# Updates HOM power studies corrected

Preliminary!!!

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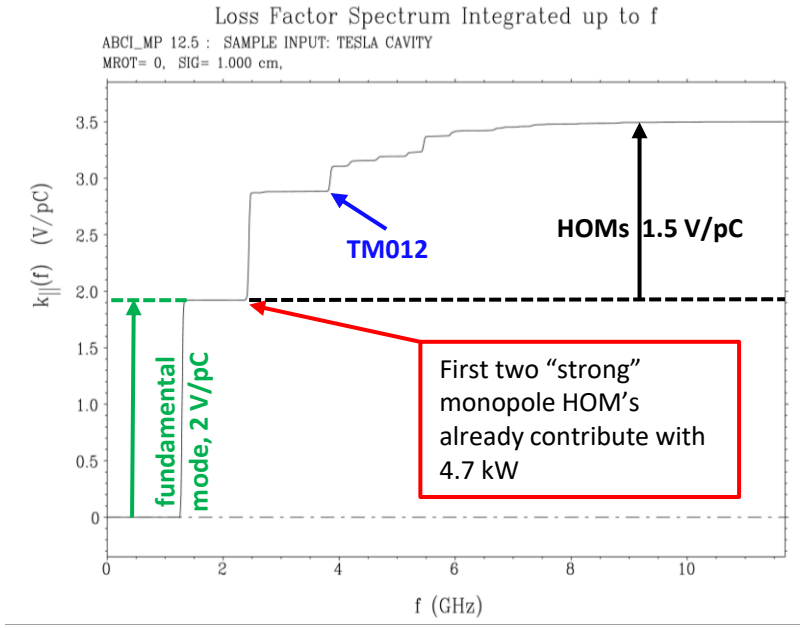
7th Meeting of Task 6.1 MuCol Design Study
11/9/2023


# Summary (1)

- K. Bane formulism not really valid with the bunch length of $\sigma_z$ = 5 - 13 mm for simulations with intensity effects
- Instead, use resonator model instead and calculate the induced voltage for each mode:

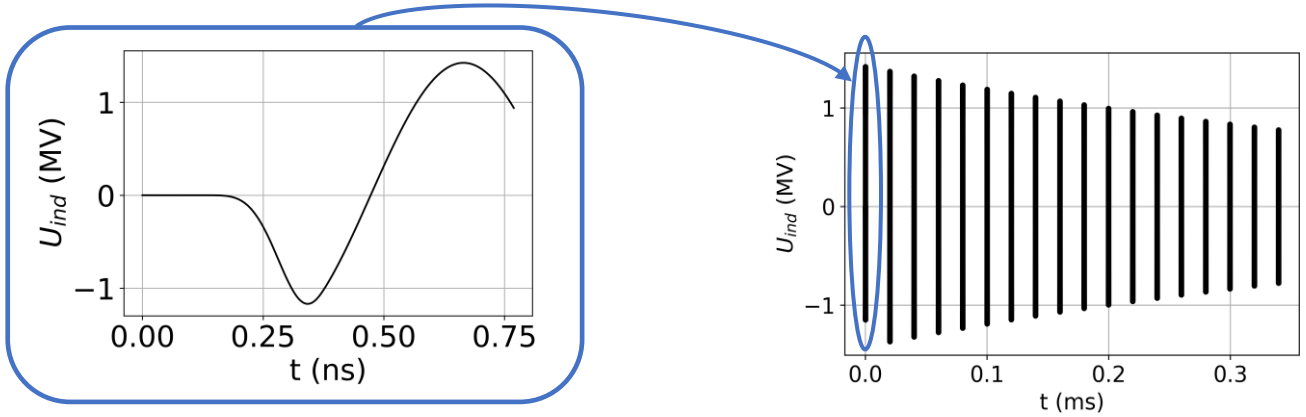



| mode | $f$ /GHz | $k^{(0)}$/ V/(pC) | $G_1$ /Ω | $(R/Q)^{(0)}$ / Ω | $Q_0/Q_{0FM}$ | $\varphi$ /° |
|---|---|---|---|---|---|---|
| Band 1 | | | | | | |
| MM- 1 | 1.2756 | $0.848\ 10^{-06}$ | 252.7 | 0.0002 | 1.027 | 20.0 |
| MM- 2 | 1.2776 | $0.239\ 10^{-06}$ | 252.9 | 0.0001 | 1.025 | 39.9 |
| MM- 3 | 1.2807 | $0.523\ 10^{-05}$ | 253.2 | 0.0013 | 1.021 | 59.9 |
| MM- 4 | 1.2845 | $0.187\ 10^{-05}$ | 253.5 | 0.0005 | 1.017 | 79.8 |
| MM- 5 | 1.2885 | $0.217\ 10^{-05}$ | 253.9 | 0.0005 | 1.012 | 99.8 |
| MM- 6 | 1.2924 | $0.776\ 10^{-05}$ | 254.2 | 0.0019 | 1.007 | 119.7 |
| MM- 7 | 1.2955 | $0.138\ 10^{-03}$ | 254.5 | 0.0339 | 1.003 | 139.6 |
| MM- 8 | 1.2976 | $0.662\ 10^{-04}$ | 254.7 | 0.0163 | 1.001 | 159.2 |
| MM- 9 | 1.2983 | 2.08 | 254.8 | 511.0652 | 1.000 | 176.1 |
| Band 2 | | | | | | |
| MM-10 | 2.3800 | $0.746\ 10^{-05}$ | 370.6 | 0.0010 | 0.433 | 159.9 |
| MM-11 | 2.3856 | $0.147\ 10^{-03}$ | 370.7 | 0.0196 | 0.431 | 139.9 |
| MM-12 | 2.3943 | $0.248\ 10^{-03}$ | 370.9 | 0.0329 | 0.428 | 119.9 |
| MM-13 | 2.4055 | $0.414\ 10^{-03}$ | 371.2 | 0.0547 | 0.424 | 100.1 |
| MM-14 | 2.4181 | $0.376\ 10^{-02}$ | 371.3 | 0.4943 | 0.420 | 80.6 |
| MM-15 | 2.4308 | $0.573\ 10^{-04}$ | 371.2 | 0.0075 | 0.416 | 61.4 |
| MM-16 | 2.4419 | 0.08 | 370.6 | 10.2352 | 0.411 | 43.0 |
| MM-17 | 2.4499 | 0.60 | 369.0 | 77.6533 | 0.407 | 25.9 |
| MM-18 | 2.4539 | 0.57 | 365.9 | 73.8717 | 0.402 | 11.5 |

- Extensive list of many HOMs in R. Wanzenberg's note, 180 pages!

# Summary (2)

- **Multi-turn wakefields calculated not for all buckets, but only those of interest:**



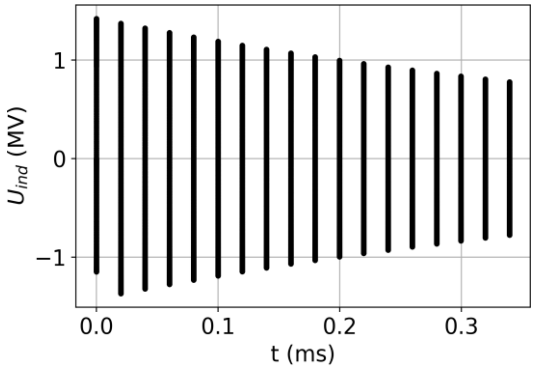

For RCS 1, $Q_L$ = 2.2e6

- **Multi-turn wakefields implemented in BlonD: Calculates induced voltage of that turn plus the multi-turn fields of the previous turn**
- **Initial bench mark tests promising, final bench marking with old code on cluster in progress**

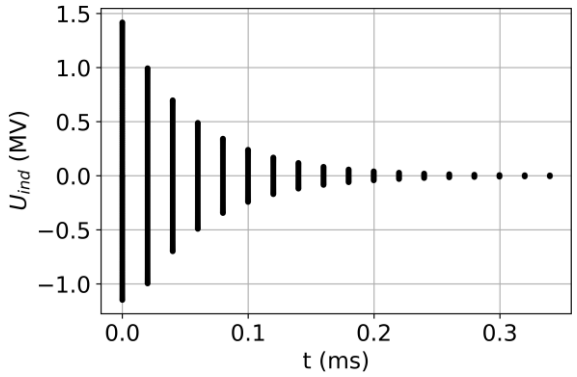
# Summary (3)

- **Multi-turn wakefields calculated for different $Q_L$ as test:**

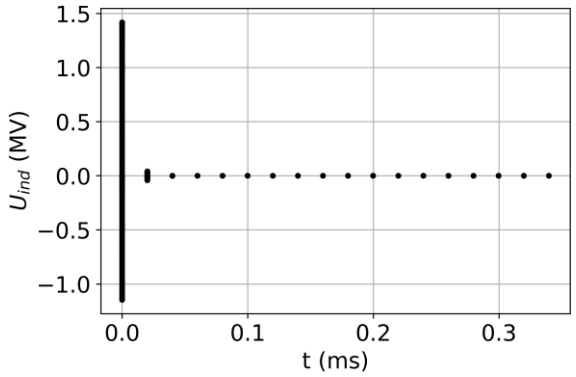
For RCS 1, $Q_L$ = 2.2e6



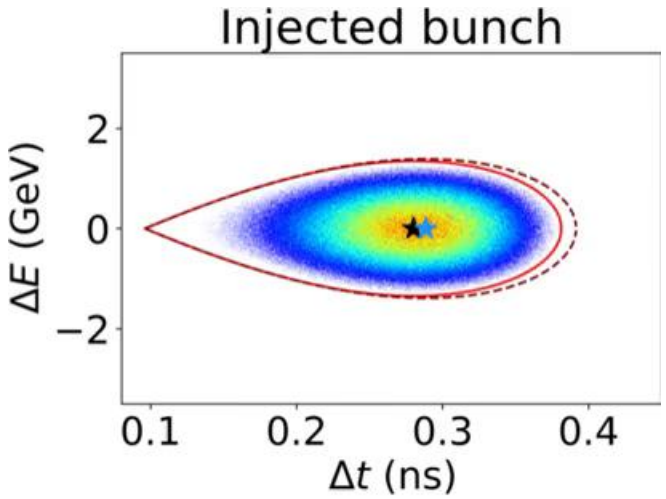

For 0.1 $Q_L$



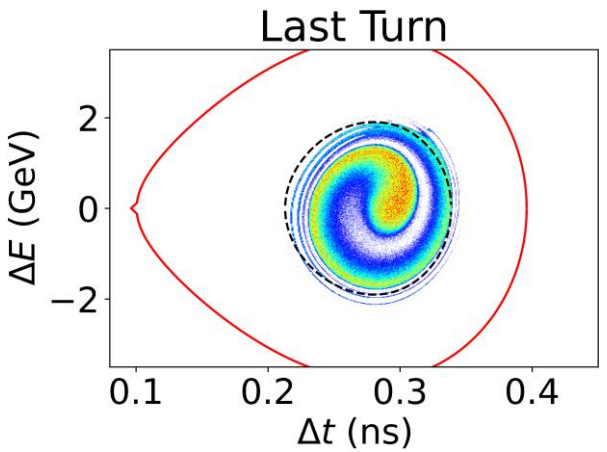

For 0.01 $Q_L$

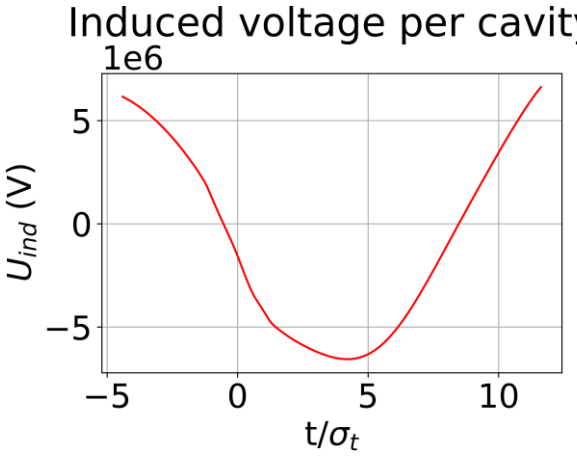



- **And in simulations** For RCS 1, $Q_L$ = 2.0e6




$2*cos\phi_s = 1.4$ times more voltage has to be supplied

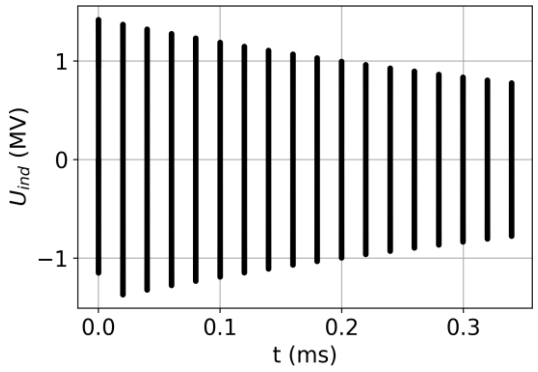


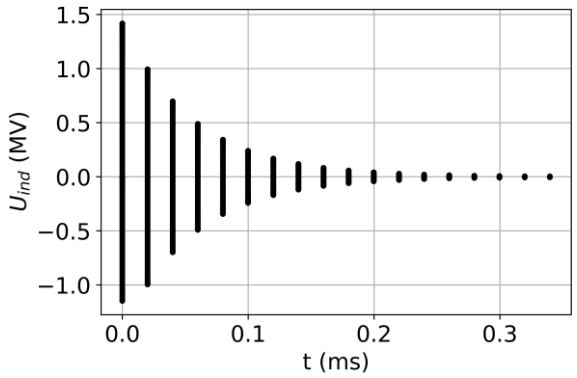
# Summary (3)

- **Multi-turn wakefields calculated for different $Q_L$ as test:**

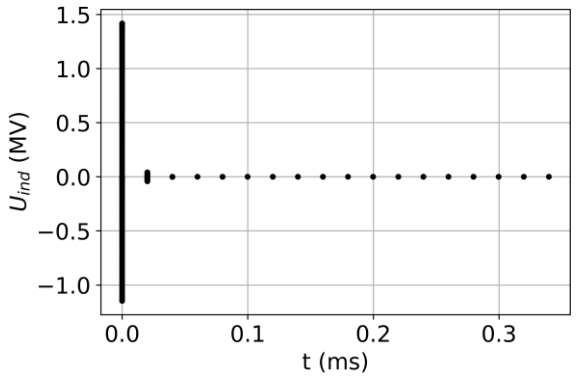
For RCS 1, $Q_L$ = 2.2e6




For 0.1 $Q_L$

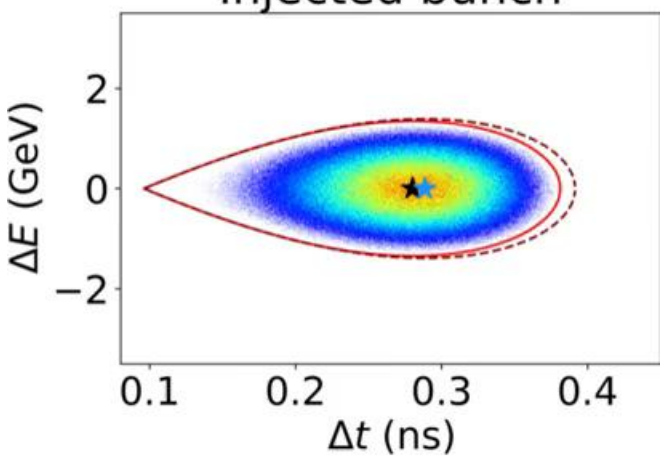



For 0.01 $Q_L$

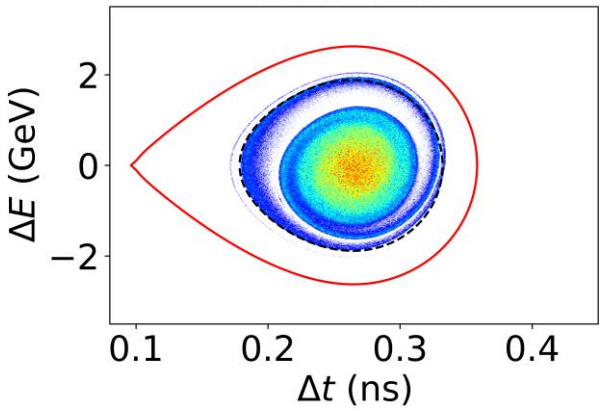



- **And in simulations** For 0.1 $Q_L$ = 2.2e5

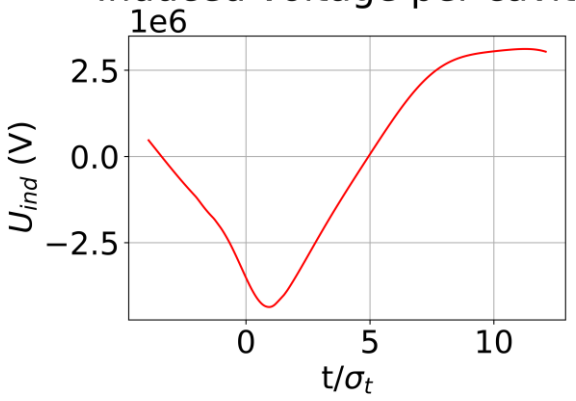
Injected bunch




Last Turn

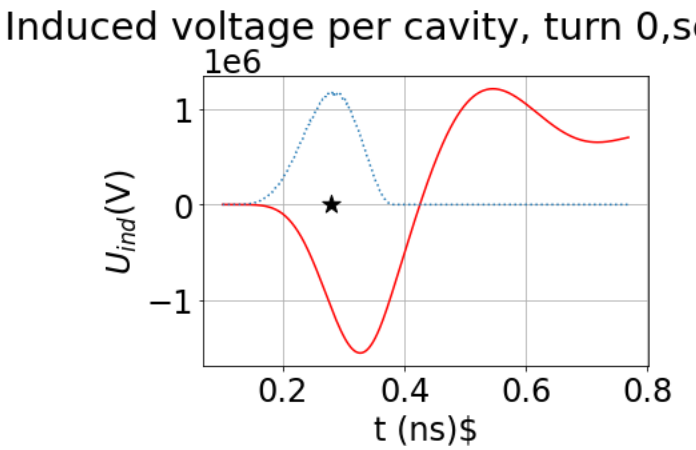


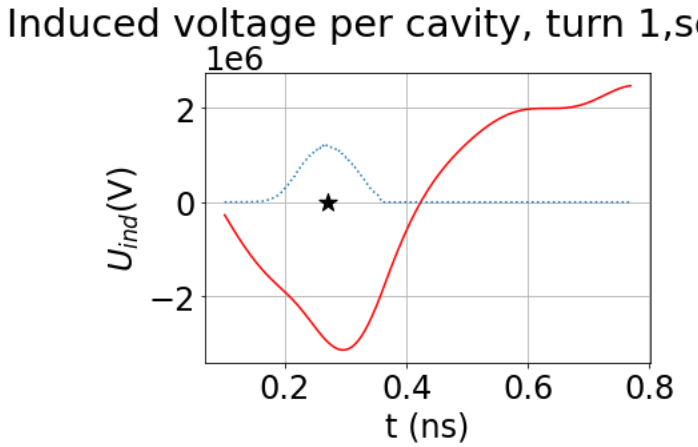

Induced voltage per cavity

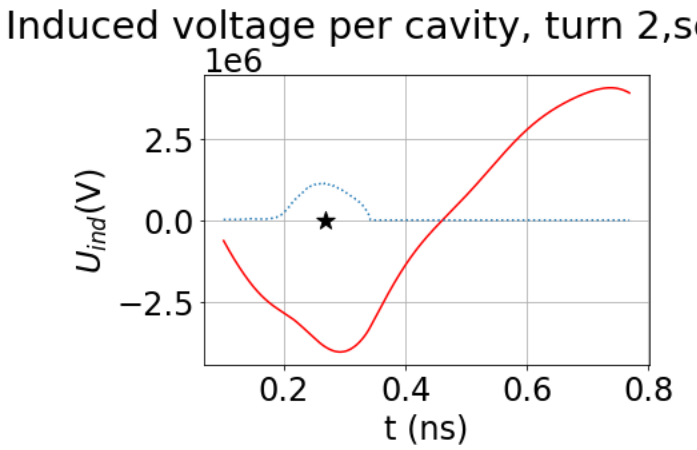


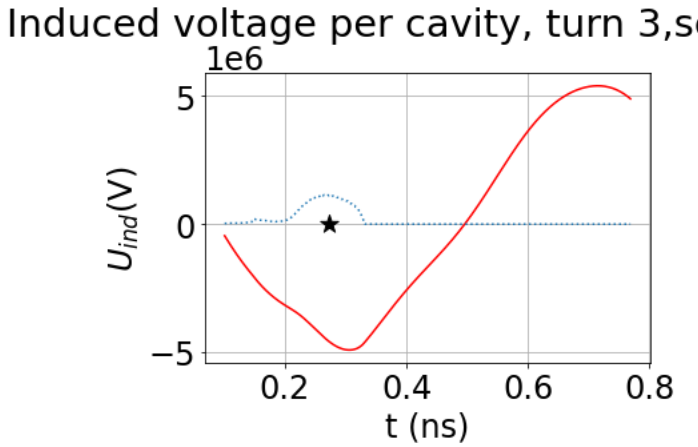
# Summary (4)

- **Induced voltages per turn:**



# Summary summary

Preliminary!!!

- Implementation of multi-turn effects and counter-rotating bunches foreseen though resonator models per mode
- Multi-turn wakefields implemented, but not 100% benchmarked
- Effect of those scale with $Q_L$
- More voltage, ca. 1.4 times more, has to be supplied to compensate the beam loading

→ Part of my HB2023 contribution “Intensity effects in a Chain of Muon RCS”



Definition of $\varepsilon_L$ unclear


CERN