

# QUANTIFYING DISSIPATED POWER FROM WAKE FIELD LOSSES IN DIAGNOSTICS STRUCTURES

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Using time domain simulation, combined domain analysis, and thermal simulation, to predict the heating of diagnostic components

## The ideal solution

Simply add up the energy loss over time at each mesh point in the simulation which would allow the energy loss spatial distribution to be computed. Unfortunately this is not possible with any of the currently available simulation tools.

## Our approach

Time domain EM simulation  
Excite with bunch  
Record wake potential  
and port mode signals

Wake potential

Port signals

Combine charge distribution with wake potential

Integrate over time and sum over ports and modes

Energy lost from beam

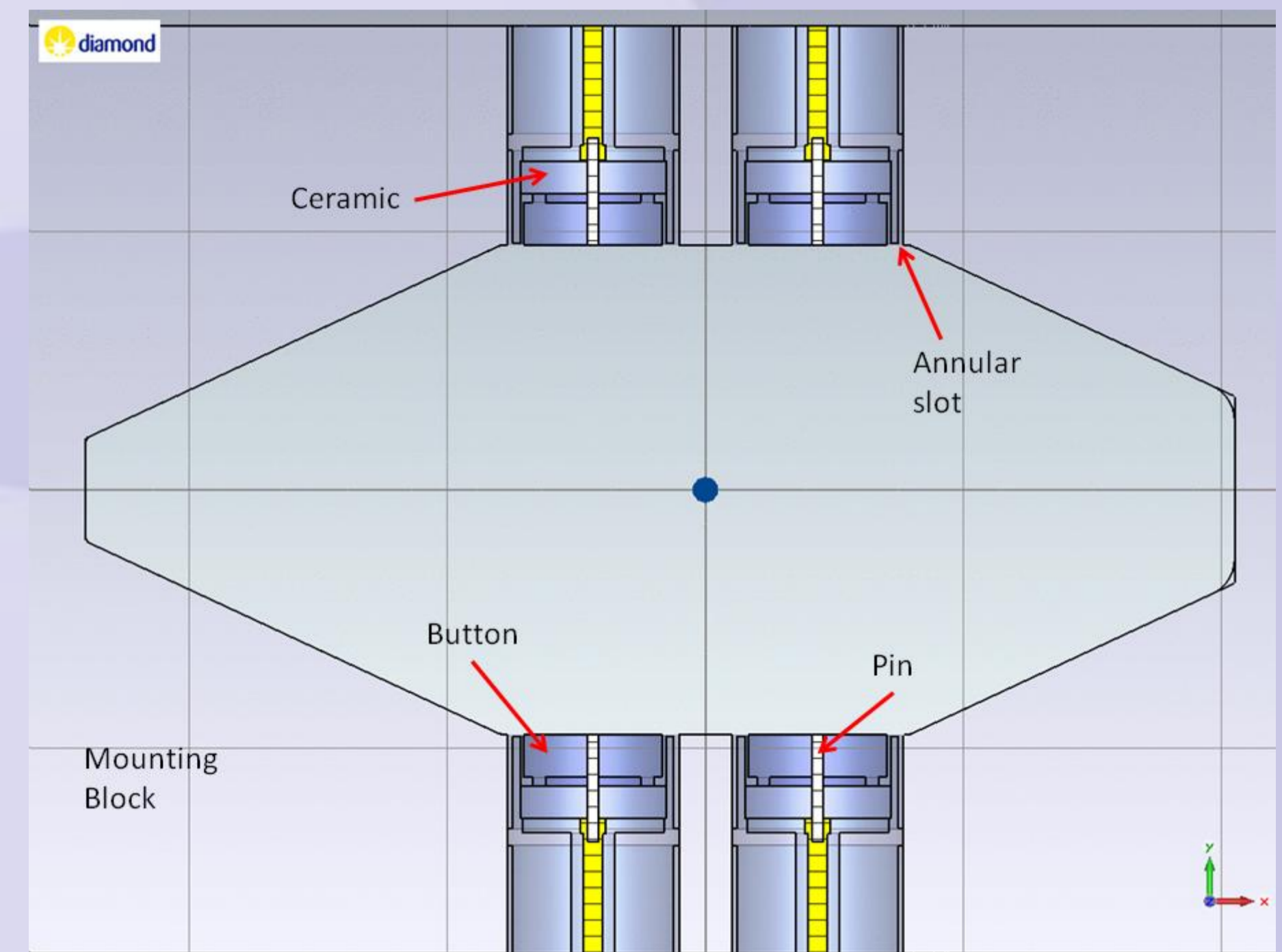
Energy lost into ports

Difference is energy left in structure

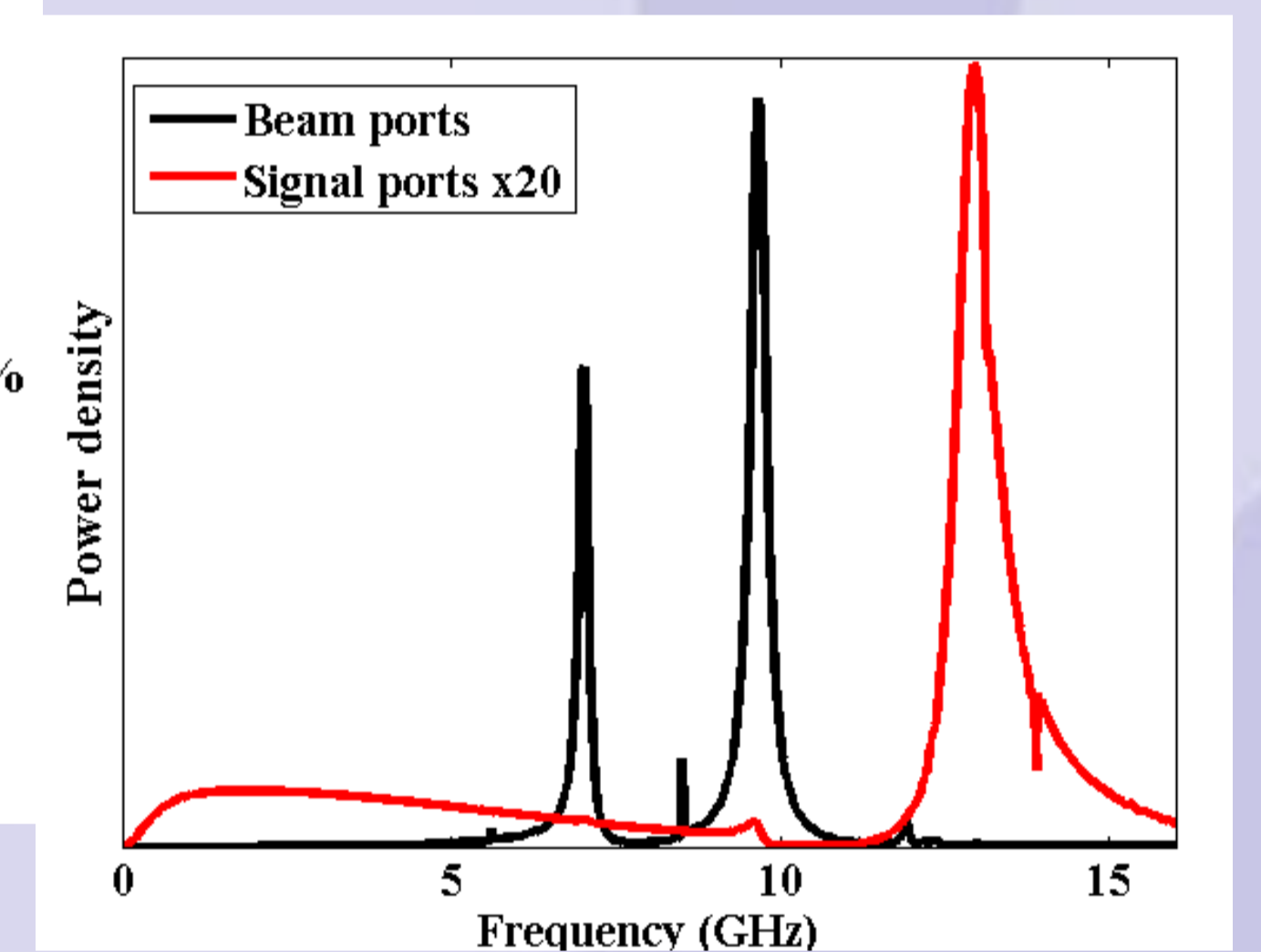
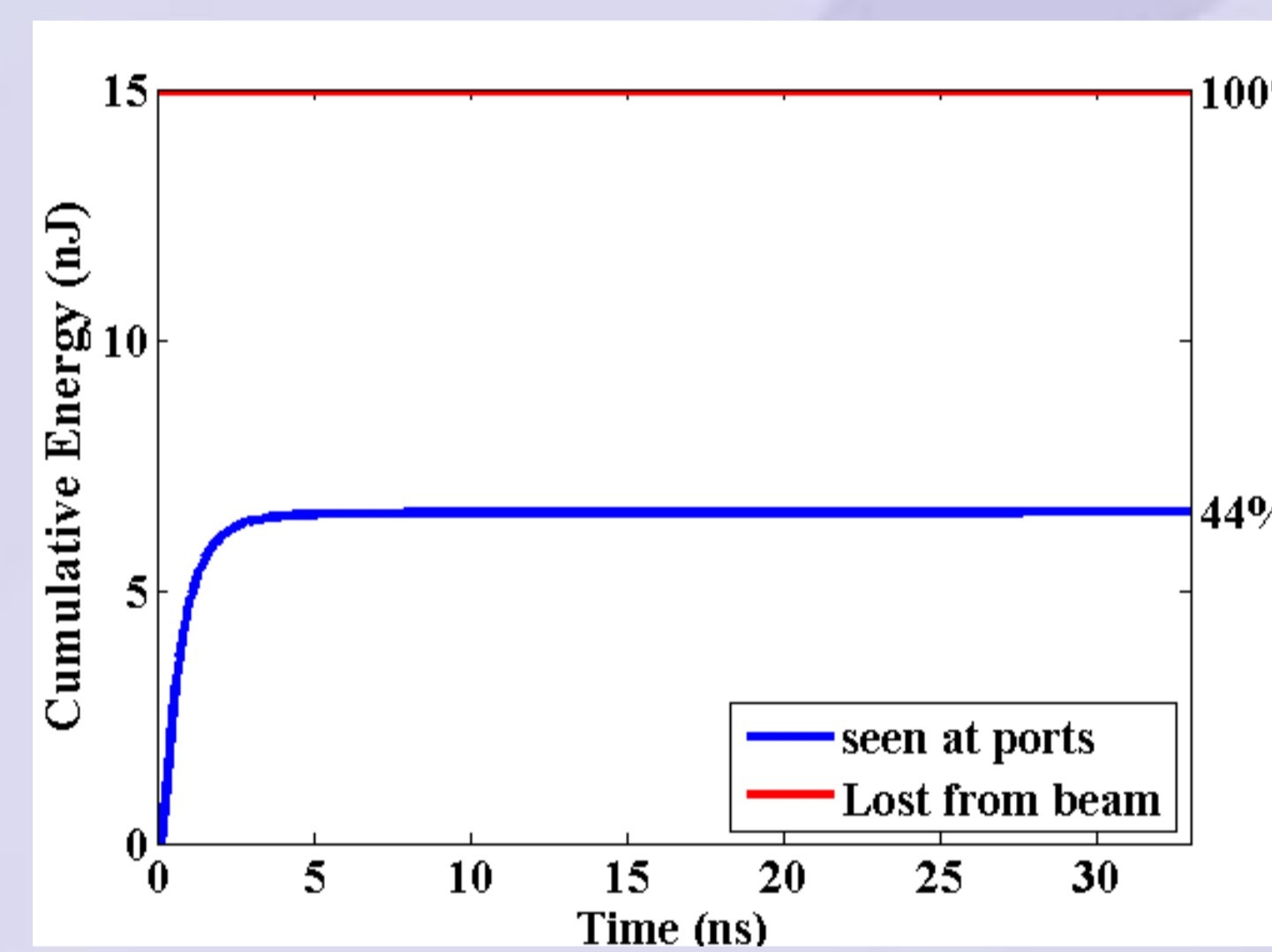
Thermal simulation

Repeat as needed

## Our example: A Diamond Light Source arc BPM

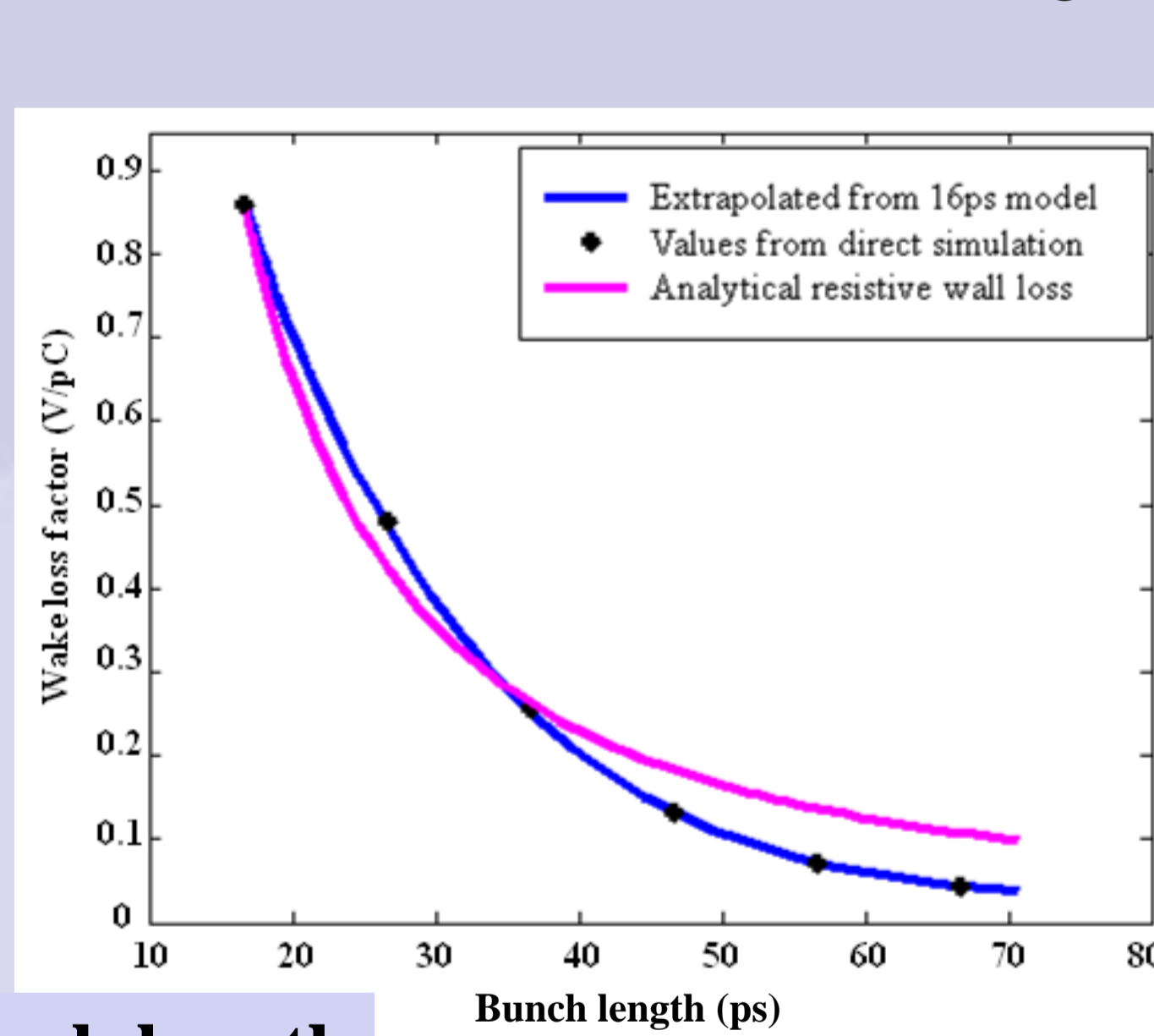


A large fraction of the energy leaves the structure and so does not contribute to heating

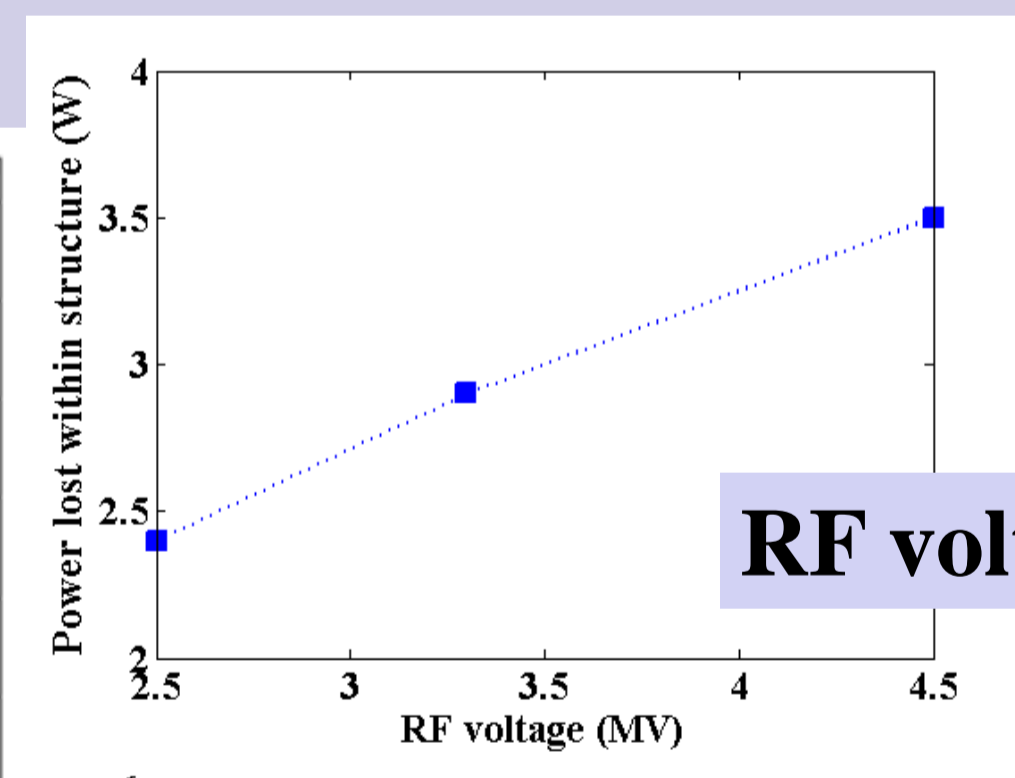


## Extrapolating to different conditions

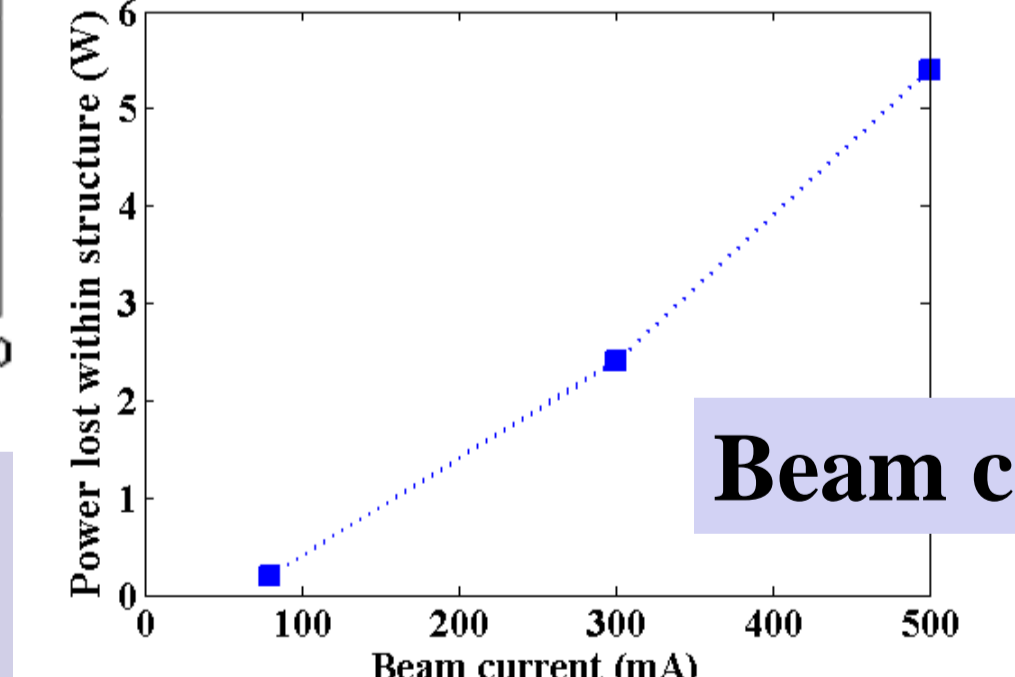
By combining the structure wake impedance with spectra for different beam conditions as a post processing step, many different machine conditions can be investigated.



Bunch length

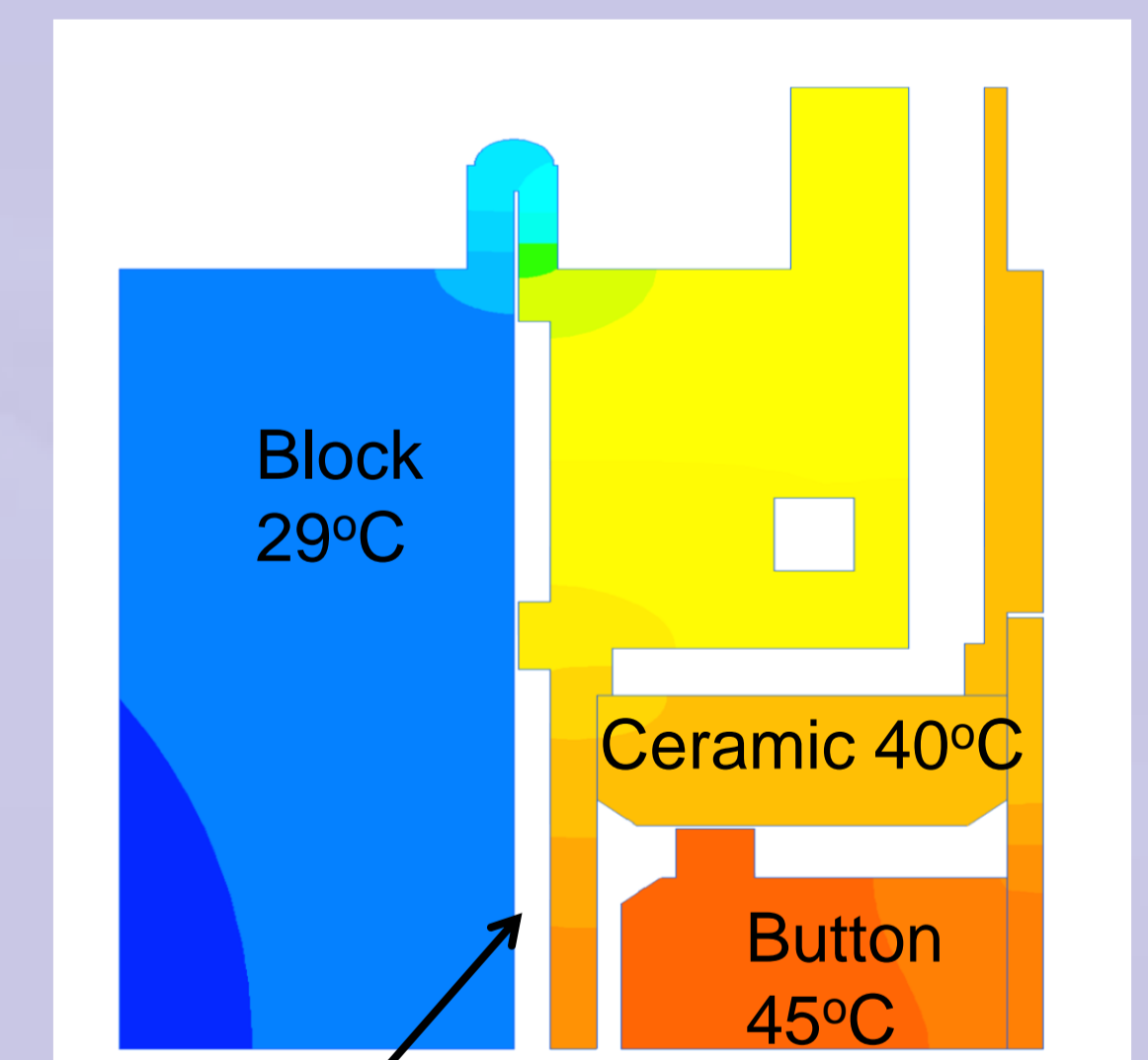
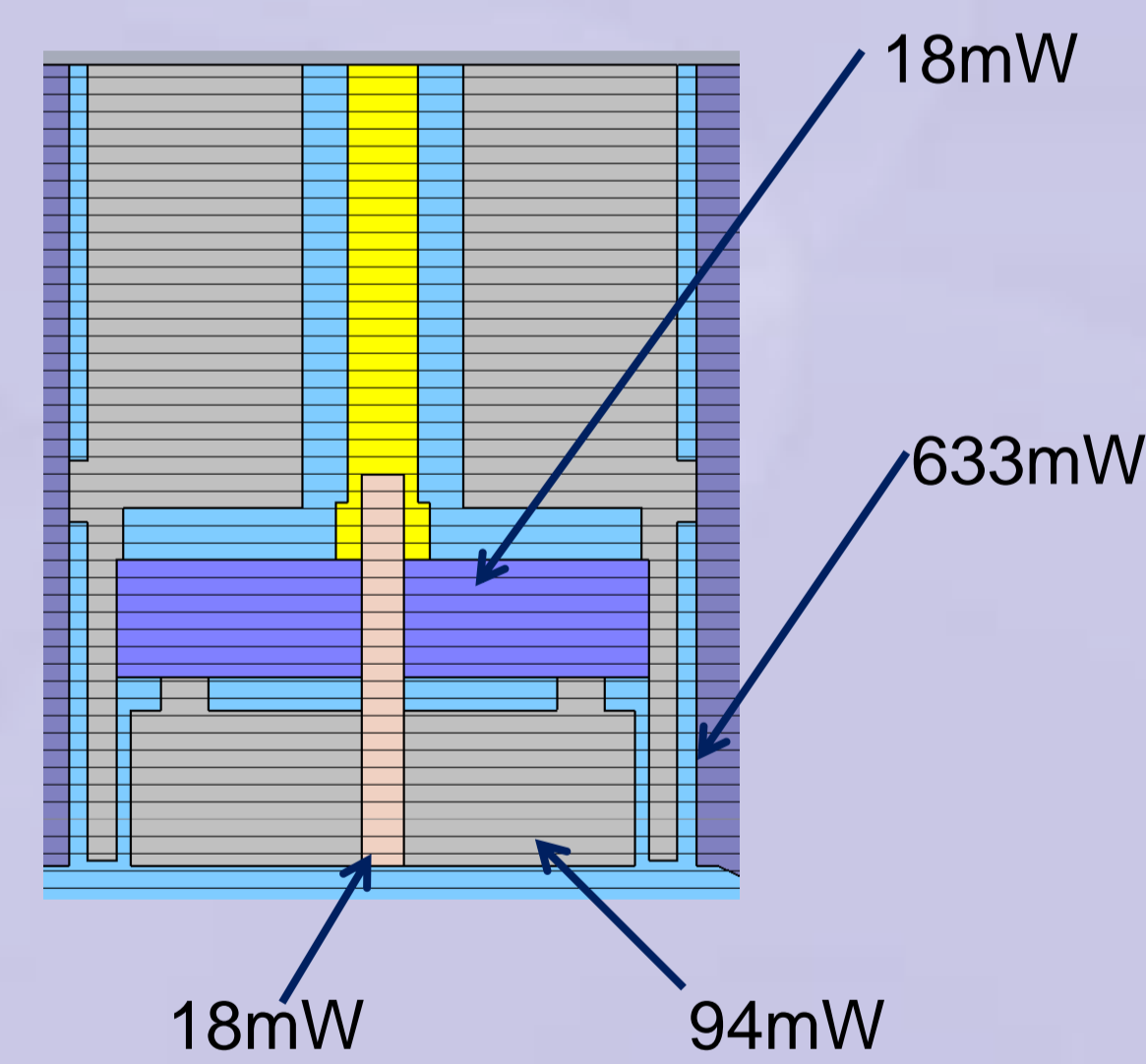


RF voltage



Beam current

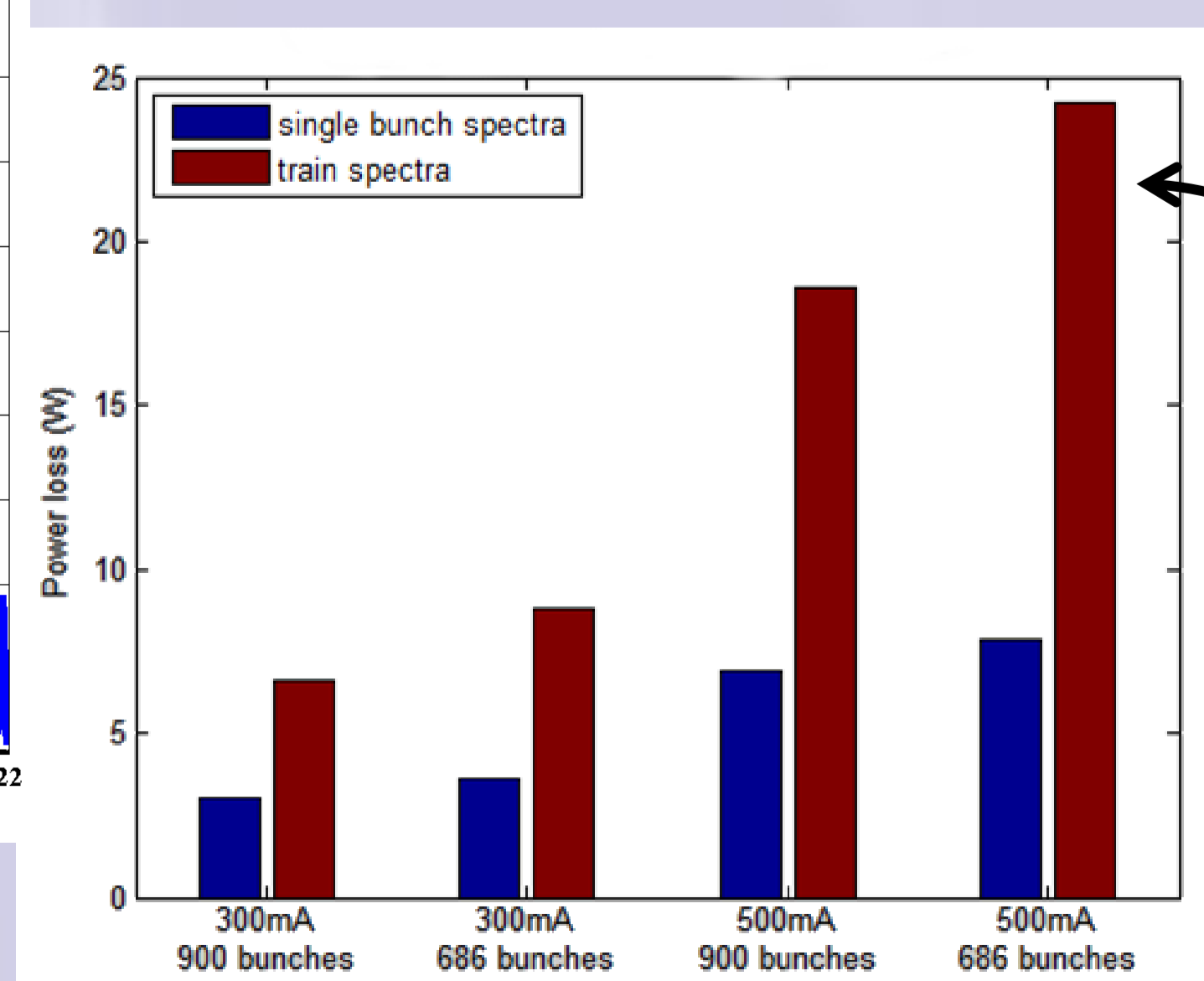
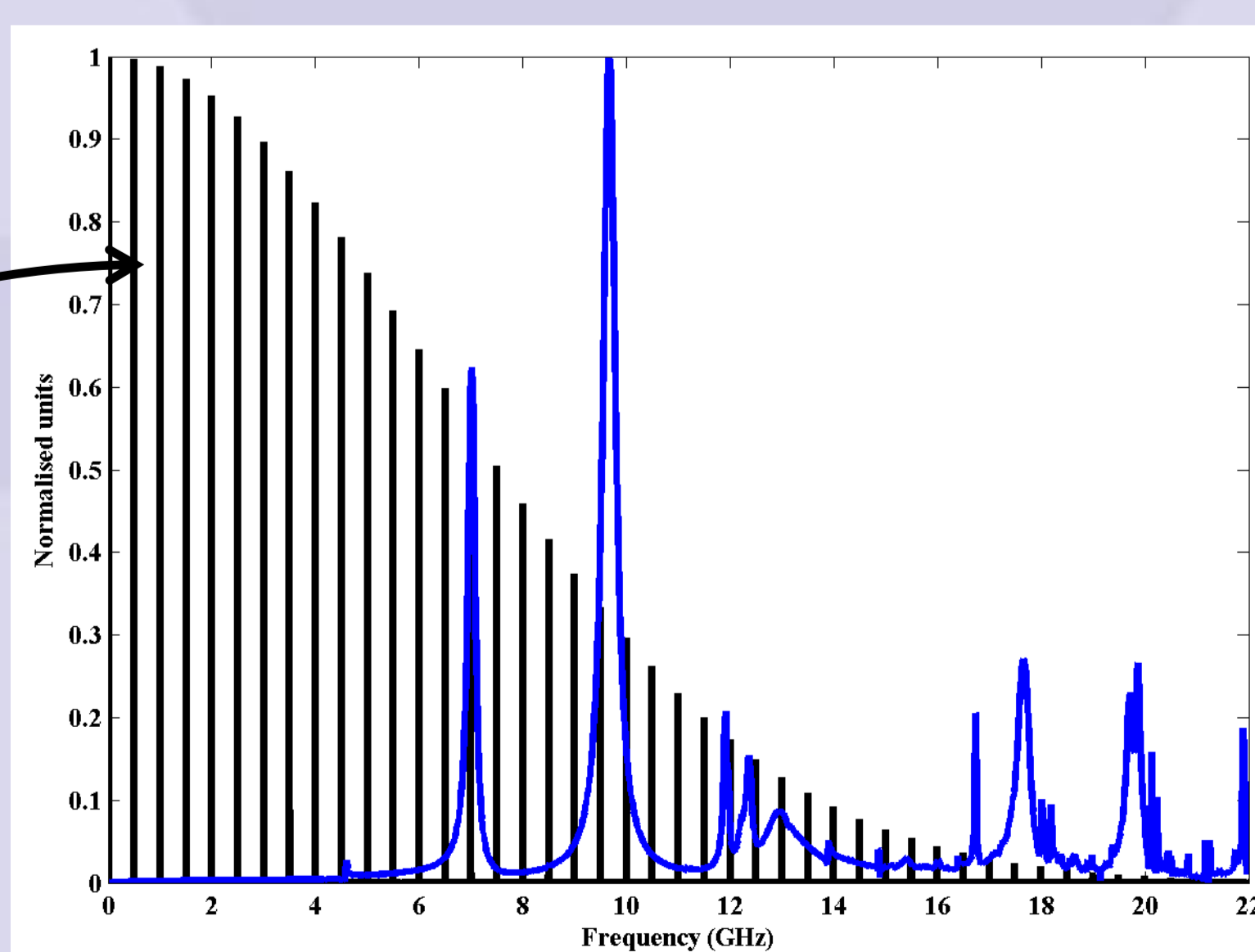
## Loss distribution in the button for normal run conditions



The vast majority of the power loss is due to the annular slot but the heating is not strongest there due to a good thermal connection with the mounting block

## A single pass is not enough

Spectra of bunch train



The behaviour when a bunch train is used rather than a pure single pass of one bunch can be very different