DAFNE Injection Upgrade

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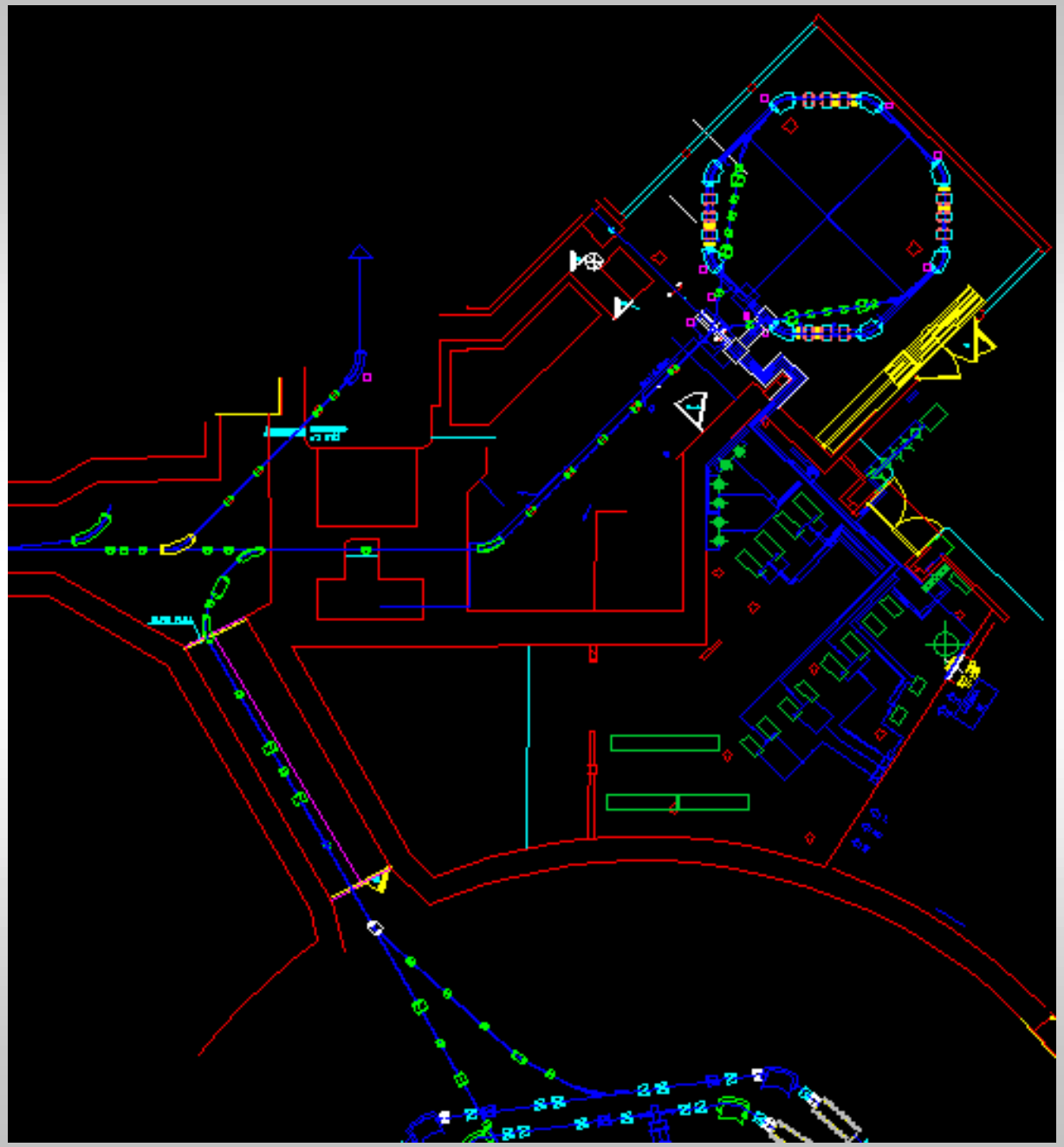
Workshop on e^+e^- in the 1-2 Gev range: Physics and Accelerator Prospects
Alghero 10-13 Settembre 2003


10m

Layout of existing transfer lines:

Electrons and positrons use the same transfer line for injection into the Accumulator ring and (partially) from the Accumulator ring into the DAFNE rings.

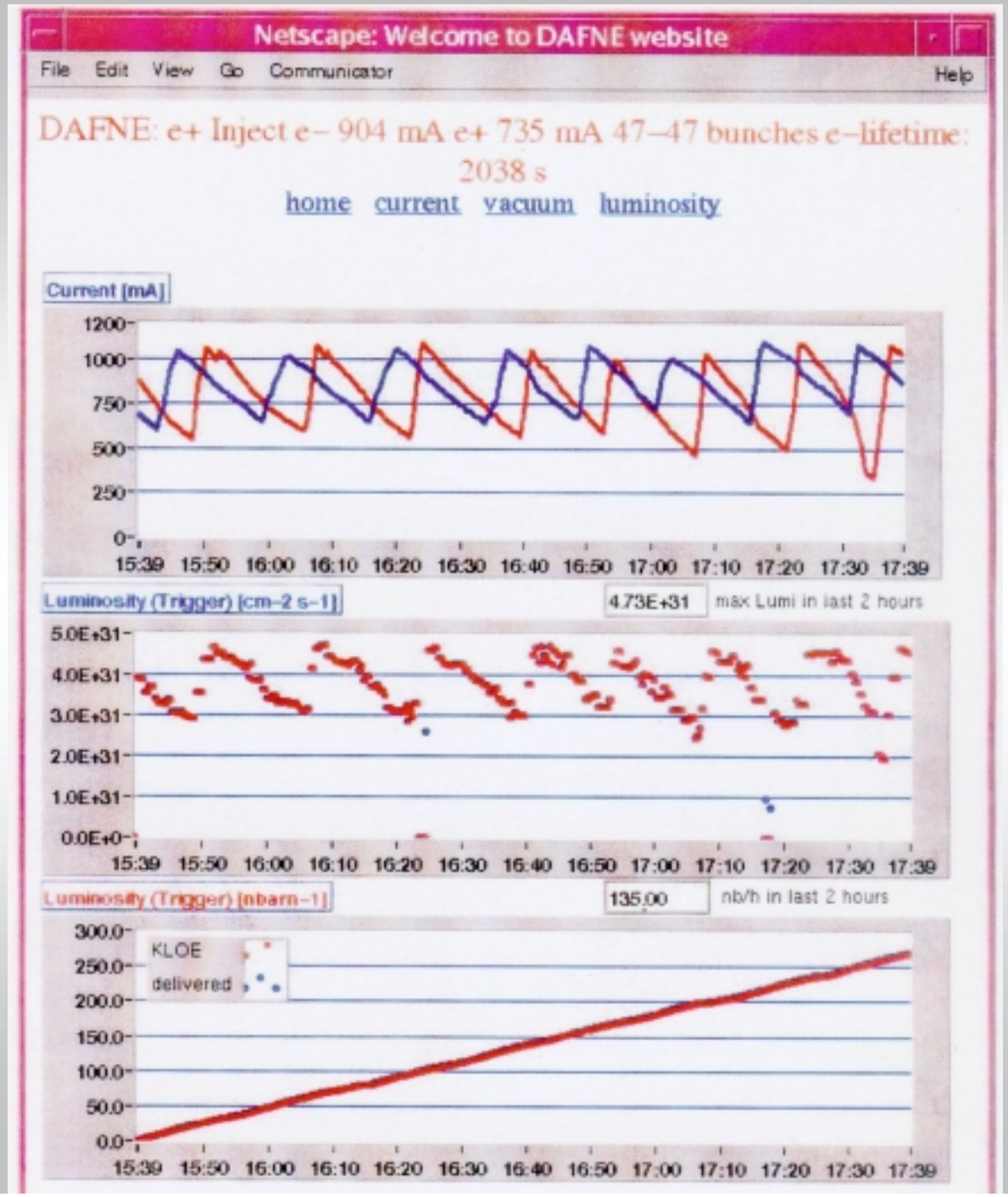
The common transfer lines magnets must change the current and some of them also the polarity in going from electron to positron mode. At least 3 min are necessary for the switch.



DAFNE + KLOE typical run

The injection is in top-up mode and the apparatus is on during the beams refill-> the data taking duty cycle is close to 100%.

Average current ranging between full current and 60% of the full current. In the present working regime, the luminosity decrease is linear with the current



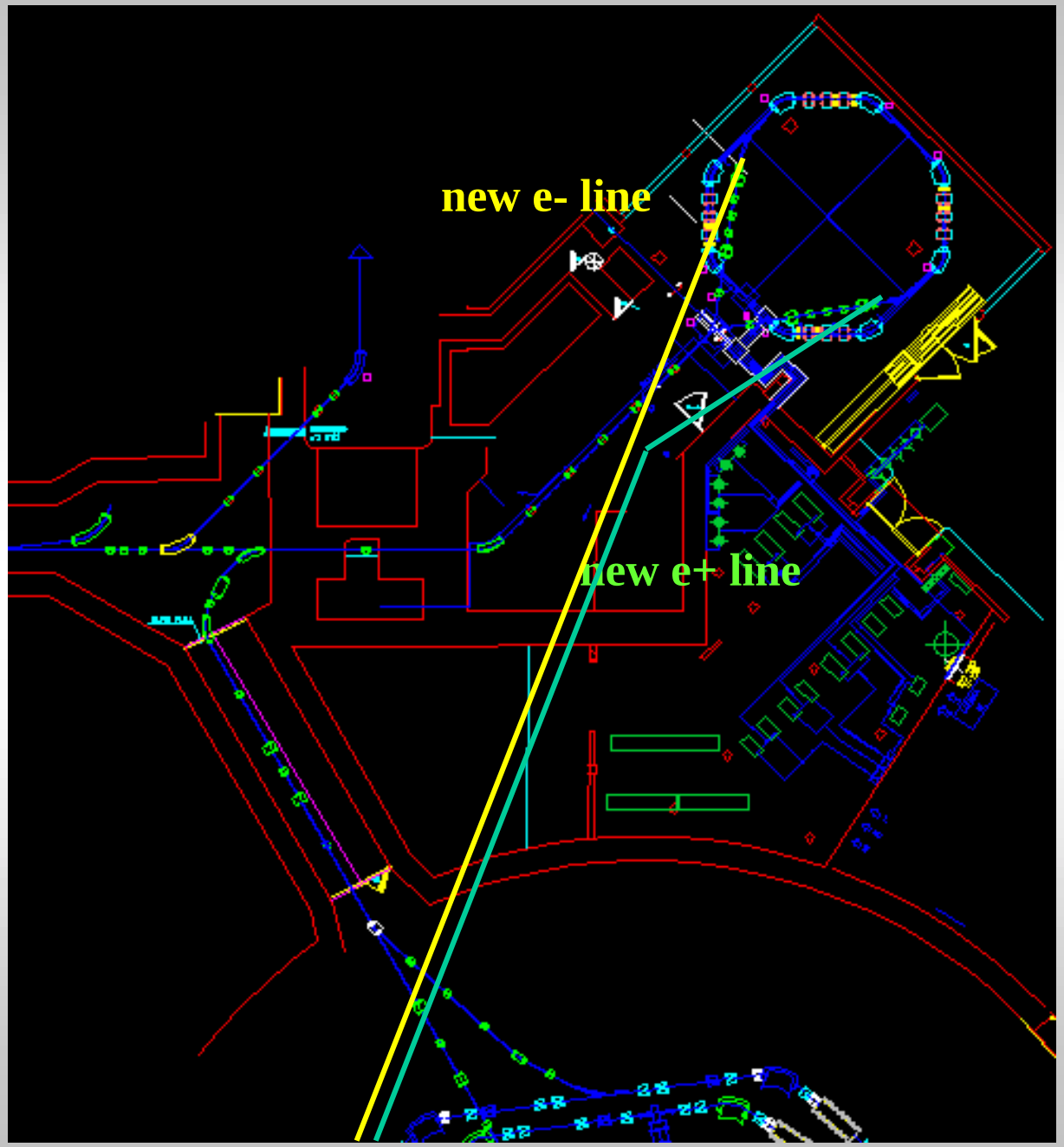
Injection Upgrade for SUPERDAΦNE

- High efficiency and high repetition rate injection system increases the average and peak luminosity.
- In topping-up injection scheme the switch time reduction between the electron and positron mode increases the average luminosity
- Separate transfer lines Linac -> Accumulator / Accumulator -> Main Rings increase overall injection efficiency
- If the corresponding bunches of the two beams are injected one after the other, balanced bunch currents keep the peak luminosity at the highest value.

Layout for separate transfer lines:

- The proposed transfer lines pass in existing controlled area

- Additional shielding needed in the area between the accumulator and DAFNE buildings

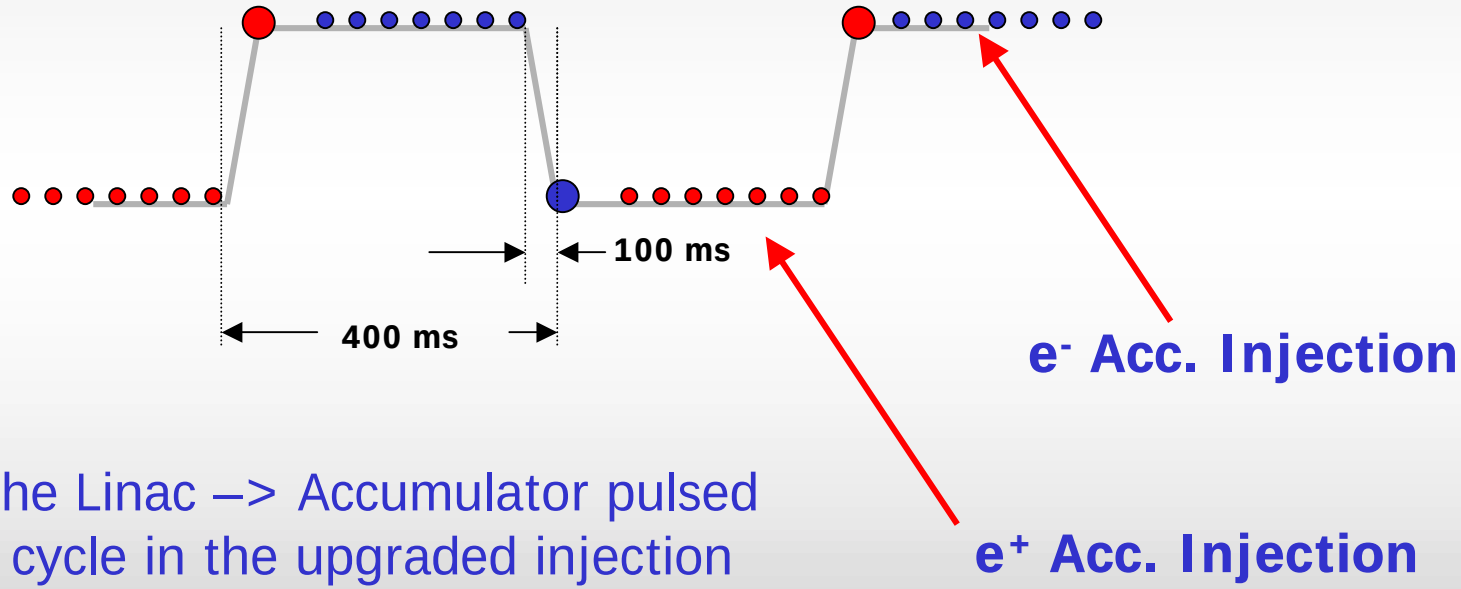


High repetition rate injecton (LINAC)

- Both e^+e^- produced with the W target in (positron converter)
- Focusing solenoids on
- Gun and modulator running at 50 Hz repetition rate
- Acceleration of e^+ or e^- switching only the linac phase
- One cycle in e^+ mode (.5 sec) and one in e^- mode in order to inject correponding bunches in the e^+ e^- Main Rings.
- Continuous injection?

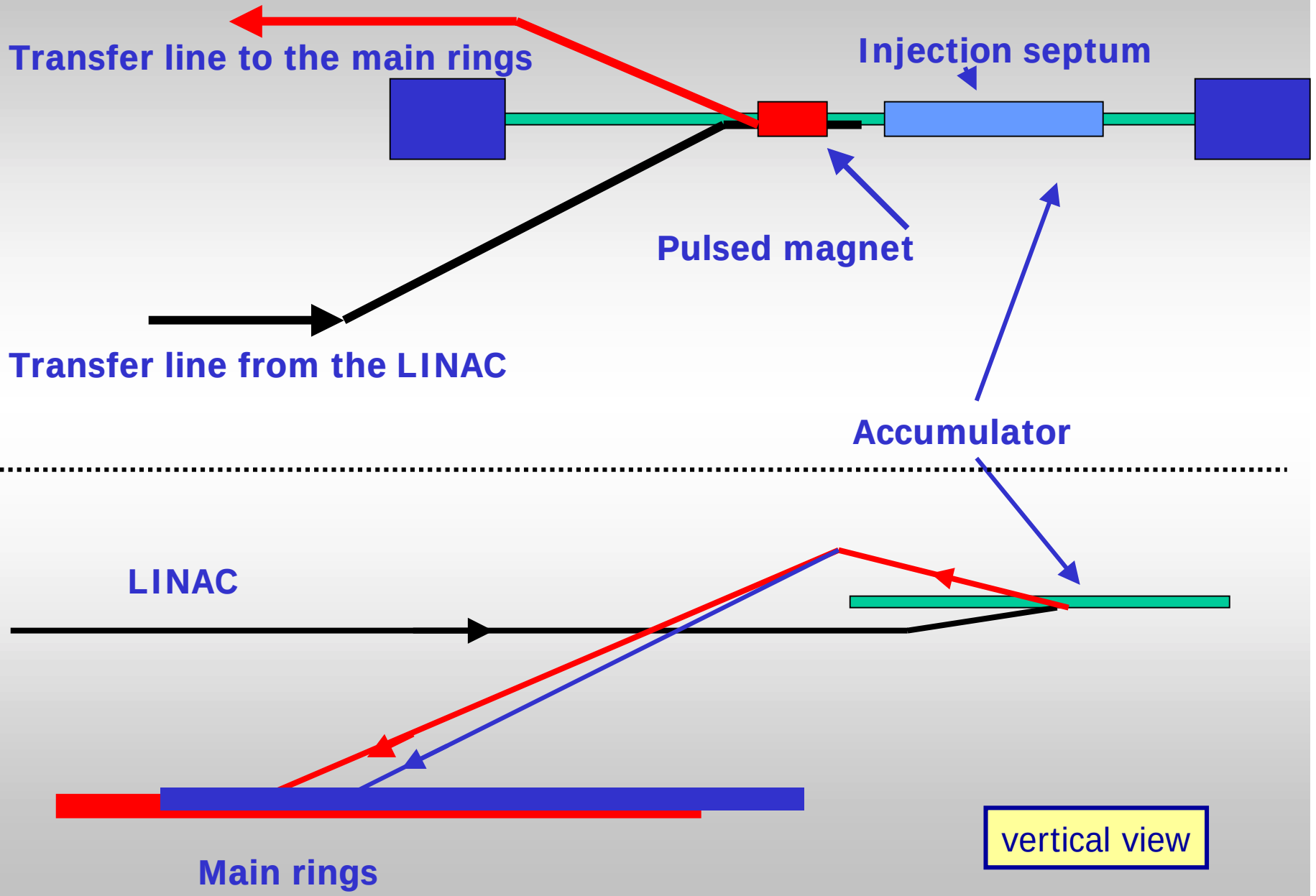
Accumulator injection-extraction cycle

From LINAC to Accumulator a fast 45^0 switch magnet change polarity (DHPT001) during the extraction cycle of the accumulator, passing from electron to positron mode



This is the Linac –> Accumulator pulsed magnet cycle in the upgraded injection

Transfer Lines schematic vertical view



Separate Transfer lines

- No changes in the magnet field and polarities passing from e^+ to e^- reduce the dead time for switching

- 45^0 pulsed magnet switch rise time <100 msec

- Pulsed magnets at accumulator extraction:
  deflection angle about 20^0 rise time+fall time < 100 msec

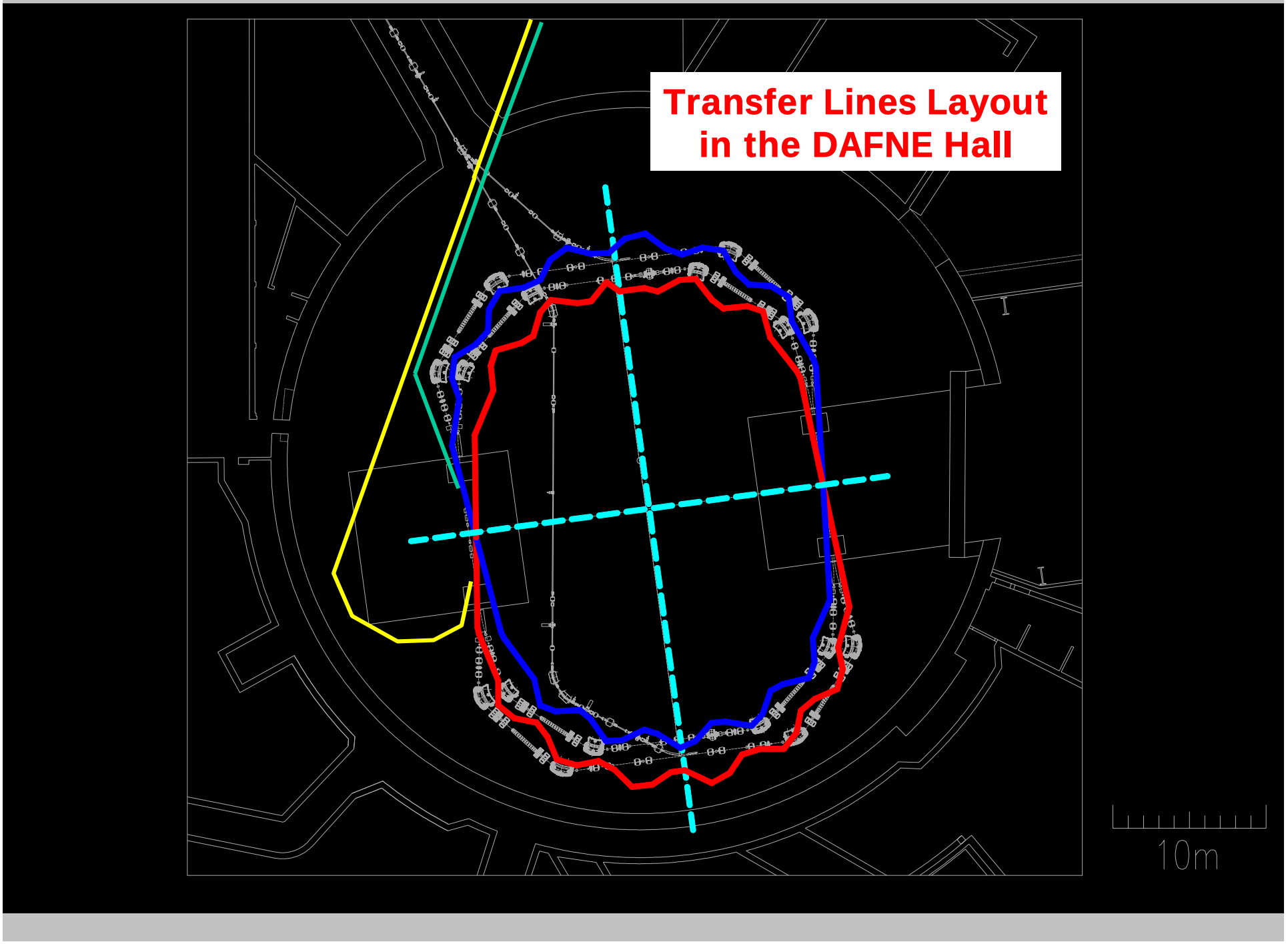
e^+ e^- Main Rings injection sections

- The machine has one interaction point. In the opposite side the two beams cross each other, vertically separated by means of magnetic chicanes, passing into separated vacuum chamber.

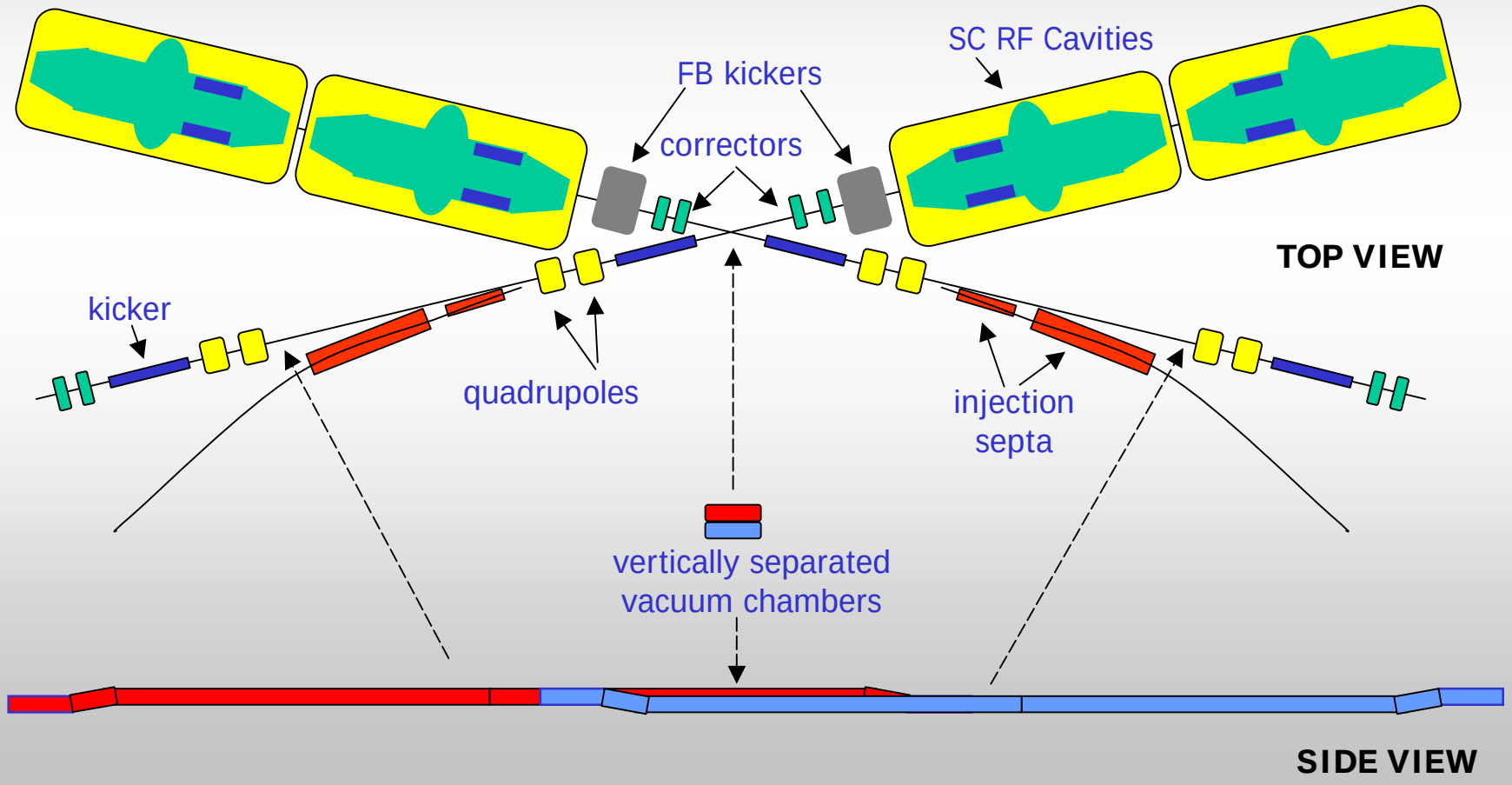
- The RF cavities must be located in a position with synchrotron phase advance difference $\mu/2$, with respect to the interaction point.

- The bunch length is maximum in the RF section than the machine devices that contribute to the machine impedance should be located in this region to minimize the wakefield effects.

- The symmetries of the rings suggest long straight sections dedicated to the injection and the RF equipments.


Transfer Lines Layout
in the DAFNE Hall
10m

Crossing point section schematic layout



Conclusions

- In SuperDAFNE the injection system upgrade is mandatory.
- Using separated transfer lines for iniection/extraction in/from the Accumulator the switch time between e- and e+ mode could be reduced to 100 ms.
- The proposed $\mathbf{e^+}$ $\mathbf{e^-}$ Main Rings injection equipments are located close to the RF system where the bunch length is maximum to reduce the wake field effect