DESIGN FOR THE DIAMOND LONGITUDINAL BUNCH-BY-BUNCH FEEDBACK CAVITY

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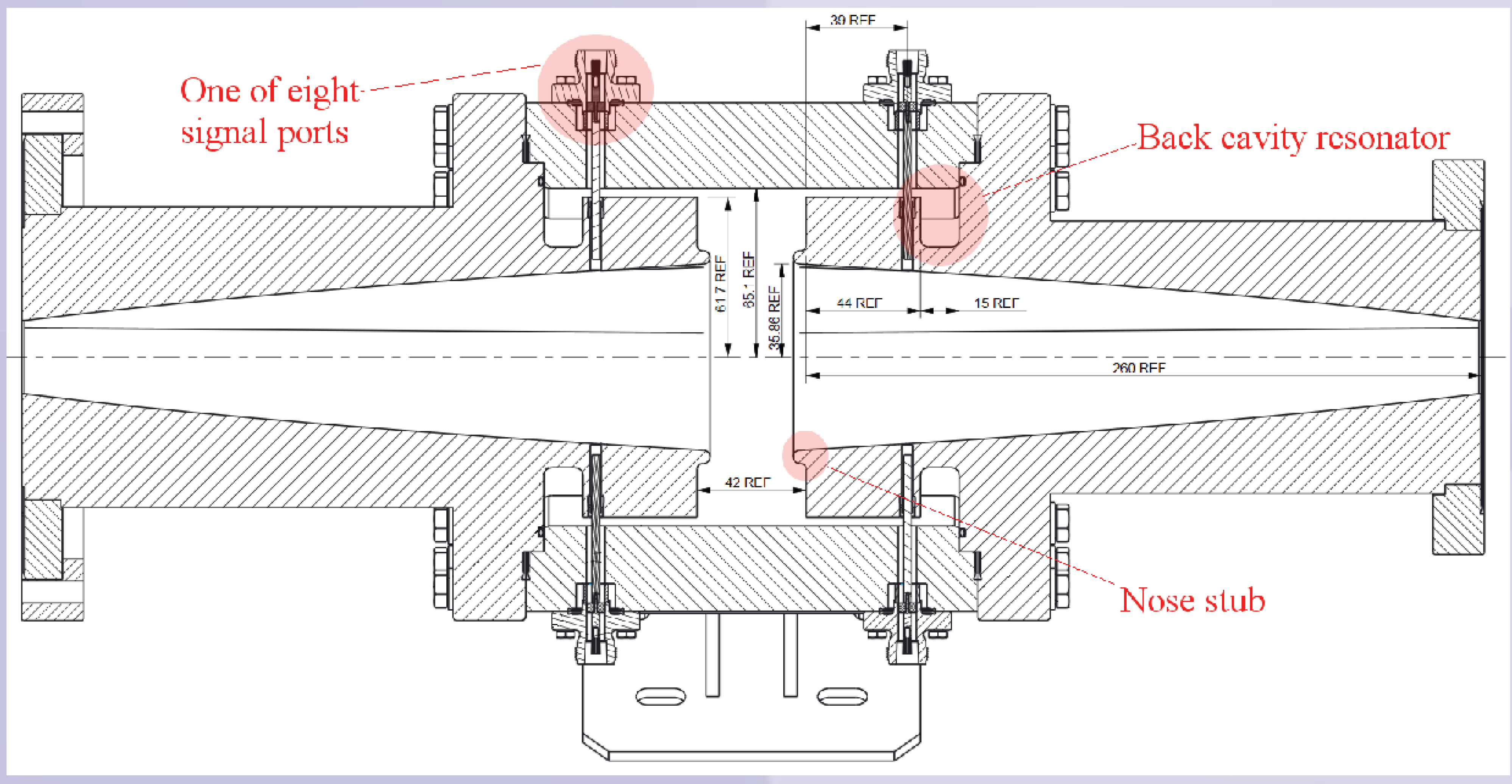
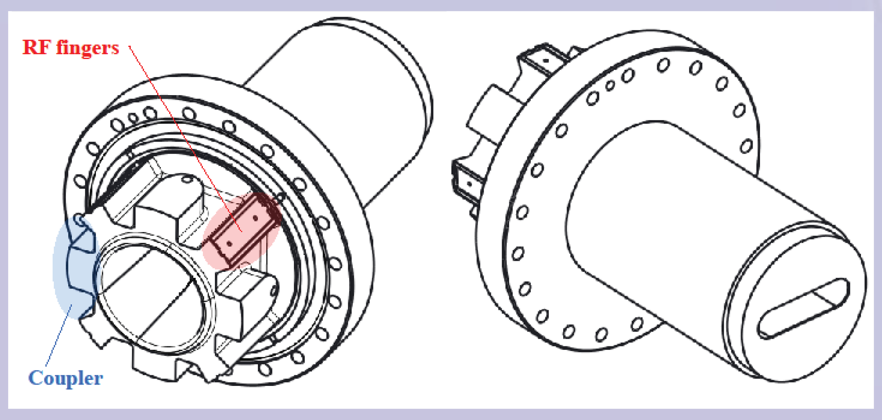
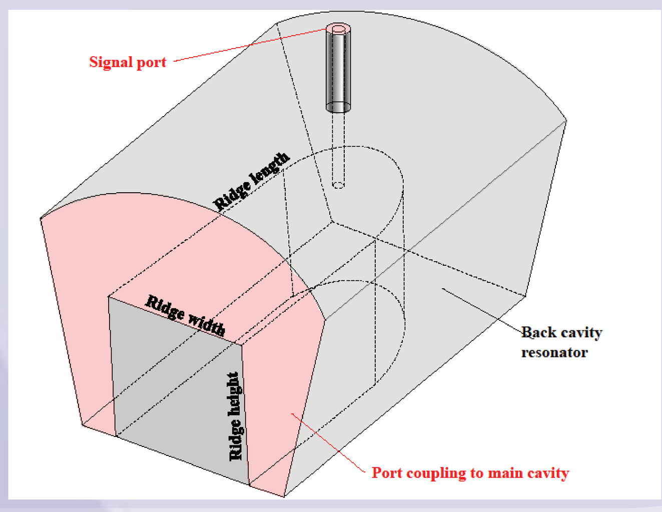
Design

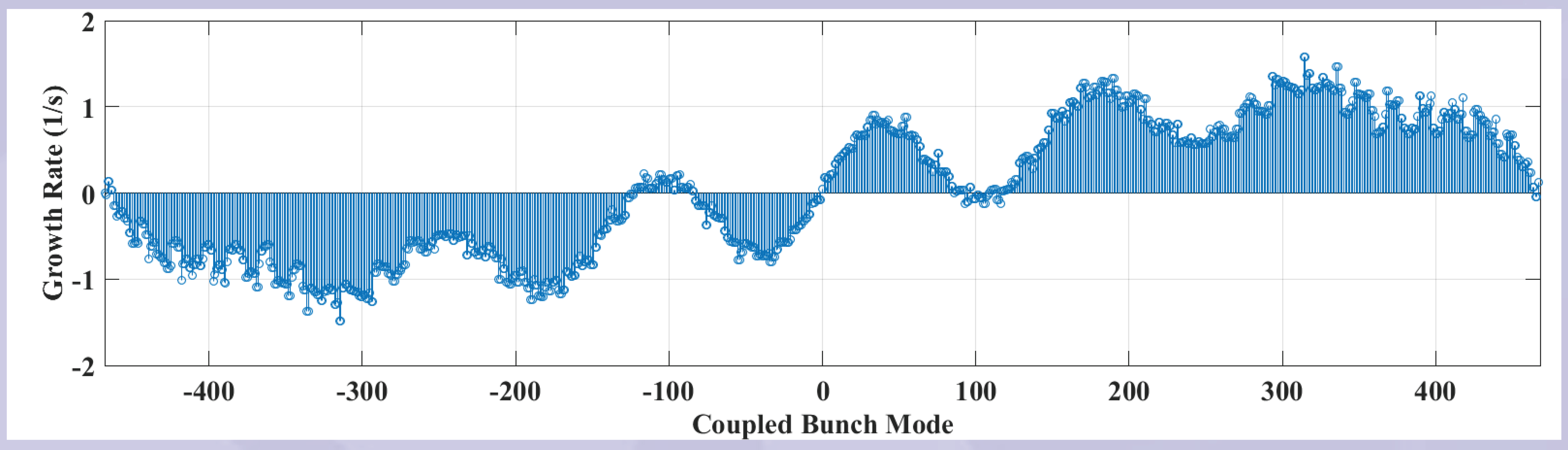




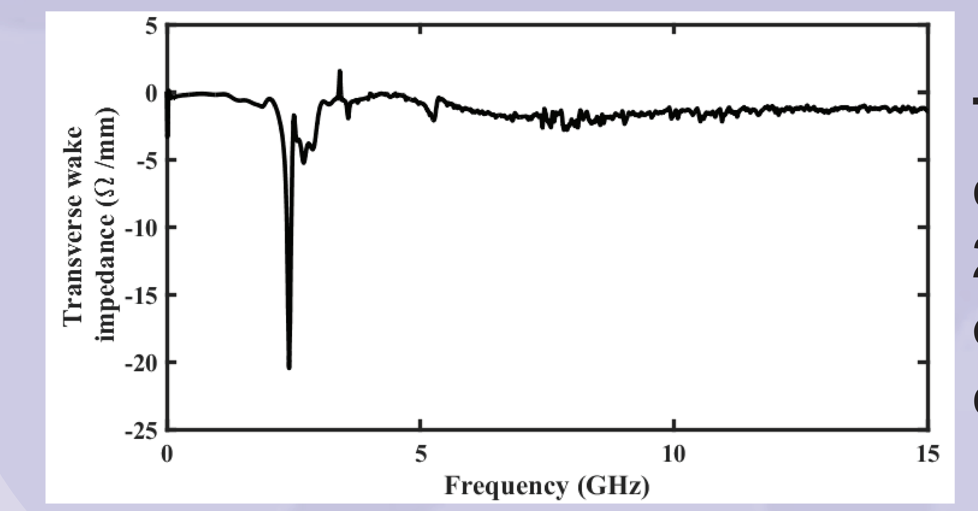


In 2017 it is planned to install some additional normal conducting cavities into the Diamond storage ring. In order to deal with the potential higher order modes in these, we are designing a longitudinal bunch-by-bunch feedback system, based on an overloaded cavity kicker, adapted to the Diamond beam pipe cross section.
Through a combination of geometry optimisation and the addition of integrated taper transitions, the design has evolved in order to reduce, among others, the strong 3rd harmonic cavity resonance seen on the introduction of the racetrack beam pipe.

Checking that the cavity will not cause unwanted behaviour in the machine

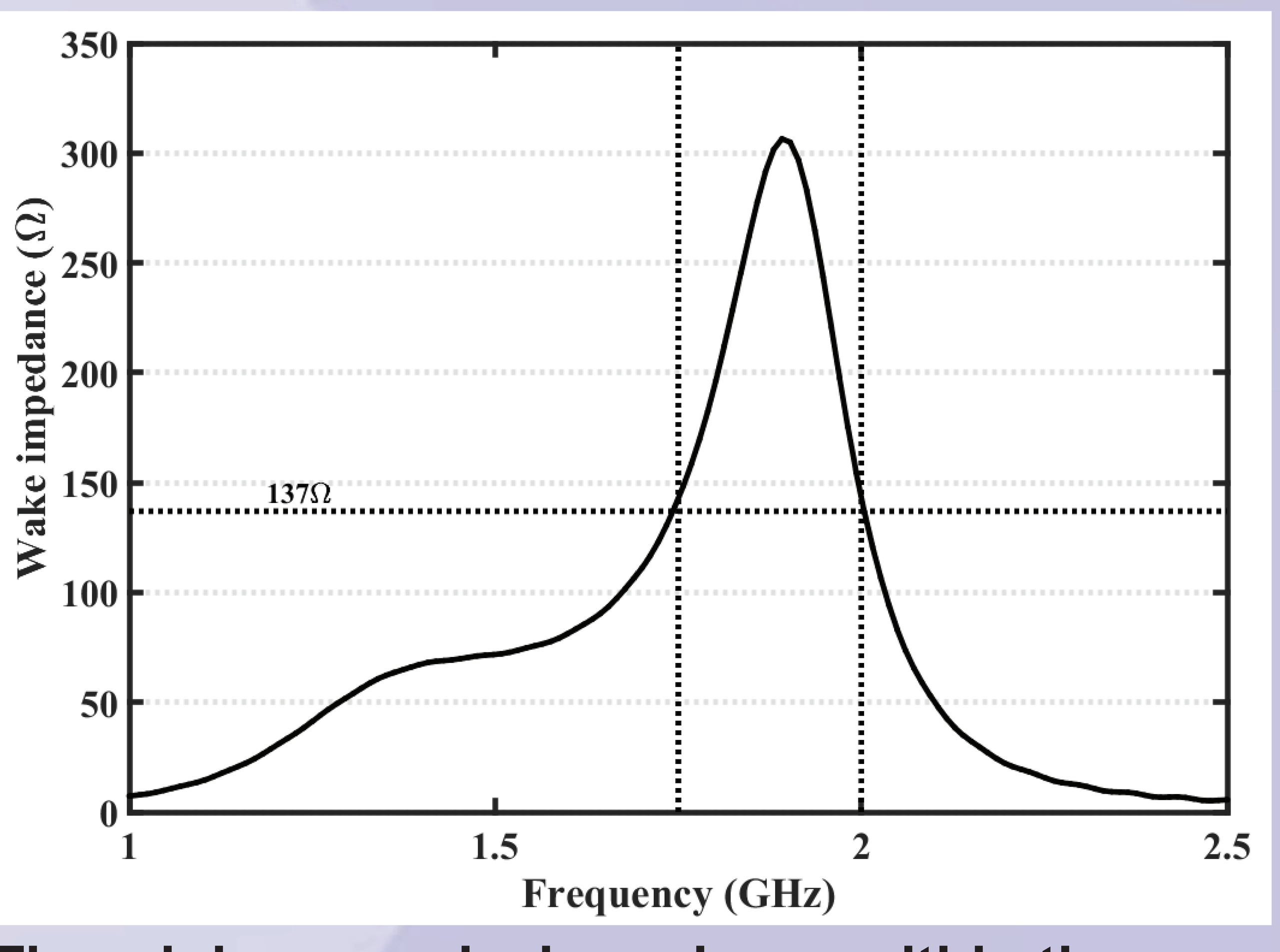


We calculated the expected growth rate of coupled bunch modes caused by the cavity, using a modified version of calculations in MatLab obtained from LNLS, based on the Wang formalism .
For this design the maximum instability growth rate was 1.5/s for nominal 300mA operating conditions, increasing to a still small value of 4/s for 500mA operation.



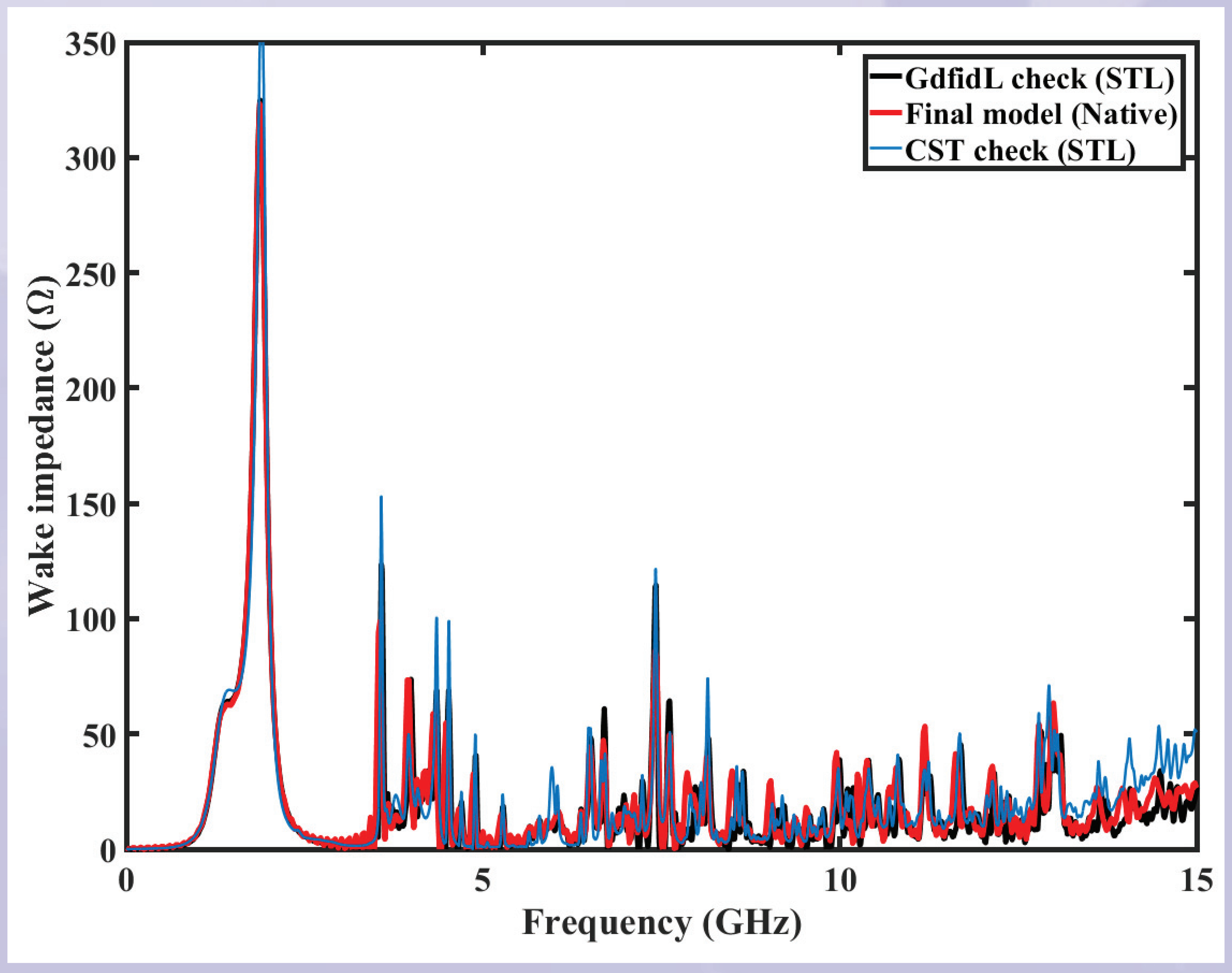
The transverse wakes were also checked and found to be a benign 20Ω/mm, which is of the same order as many other existing components.

Expected wake impedance



The minimum wake impedance within the operational band is 137Ω, which implies a minimum shunt impedance of ~274Ω. The peak wake impedance is 306Ω giving a peak shunt impedance of 612Ω.

Closing the loop between the mechanical drawings and the simulation



The mechanical drawings were imported into both GdfidL and CST modelling software and the results compared with those from the final design written in native GdfidL input code.
The agreement was very good giving us confidence that the mechanical drawings accurately represent our requirements.

The MatLab framework that was used with GdfidL can be found at

https://github.com/alunmorgan/GdfidL-framework.git

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