NEW PC-BASED CONTROL FOR THE RF SYSTEM AT INFN-LNS

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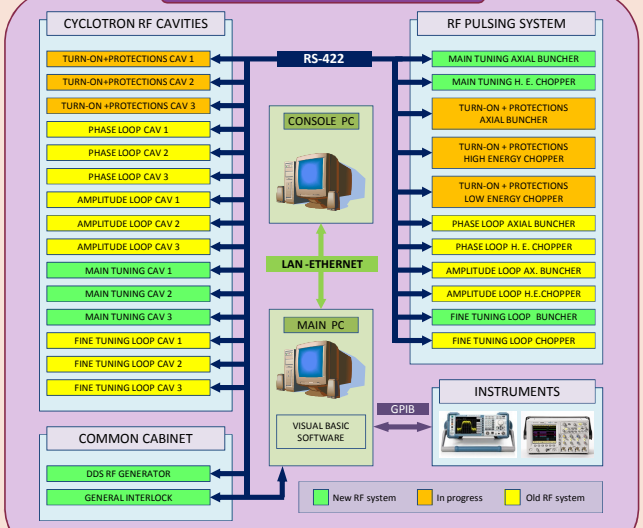
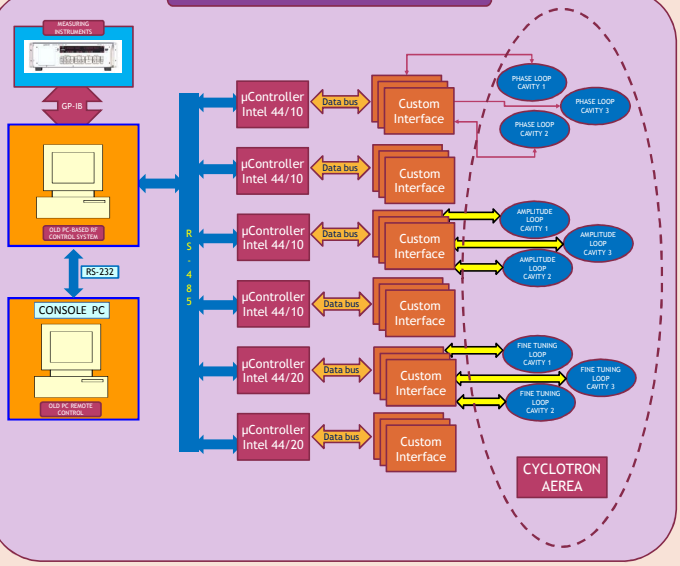
NEW RF CONTROL SYSTEM ARCHITECTURE



OLD RF CONTROL SYSTEM ARCHITECTURE



RF GENERATOR BASED ON DIRECT DIGITAL SYNTHESIZER

DDS GENERATOR RESOLUTION

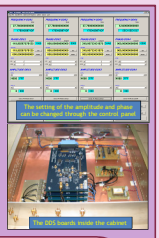
The core of the DDS generator is based on the µchip AD9854. The frequency resolution is 48 bit, the system clock is 300 MHz. The amplitude and phase resolutions are related to the bit conversion only. 14 bit for the phase and 12 bit for the amplitude give

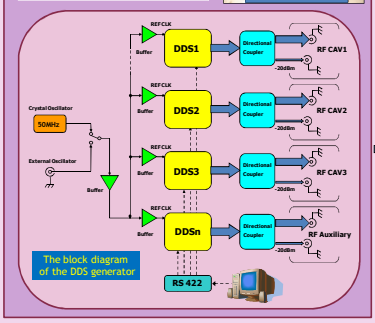
$\Delta\Phi = 2\pi/2^{14}$, $\Delta V = V_{max}/2^{12}$, $\Delta f = f_0 - f_{output}$

Δf=0.394µHz

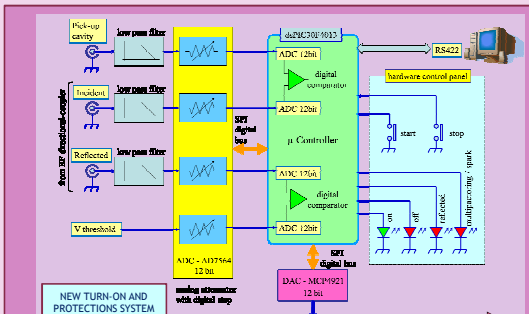
ΔΦ=0.02°

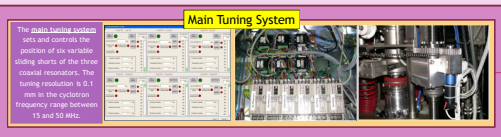
ΔV=43µV.

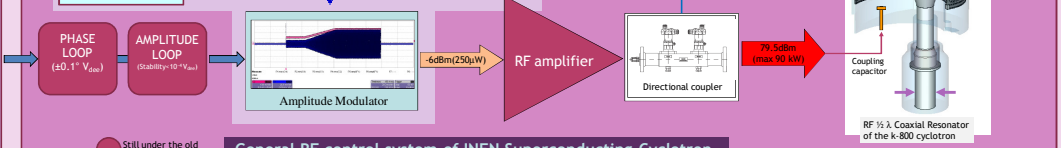




The block diagram of the DDS generator

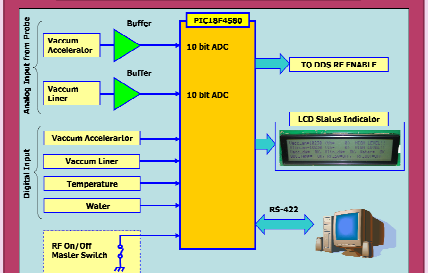


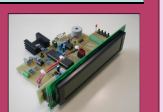




General RF control system of INFN Superconducting Cyclotron

THE GENERAL CONTROL INTERLOCK SYSTEM





The control electronic board and the PC-unit control panel

SUPERCONDUCTING CYCLOTRON

The cyclotron resonators

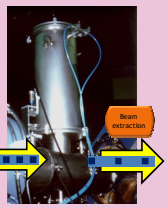
- Frequency range 15-50 MHz
- λ/2 coaxial resonator, connected at the centre by the Dees
- Sliding short movement between 0.85-3.5m.
- V_{max} 100 kV
- 120° phase difference between the dees, h=2
- Phase stability ± 0.1°
- Amplitude stability better than 0.01%
- Vacuum in the Dees area 10^{-7}mbar
- Alumina insulator
- Coupling capacitor to feed the power (2-5pF)
- Trimming capacitor for the fine tuning
- Short circuits 50A/cm (spherical contact)
- Q_{factor} = 4000-5000
- R_{shunt} = 181 kΩ (27.5 MHz, 22kW)

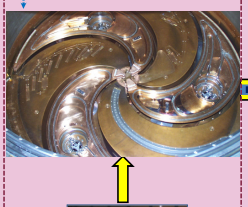
Superconducting Cyclotron

Bending limit	K=800
Focusing limit	Kfoc=200
Pole radius	90 cm
Yoke outer radius	190.3 cm
Yoke full height	286 cm
Total weight	176 tons
Min-Max field	2.2-4.8 Tesla
Main coil	6.5 10⁶ At
Sectors	3
Min. hill gap	8.6 cm
Max valley gap	91.6 cm
Trim coils	20
Dees	3
RF range	15 - 50 MHz
Operating harmonics	1,2,3,4
Peak dee voltage	100 kV

The high energy chopper

- Frequency range 4.5 - 9MHz
- V_{dee} 70kV, V_{trig} 12-14kV
- Q_{factor} = 450 (loaded)
- separation time 400-200ns
- L-C lumped element
- inductive coupled
- water cooled coil
- R_{shunt}= 190kΩ @ 14kV, 500 W





The axial buncher

- Drift tube solution inside the CS yoke
- ½ meter from median plane
- Frequency range 15-50 MHz
- Electrode length 41 mm, L=2πR/2h
- Efficiency measured 3.5-4.5
- Extracted beam bunch = 1ns FWHM
- V_{dee} 1500 V - P_{max} 150 W
- Vacuum environment.

The future Chopper-500

- Maximum Peak Voltage 200 kV
- Frequency range 65-110 MHz
- Qo 6000-9000
- R shunt 450-720 kΩ
- Power dissipated 27-45 kW
- VSWR < 1.1
- Coupling capacitive
- Input impedance 50Ω on 3"⅛

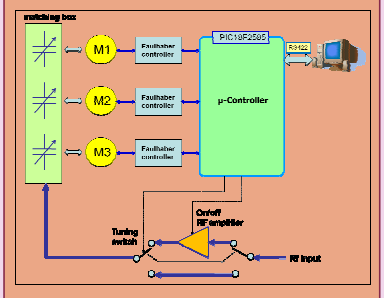
Beam Injection

The low energy chopper

as beam attenuator
Frequency 1-10 kHz
Duty cycle 0-100%
V_{max} 1500 V_{pulse}

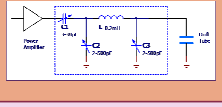
RF devices along the beam line

AXIAL BUNCHER TUNING AND MATCHING BOX



Control panel

Matching box



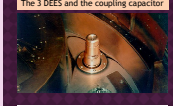
2009 ICALEPCS

INFN-LNS General Layout

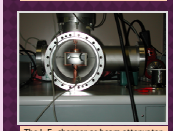
The 15 MV Tandem

K-800 superconducting cyclotron

The 3 DEES and the coupling capacitor

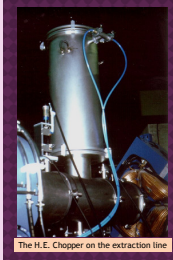


The coaxial 6th/4 directional coupler



The L.E. chopper as beam attenuator

The axial buncher drift tube



The H.E. Chopper on the extraction line

The chopper-500 work progress