Energy Upgrade Working Group Summary

Lattice (G.Benedetti)

IR Design (S.Temnykh)

Dipole (C.Ligi and R.Ricci)

Energy measurement (M.Placidi)

Ramping (C. Milardi)

On Energy injection (R.Boni)

DAFNE2

Specifications

Upgrade of DAΦNE from the present energy of 1.02 GeV c.m. up to and above the neutron-antineutron threshold, 2-2.4 GeV c.m., using the existing systems and structures.

Luminosity ~ 10^{32} cm^{-2} s^{-1}

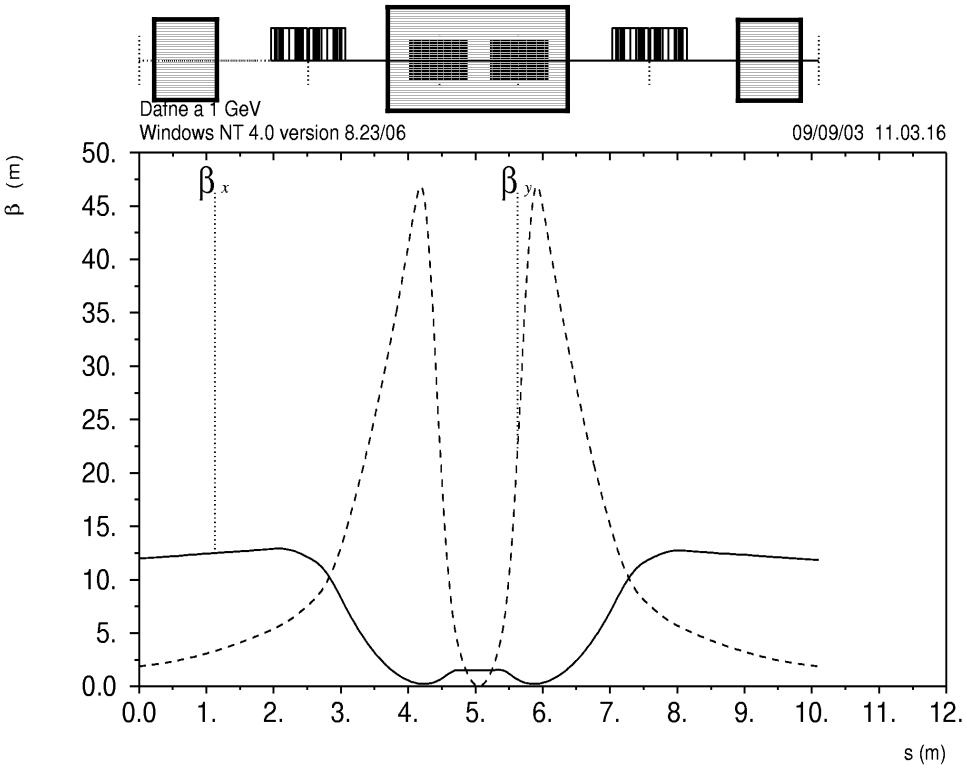
Compatibility with present operation at Φ

WHAT CAN BE USED FROM DAΦNE

- DAFNE2 can exploit DAΦNE hardware:
  - vacuum chamber
  - all quads and sexts
  - RF cavity
  - Feedback, vacuum system...
- But needs new:
  - stronger bending dipoles
  - 4 SC quads in IR2

IR2 BETA FUNCTIONS

- β_x =2.5 *m* and β_y =2.5 *cm*, already achieved at DAΦNE
- FF DFFD FF quad sequence



RF SYSTEM

	DAFNE2	Limit value
RF peak voltage V_{RF}	250 *kV*	350 *kV*
RF frequency f_{RF}	368.26 *MHz*	
Energy loss $U_{rad}+U_{paras}$	83.5 +6.5 *KeV/turn*	
RF power $P_{beam}+P_{wall}$	40.5 + 17.5 *kW*	150 *kW*
Synchr. frequency f_{syn}	11.7 *kHz*	

- The existing RF system is completely compatible with the required specifications

- Vacuum system
  - DAFNE2 ($I_{\mathbf{tot}}$=0.45 *A*) synchrotron radiated photon flux is $1.8 \cdot 10^{20}$ phot/s corresponding to a power of 38 kW
  - Existing vacuum chamber is designed for P_{synch} = 50 kW

- Feedback
  - Existing systems OK if betatron and synchrotron tunes stay constant during the ramping

Dipoles

e^+/e^- Energy	510 MeV	1.1 GeV
Bρ	1.7 T m	3.7 T m
Nominal Field	1.214 T	2.4 T
Bending Radius	1.400 m	1.530m
Nominal Current	262.8 A	150 kA-turns
Current Density	2.5 A/mm^2	8.4 A/mm^2
Magnet Gap	75 mm	70 mm

- increase the dipole iron yoke

Dipoles - OPEN POINTS in ongoing design

- CURRENT DENSITY (8.4 A/mm^2)
- FIELD QUALITY ($\Delta B/B = 9\ 10^{-4}$)
- GOOD FIELD REGION (± 20 mm)
- STRAY FIELDS (500 G @ 1 m)
- FRINGING FIELDS (unknown)

Dipoles - OPEN POINTS

Permendur (Hyperco 50 A)

Saturates at a higher field than iron

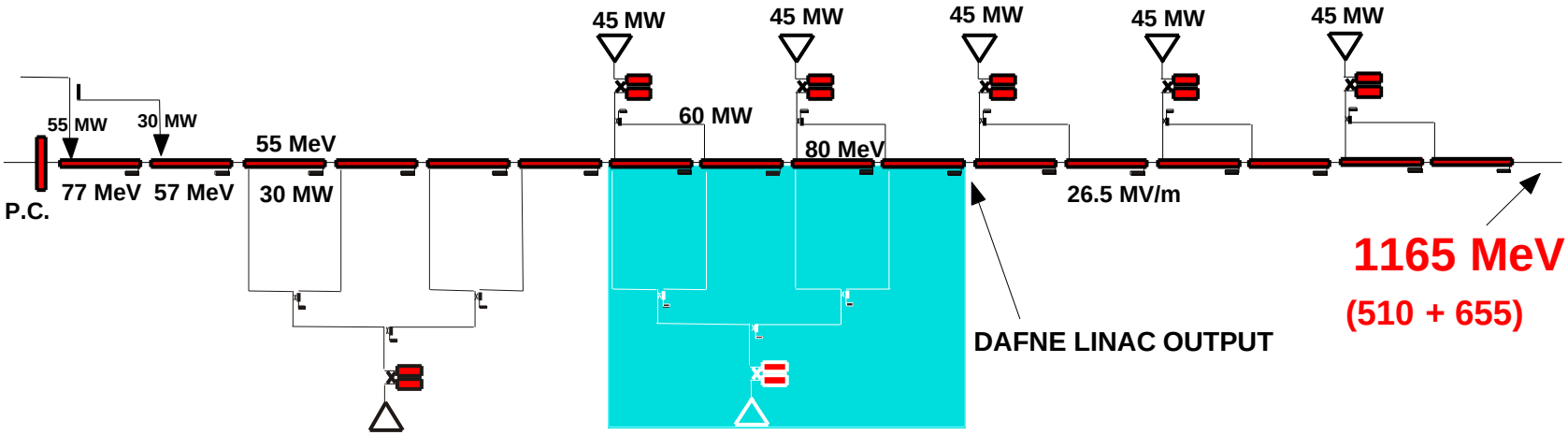
With permendur pole tips would require

- Less current
- Better field quality

Material	B_{sat} [Tesla]	Coercitive Force [Amp/m]
Hiperco 50A	2.40	79.6
Pure Iron	2.15	79.6
1008 Steel	2.09	64

Injection - Full Energy

DAFNE2 - LINAC UPGRADE
Mixed version



EXTRA-LENGTH = 21 mt

EXTRA COMPONENTS

- 6 Acc. Sections
- 4 SLEDs
- 4 Power Stations
- Waveguides + accessories
- Vacuum - Magnetics - Cooling - Controls etc ....

Injection

DOUBLING THE DAFNE-LINAC ENERGY IS FEASIBLE AT MODERATE COST but ……..

1. **The EXISTING WAVEGUIDE-NETWORK MUST BE PARTIALLY *RE-ARRANGED***

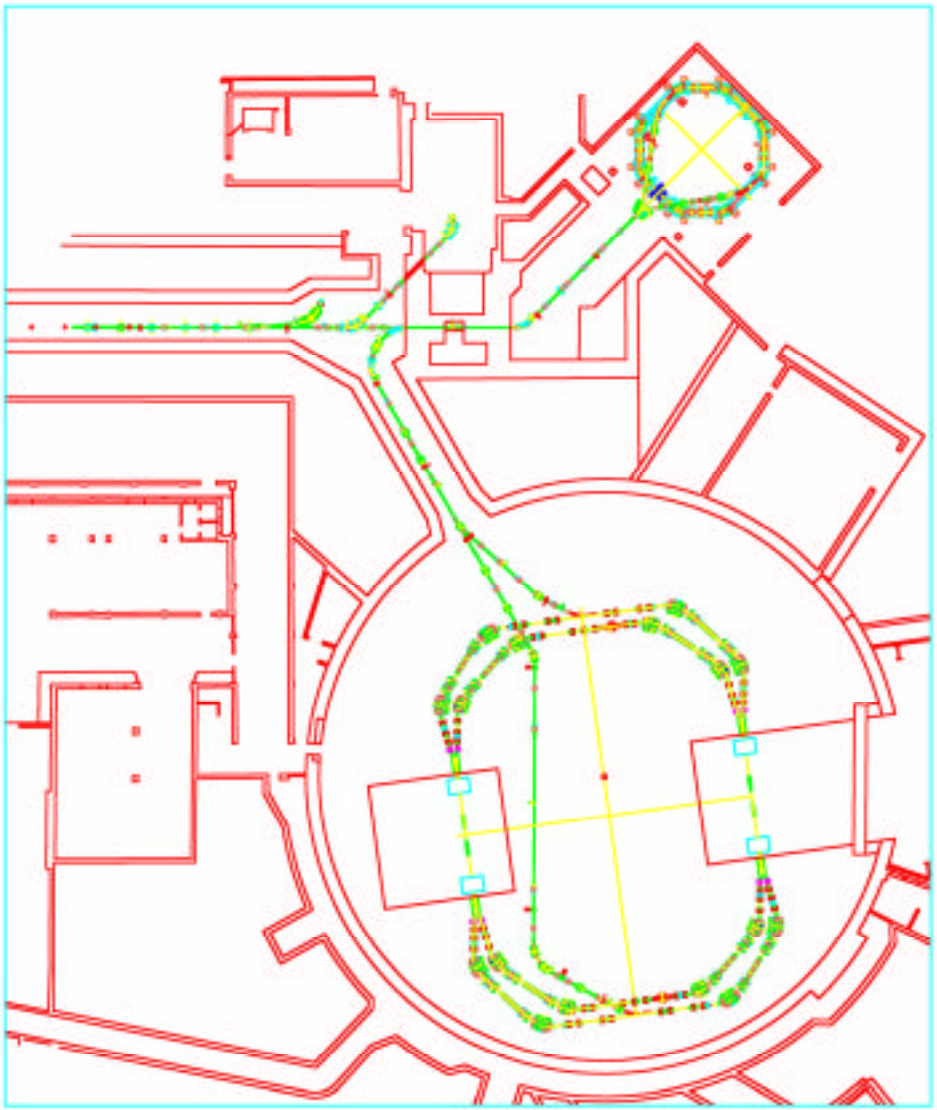
2. **The DC POWER SUPPLIES and other EQUIPMENT MUST BE *RE-POSITIONED* in the KLY GALLERY**

3. **The EXISTING LOW CURRENT ACCELERATING STRUCTURES NEED *NEW BAKE-OUT* and *NEW RF CONDITIONING*.**

   ***NEW INTERNAL CLEANING* MAY NOT BE EXCLUDED " *a priori* ".**

Injection - Ramping

With the existing injection system



Injection - Ramping

... there is no problem implementing energy ramping for DAFNE II

Inject and ramp time << beam lifetime at 1.1GeV

All of the PS can be reused

It simply requires:

- High Level Software development
- careful hardware configuration.

Superconducting IR Quadrupoles

Requirements

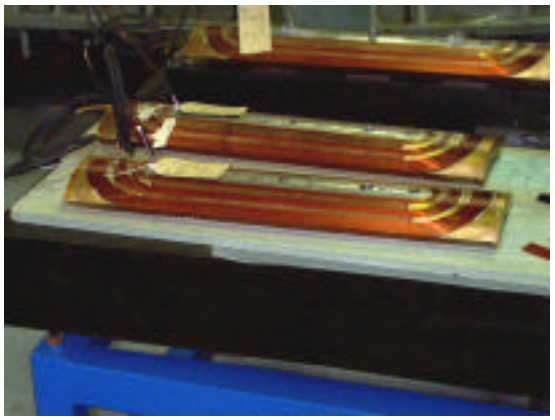
Tunable

510MeV -> 1.2GeV

Solenoid compensation

Superimposed skew quad windings

Superconducting IR Quadrupoles



CESR IR quad gradient >> DAFNE

Length = 650mm	ID	Thickness	Max. field/gradient
Main quad coils	184.0mm	37.4mm	48.4 T/m
Skew quad coils	269.4mm	3 layers x 1.27 = 3.81	4.8 T/m
Dipole coils	280mm	1 layer x 1.27	0.13 T

Conclusions

Energy upgrade to 1.1 GeV/beam straight forward
and at moderate cost

Exploit most of existing hardware

Preliminary design for dipoles
with some questions about
- current dependence of field quality
- current dependence

Parameters of superconducting IR quadrupoles
are well within the range of exisiting designs