondary collimators** (low-impedance) nearly ready for prototyping
  - → *Two single full jaws for HRM in 2015;*
  - → *Aim: 1 collimator for IR7 by end of 2015.*
- ☑ Collimators with **embedded wire** (LRBB)
  - → *still pending feasibility issues!*
- ☑ In addition: on-going **major revision** of the TCLD collimator for the 11T dipoles
- ☑ Design of **HiRadMat collimation tests**
- ☑ Preliminary but advanced technical design of **hollow e-lenses**



*Need detailed work of integration from **vacuum team** (WP12) before finalizing the TCLD active length.*



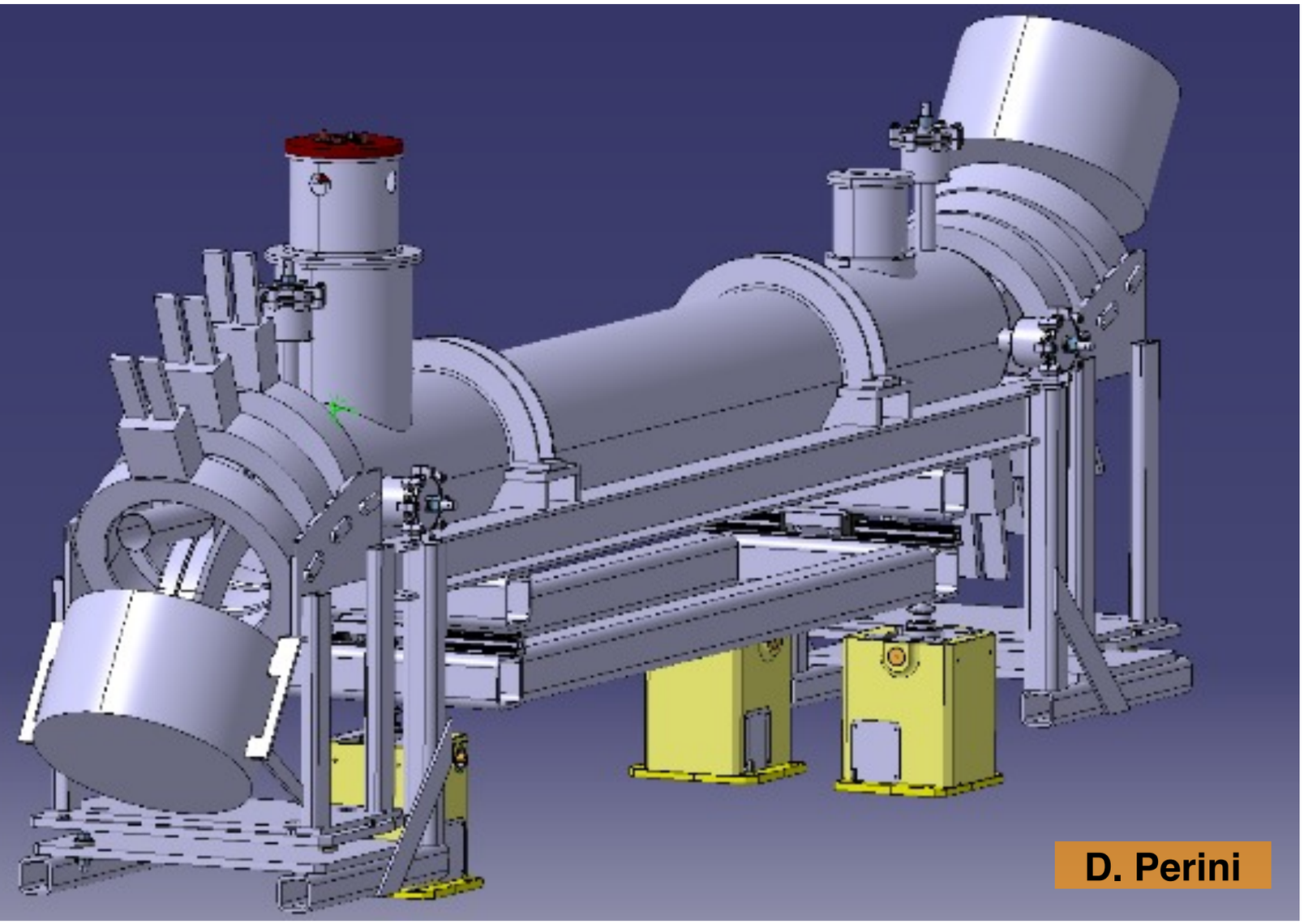
New secondary collimator in MoGR or CuCD

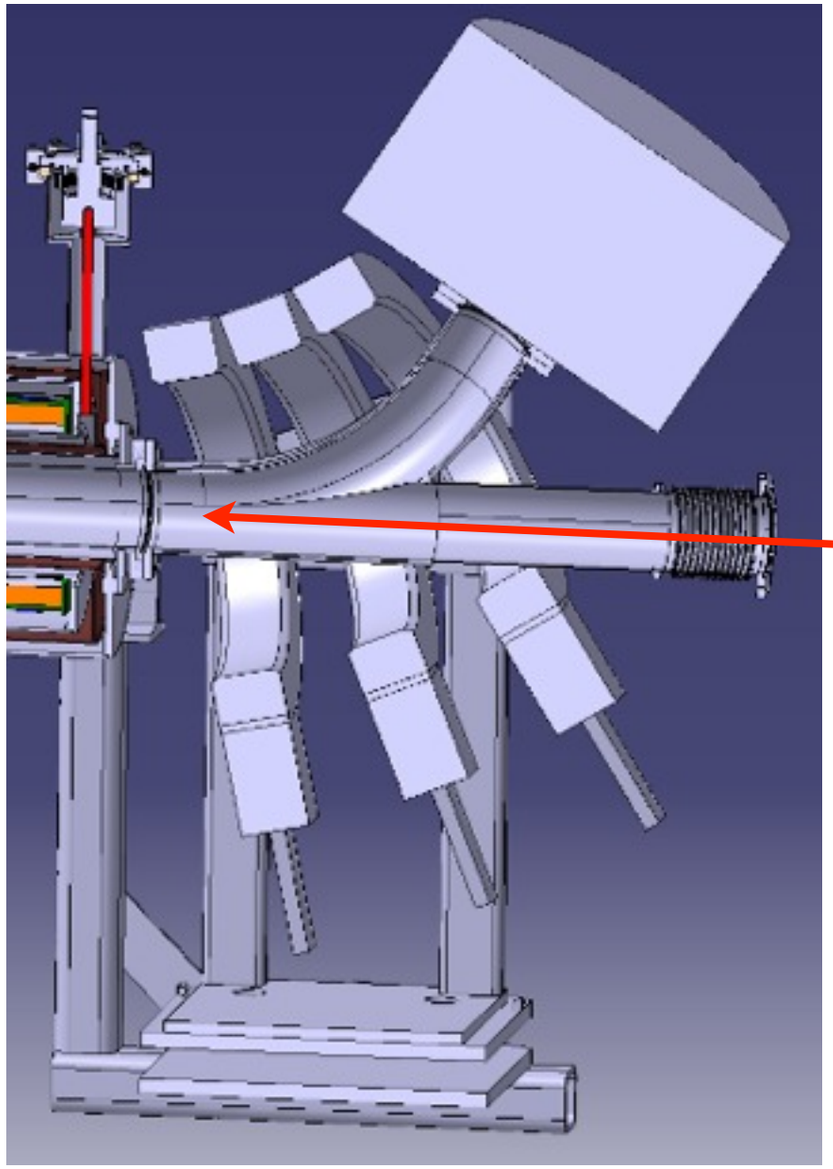


Tertiary collim. with embedded wire for LRBB MDs

D. Perini
F. Carra

Prelim. technical hollow elens design



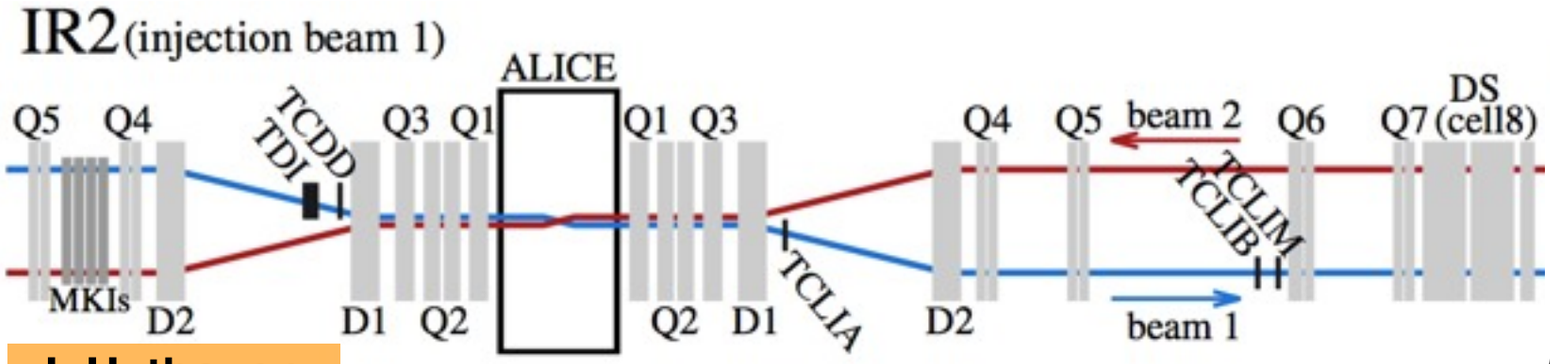


- ☑ One year ago → first version of the conceptual design report from FNAL
  Summer 2014: first preliminary design addressing the main key components!
- ☑ Presently discussing prototyping plans for deployment at the LHC.
- ☑ Priority for first part of 2015: finalize a strategy for LS2 (prototypes, test stands)

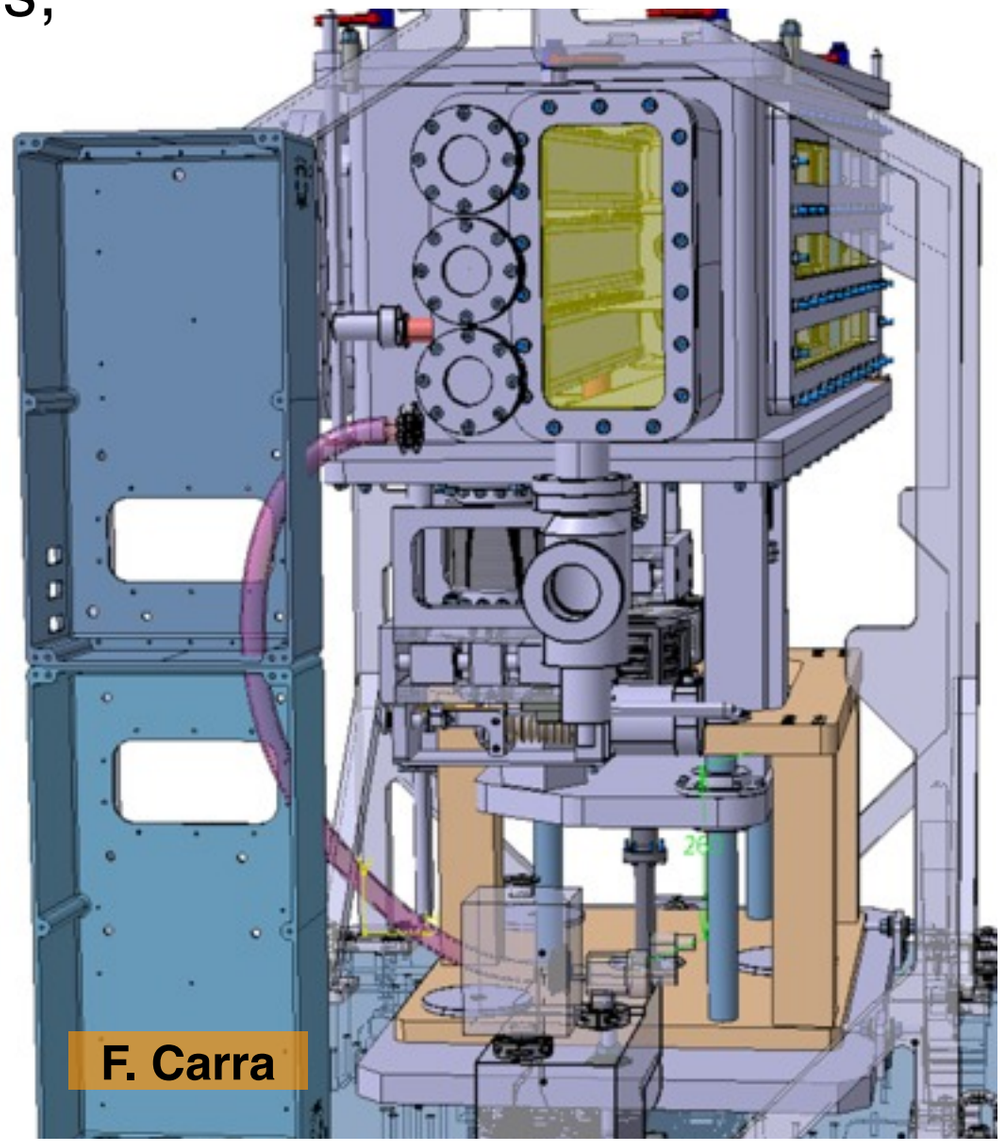
Machine protection and Inj&Dump

Joint session between WP5, WP7 (Machine Protection) and WP14 (Inj&Dump)

- ☑ Overview of the planned works for the injection areas for deployment in LS2:
  - New TDI;
  - On-going studies on needs of TCLIs upgrades;
  - Need of upgraded D2 masks (TCDD).
- ☑ Discussed important synergies for material beam test plans at HiRadMat.
- ☑ Focus of machine protection studies:
  - Availability!
  - Updates of quench and damage limits.
  - Validation of ATS optics.



J. Uythoven, A. Lechner



HiRadMat tests for HL secondary collimators: prepare one prototype for 2015! A. Bertarelli

See also talk by D. Wollman

Status of US-LARP collimation works

Scope: **Rotatable design** (SLAC), **hollow e-lens** (FNAL), **material irradiation** (BNL)

- ☑ SLAC **RC collimator** delivered to CERN 1 year ago. Test campaign at CERN showed that the prototype is acceptable for installation in the SPS.

  *Proposed to **test it with beam in the SPS** in 2015 before carrying out destructive tests at HiRadMat.*

- ☑ Study of **collimator material irradiation** at BNL now continues under the umbrella of a direct collaboration with CERN.

  *Proceeding **very well**: irradiation phase COMPLETED in 2014, now entering the sample analysis phase!*

- ☑ **Hollow e-lens** studies at FNAL

  Continued progress in the conceptual design and simulations;
  We continue to rely on FNAL for simulation support;
  Soon a student will start at CERN, in collaboration with G. Stancari.

- ☑ Recent proposal under discussion to **get the Tevatron TEL2 at CERN** and setup an hollow and Gaussian electron beam tests stand (H. Schmikler et al.).

  Synergies: collimation, BBLR compensation, e-beam monitoring.

We hope that, as the LARP project develops further, the R&D branch maintains a level of support.

T. Markiewicz

Conclusions

- ☑ Good progress of the collimation activities in the last year.
  - → Many thanks to all the contributors for excellent presentations in all sections!
- ☑ Main deliverables of the European programme are under control, but a very significant amount of work is ahead of us.
  - → Finalizing the IR layouts requires still a significant simulations effort;
  - → On going iteration in simulations include cleaning, protection and halo backgrounds;
  - → The proposed conceptual solutions are satisfactory but require more design and integration studies: TCL design, TCT design and integration, ...
- ☑ Other important results on the design and prototyping of new collimators
  - → Launched production of 4 for BBLR compensation studies;
  - → Ready for prototyping phase of new low-impedance collimators;
  - → First good ideas of how the LHC hollow e-lens might look like.
- ☑ Important work ongoing on machine protection and inj&dump fronts
  - → Tight schedule imposed by LS2 deadline for HL deployment of injection upgrade
- ☑ Several upgrades depend critically on the LHC performance at 7 TeV
  - → Important decisions will be finalized after adequate operational experience
  - → We are looking forward to seeing the LHC performance in 2015.

Annual meeting highlights

Tom pointed out that someone was doing even better...