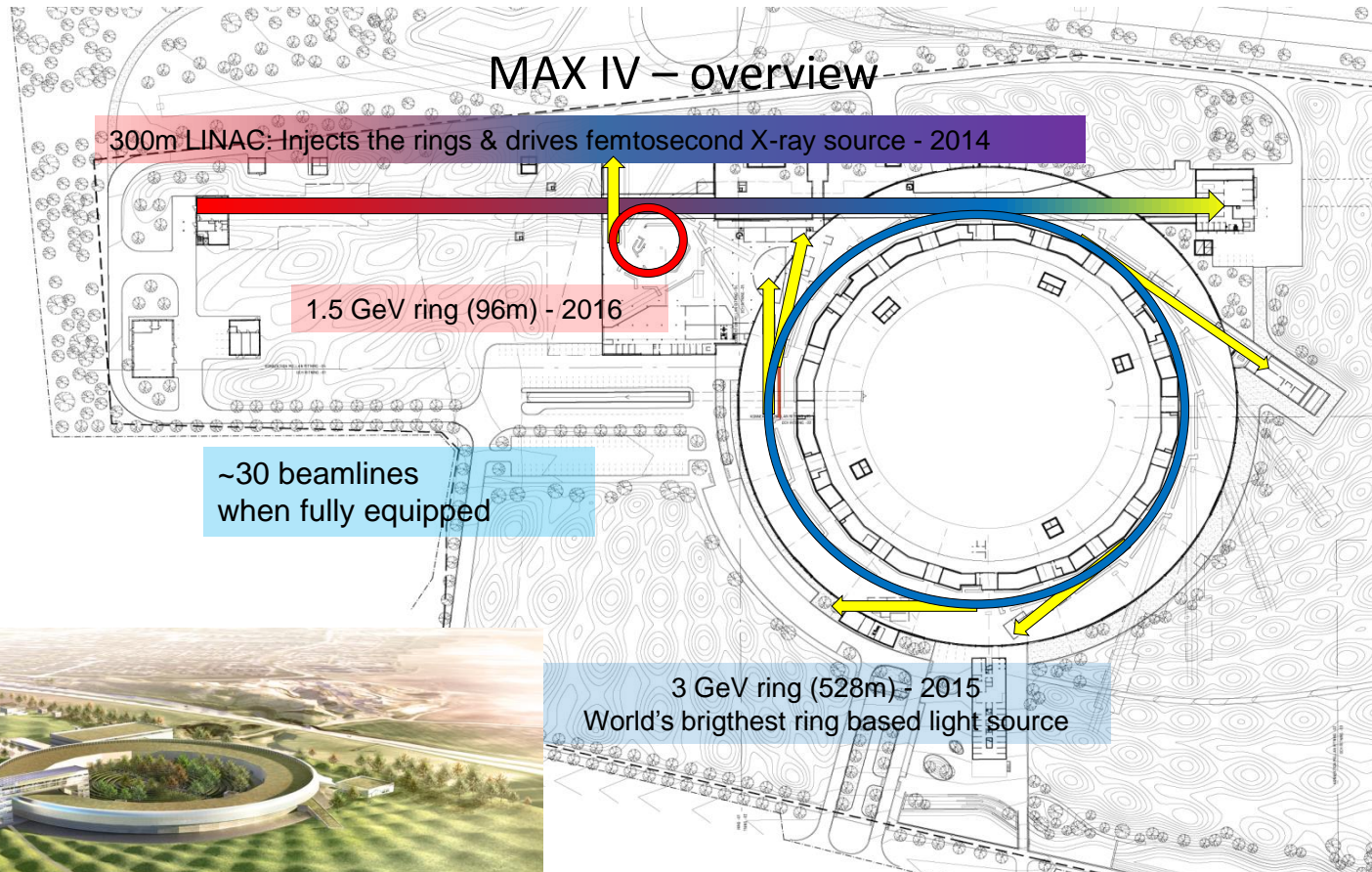


Status of the MAX IV RF systems



Outline

- MAX IV overview
- Status at construction site
- MAX IV - Linac
- MAX IV - Ring RF systems
- Ring RF – Cavities
- Ring RF – Power plants
- Digital low level RF
- BPM button sorting
- Chopper for ring injection



Inauguration June 21, 2016

Aerial View of the MAX IV Site



Photo Perry Nordeng 130903

Aerial View of the MAXIV 3 GeV Ring



Photo Perry Nordeng 130903

MAX IV Linear Accelerator



Klystron gallery

Photo Annika Nyberg 20130813



Linear accelerator

Photo Annika Nyberg 20130806

The design and installation of all S-band high power linac components will be covered by the talk of Dionis Kumbaro

Lars Malmgren, 17th ESLS RF Workshop Berlin, 18-19 September 2013

MAX IV Linac

The linac should be used as an injector for both the 1.5 and 3 GeV storage rings and the SPF (Short Pulse Facility)

18 klystrons

18 SLEDS

39 linac structures

Operating frequency 2998.5 MHz

Maximum rep. rate 100Hz

Maximum RF power 35 MW

RF pulse length 4.5 μ s

Linac length 250 m

1 klystron (7.5MW) feeding a thermionic RF gun used for ring injections

A photo cathode gun for the SPF

Operating beam energy 3 GeV

Max. on-crest beam energy 3.6 GeV

 **44% RF power redundancy**

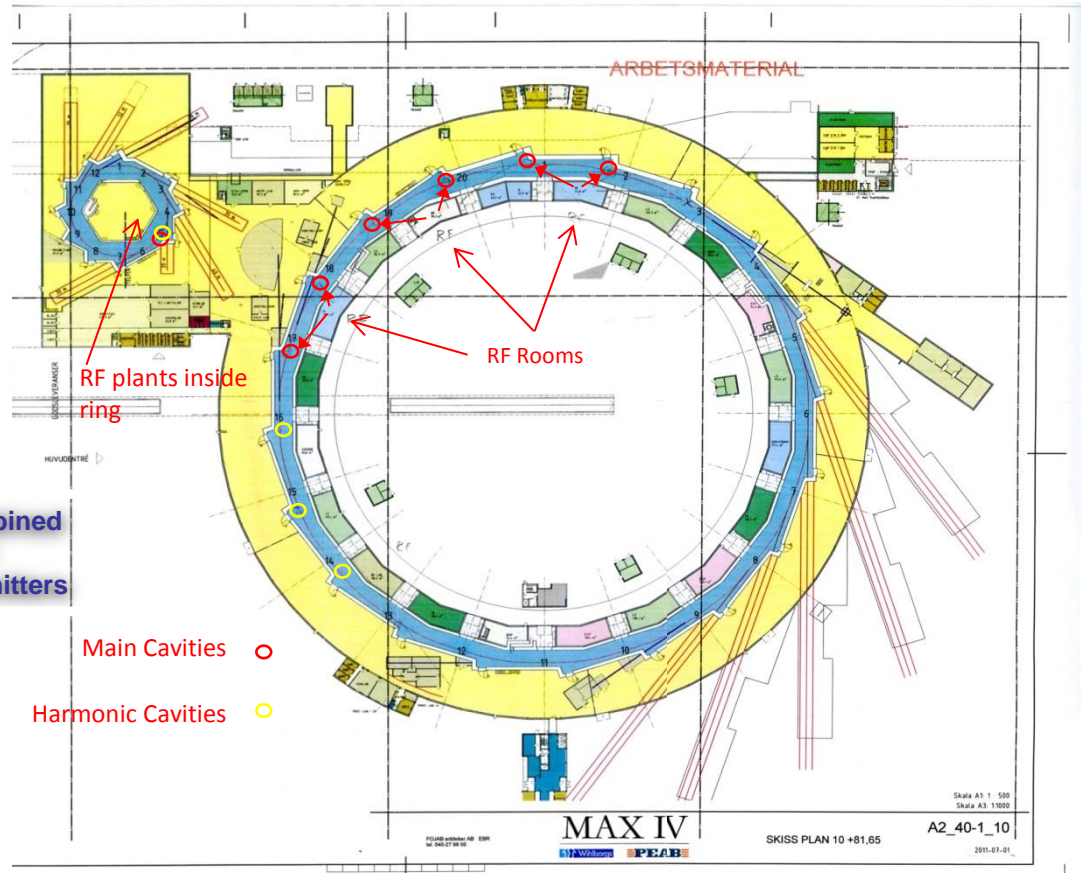
MAXIV Ring RF Systems

Storage Rings Parameters

Energy	1.5 GeV	3.0 GeV
RF	99.931 MHz	99.931 MHz
Circumference	96 m	528 m
Harmonic number	32	176
Current	500 mA	500 mA
No of cavities	2	6
RF station power	60kW	120kW
Cavity voltage	280kV	300kV
Coupling (beta)	2.3	4.0

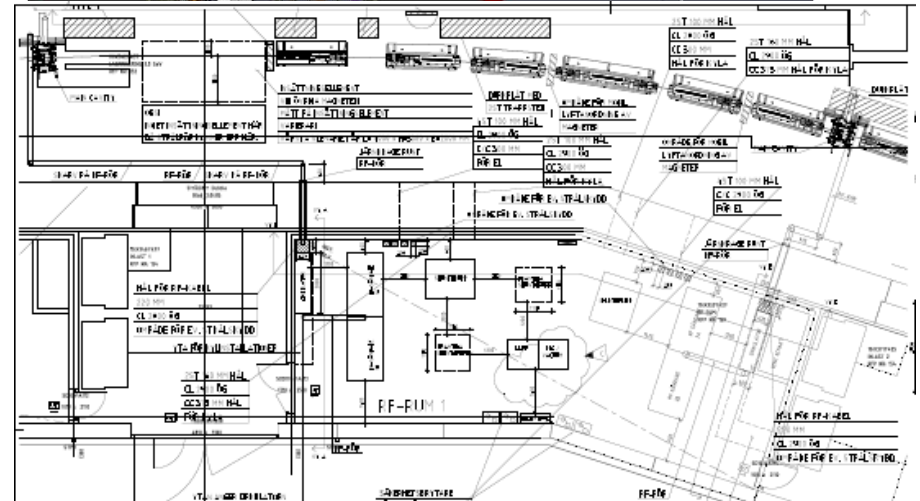
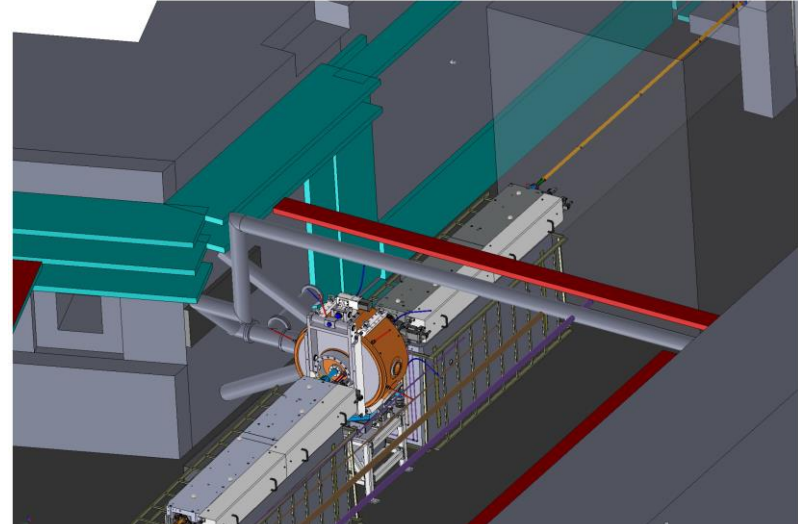
1 single 60 kW transmitters

2 combined 60 kW transmitters



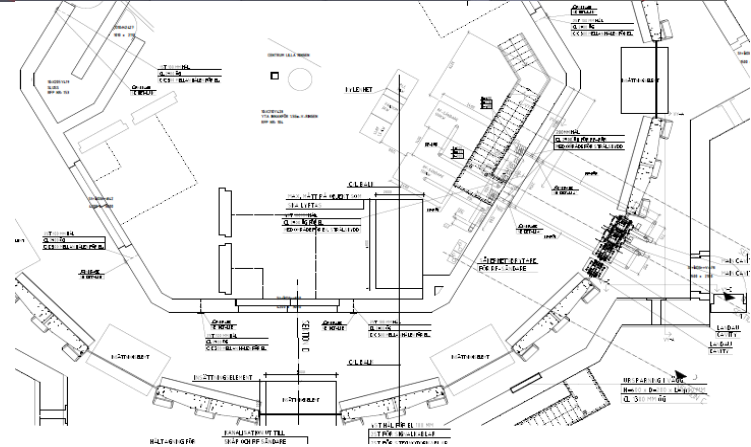
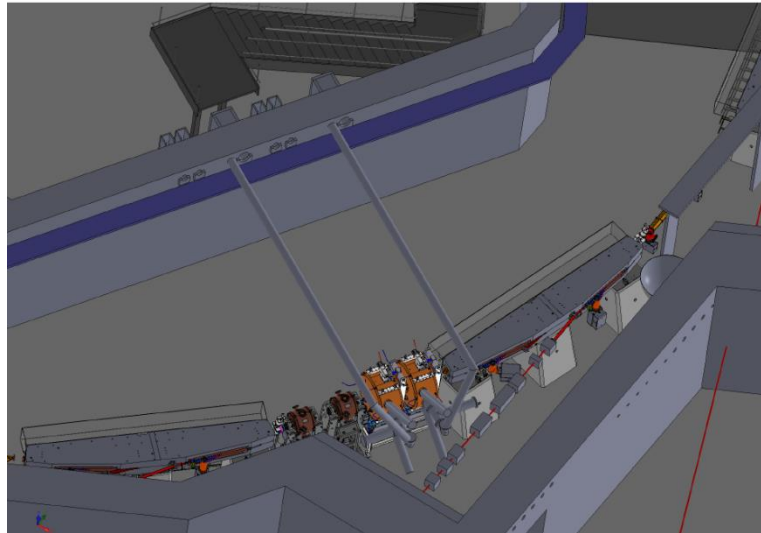
Ring RF Systems - 3 GeV Ring RF

- The main cavities are placed in the second short straight section of six consecutive achromats.
- Each RF-room contains two RF power plants.



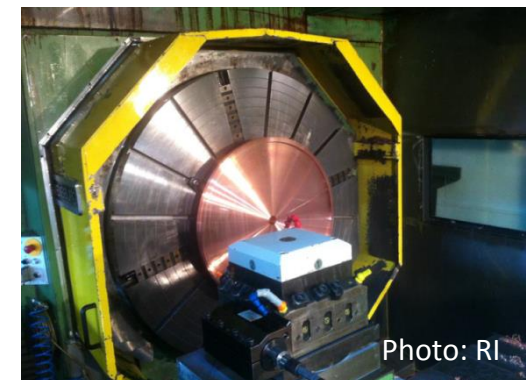
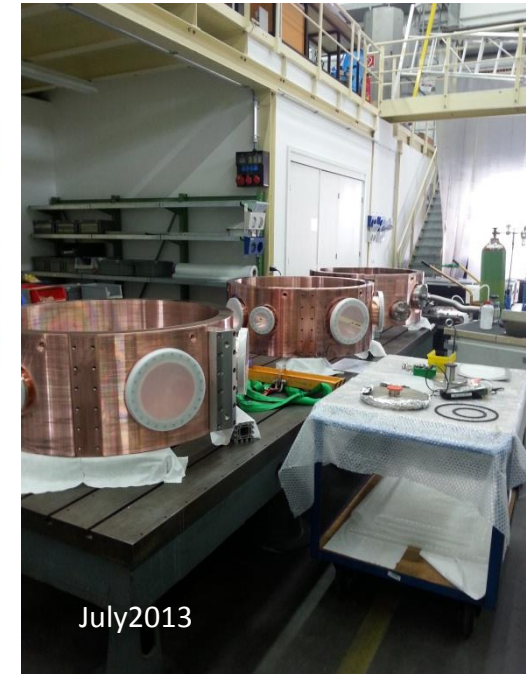
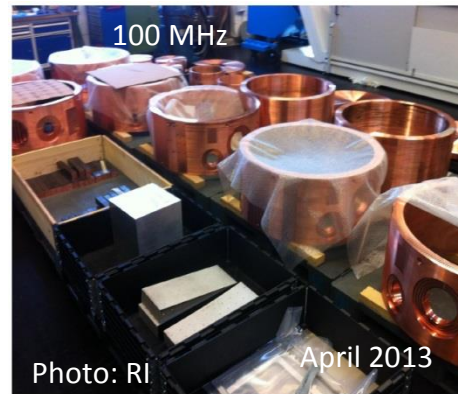
Ring RF Systems - 1.5 GeV Ring RF

- Two Main Cavities and two Harmonic Cavities occupy one straight section
- Two 60 kW Power Plants are placed inside the ring tunnel.



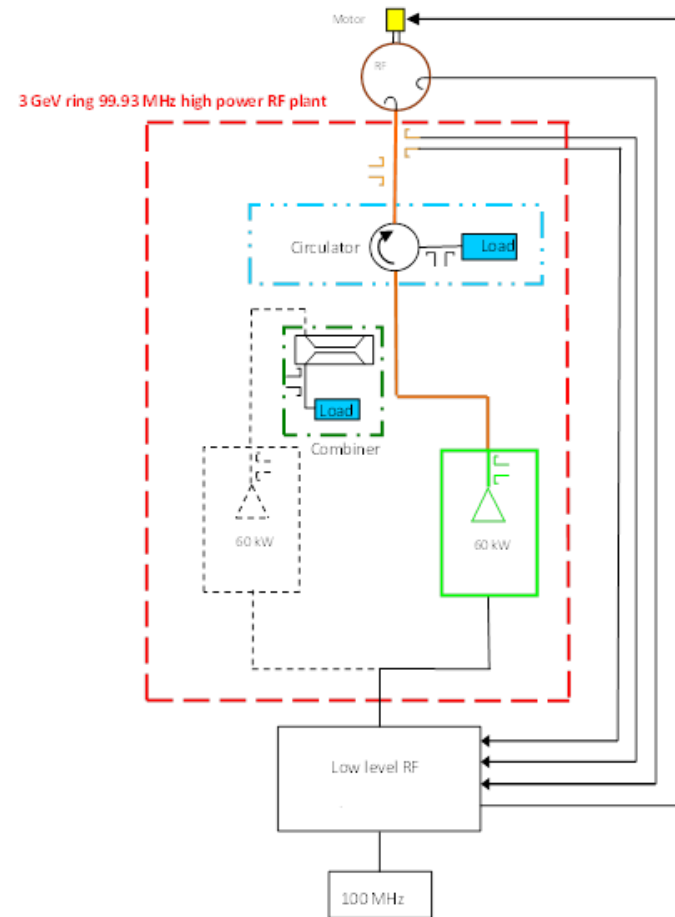
RF Systems - Cavities

- Cavity (100 and 300 MHz) production ongoing:
 - **Delivery in October – November 2013**
- Conditioning at Maxlab
- New cooling station ready for conditioning.
- Mechanical Parts for HC tuning system ordered – **Delivery November 2013.**



Ring RF Systems – High Power Plants

- **Positive decision** on Transmitter procurement appeal.
- Contracts signed for
 - Transmitters (Electrosys, Italy)
 - Circulators (AFT, Germany)
 - Transmission Lines and Integration Work (Exir Boadcasting AB, Sweden)
- **Delivery of First Transmitter: March 2014**
- **Full Delivery: August 2014**



Ring RF Systems – High Power Plants

- Thales 60 kW CW Tetrode Tubes TH 595
- Switched Mode High Voltage PS
- >60% overall power efficiency

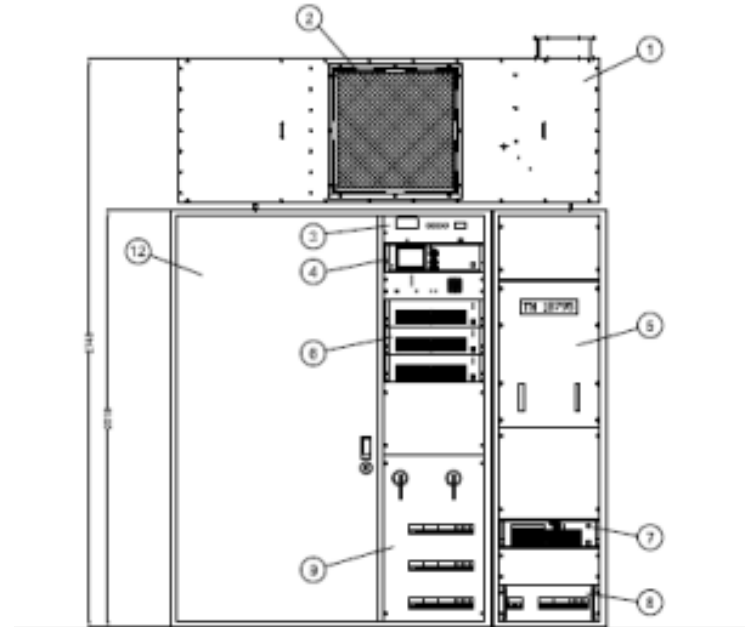


Image: Electrosys

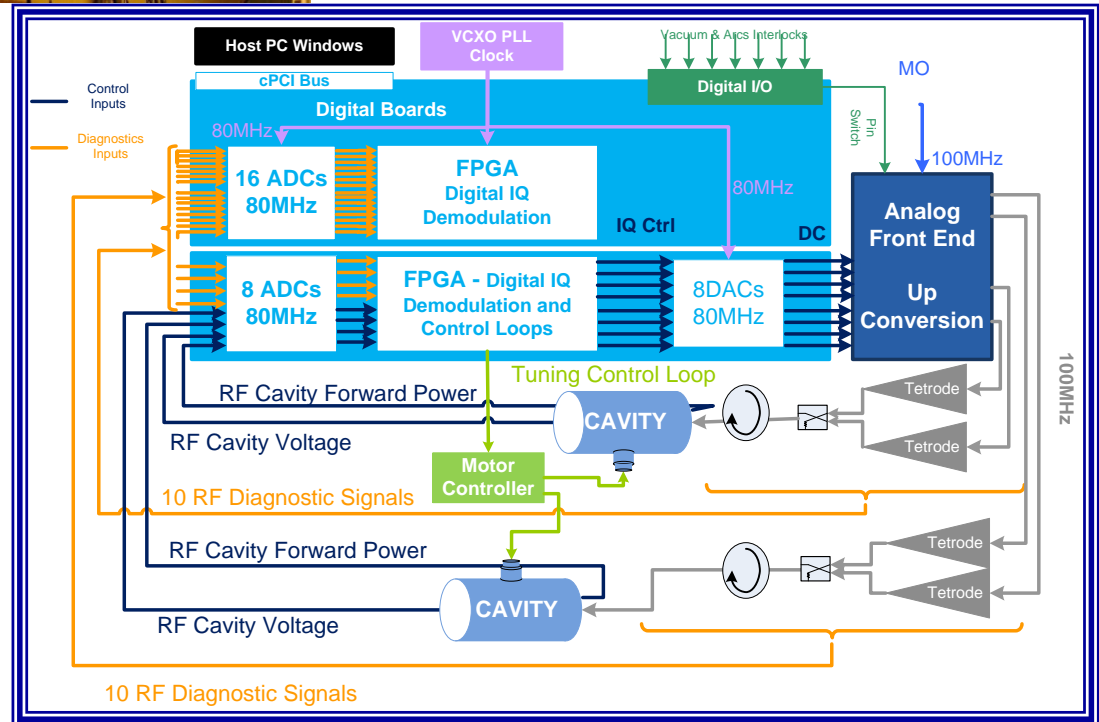
Digital Low Level RF

Design by Angela Solom
GUI by Antonio Milan



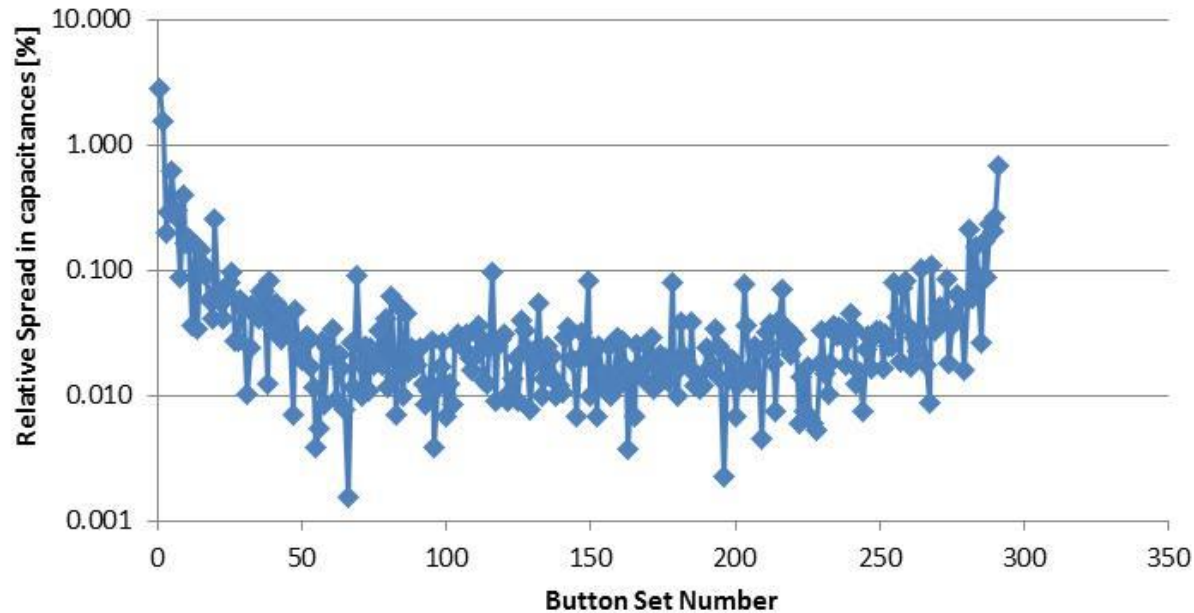
	Resolution	Bandwidth	Dynamic Range
Amplitude Loop	< 0.5% rms	< 10kHz	30dB
Phase Loop	< 0.5° rms	< 10kHz	360°
Tuning	< $\pm 1^\circ$	< 1kHz	< $\pm 75^\circ$

- Parts for series production of the remaining four digital LLRF systems are delivered.
- Possible upgrade to new FPGA platform under consideration. Tests will be performed in **October**.



Vacuum Systems – BPM Button Sorting

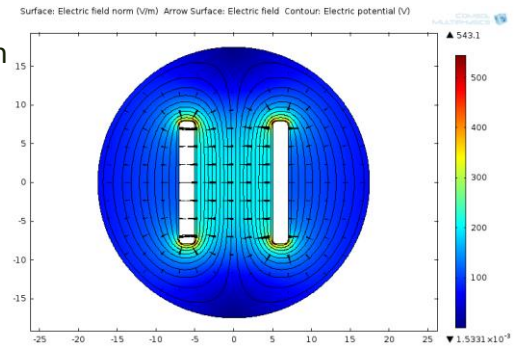
$(\text{MAX}-\text{MIN})/\text{Avg} \text{ [\%]}$



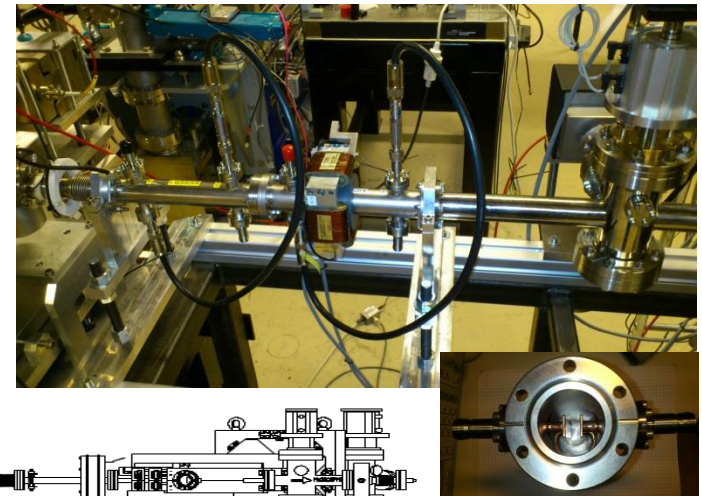
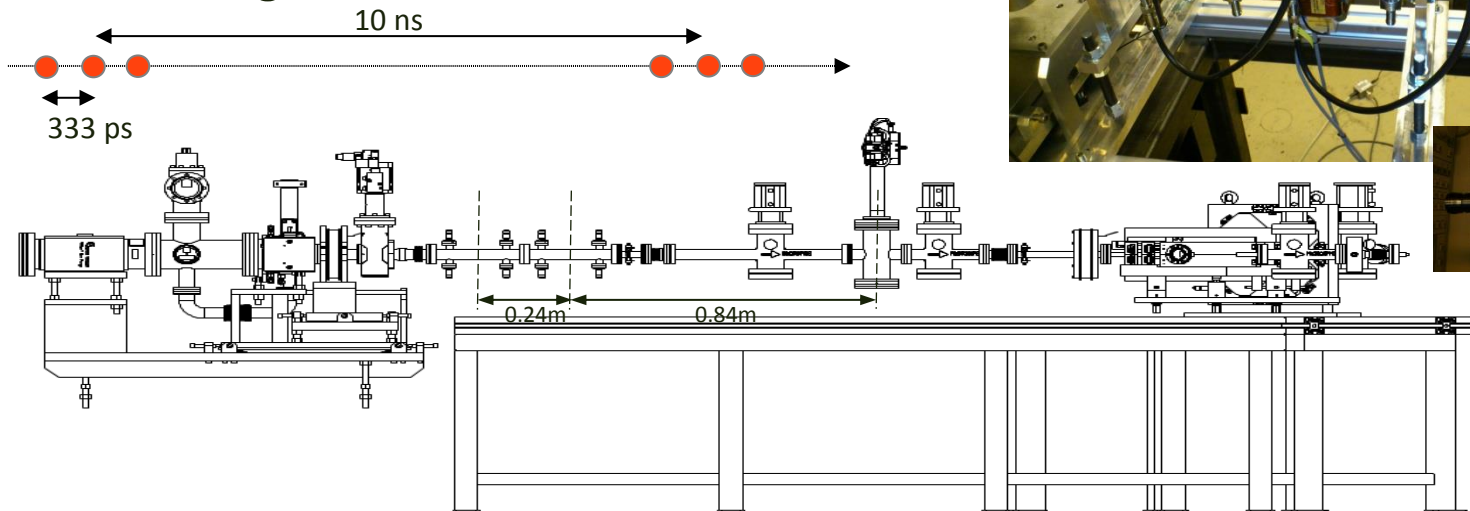
Chopper for Ring Injection

- Has two identical vertical kickers.
- The kickers consist of a 15 cm long stripline pair with a characteristic impedance of $50\ \Omega$ for odd TEM modes.
- Both electrodes are fed by RF
- An aperture is located downstream. The unwanted bunches will be dumped here.
- The aperture can be selected so the wanted bunches either passes a 1 mm iris, a 2 mm iris, or over an edge.

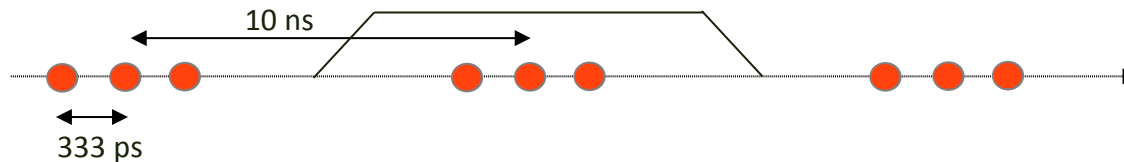
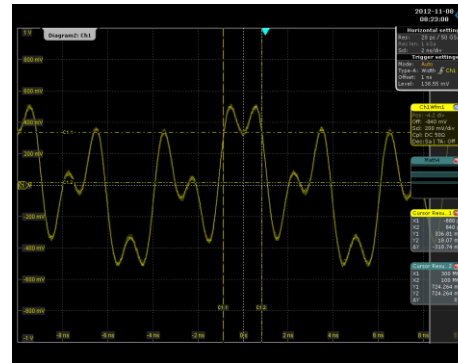
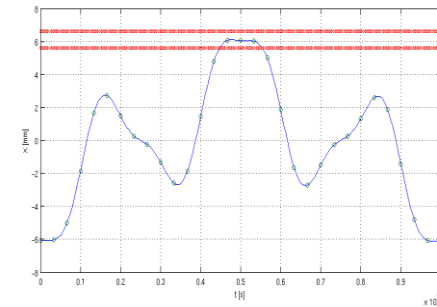
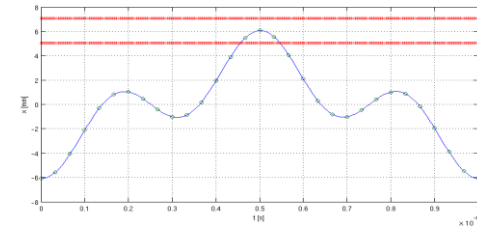
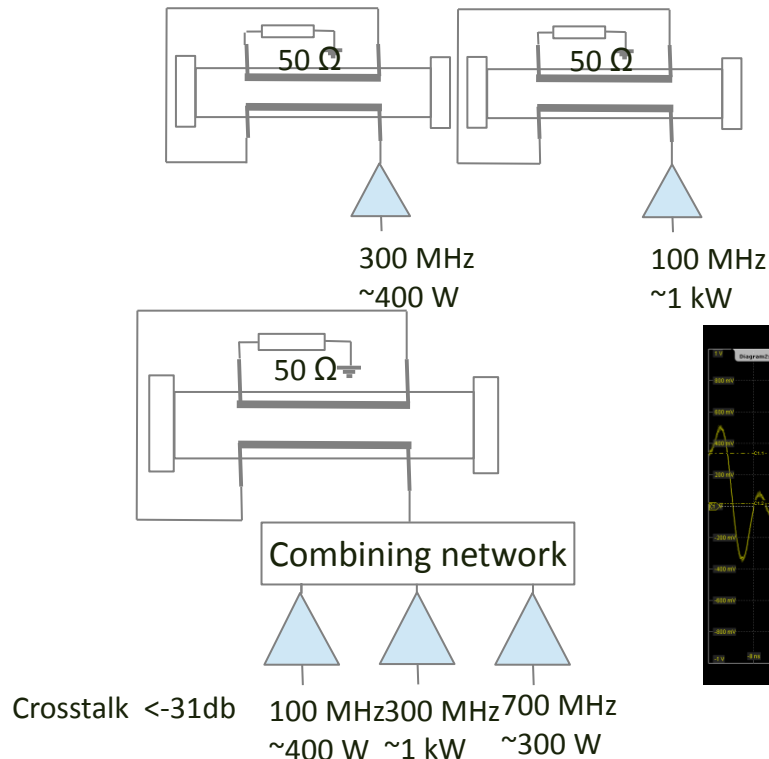
2 D design



$$\begin{aligned} \text{If } \phi_1 &= -\phi_2 \rightarrow Z_0 = 49.9\ \Omega \\ \text{If } \phi_1 &= 0 \rightarrow Z_0 = 63.8\ \Omega \\ \text{If } \phi_1 &= \phi_2 \rightarrow Z_0 = 88.2\ \Omega \end{aligned}$$



Kicker system for ring injection



Thanks for your attention
Questions?