Proposal of Doubling the DAPHNE-Linac Energy

Workshop on: e^+e^- in the 1-2 GeV range

Alghero 10-13 Sept. 2003

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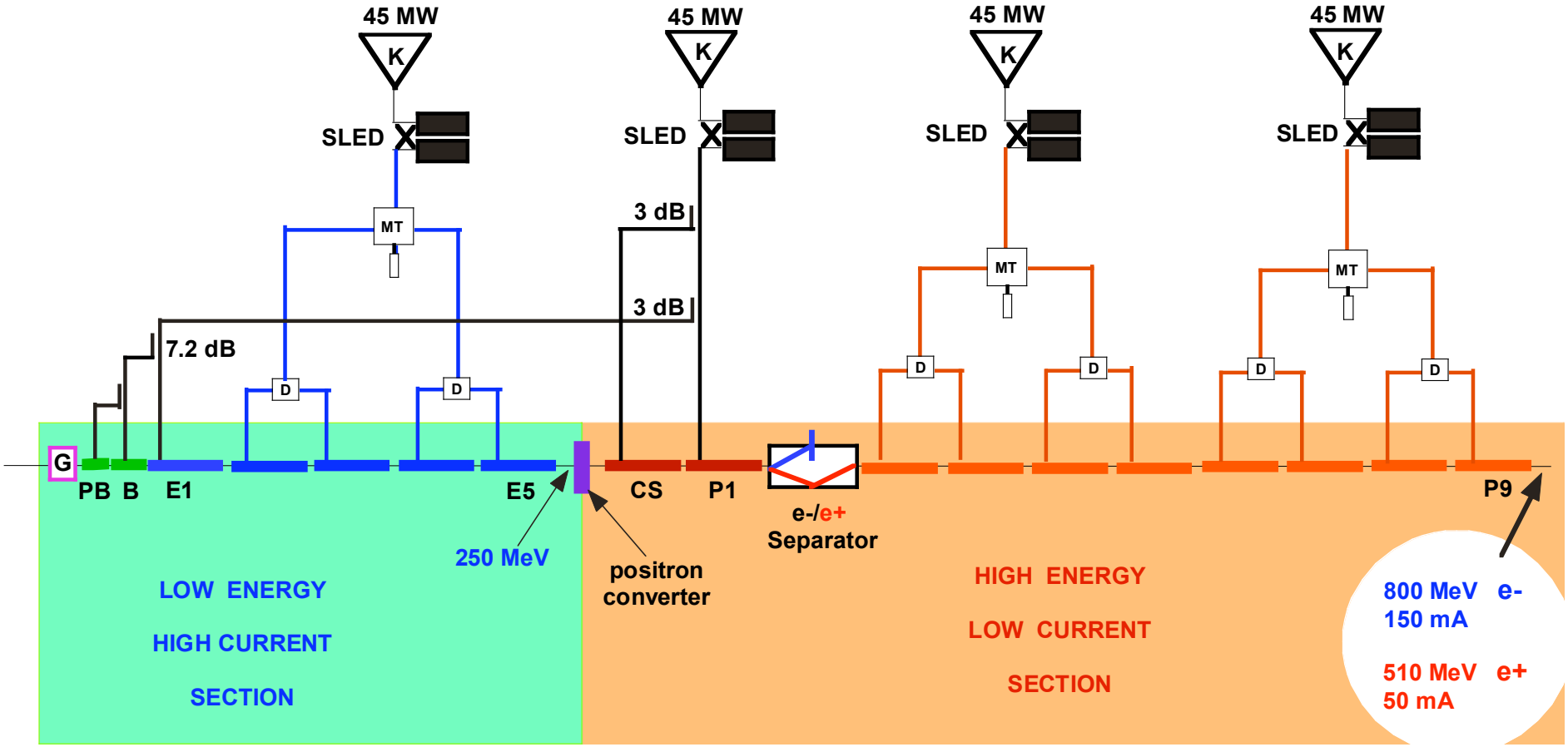
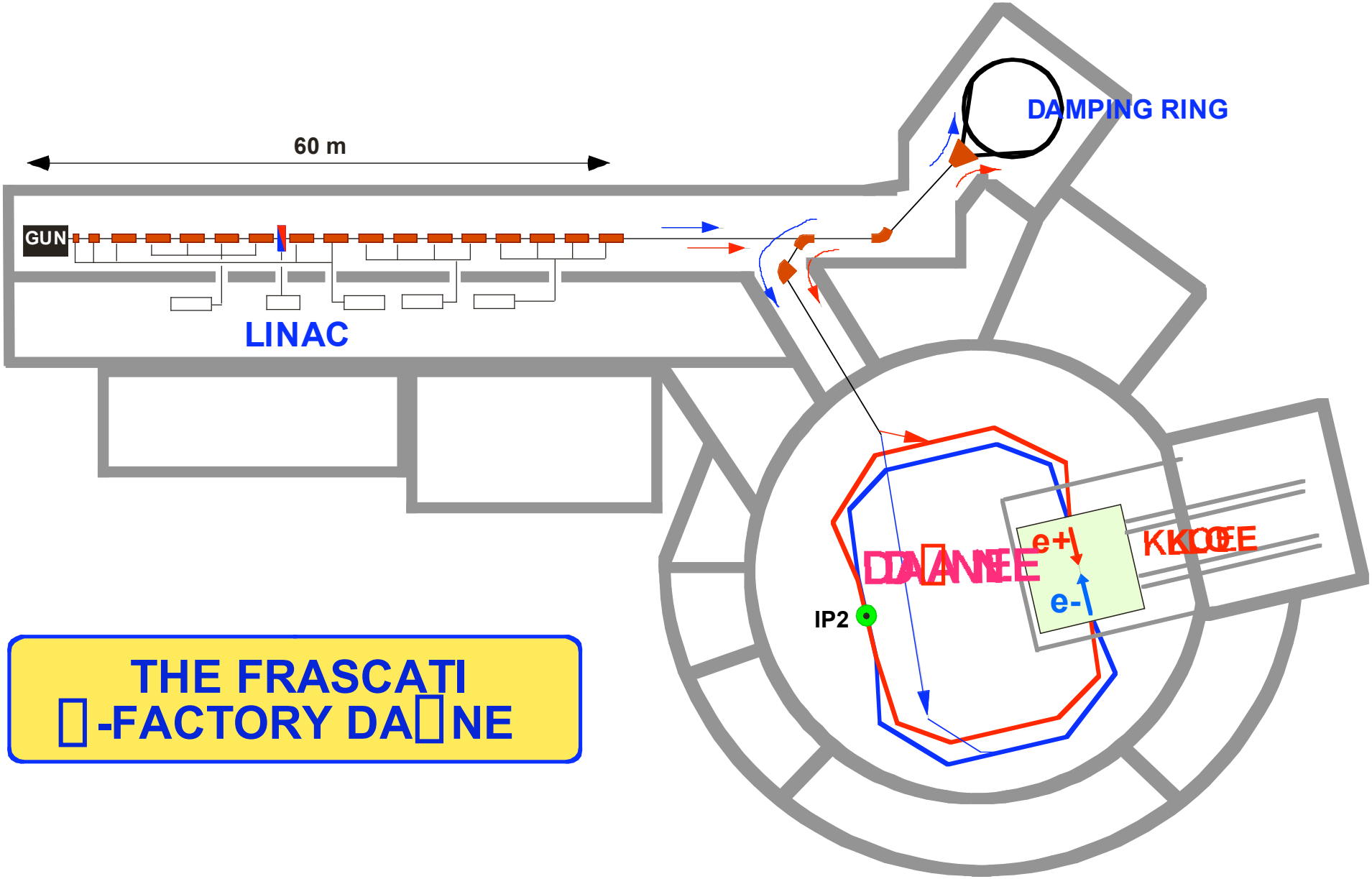


DAPHNE LINAC

Frascati Linac Parameters

	DESIGN	OPERATIONAL
Electron beam final energy	800 MeV	510 MeV
Positron beam final energy	550 MeV	510 MeV
RF frequency	2856 MHz	
Positron conversion energy	250 MeV	220 MeV
Beam pulse rep. rate	1 to 50 Hz	1 to 50 Hz
Beam macropulse length	10 nsec	1 to 10 nsec
Gun current	8 A	8 A
Beam spot size on posit. conv.	1 mm	1 mm
e- current on Pos. Conv.	5 A	5.2 A
norm. Emittance (mm. mrad)	1 (e) / 10 (p)	≤1.5 (e & p)
rms Energy spread (%)	±0.5 (e) / ±1.0 (p)	±0.5 (e) / ±1.0 (p)
Max output electron current	> 150 mA	350 mA
Max output positron current	36 mA	100 mA max (85 routinely)
Transport efficiency from capture section to linac end	90 %	90 %
Accelerating structure	SLAC-type, CG, 2π/3	
RF sources	4 x 45 MWp sledded klystrons TH2128C	



THE FRASCATI □-FACTORY DA□NE

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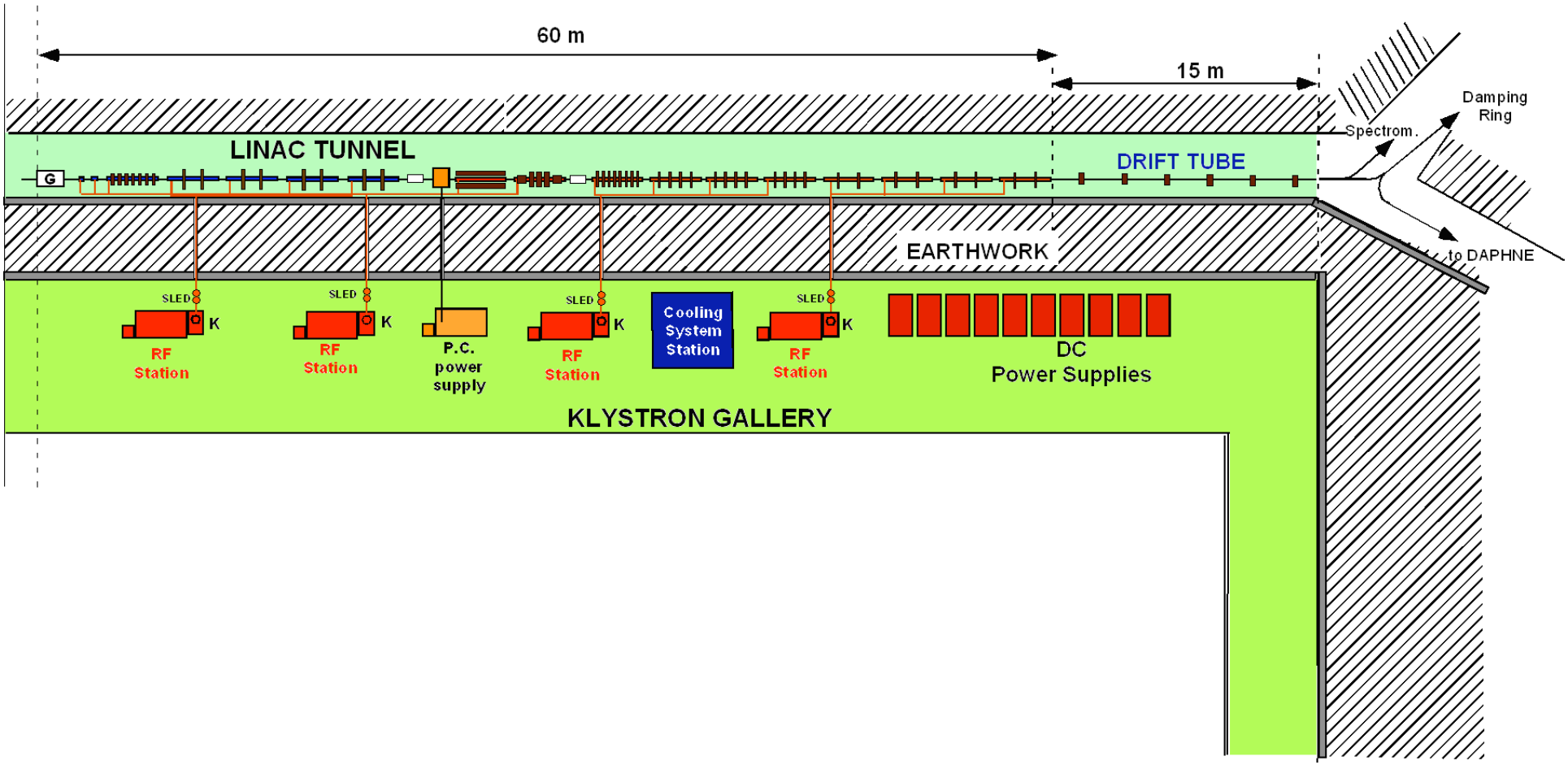
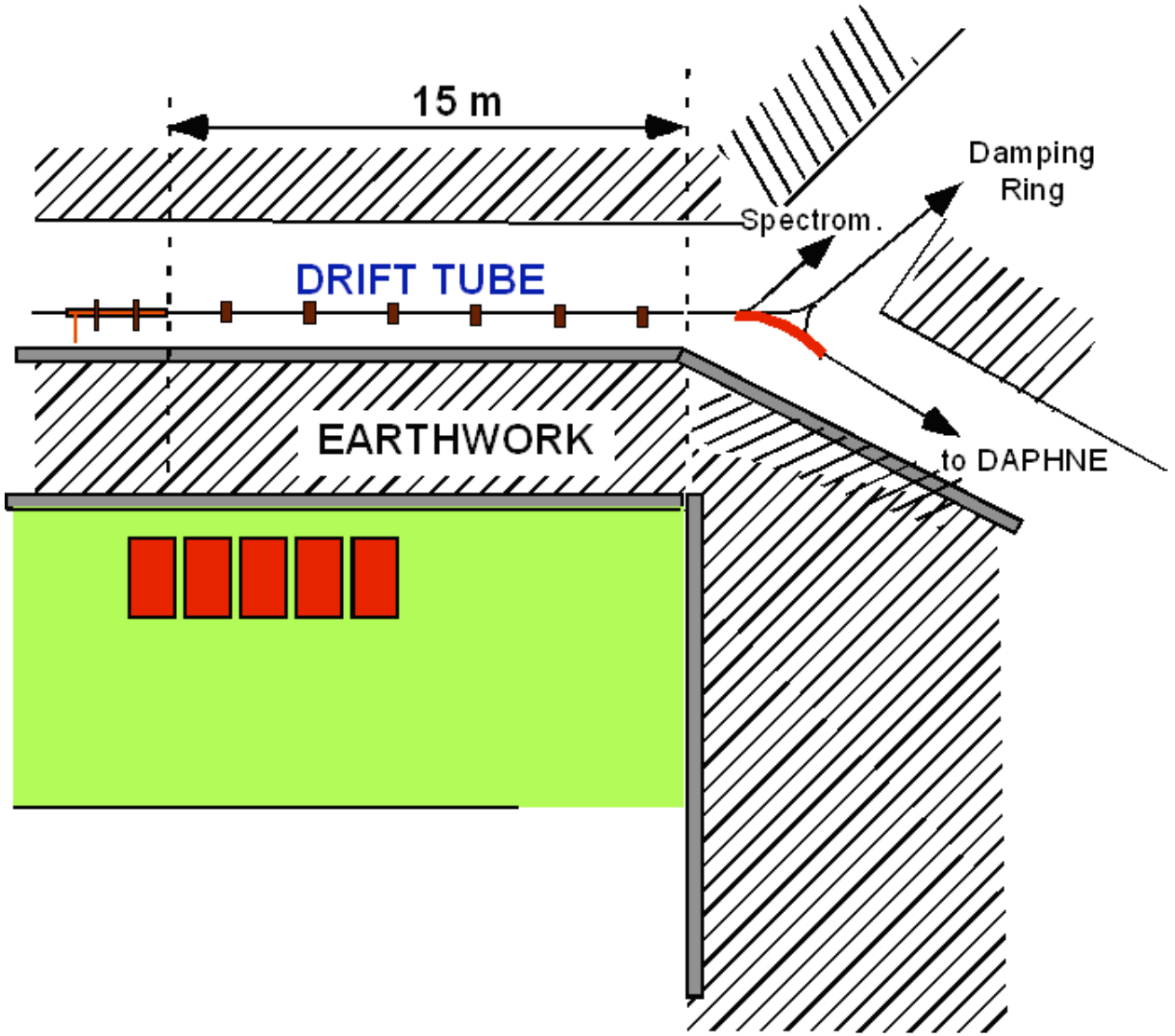
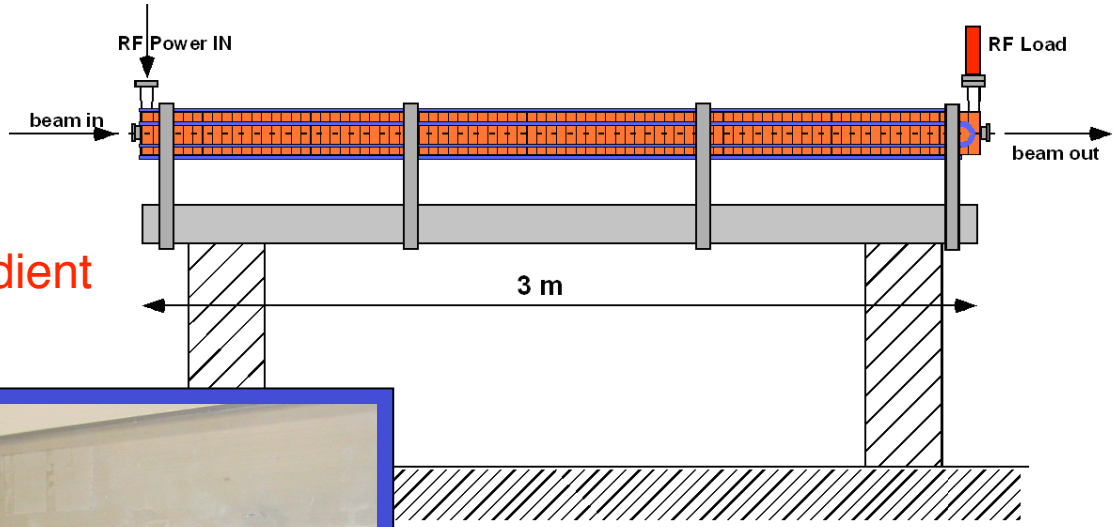
DAPHNE- LINAC PLAN-VIEW TODAY
(schematic)

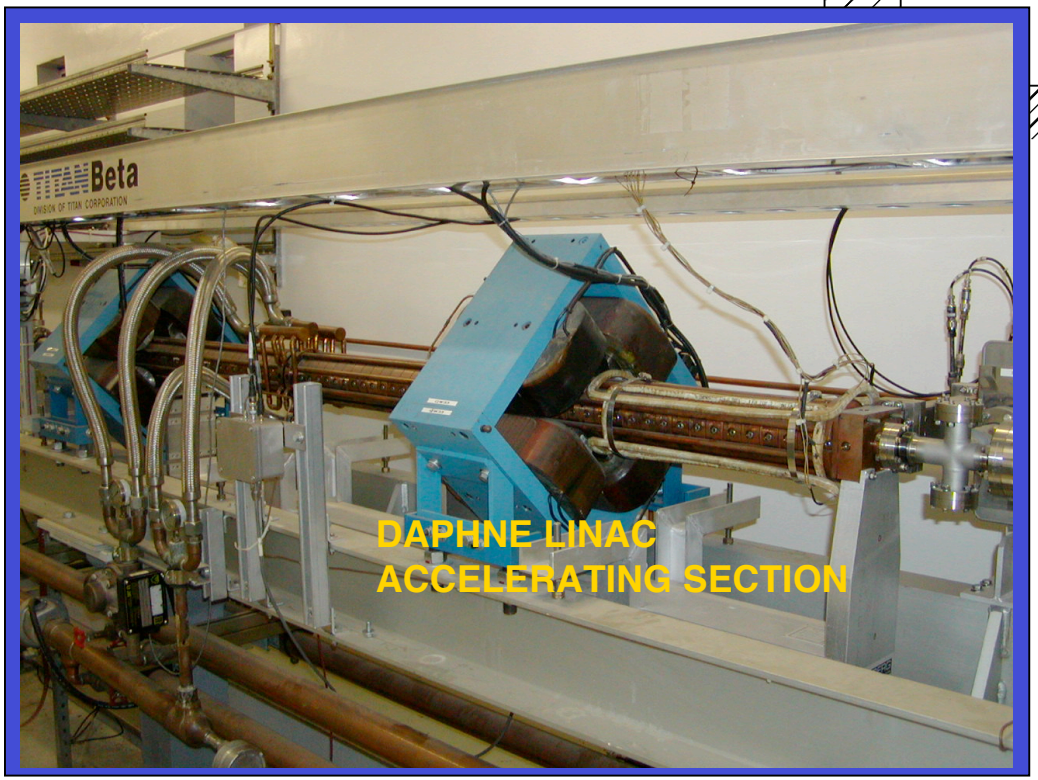



15 m
Damping
Ring
Spectrom.
DRIFT TUBE
EARTHWORK
to DAPHNE

Main parameters of the DAPHNE-Linac Accelerating Structures

- SLAC-type
- Frequency 2856 MHz
- Disk-loaded – 86 RF cells
- phase shift per cell 2π/3
- Traveling Wave – Constant Gradient
- 3 mt length - copper guide



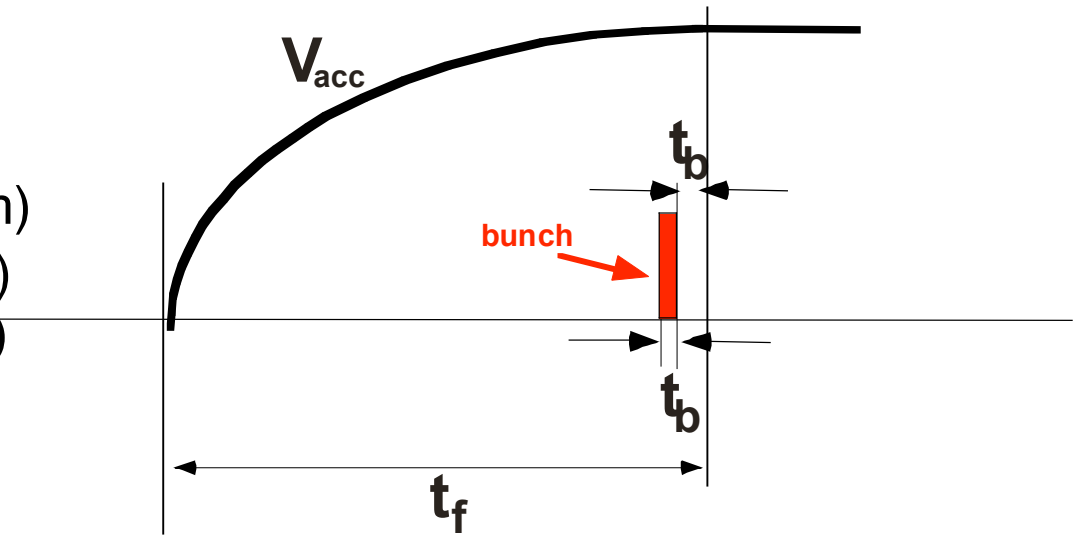


In TW-CG, accelerating structures,
the voltage V_b induced by a bunch of peak current **Io**
and duration t_b very short with respect to the filling time t_f,
is given by the following expression:

(P. B. Wilson, SLAC-PUB 2884, p.51, 1981, and ….
… J. W. Wang, SLAC-REP 339, p.46, 1989)

$$V_b = \frac{R_{sh} I_0 L}{2\,(1 - e^{-2\tau})}\left[1 - e^{-2\tau x_b} - 2\tau x_b e^{-2\tau}\right]$$

with : R_{sh} = Impedance (MΩ/m)
L = structure length (m)
τ = atten. Constant (Np)
$x_b = t_b / t_f$



In SLAC-type structures:

τ = atten. constant (0.57 Np)

r_0 = shunt imp. (53 MΩ/m)

L = acc. struct. length (3m)

$V_b \ll 1.1$ MV/amp

Beam loading is negligible in the high energy section accelerating structures of DAFNE2

Energy gain **Uo** in TW-CG structures is:

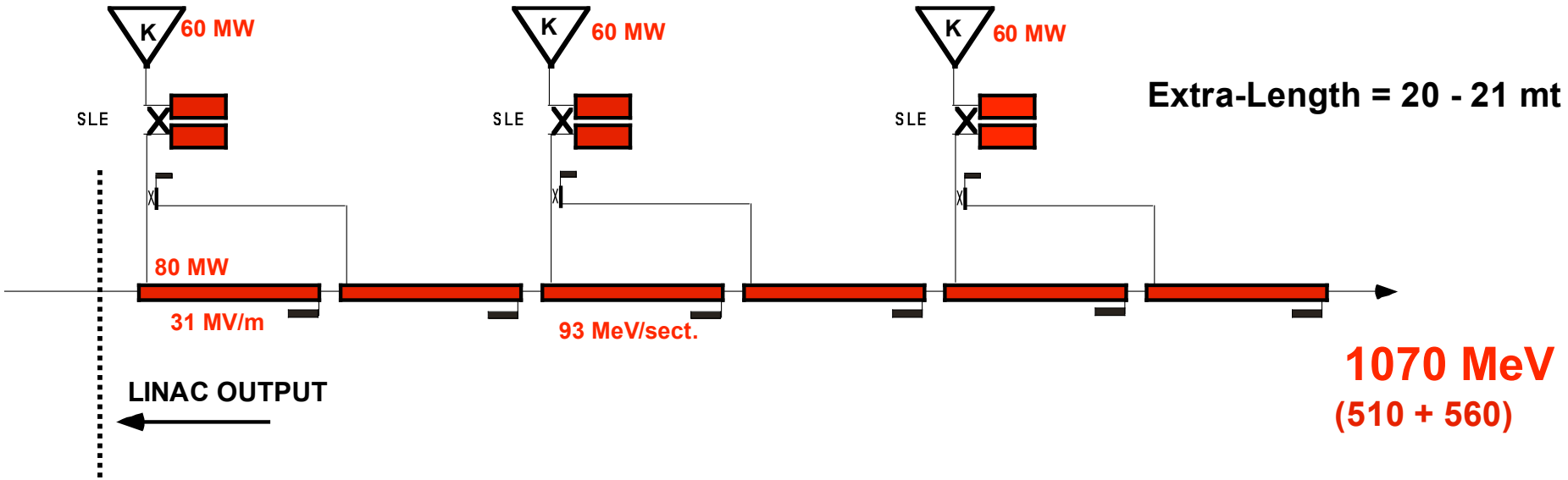
$$U_0 = \left(1 - e^{-2\tau}\right)^{1/2} \left(P_{in} R_{sh} L\right)^{1/2}$$

(*" G. A. Loew, The Stanford 2-mile Accel, p.116, 1968,"*)

In SLAC-type structures: $\Rightarrow$ $U_{MeV} \ll 10.4 \cdot \left(P_{in(MW)}\right)^{1/2}$

DAFNE2 - LINAC UPGRADING

High-field version



CHALLENGING PROJECT !!

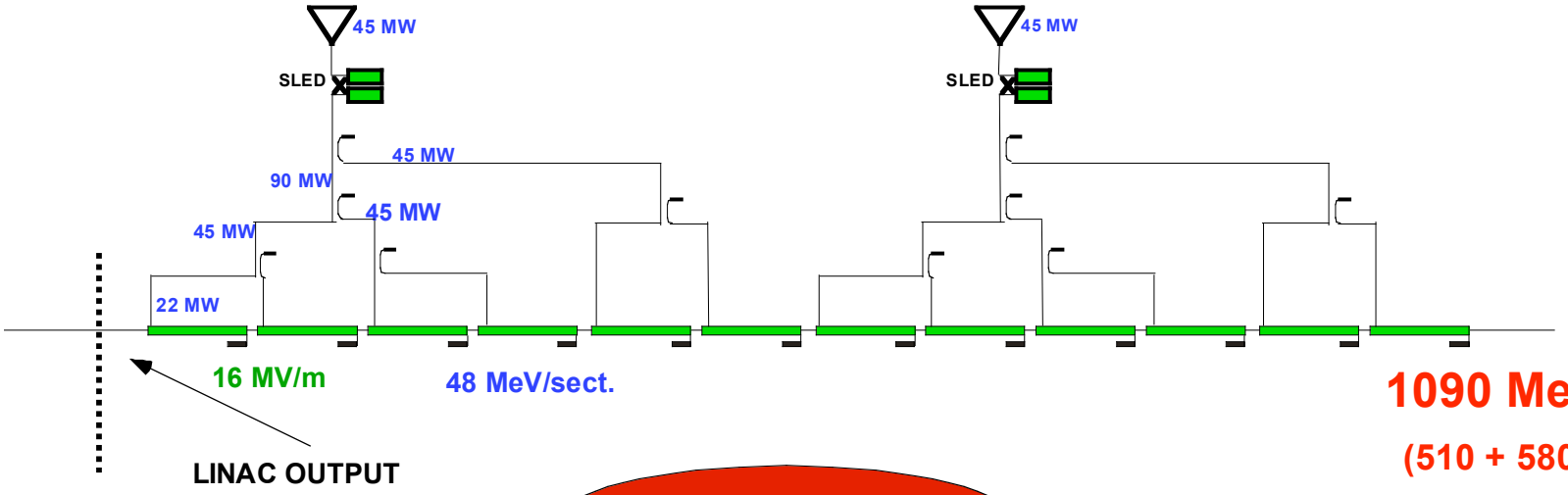
ACCEL. STRUCTURES & SLED's

EXTRA COMPONENTS

- 6 Acc. sections
- 3 SLEDs
- 3 Power Stations
- Waveguides, Dir. Coupl., windows
- Vacuum, Diagnostics, Controls, Magnetics, Cooling, ...

DAFNE2 - LINAC UPGRADING

Low-field version



1090 MeV

(510 + 580)

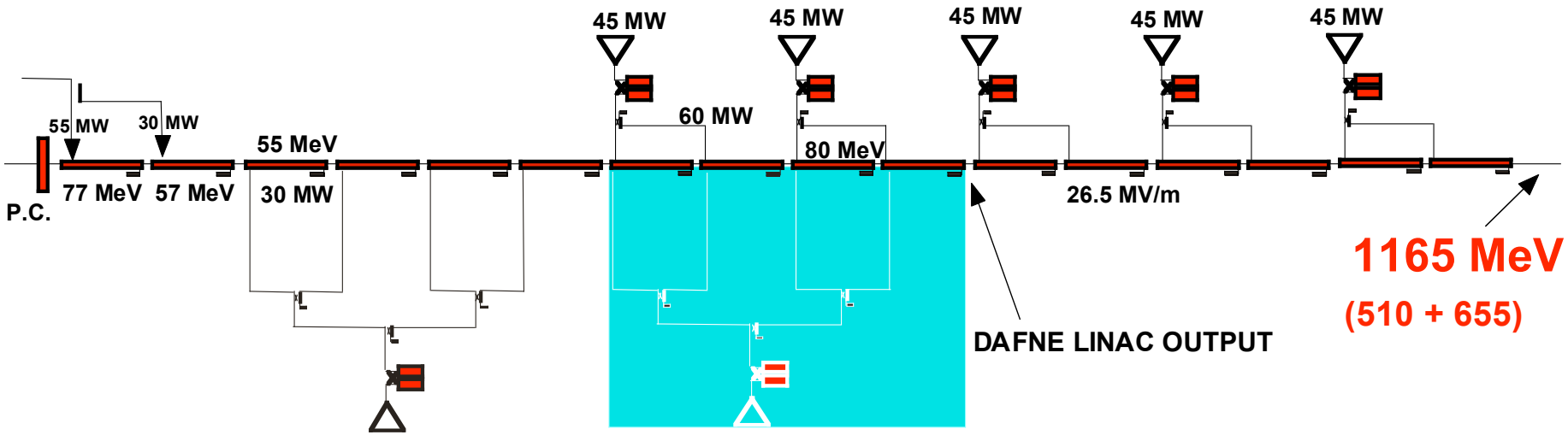
Extra-Length = 40 mt

SAFE SOLUTION

EXTRA COMPONENTS

- 12 Acc. sections
- 2 SLEDs
- 2 Power Stations
- Waveguides, Dir. Coupl., windows
- Vacuum, Diagnostics, Controls, Magnetics, Cooling, ...

DAFNE2 - LINAC UPGRADE
Mixed version



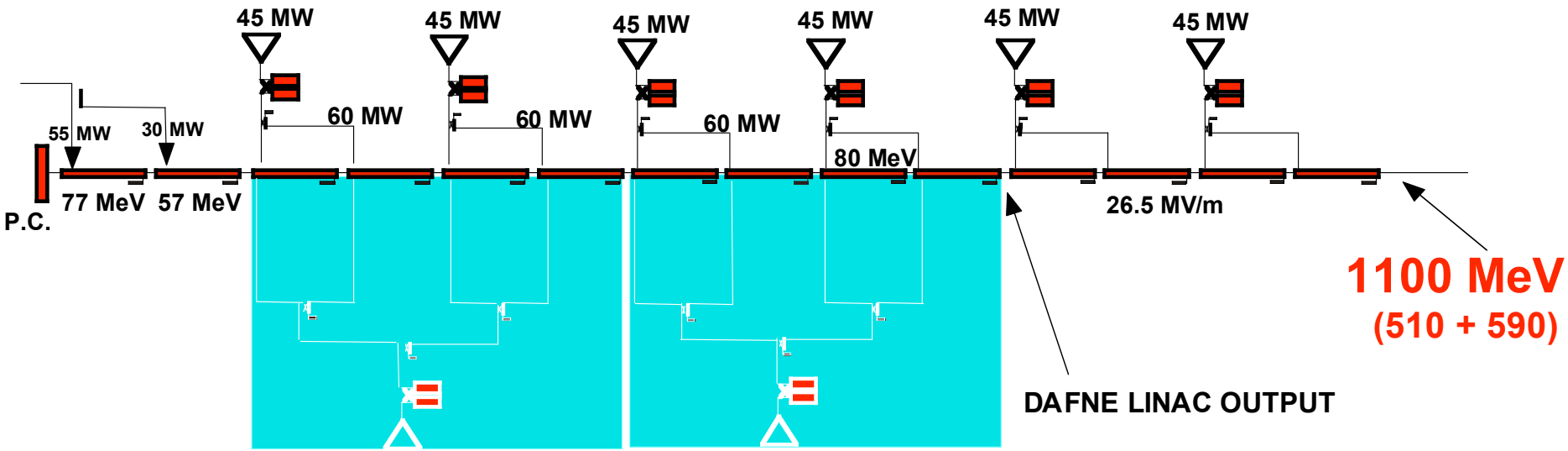
EXTRA-LENGTH = 21 mt

EXTRA COMPONENTS

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

DAFNE2 - LINAC UPGRADE

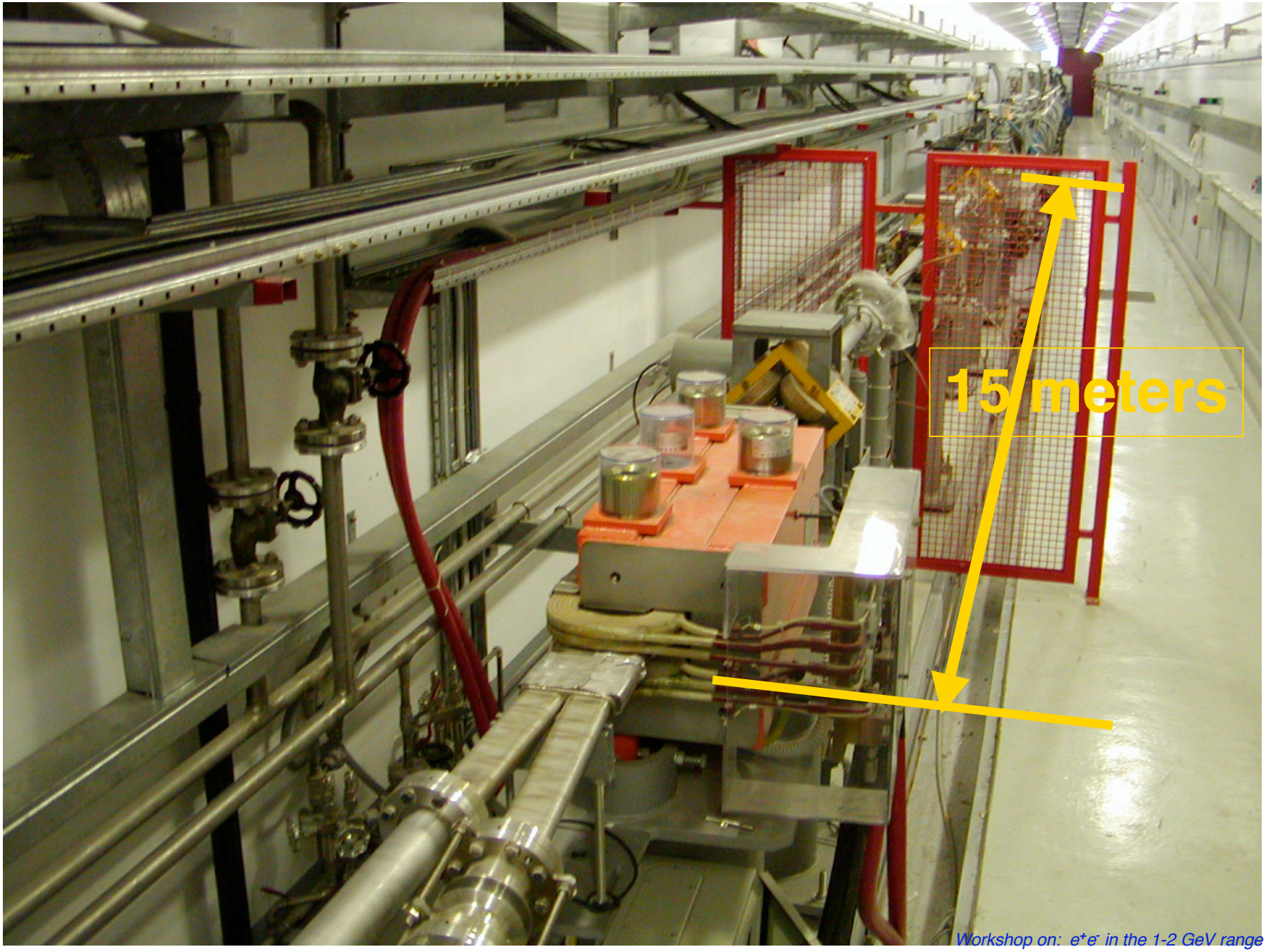
Mixed version

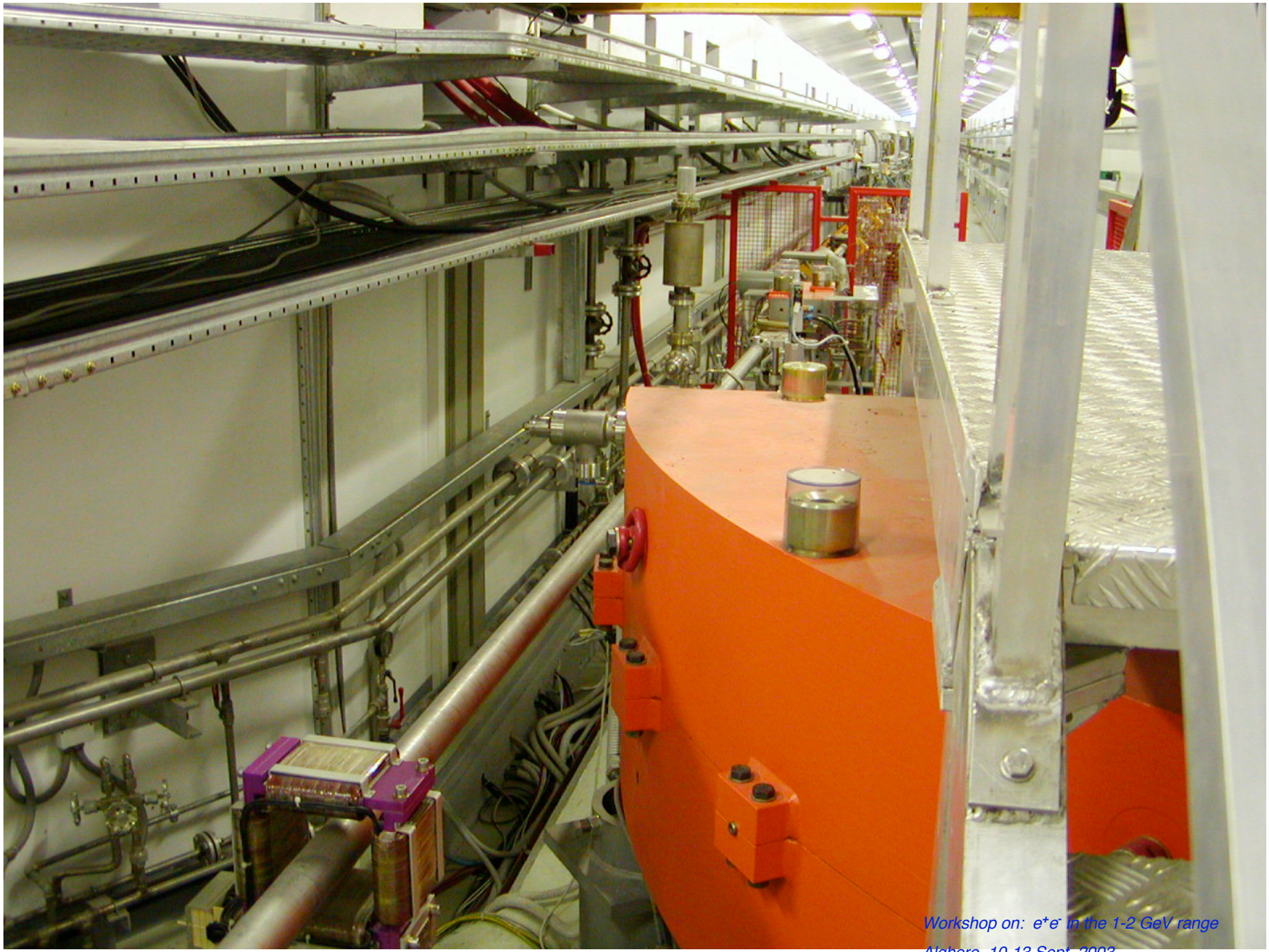


EXTRA-LENGTH = 14 mt

Extra Components

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


15 meters



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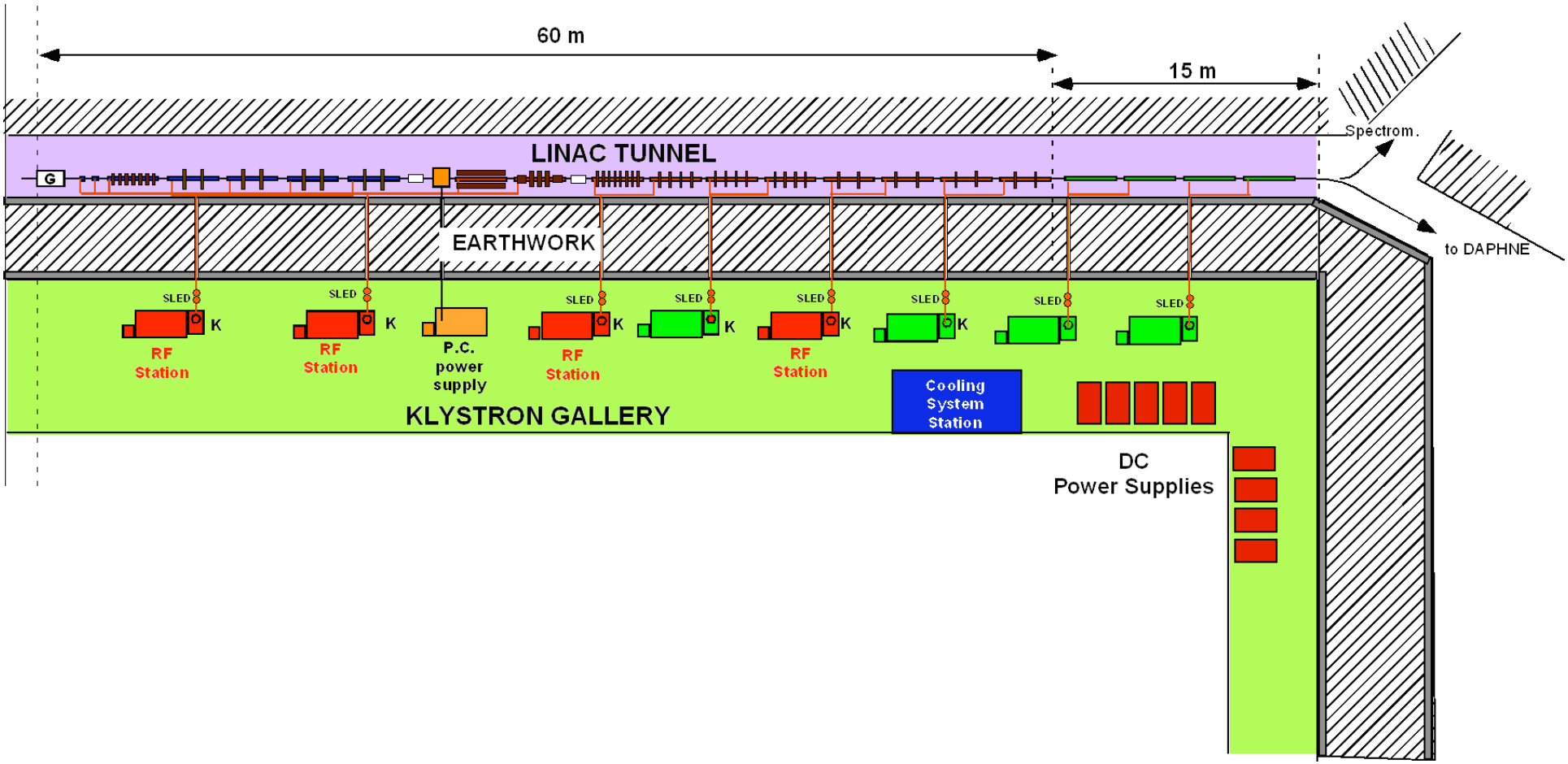
DAPHNE2 LINAC PLAN-VIEW ..... tomorrow



CONCLUSIONS

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* ".**