

# 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*

drive

position

Gaussian noise  
Environmental sources?

outer

*outer\_prod.v*

Piezo control

Virtual Piezo

V

outer

*outer\_prod.v*

$\Sigma$

Cavity electromagnetics simulator

Beam timing

Drive

IQ

upconvert  
*pair\_couple.v*

Forward

Reflected

Probe

Outputs at IF  
updated every 10 ns

Electromagnetic  
eigenmode  
propagator  
( $\pi$  mode)  
*cav\_mode.v*

$v^2$

outer

*outer\_prod.v*

$\Delta\omega$

dot

*dot\_prod.v*

Electromagnetic  
eigenmode  
propagator  
( $8\pi/9$  mode)  
*cav\_mode.v*

$v^2$

outer

*outer\_prod.v*

$\Delta\omega$

dot

*dot\_prod.v*

$\Sigma$

$\Sigma$

$\Sigma$

*cav\_elec.v*

m time-multiplexed complex  
values in eigen-coordinates

drive

position

to additional cavities