

# Cavity Simulator in FPGA

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(abridged)

Clocks at ~200 MHz in Xilinx 7Axxx  
8 cavity-controller pairs could fit on AC701?

m mechanical modes  
updated every 2m cycles

Mechanical  
eigenmode  
propagator

$$zy = My + d$$

resonator.v

m time-multiplexed complex  
values in eigen-coordinates

drive

position

Gaussian noise  
Environmental sources?

outer

outer\_prod.v

Piezo control

Virtual Piezo

V

outer

outer\_prod.v

$\Sigma$

Cavity electromagnetics simulator

Electromagnetic  
eigenmode  
propagator  
( $\pi$  mode)

cav\_mode.v

$v^2$

outer

outer\_prod.v

$\Delta\omega$

dot

dot\_prod.v

$\Sigma$

Beam timing

Drive

IQ

upconvert  
pair\_couple.v

Forward

Reflected

Probe

Outputs at IF  
updated every 10 ns

$\Sigma$

$\Sigma$

Electromagnetic  
eigenmode  
propagator  
( $8\pi/9$  mode)

cav\_mode.v

$v^2$

outer

outer\_prod.v

$\Delta\omega$

dot

dot\_prod.v

cav\_elec.v

to additional cavities