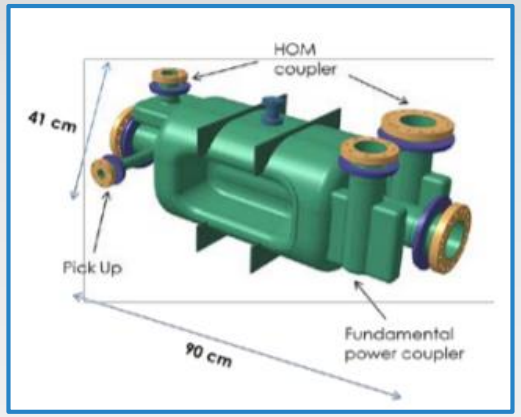
Update on DQW crab cavity HOMs

S. ANTIPOV, J. MITCHELL, B. SALVANT

HL-LHC WP2 MEETING 29.01.19

Crab cavity HOMs

RADIO FREQUENCY DIPOLE



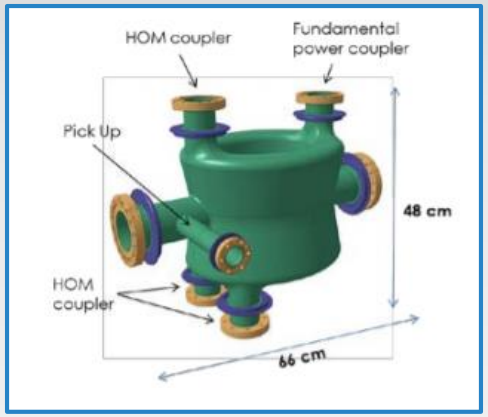
Nominal power loss is below 500 W threshold

- The actual mode frequency should not vary from the design value by more than 0.3%

HOM shunt impedance is below 1 MΩ/m

S. Antipov *et al.*, 129th HSC Section Meeting, CERN, 12.01.17

DOUBLE QUARTER WAVE



Scope of this presentation

New HOM tables have been released for DQW crab cavity

Designers attacked heat load and beam stability issues

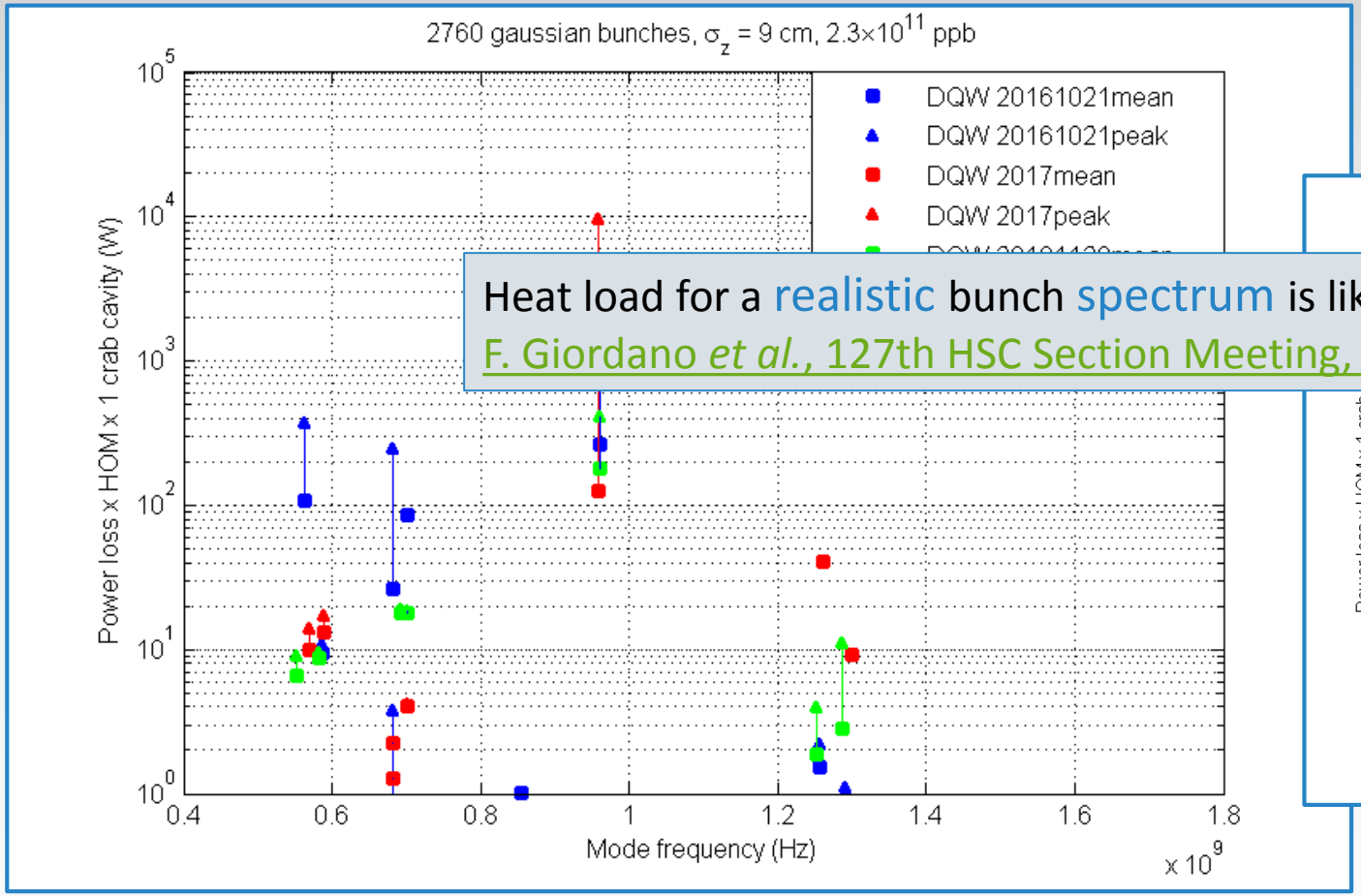
- Detuning low-Q modes that are close to beam line
- Lowering shunt impedance of the most critical high-R_s modes

The table is close to the final one

- Optimization is ongoing to meet mechanical and cryogenic constraints

Link to EDMS

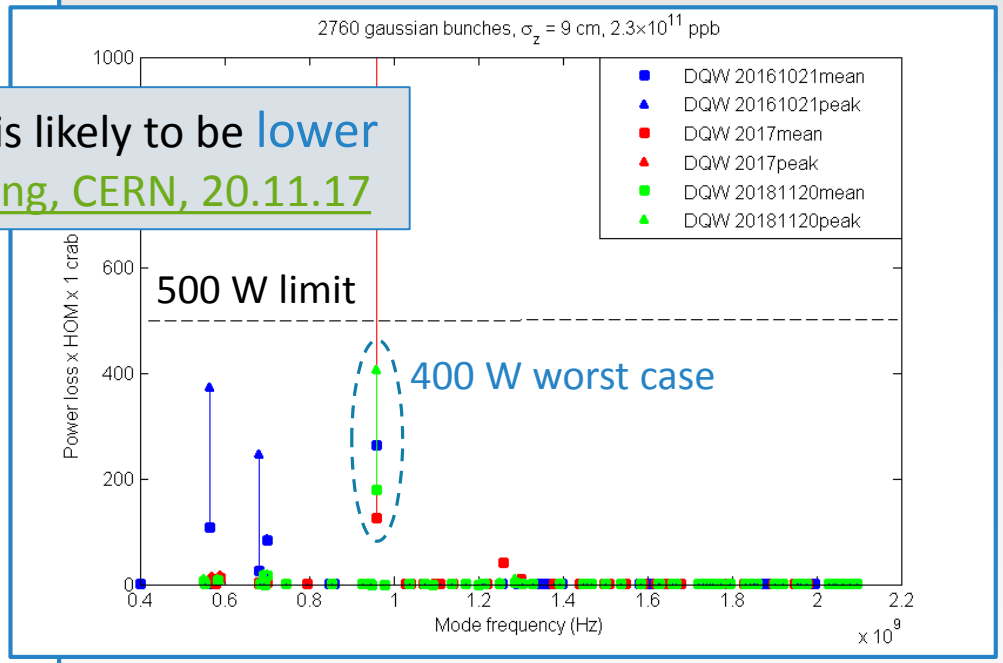
Maximum heat load is below 500 W



f (GHz)	R_l (kΩ)	Q
0.960	3.5	390

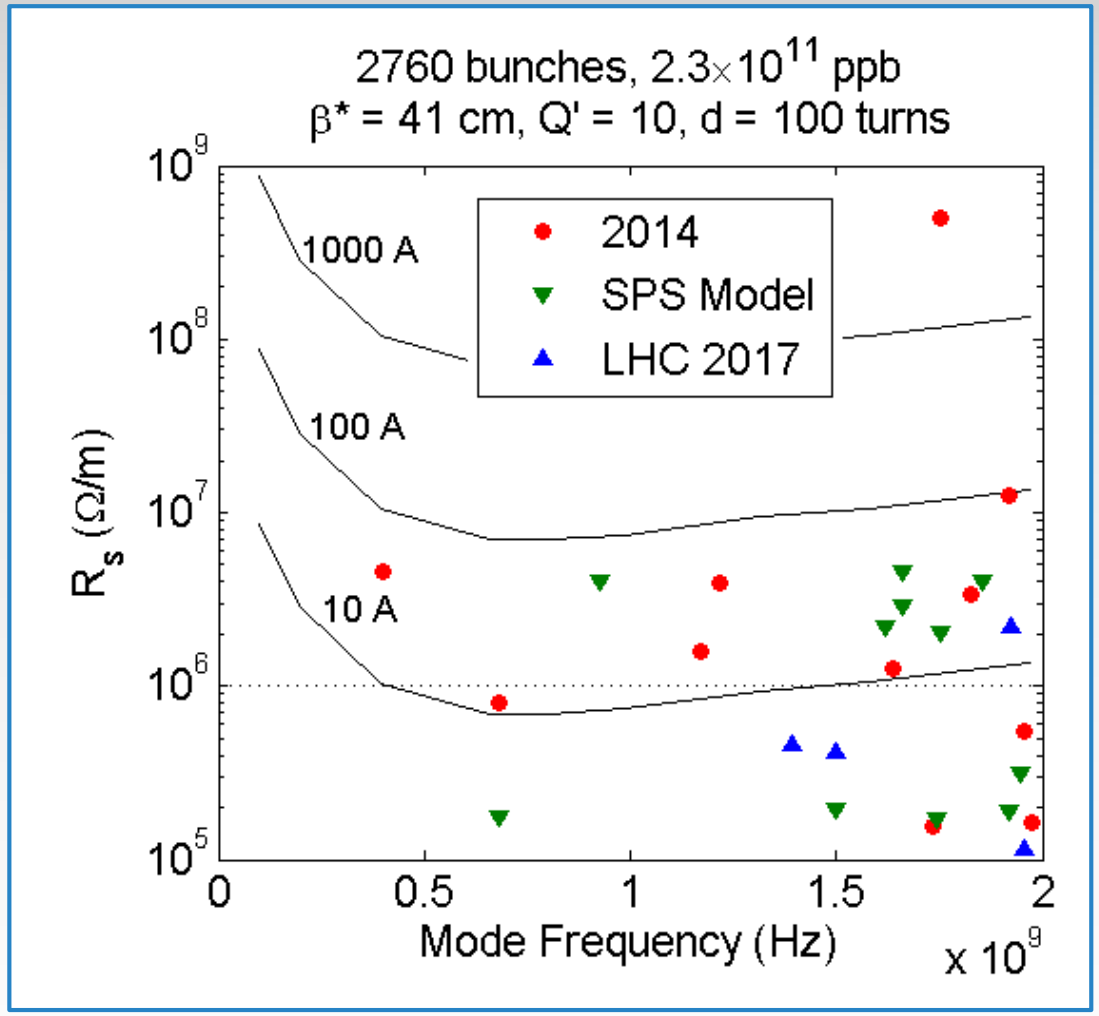
Heat load for a realistic bunch spectrum is likely to be lower

F. Giordano *et al.*, 127th HSC Section Meeting, CERN, 20.11.17



Peak values calculated assuming ±0.3% frequency uncertainty (based on CERN DQW test)

HOM impedance has been reducing



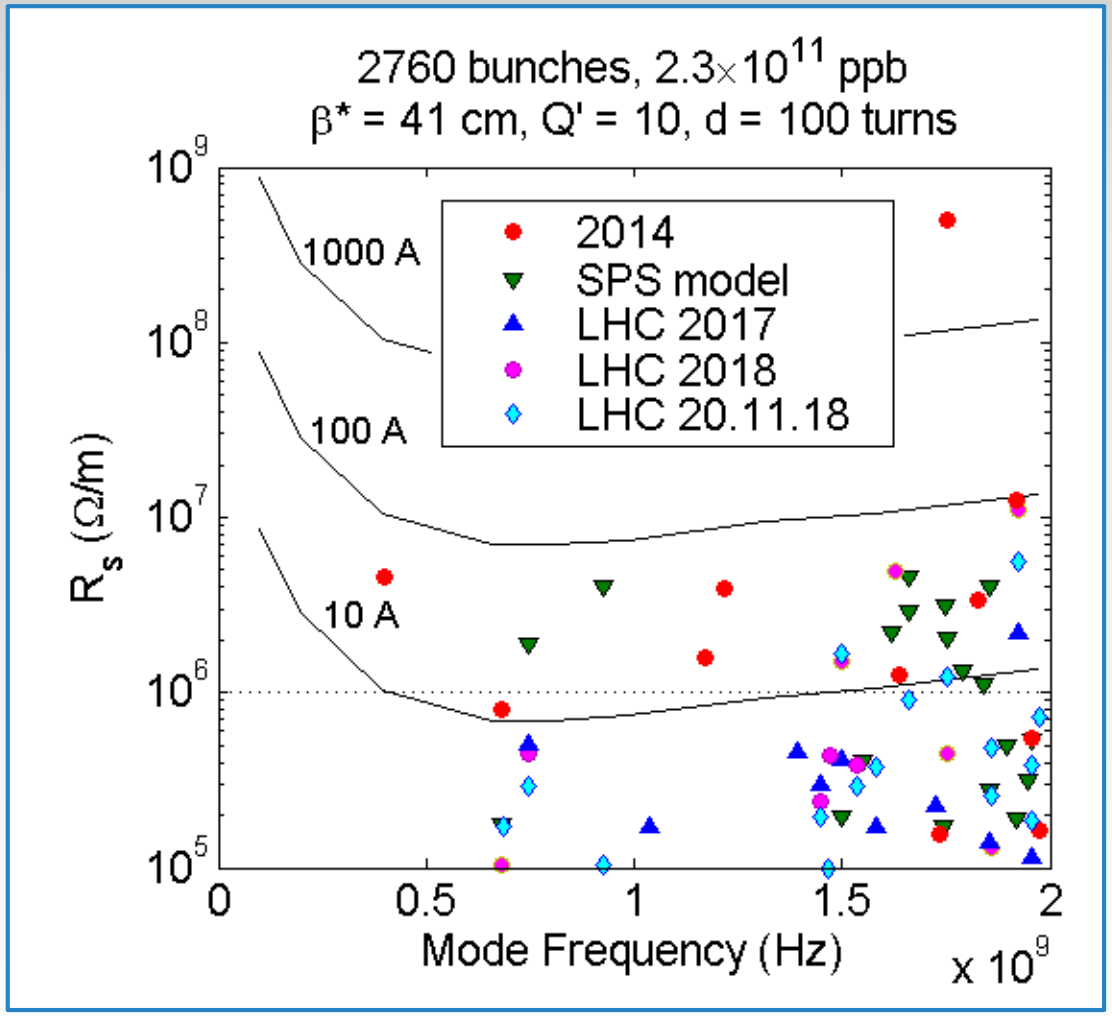
To ensure beam stability
HOMs should be kept under control

E. Metral *et al.*, HiLumi'14, KEK, Japan, 2014

N. Biancacci *et al*, HiLumi'15, FNAL, USA, 2015

S. Antipov *et al.*, HiLumi'17, Ciemat, Spain, 2017

Potentially dangerous modes – Dec. 2018

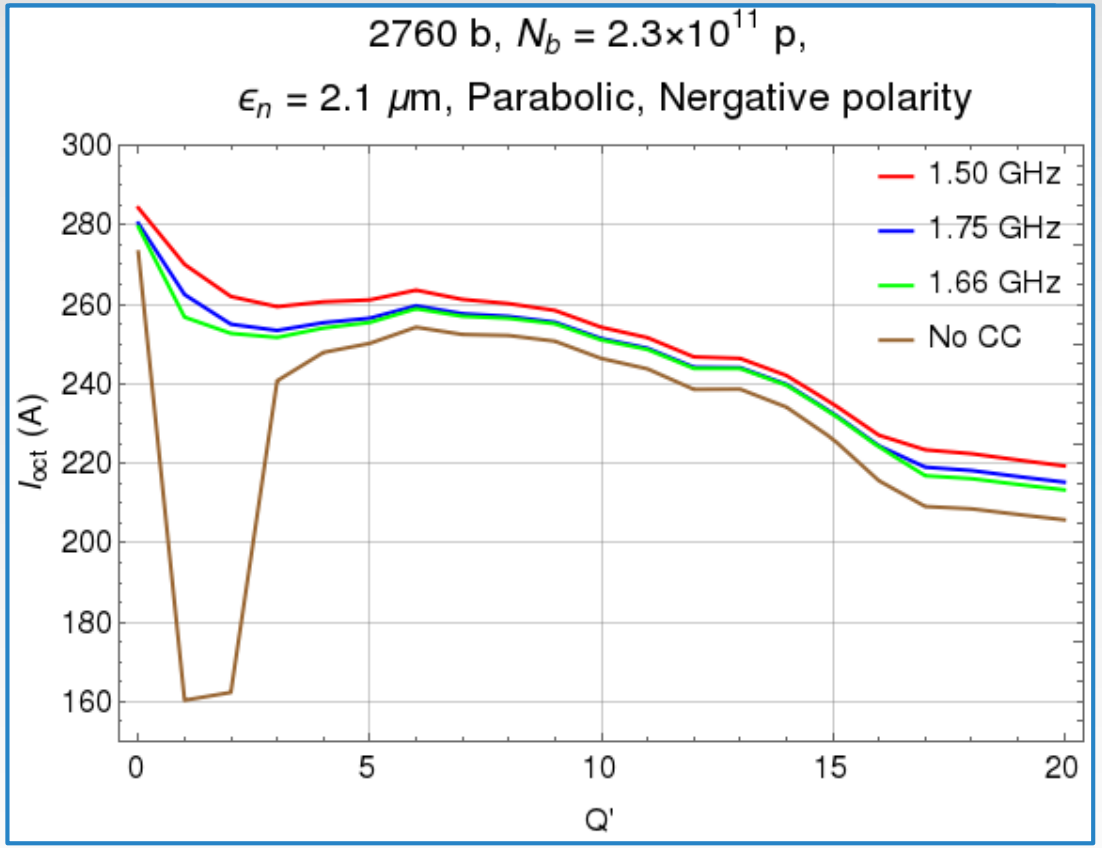


f (GHz)	R_s (MΩ/m)	Q	Plane
1.922	5.6[1]	1.45x10^5	Hor.
1.50	1.7[2]	3.4x10^4	Hor.
1.754	1.2[2]	1.6x10^4	Hor.
1.661	0.9	6.8x10^4	Hor.

[1] Upper limit, mode purely converged
[2] Mode impedance has been further lowered a bit

Little impact from modes 1.50, 1.66 & 1.75 GHz

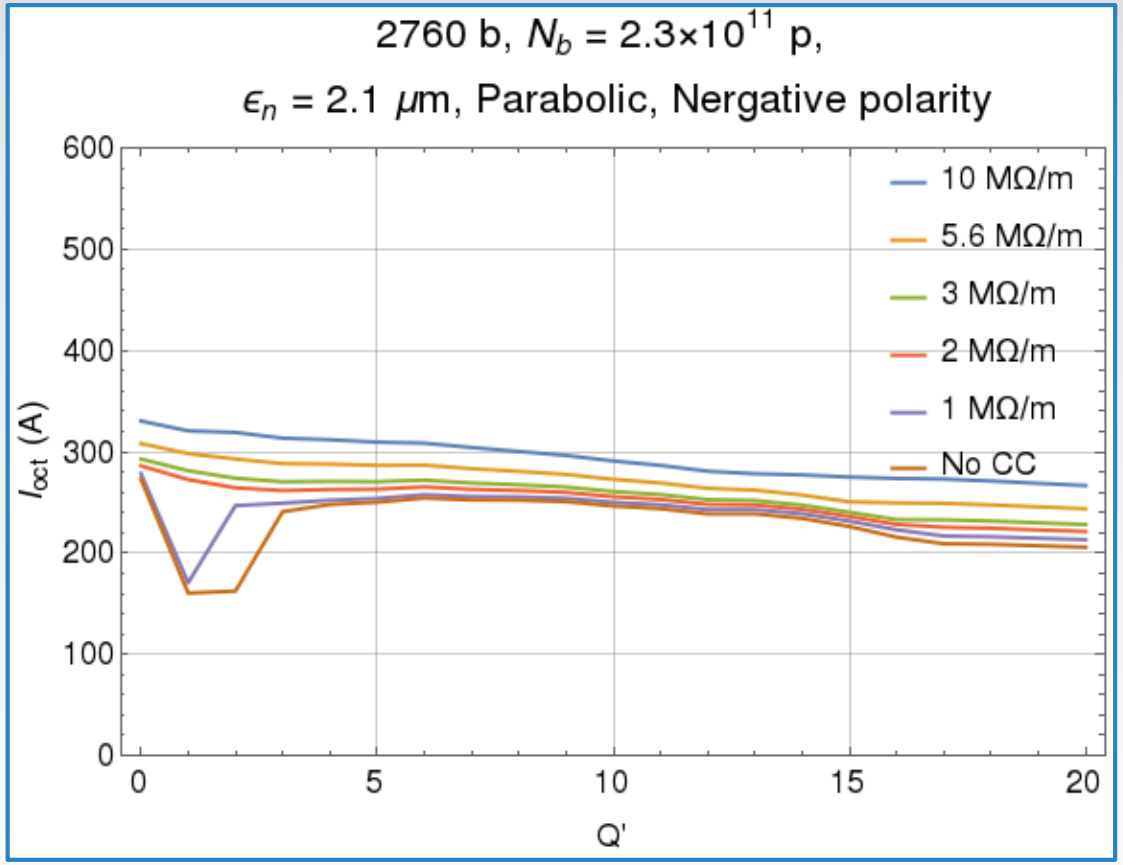
BCMS beam – slightly larger impact
Standard OP – slightly lower impact



~ 10 A

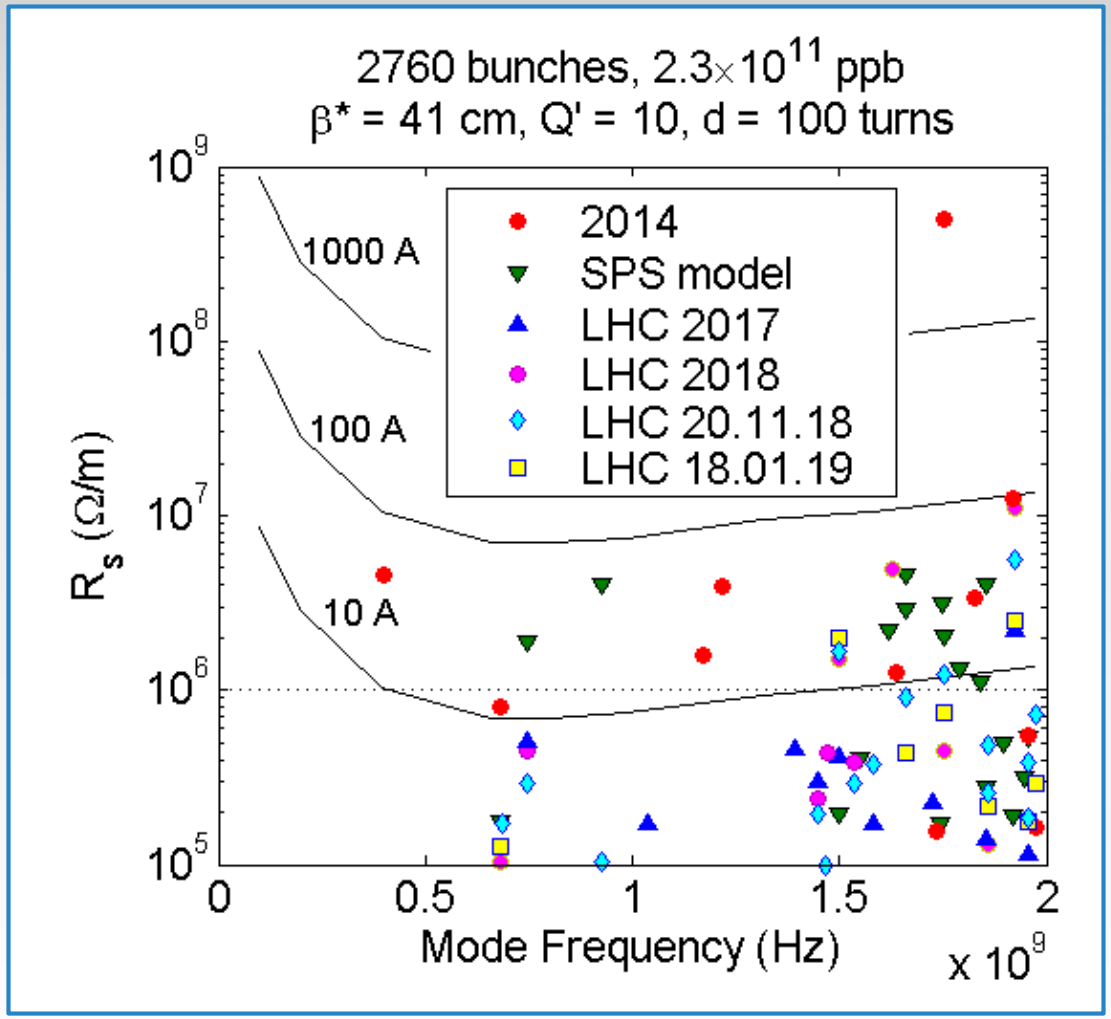
Impact of 1.92 GHz HOM can be large

BCMS beam – slightly larger impact
Standard OP – slightly lower impact



- 70 A
- 50 A
- 20 A
- 10 A

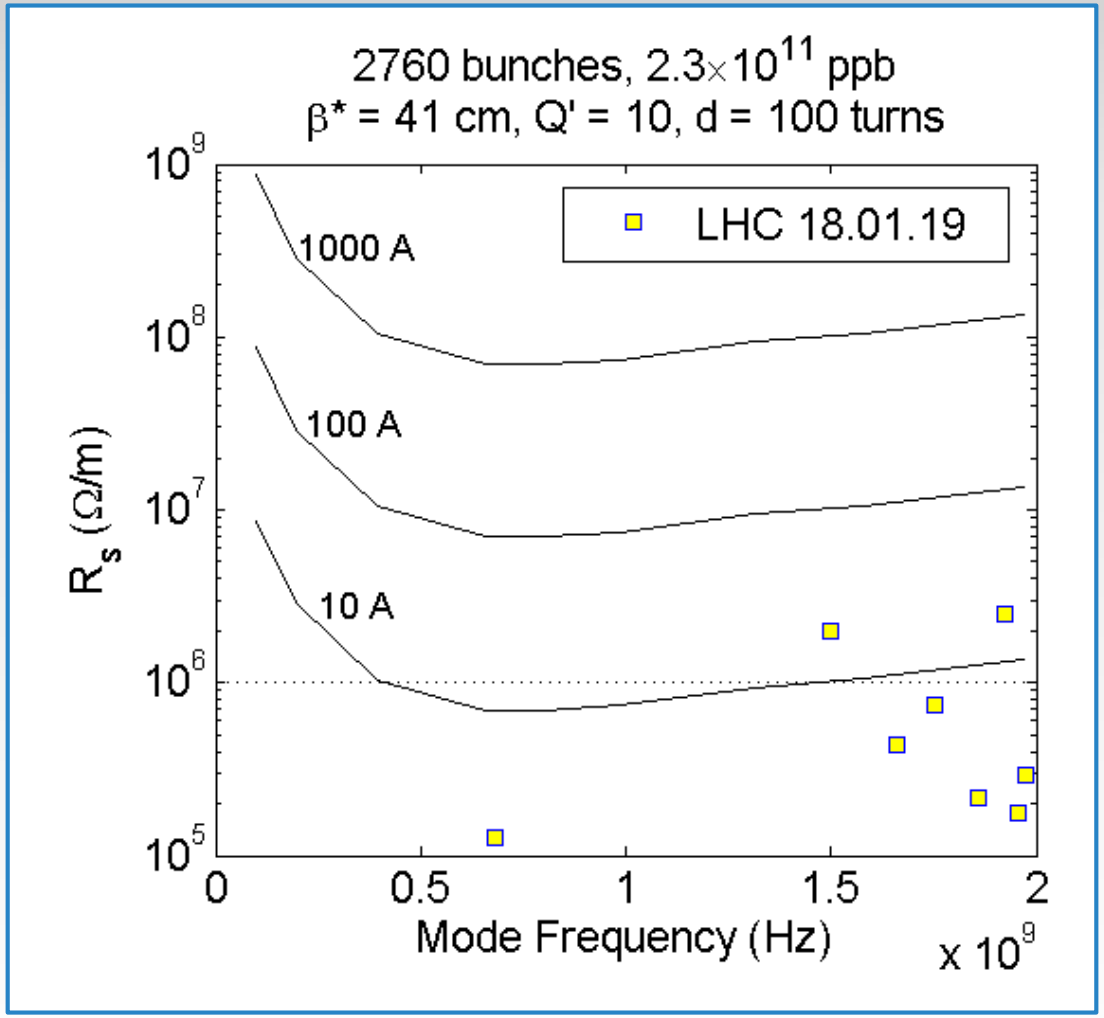
Potentially dangerous modes - Latest



f (GHz)	R_s (MΩ/m)	Q	Plane
1.922	2.5[1]	5.8×10^4	Hor.
1.50	2.0	2.8×10^4	Hor.
1.754	0.75	8.8×10^3	Hor.

[1] Mode purely converged

Potentially dangerous modes

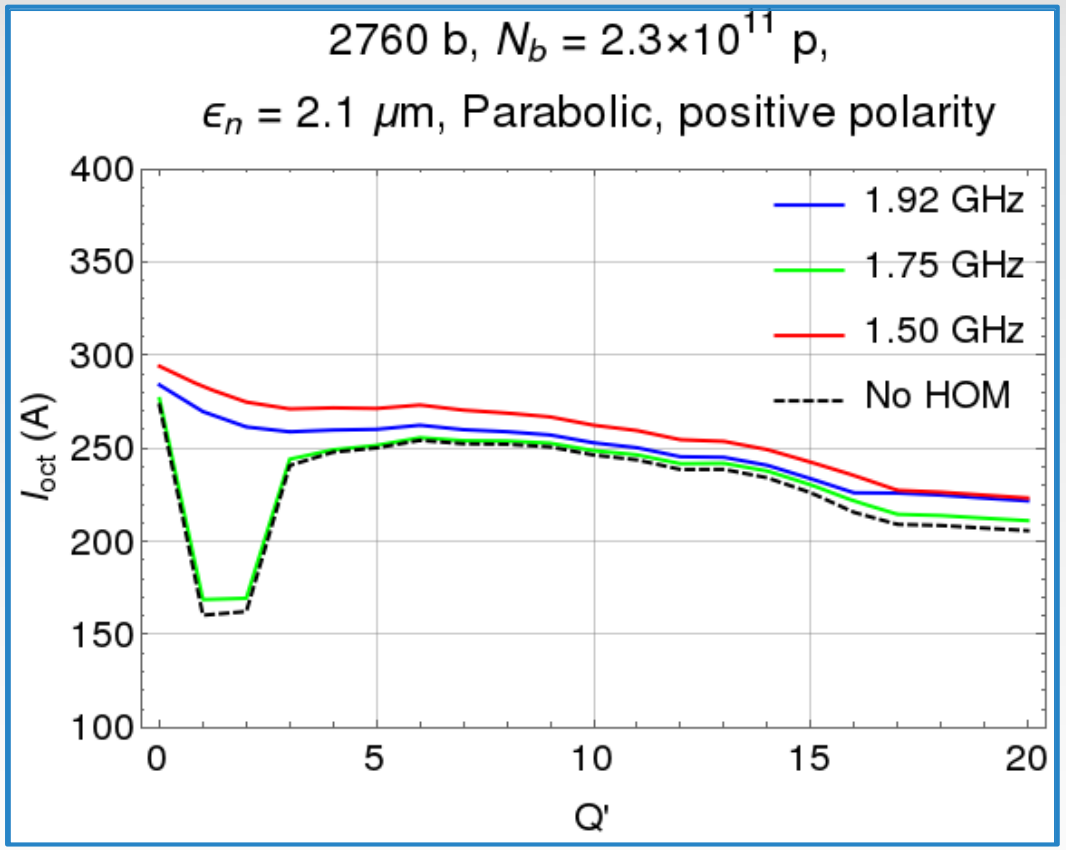


f (GHz)	R_s (MΩ/m)	Q	Plane
1.922	2.5[1]	5.8×10^4	Hor.
1.50	2.0	2.8×10^4	Hor.
1.754	0.75	8.8×10^3	Hor.

[1] Mode purely converged

Larger impact from mode 1.50 GHz

BCMS beam – slightly larger impact
Standard OP – slightly smaller impact



~ 20 A

There may still be issues for beam stability

Most worrying HOM – 1.92 GHz
- Little control, up to 50 A in the worst case scenario
- Purely converged, the real impedance is likely to be smaller
- Would like it to be closer to 1 MΩ/m to ensure 10 A or lower impact
- Dipolar/Quadrupolar? (*B. Salvant*)

1.50 GHz provides around 10-20 A
- Can be optimized to lower shunt impedance (*J. Mitchell*)

No issue for beam induced heating
- Peak heat load is below 400 W assuming 0.3% mode frequency variation