Wrap-up from WP2

G. Arduini for WP2

Acknowledgments: WP2 Task Leaders and Members, Speakers and Conveners of the WP2 Sessions

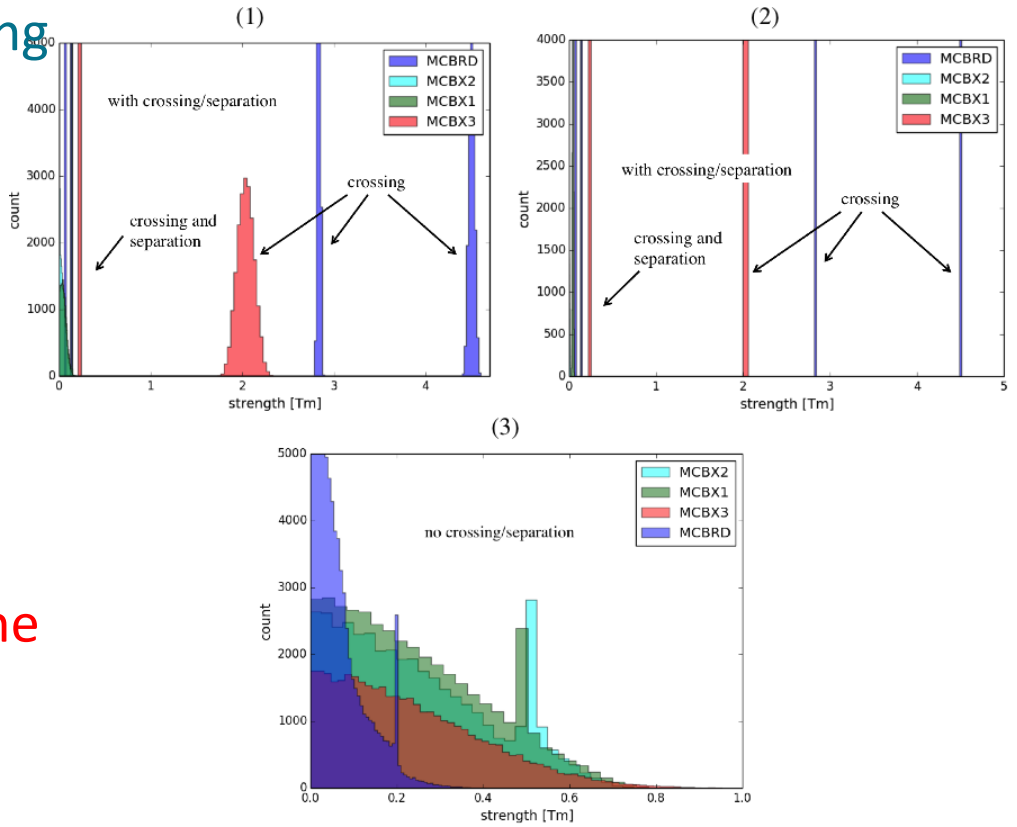
The HiLumi LHC Design Study is included in the High Luminosity LHC project and is partly funded by the European Commission within the Framework Programme 7 Capacities Specific Programme, Grant Agreement 284404

Detailing an operational scenario for the nominal HL-LHC…

- Specifications for the dipole IT/D2/Q4 corrector magnets taking into account their required functionalities and constraints.

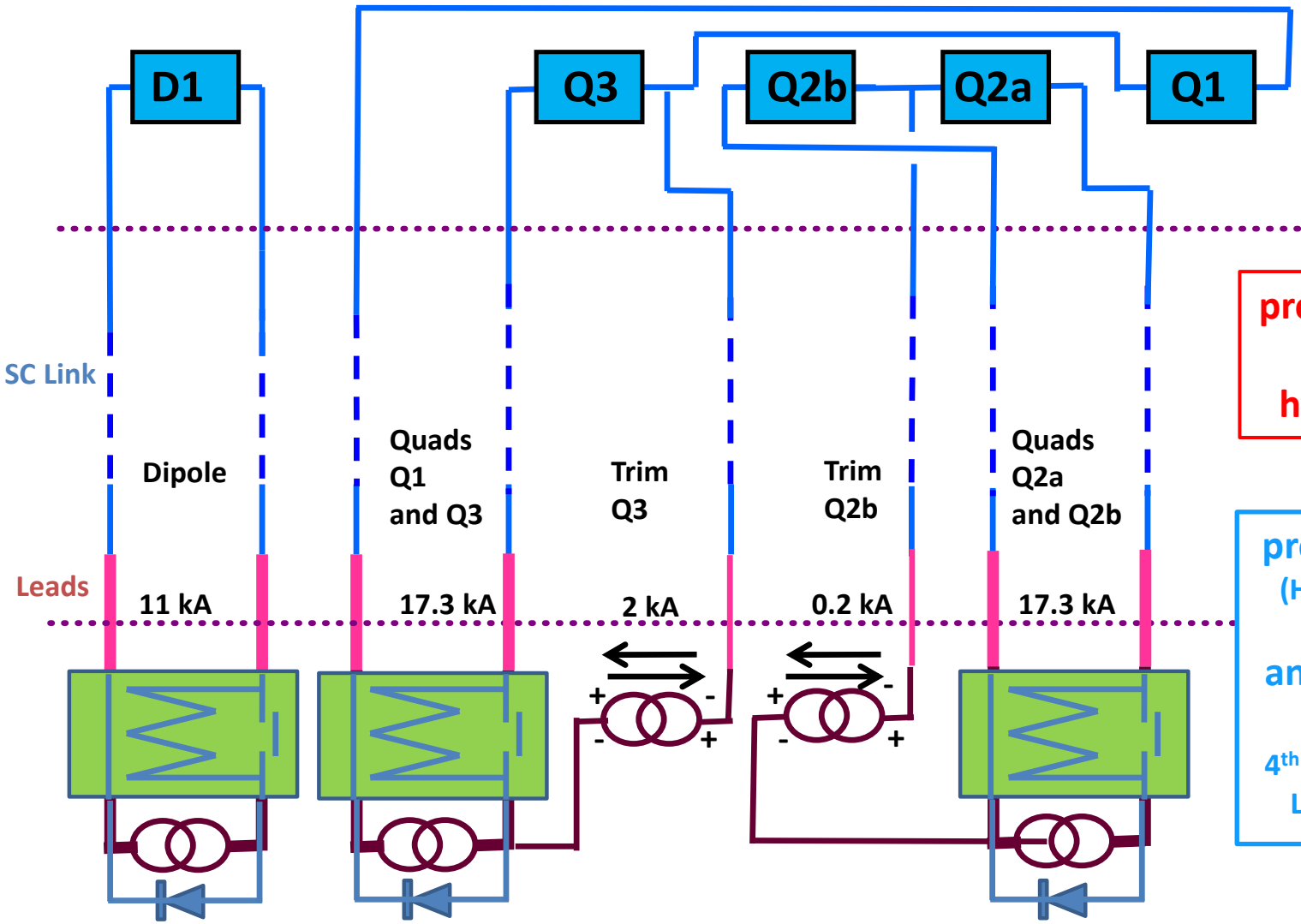
- Requirements could be further relaxed if crab cavities could be remotely aligned on a fill by fill basis. Feasibility should be assessed and weighted against the cost/complexity of high field correctors

M. Fitterer



Realistic assumptions for alignment, transfer function errors, …

Detailing an operational scenario for the nominal HL-LHC…



preferred option from hardware side

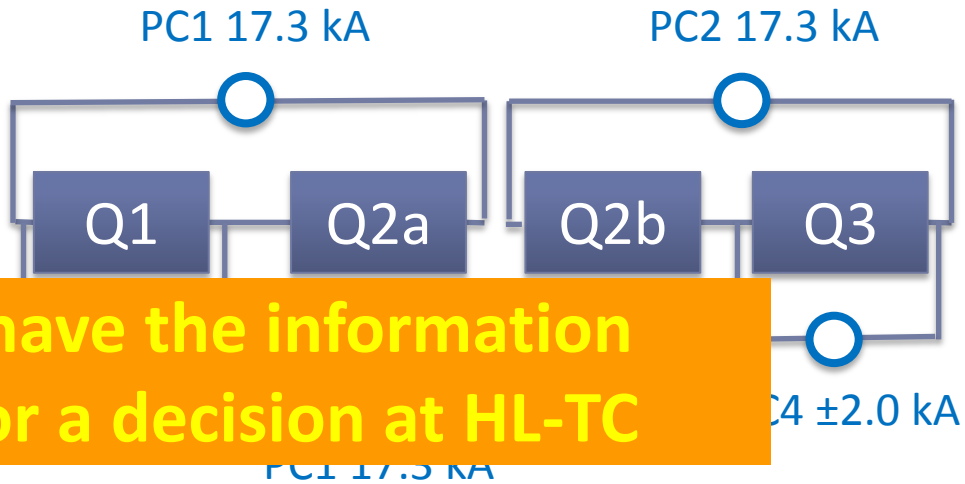
proposed by WP3
(HL-LHC perliminary Design report)
and presented by A. Ballarino,
4th LHC Parameter and Layout Committee

Detailing an operational scenario for the nominal HL-LHC…

In general: tune spread can be reduced by changing the powering of the IT

-> exploit compensation between Q1/3 and Q2a/Q2b

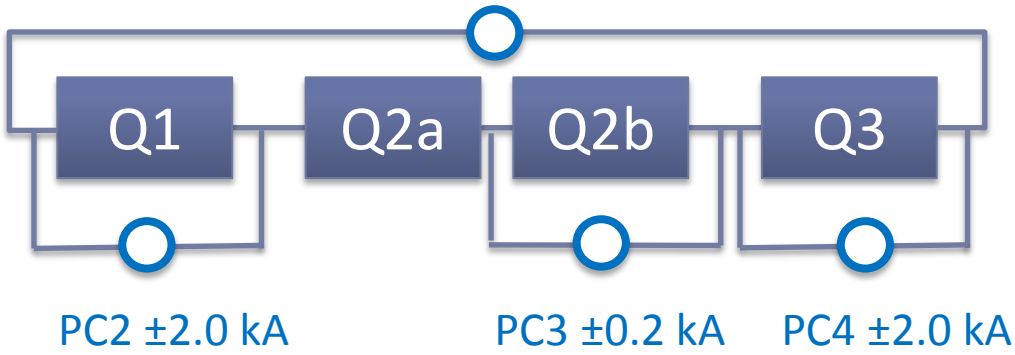
Q1-Q2a Q2b-Q3:
largest reduction of tune spread
-> preferred from beam dynamics side



Propo

We should have the information necessary for a decision at HL-TC

Q1-Q2-Q3 (all in series):
preferred from hardware
side over Q1-Q2a Q2b-Q3

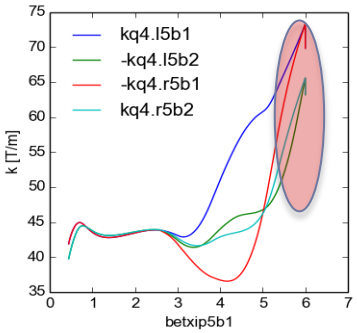


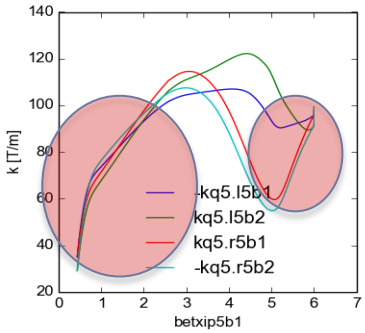
M. Fitterer

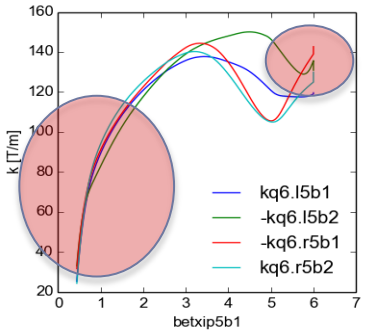
Detailing an operational scenario for the nominal HL-LHC…

- Longer transition from to β*= 6 injection tunes to 44 cm. ATS condition starts from 3 m.
- Further optimizations to smooth the transition are foreseen for HLLHCV1.1.

Time	β*	Slower
0 s	6 m	
68 (241) s	3 m	Q4/Q6
88 (313) s	1.9 m	Q6
150 (490) s	70 cm	Q6
270 (792) s	44 cm	Q6







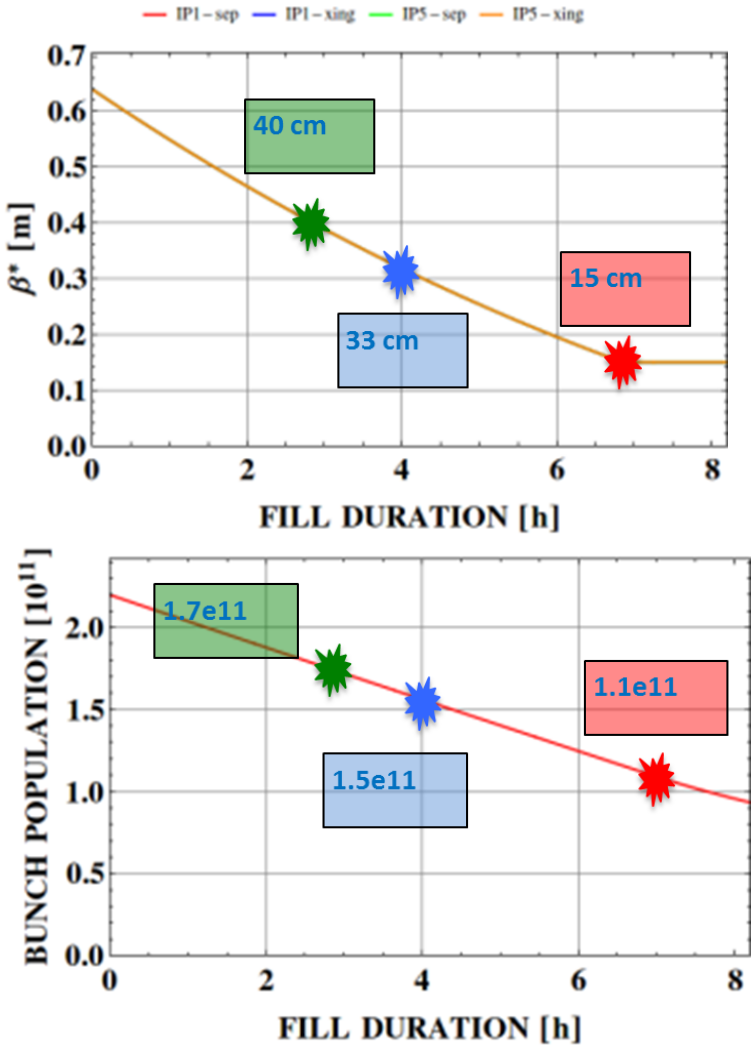
JP Burnet, R. De Maria, M. Giovannozzi, Q. King

270 s reached with bipolar converters in Q5 and the small inductance of MQYY.

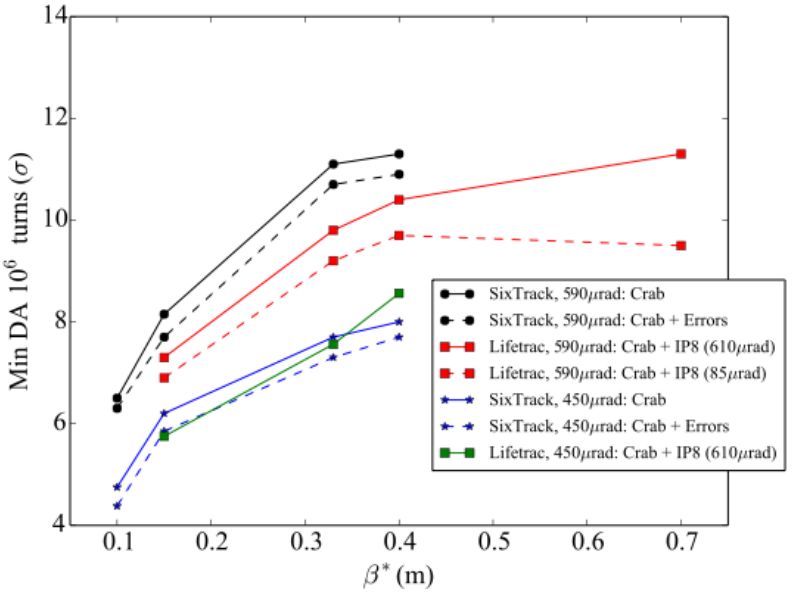
Analysis of the squeeze to be continued:

- QPS limit
- rounding in/out
- Limitations for the ramp down/pre-cycle

Operational scenarios



Viable scenarios for levelling at $5x10^{34}$ cm^{-2} s^{-1} and at $7.5x10^{34}$ cm^{-2} s^{-1} exist

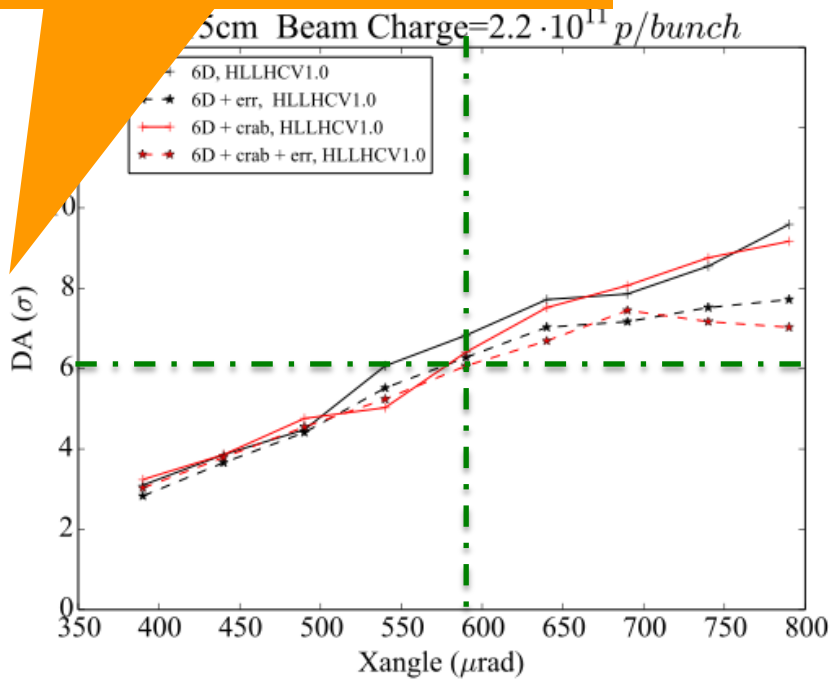


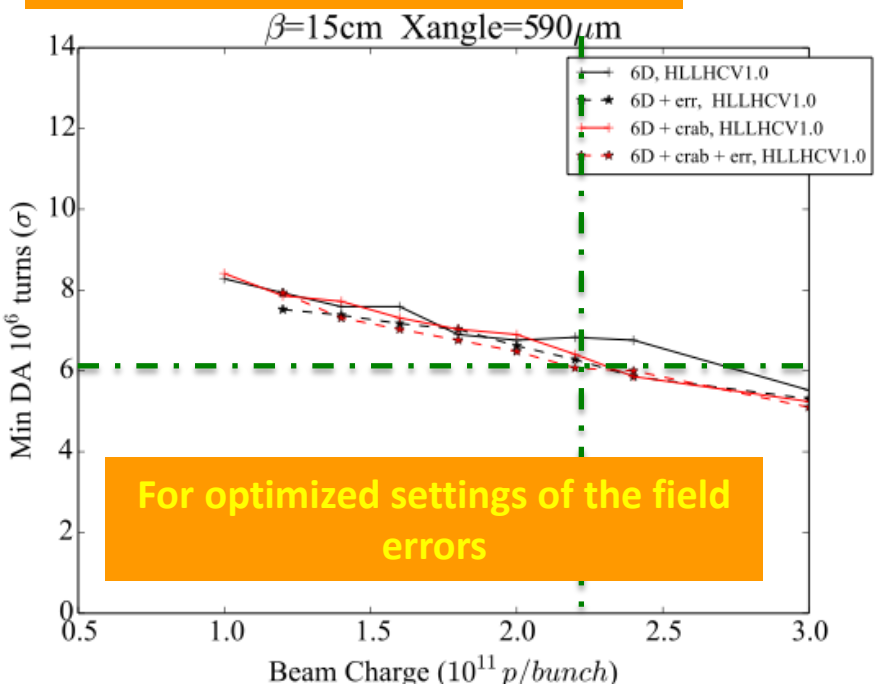
D. Banfi, D. Barranco, T. Pieloni, A. Valishev

Field quality margins?

This is beam sigma (ε=2.5 μm)!

D. Banfi, D. Barranco, T. Pieloni

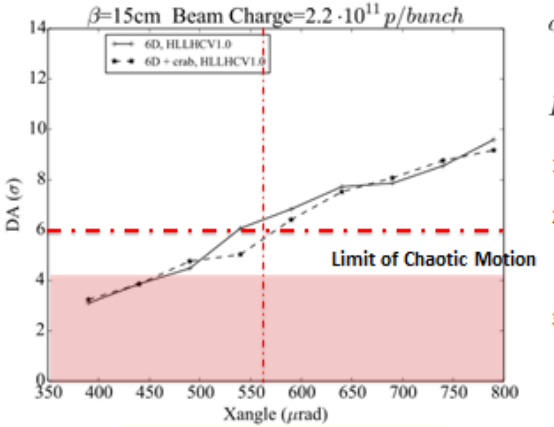




- Multipolar Errors do have an impact at nominal intensity for 15 cm optics.
- Above 600 μrad x-angle multipolar errors not more in shadow of BB
- Evaluating the impact of each multipolar error of the triplet

Field quality margins?

- We have some uncertainties on the predictions of the DA (20-30% from Run I experience)
- We need margins for:
  - N_b and ε variations
  - Chromaticity and octupoles for stability
  - Additional effects are being studied individually (IP2/8, crab cavities) need to minimize and integrate them
  - Note that the possibility for sorting will be very limited

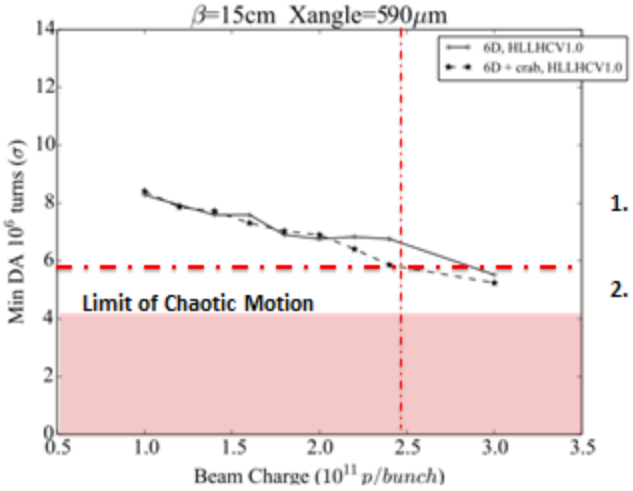


$$d_{sep} = \alpha \cdot \sqrt{\frac{\beta^*}{\epsilon/\gamma}}$$

$$DA \propto d_{sep} \propto \alpha$$

1. 10% larger ε_n (2.5→2.75)
2. Equivalent to reduction of the angle 590μrad→560μrad
3. Equivalent to reduction of DA 1σ

10% increase ε_n reduces DA 6.4 → 5.5 σ



$$F_{bb} \propto Intensity$$

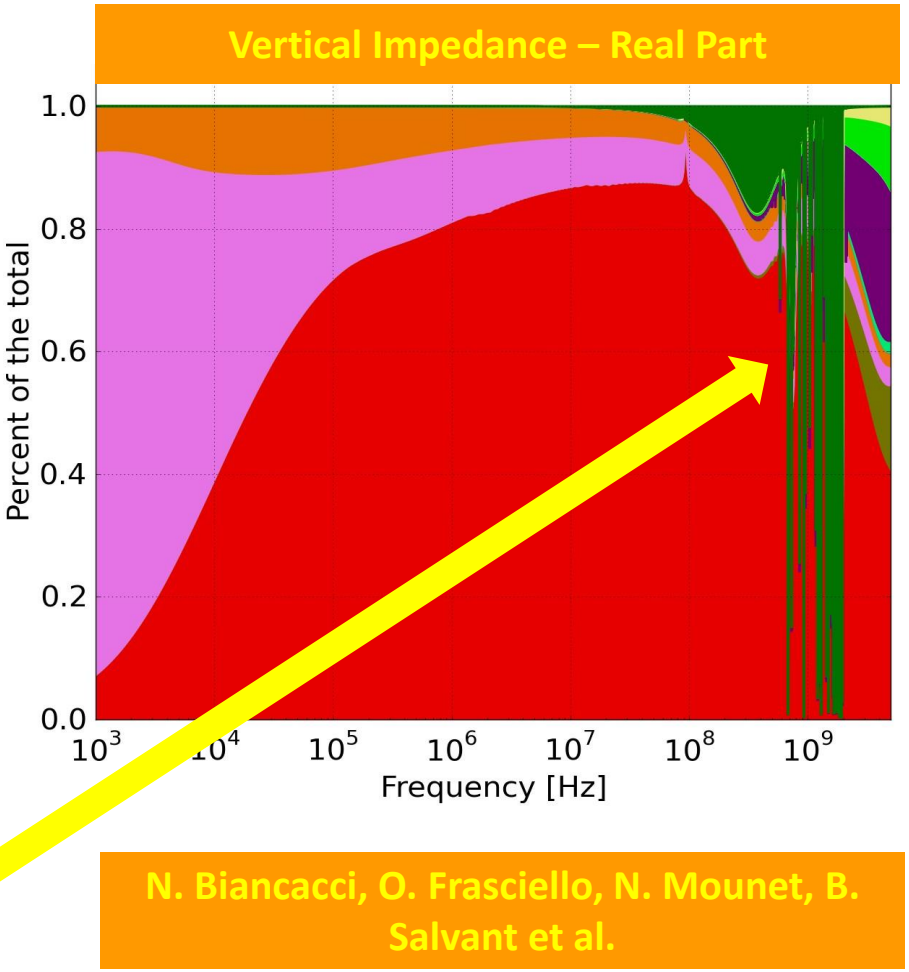
$$DA \propto Intensity$$

1. 10% Intensity increase (2.2→2.4)
2. Equivalent to reduction of DA 0.6 σ

10% Intensity fluctuations reduces DA 6.4 → 5.8 σ

D. Banfi, D. Barranco, T. Pieloni

HL-LHC impedance

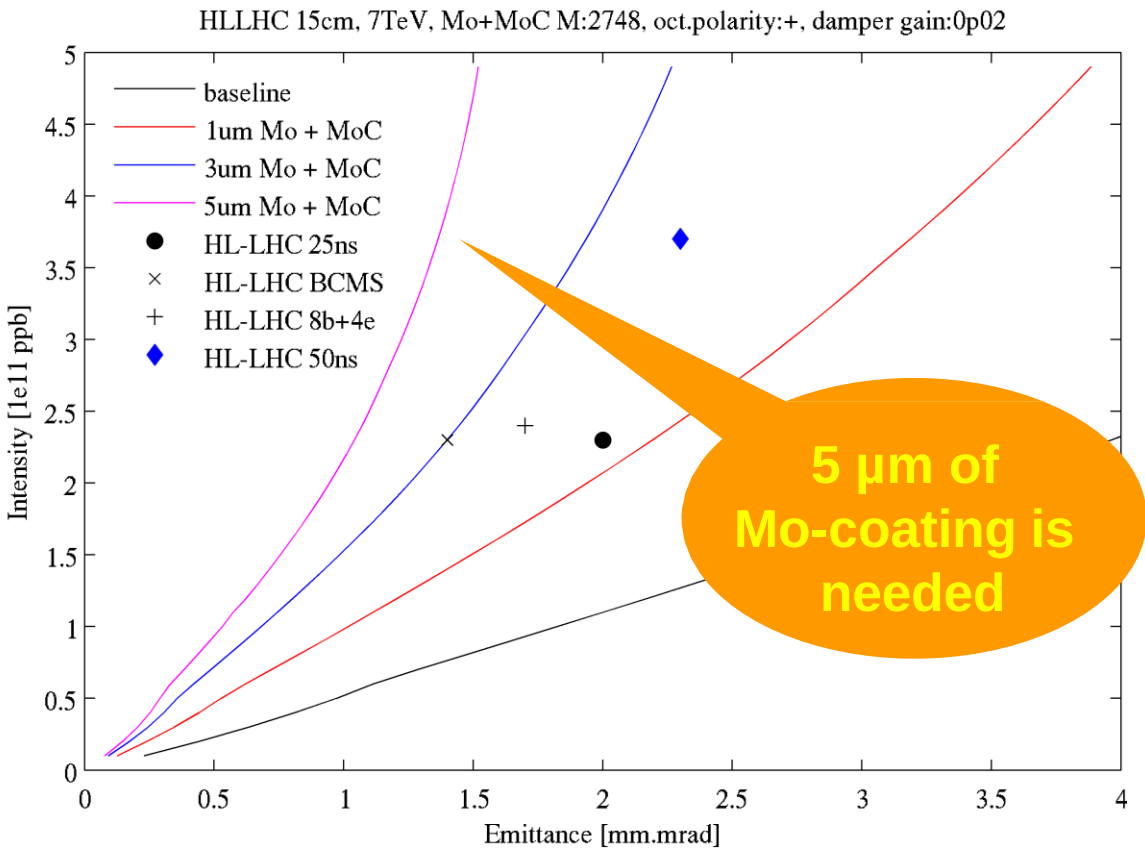


- Progress with the LHC/HL-LHC Impedance model
- Reduced discrepancy model / measurement
- Significant contribution of crab cavities

Beam stability

- We need low impedance collimators:
  - Mo coated – Mo Gr collimators seem to provide the best match resistance to damage/low impedance

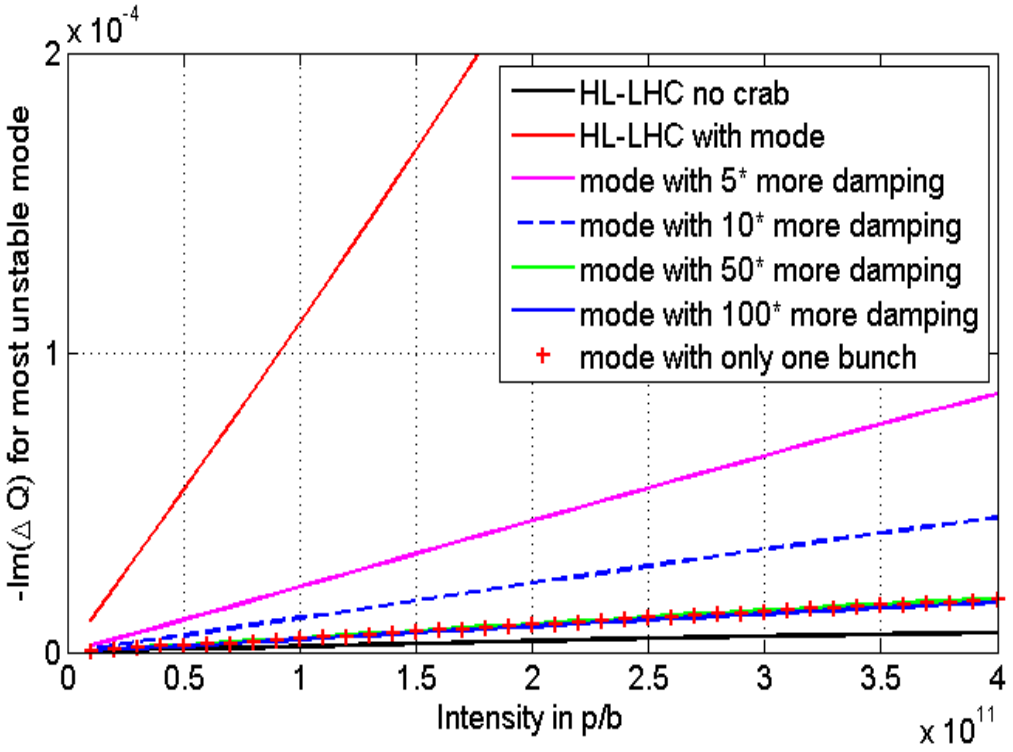
W/o Crab cavities



E. Métral, N. Mounet, F. Carra

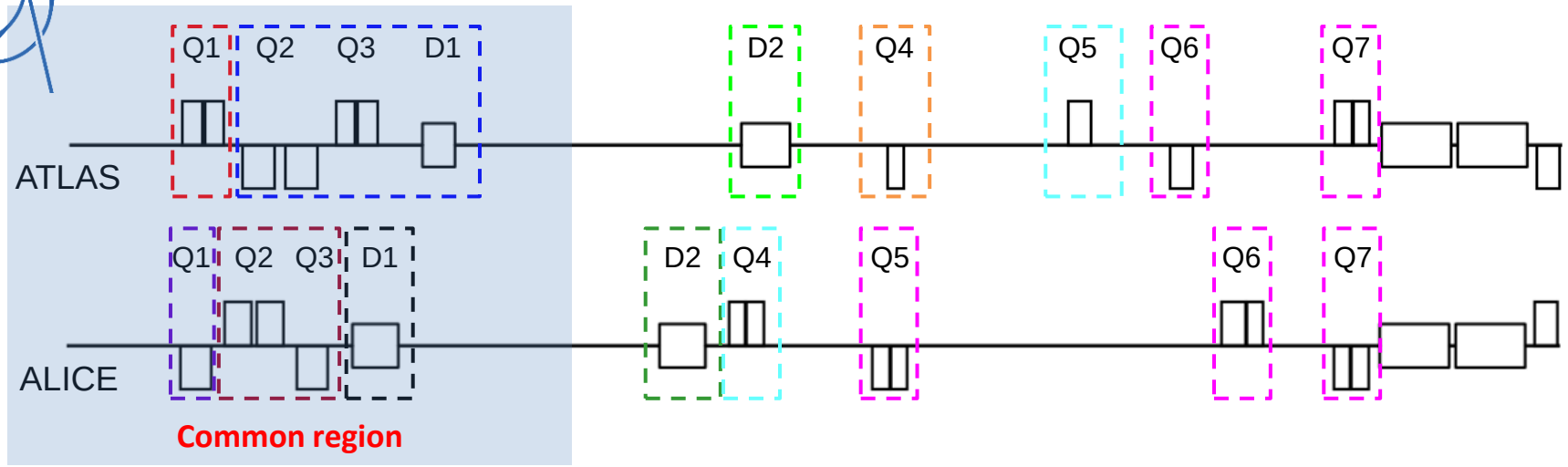
Beam stability

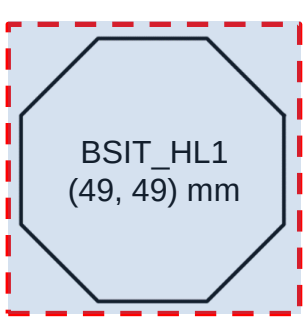
- Crab cavity HOM Impedance is dominates at low β^*
  - ➔ Some HOM modes to be damped.
  - ➔ R/Q must be reduced as well.
- Advantage in reducing the number of cavities if higher voltage per cavity can be achieved
- Need to continue the optimization work in tight collaborations with WP4

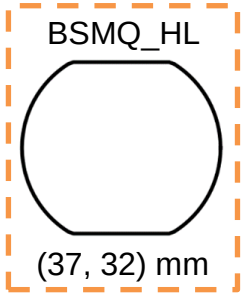


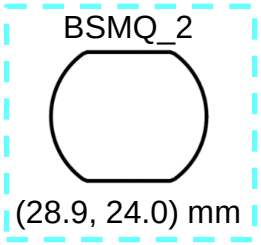
E. Métral, N. Mounet, N. Biancacci, B. Salvant

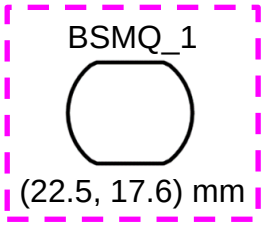
Beam screen geometries in the IRs (HL-LHC)

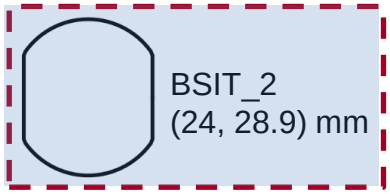


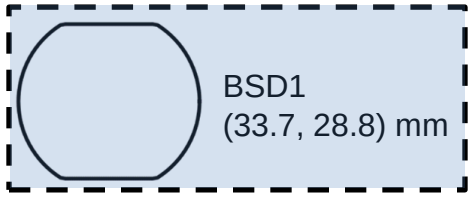


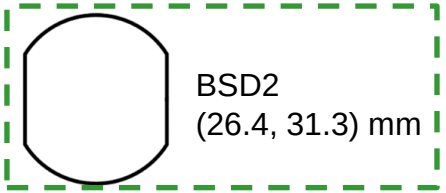










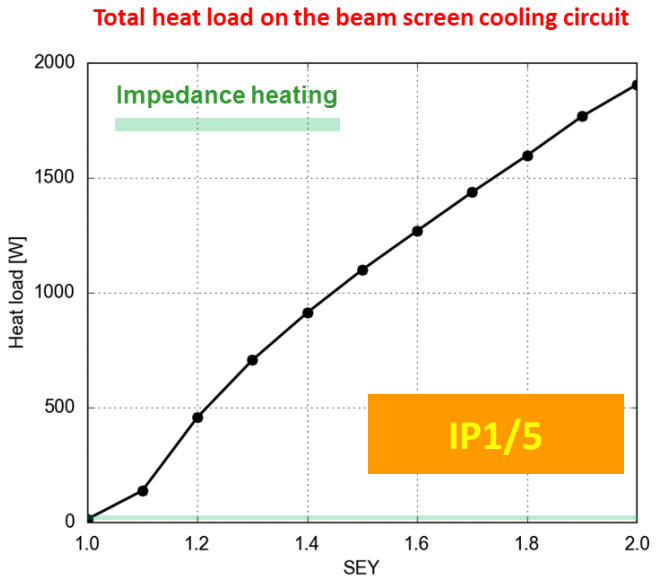


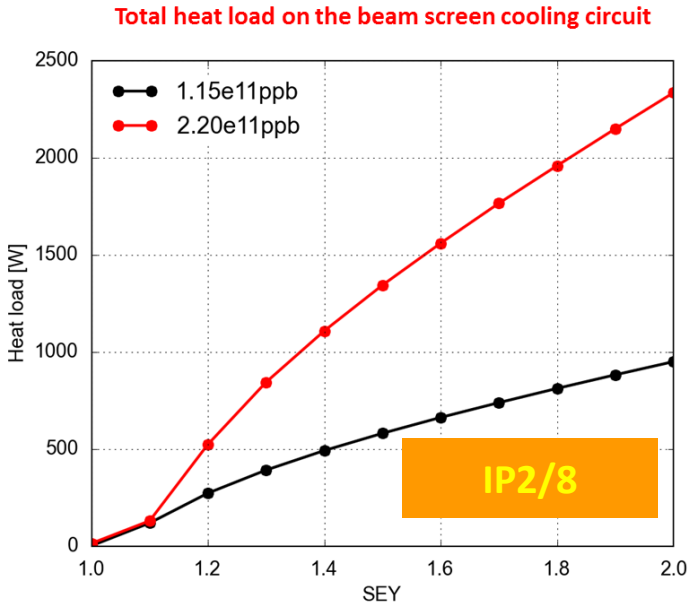
G. Iadarola

Heat loads

- Complete analysis of the zoo of vacuum chambers and magnets in the TAS-Q7 area for heat loads:
  - Electron cloud
  - Image currents
  - Synchrotron Radiation (at first view negligible)
- Confirmed the need for e-cloud suppression measures (coating and possibly clearing electrodes) for the triplets/D1 in IP1/5 and IP2/8

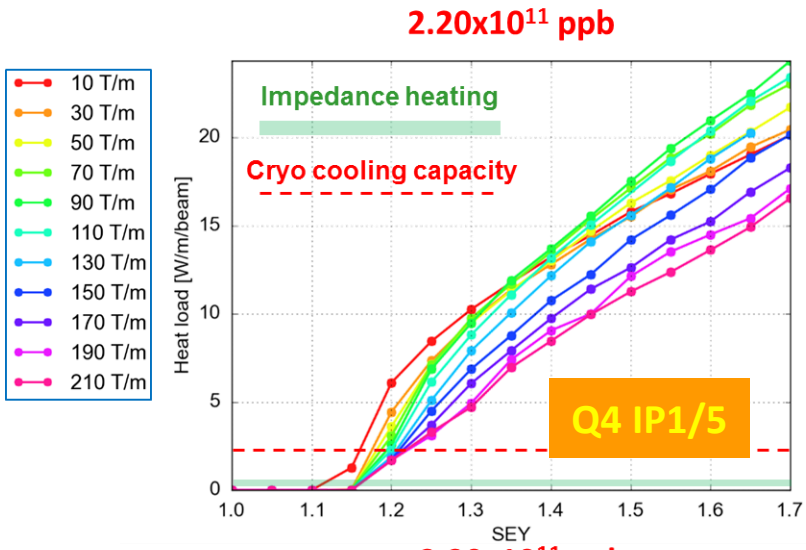
G. Iadarola

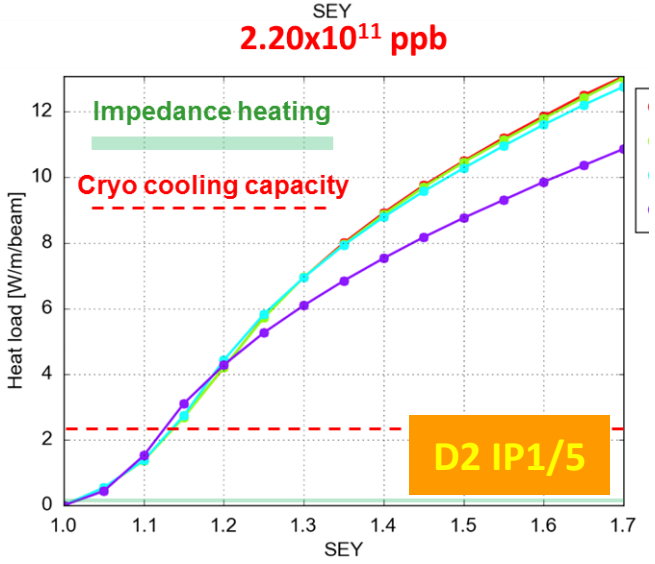




Heat loads

- Matching sections:
  - New Q4/D2 in IP1/5 will require aC coating.
  - Pending the results of the scrubbing run 2015 (i.e. minimum SEY achievable):
    - Proposal for D2 IP2/8 and other Quads of the IP1/5 MS





G. Iadarola

Next step for the layout

- Aiming for a second layout version in the first half of 2015:
  - Need to fix geometry of the triplet area (integration and triplet quadrupole length). Implications:
    - Increased Strength D1/D2 or movement of the matching section
    - Reduction of the β^* reach and possible implications on field quality
  - To be noted:
    - Once we reduce the gradient and increase the length of the quadrupoles to get a constant integrated gradient any gain in gradient performance will not be usable (except as margin for operation to higher energy)
    - The same applies for the space increase.