SPS de-bunching simulated with Headtail

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Where are we now?

Some observational facts…

De-bunching of 25 ns long bunches:

Presence of an unknown 1.4 GHz impedance and its “sidebands”

Bunch length vs intensity on flat top for bunched beam:

Strong bunch lengthening effect, which cannot be explained by potential-well distortion alone; *microwave instability?*

Instability thresholds don’t scale as expected with energy:

Microwave instability at flat top could perhaps explain this…

SPS impedance model (1)

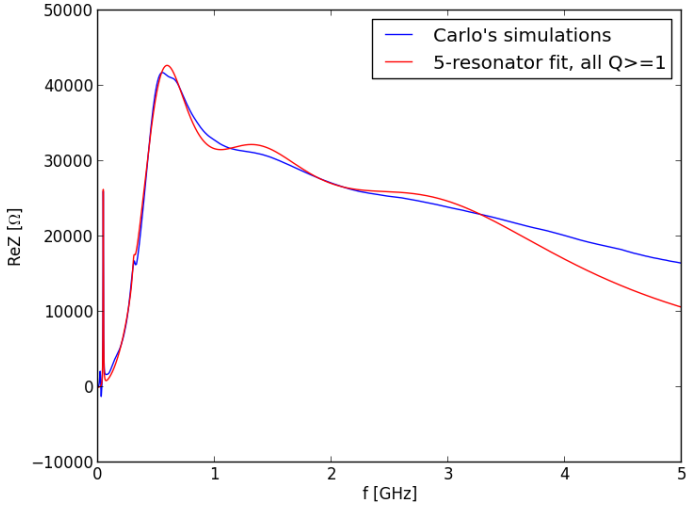
5 cavity contributions

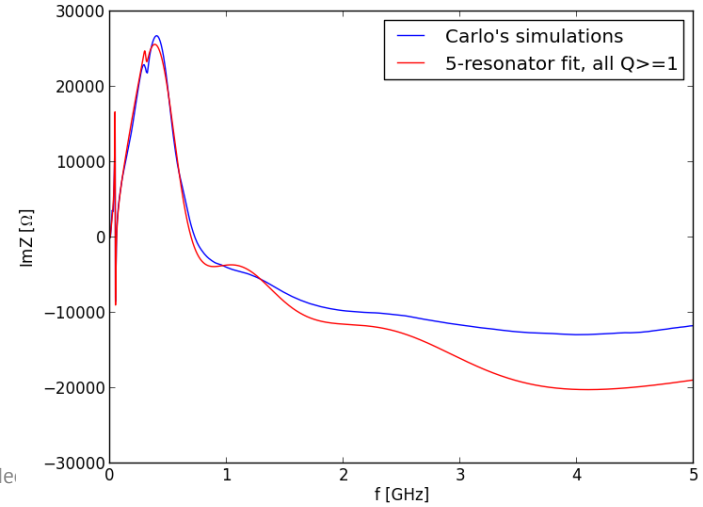
fr (MHz)	Rsh (MOhm)	Q	R/Q (kOhm)
200.222	2.86	150	19.07
200.222	1.84	120	15.33
629	0.388	500	0.78
800.888	1.94	300	6.47
1400	*unknown*	*unknown*	*unknown*

SPS impedance model (2)

5 kicker contributions

fr (MHz)	Rsh (MOhm)	Q	R/Q (kOhm)
44	0.026	11	2.36
305	0.0025	12	0.21
570	0.038	1	38.00
1400	0.02	1	20.00
3000	0.018	1	18.00



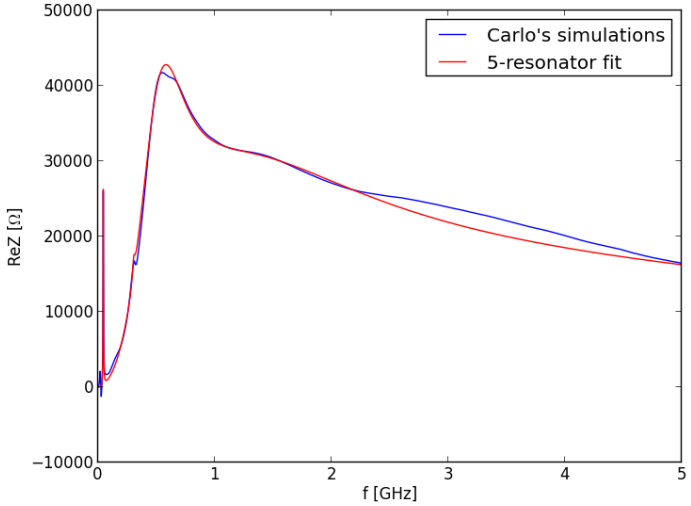


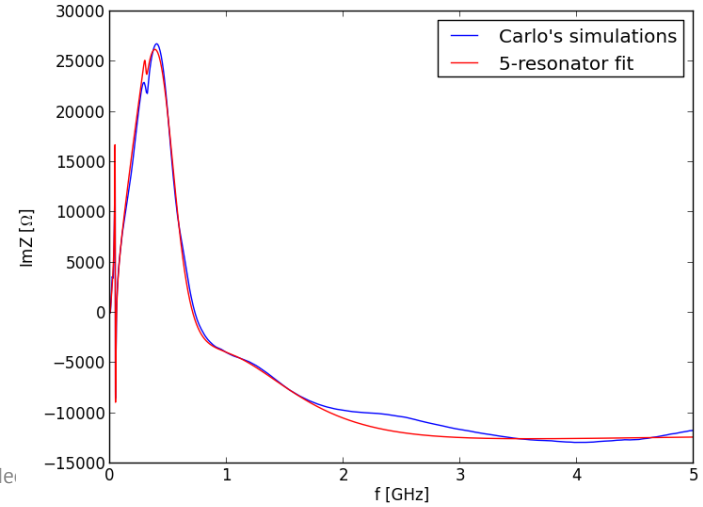
A more "perfect" fit to kicker data (not used in simulations)

5 kicker contributions

fr (MHz)	Rsh (MOhm)	Q	R/Q (kOhm)
44	0.026	11	2.36
305	0.0025	12	0.21
550	0.032	1.1	29.09
1400	0.014	0.6	23.33
3000	0.014	0.25	56.00

N.B. the over-damped 3 GHz resonator…



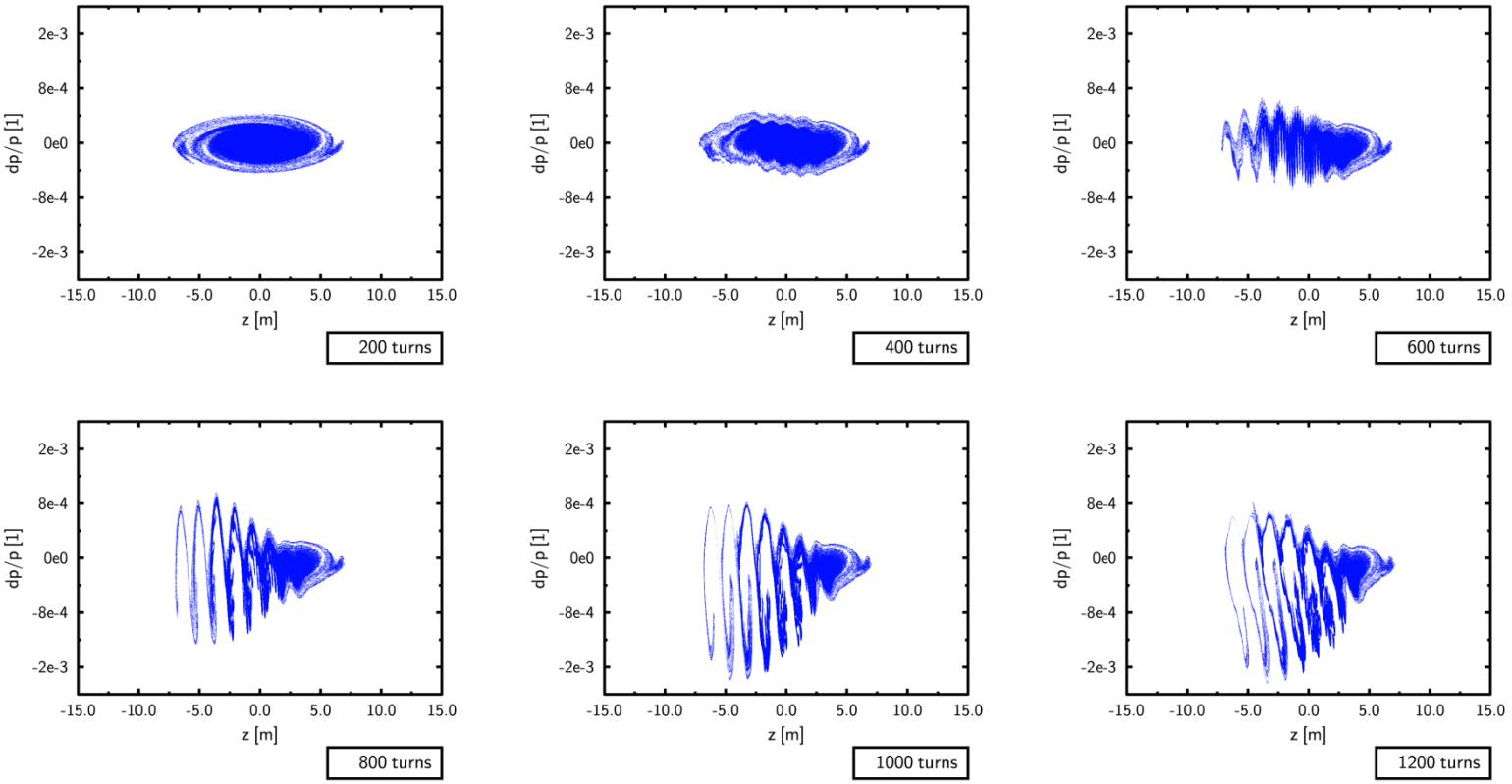


SPS impedance model (3)

9 BPM + 1 Zs contribution

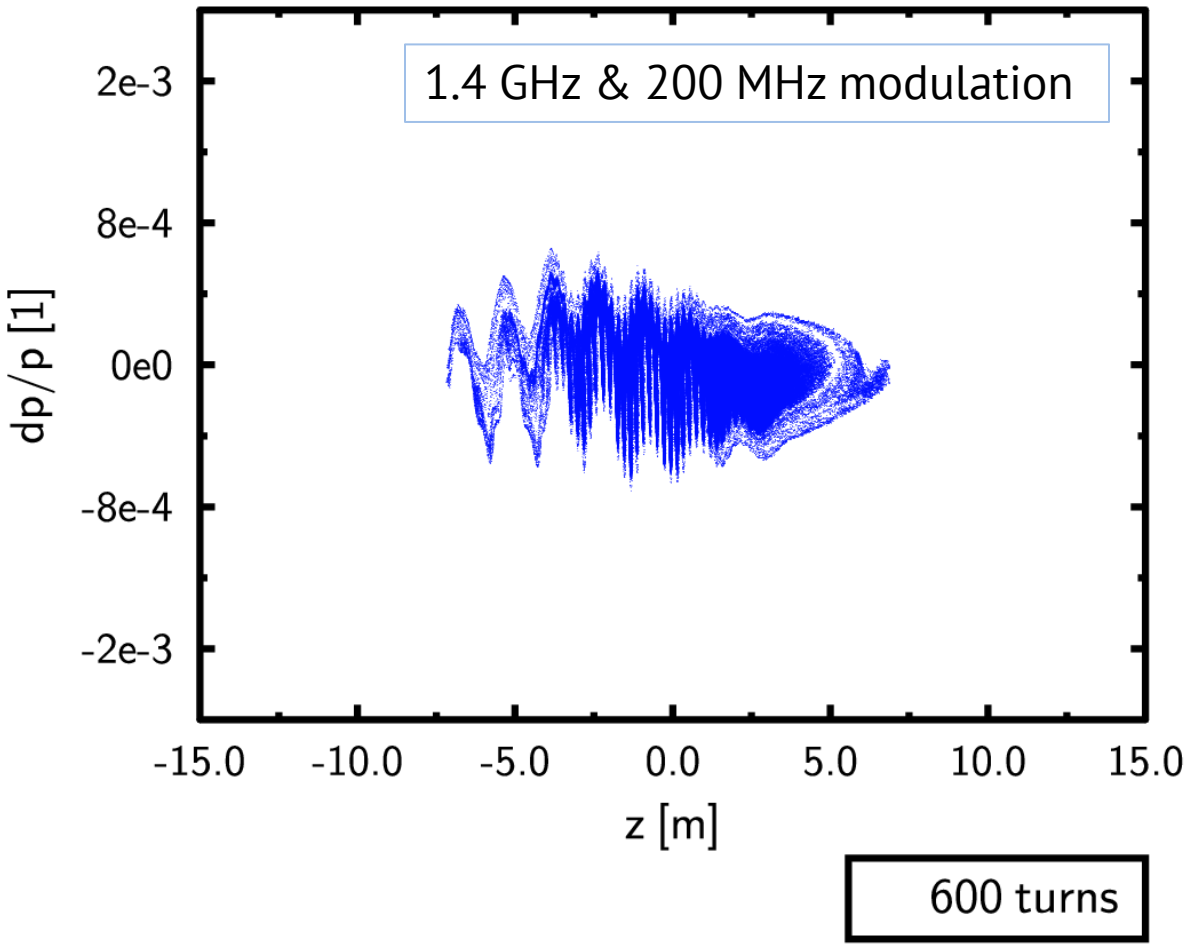
fr (MHz)	Rsh (MOhm)	Q	R/Q (kOhm)
265	0.187	260	0.72
295	0.162	240	0.68
890	0.069	490	0.14
1055	0.7	770	0.91
1080	0.205	660	0.31
1200	0.026	620	0.04
1600	1.28	680	1.88
1860	0.59	900	0.66
1960	0.144	2000	0.07
(Zs) 1180	6.6	14000	0.47

De-bunching of “long” bunches



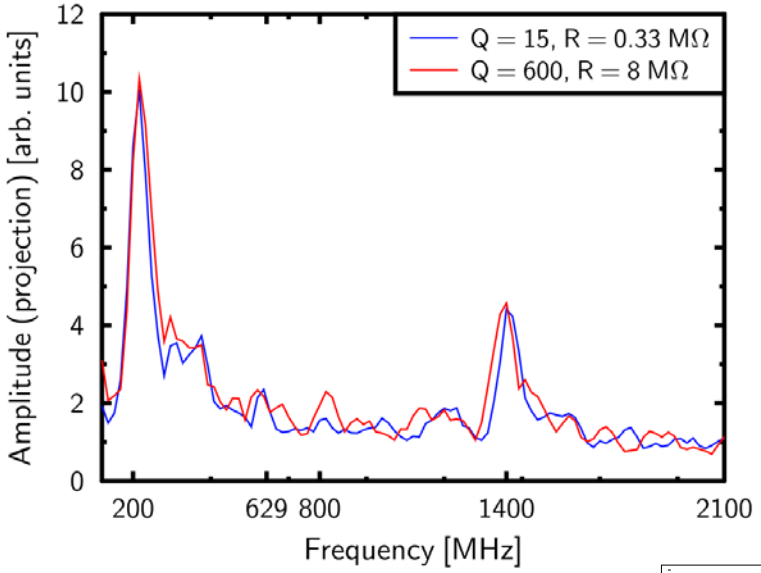
Thanks for Headtail debugging to K. Li, N. Mounet, and G. Rumolo

De-bunching of “long” bunches

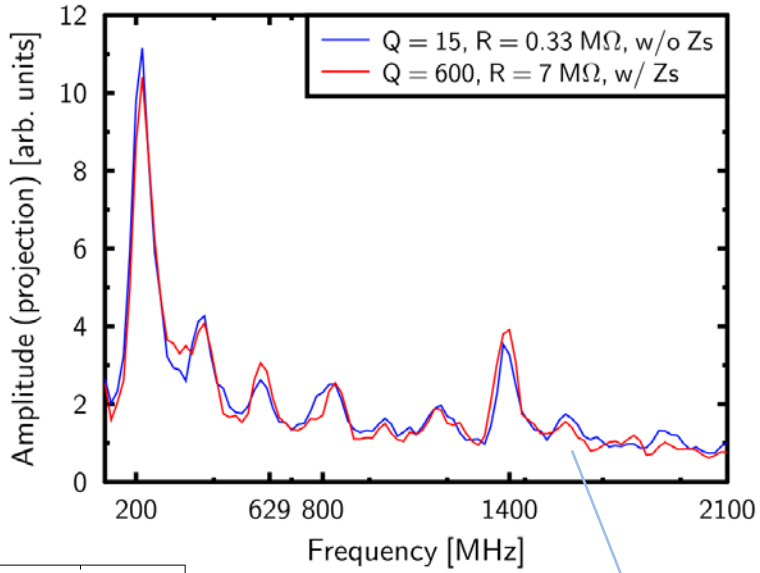


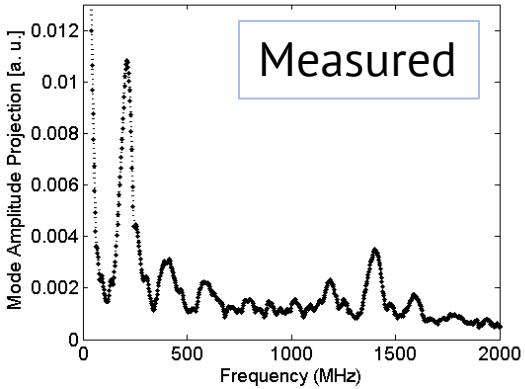
The 1.4 GHz impedance could have a high Q value

Cavities & kickers



Cavities, kickers, BPMs & (Zs)





'Sidebands' originate from the combination of 200 MHz and 1.4 GHz modulation

Possible 1.4 GHz characteristics

Theodoros' code

fr = (1.35–1.45) GHz

Q = 5–10

Rs = (300–400) kΩ

R/Q < 40 kΩ

Headtail

Q has a wide range

For Q = 10—20

R/Q = (20–30) kΩ

For Q = 600

R/Q = (10–15) kΩ

For the same Q, we find a slightly different Rs. However, we use very different codes and we both find that the results are very sensitive to Rs (~10—20 %).

Conclusions

Comparing the two codes

- Agree qualitatively
- Still give up to a factor 2 different results for Rs
  - We have started benchmarking tests today

The 1.4 GHz peak's Q value

- Could be higher than we thought originally
  - Results to be checked with Theodoros' code