Impact of collimator geometric impedance on tuneshift measurements - the case of **TCP.C6L7.B1**

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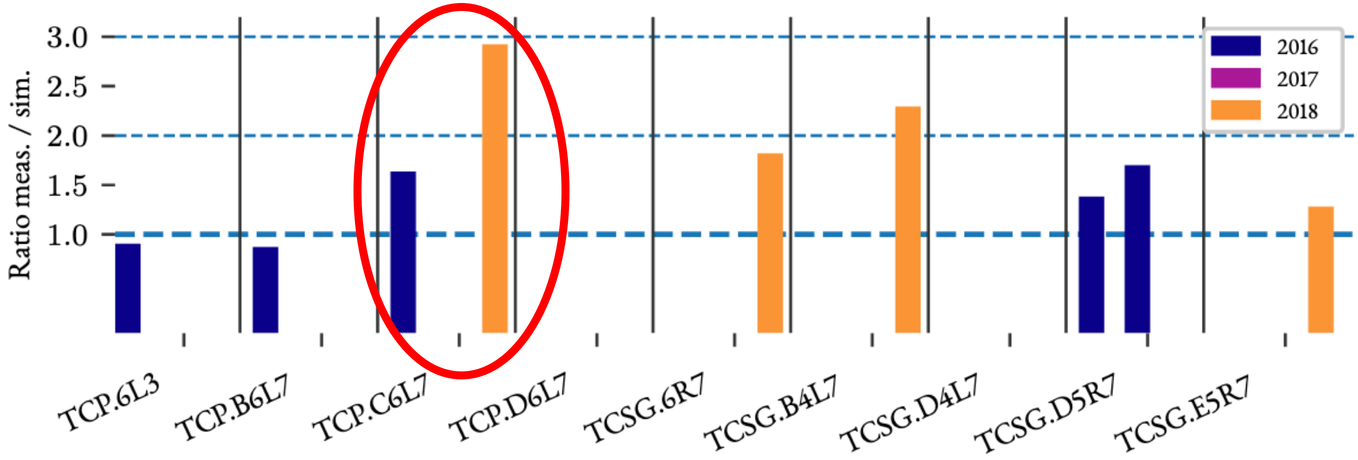
Acknowledgements: S. Antipov, G. Arduini, R. Bruce, X. Buffat, F. Carra, L. Gentini, A. Mereghetti, E. Métral, S. Redaelli, B. Salvant.

The issue

- The discrepancy between model and tuneshift measurement for the horizontal, primary collimator TCP.C6L7 in beam 1, seems to have doubled between 2016 and 2018:



(a) Ratios B1H

From ***D. Amorim*** PhD Thesis, CERN-THESIS-2019-272.

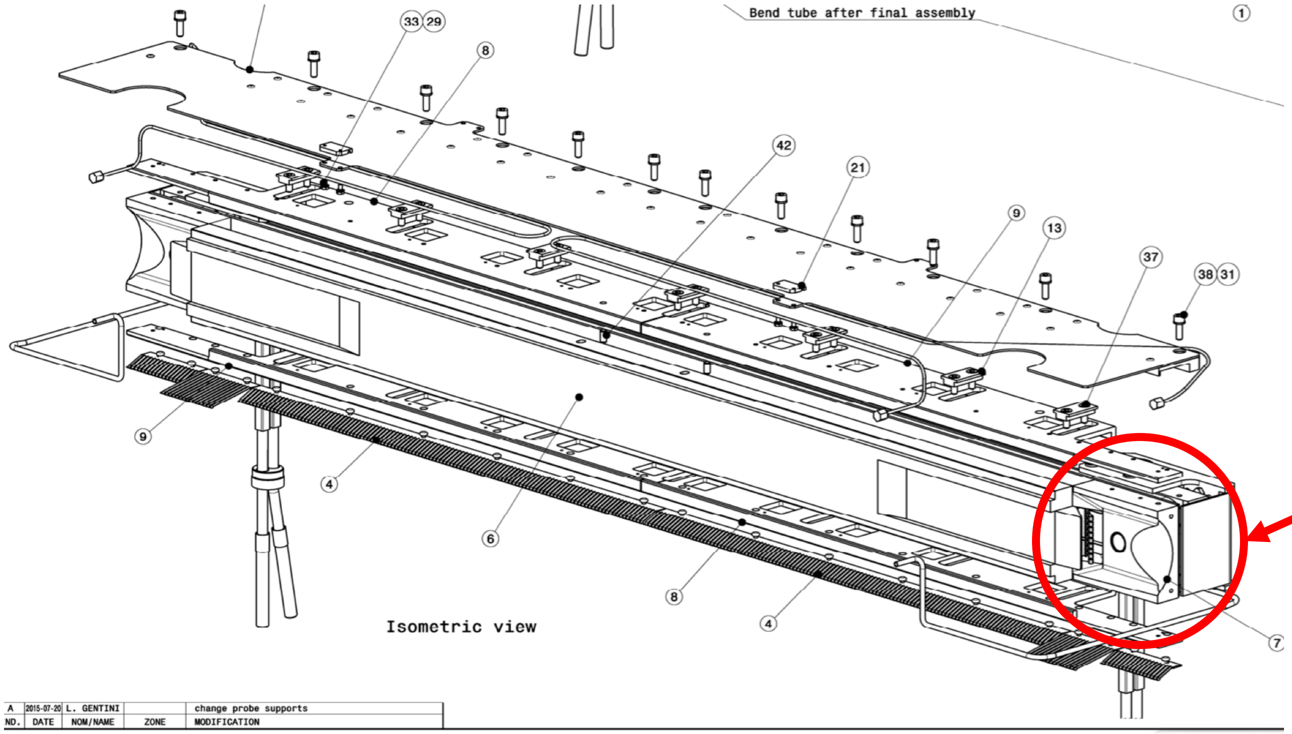
Summary presented by ***X. Buffat*** at 170th WP2 meeting, 10/03/2020

- During the WP2 meeting, ***R. Bruce*** mentioned that "the TCP.C6L7.B1 collimator was changed in the 2016-17 EYETS, when a new collimator with BPM buttons was installed. The hardware used in the measurements was thus not the same."

$\Longrightarrow$ **what is the (theoretical) impact of this change of hardware?**

Design of TCP.C6L7 after 2016-2017 EYETS

➢ From ***L. Gentini / F. Carra / S. Redaelli*** : this is a specific design, "**TCPP**"



From **LHCTCPP_0003** drawing

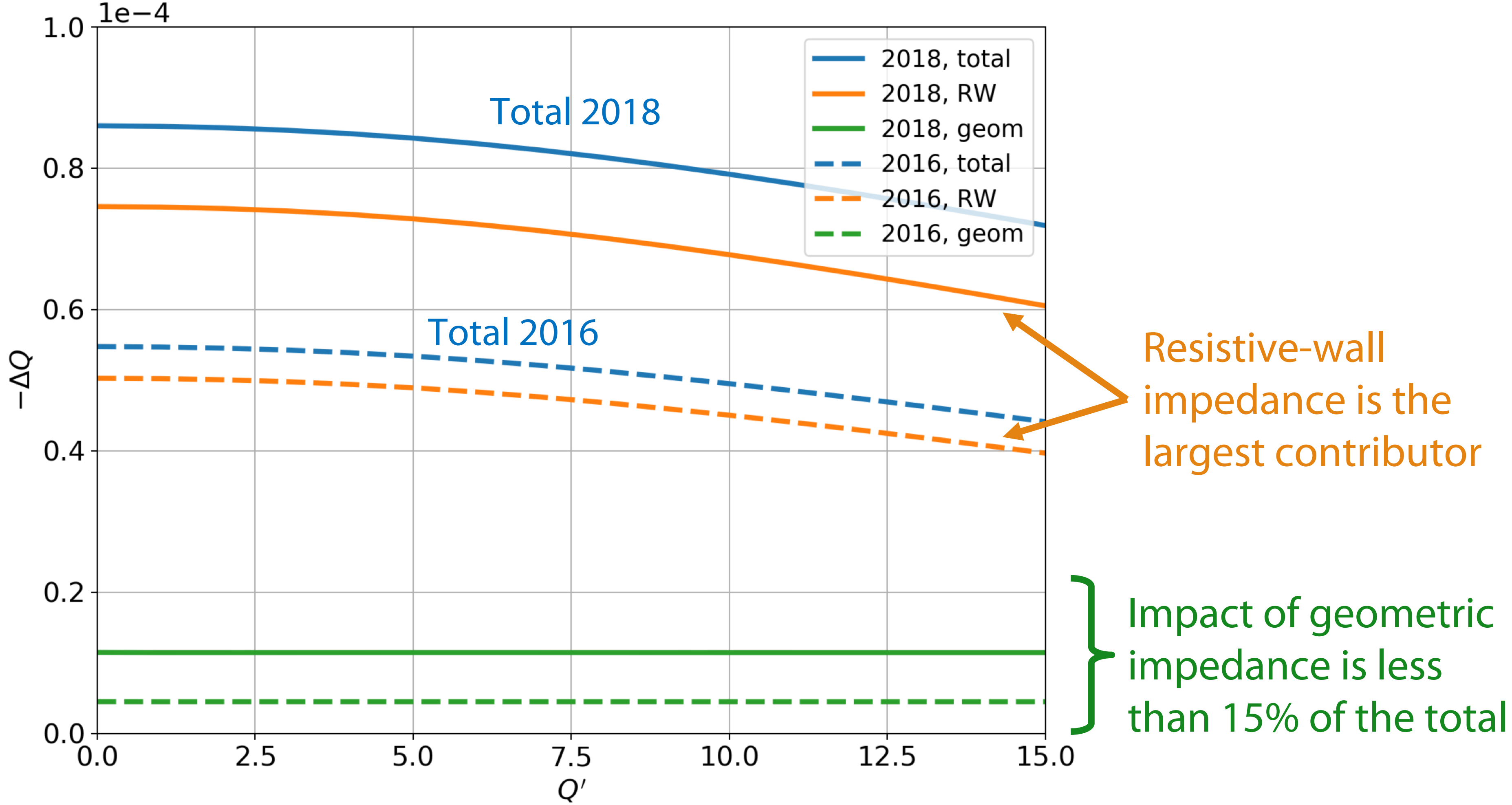
BPM button with taper

⟹ same BPM button design as TCSP…

… but it has RF-fingers instead of ferrite ⟶ no high order mode at ~100 MHz (the so-called "TCTP mode").

Impact of geometric impedance

- Using Sacherer formula, and equalizing some of the 2016 and 2018 parameters (1ns, 1e11 p+/b): **horizontal tune shift**



Conclusion

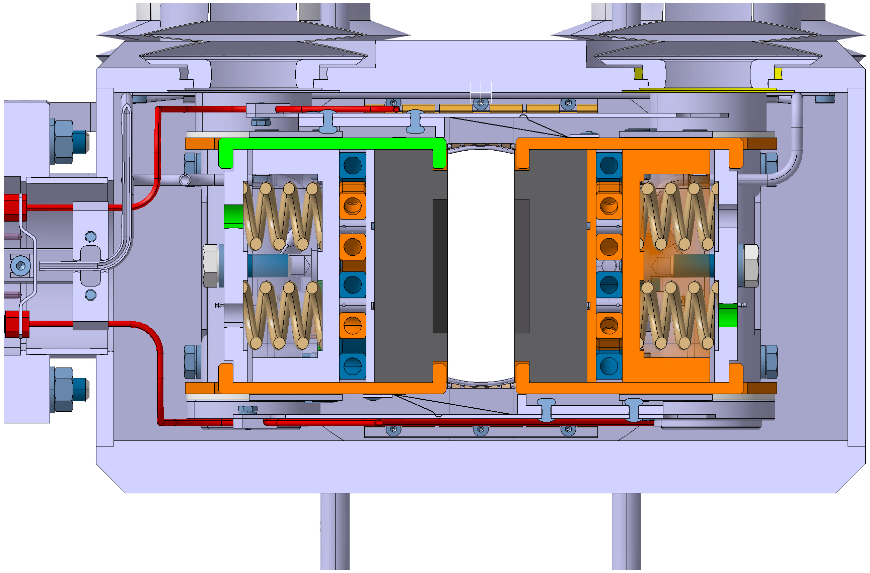
- The change of design has indeed increased the geometric impedance (essentially from tapers).

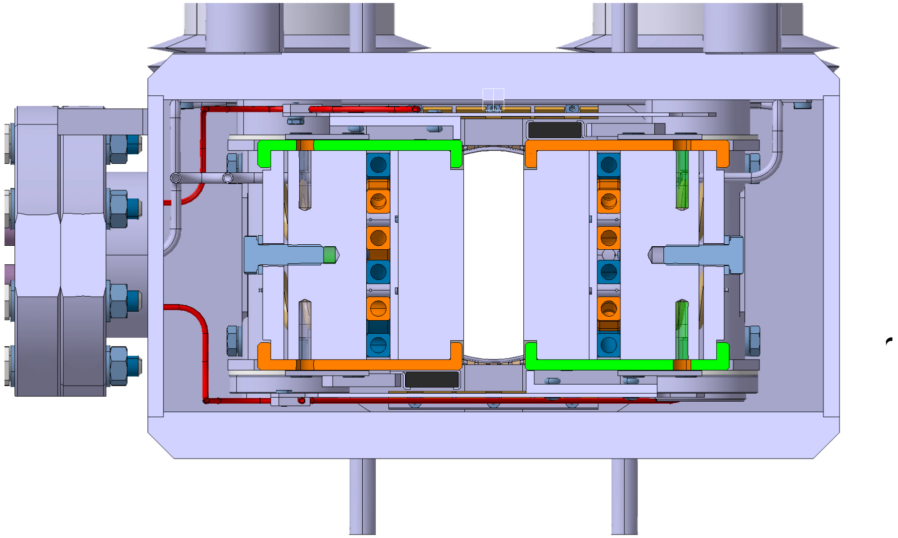
- But it cannot explain the increase of discrepancy with the impedance model as even with the new design, the impedance is largely dominated by the resistive-wall contribution (>85%).

Appendix

TCPP vs. TCSP design – RF fingers

➢ From ***L. Gentini***:

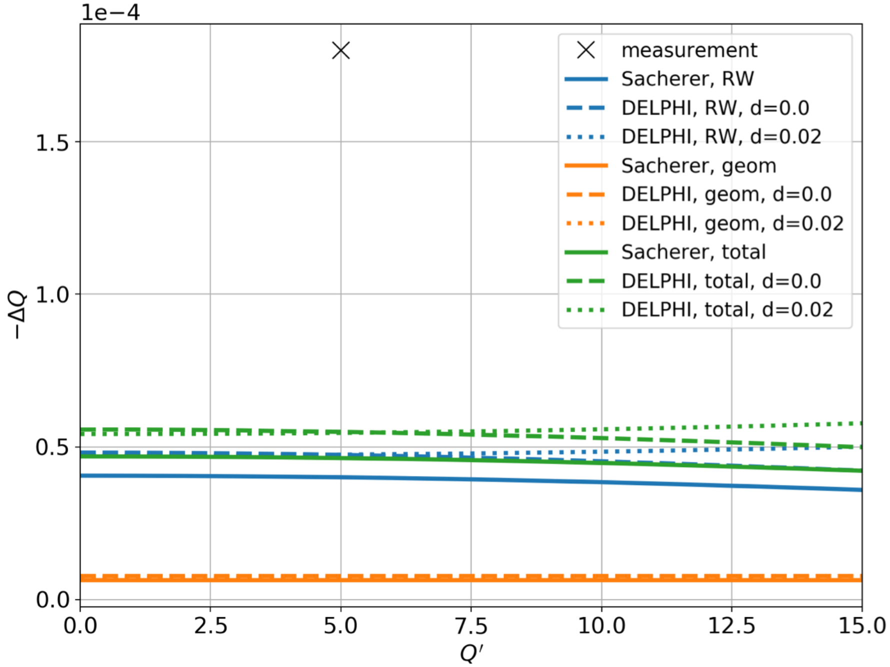




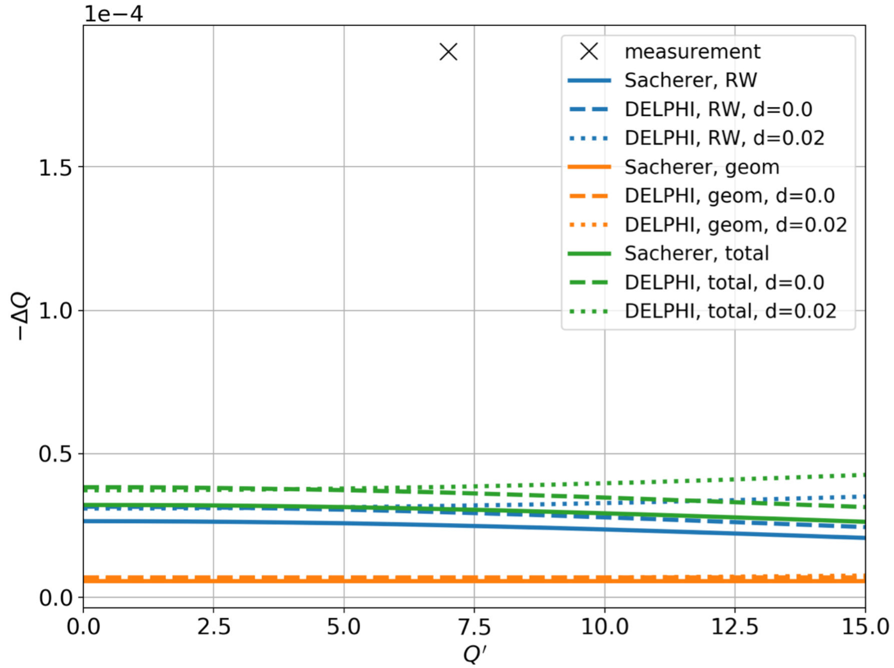
Comparison DELPHI / Sacherer - dipolar

➢ With the MD parameters (still rescaled to 1e11 p+/b):

2016 MD, new, Nb=0.7×10^{11} p+/b (rescaled to 10^{11} p+/b), taub=0.7 ns, dip only



2018 MD, new, Nb=1.3×10^{11} p+/b (rescaled to 10^{11} p+/b), taub=1.1 ns, dip only

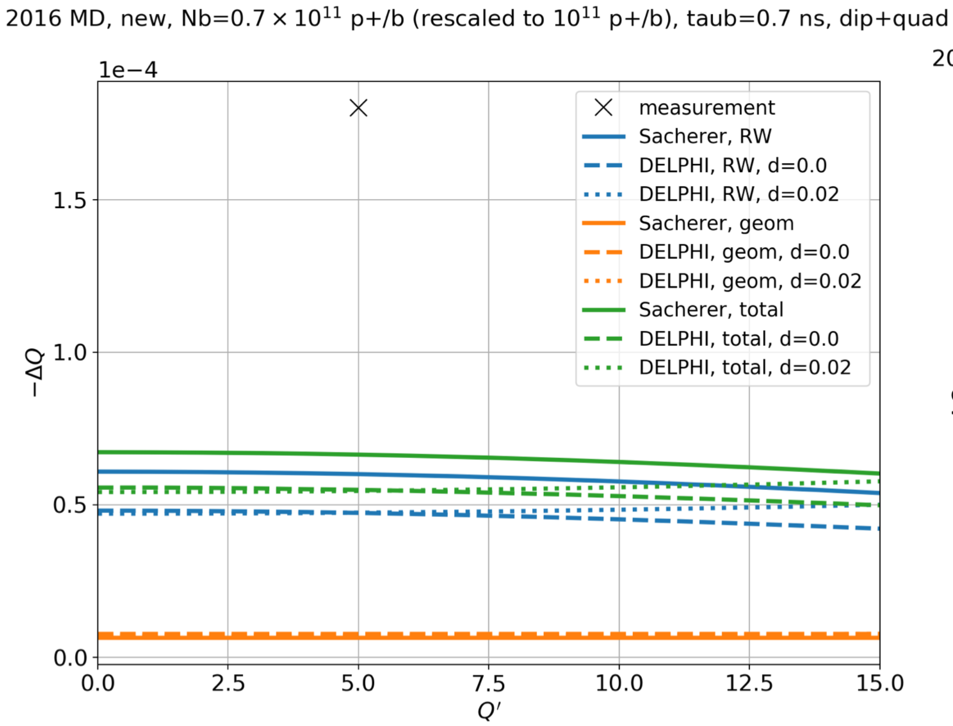


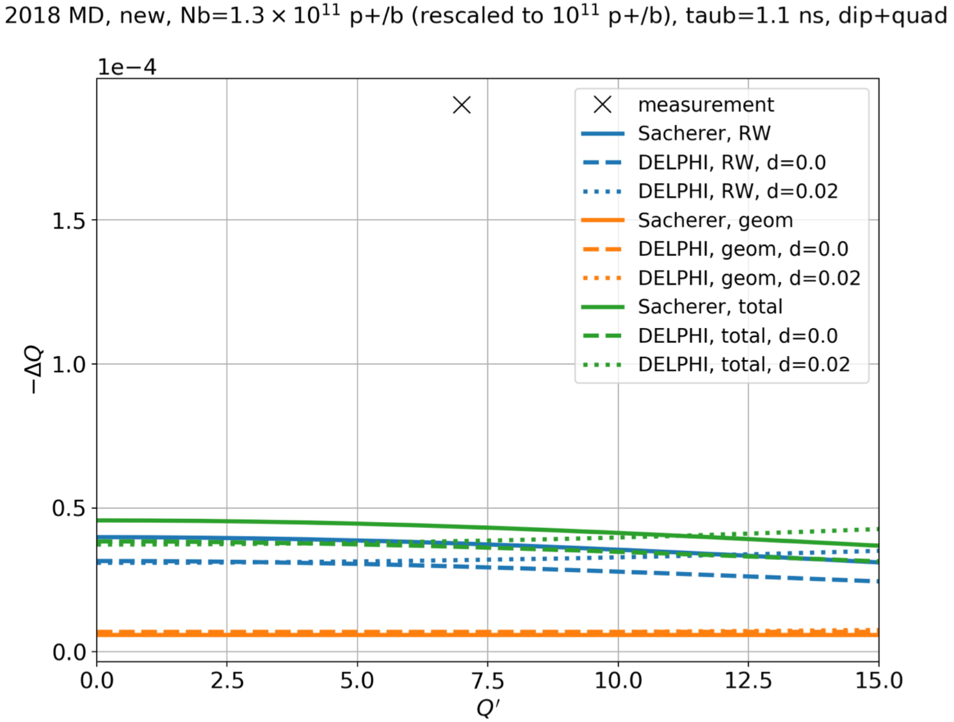
➢ DELPHI tuneshift almost independent of damper gain at low chromaticities.

➢ DELPHI and Sacherer relatively close (DELPHI slightly higher).

Comparison DELPHI / Sacherer – dip+quad

- With the MD parameters (still rescaled to 1e11 p+/b):

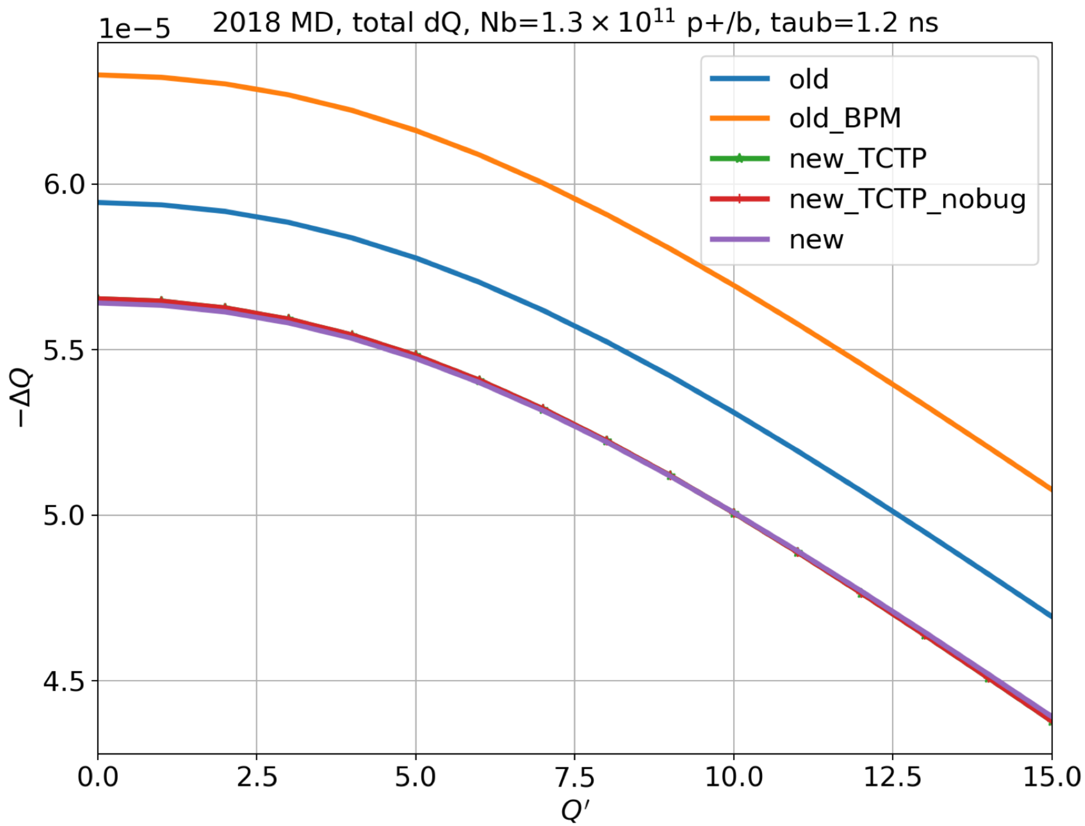




- Now DELPHI is slightly lower than Sacherer.

Different versions of the model – dip+quad

- With the 2018 MD parameters, with various version of the imp. model:



- TCTP mode could have been included in an old version of the model (with or without a bug on the frequency sampling).
- "old_BPM" is the old implementation of the BPM button taper.
- "old" is the old model without any BPM button.

- The TCTP mode (if included) could not explain the higher discrepancy.
- The new taper implementation has actually a lower impedance than the old one ⟶ this also cannot explain the higher discrepancy.