

# **Fast kickers design @ LNF-INFN**

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*for the LNF Fast kickers study group\**

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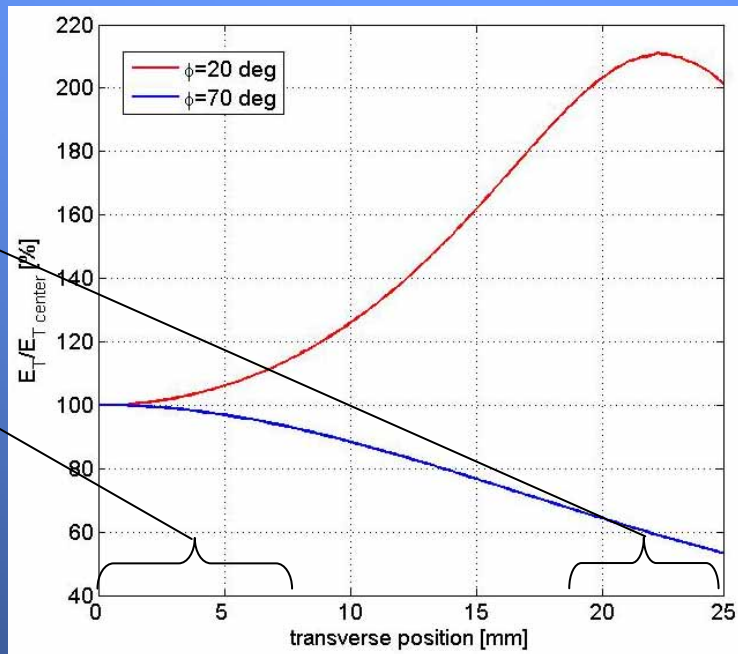
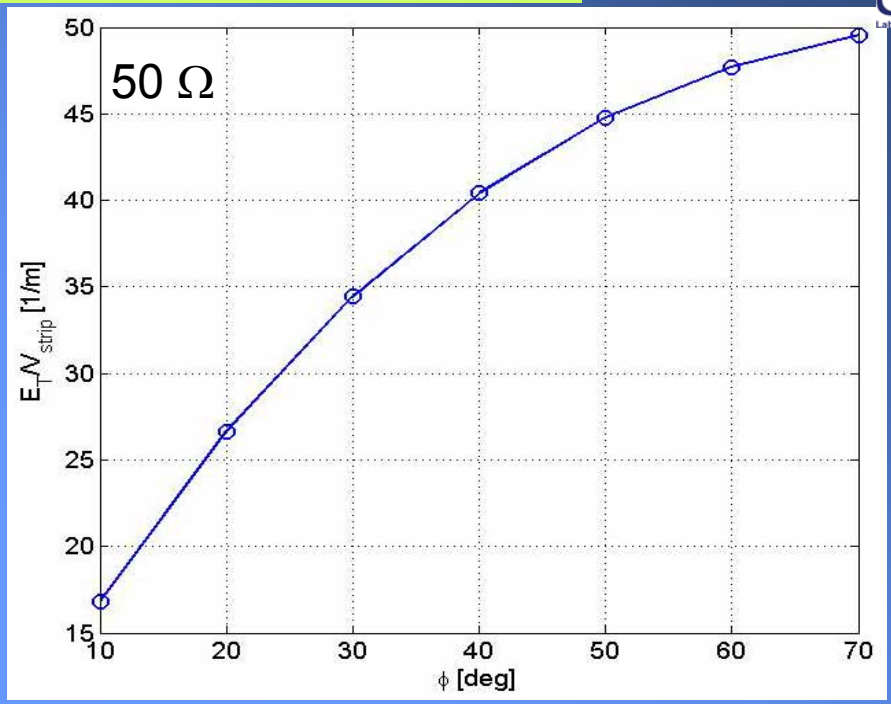
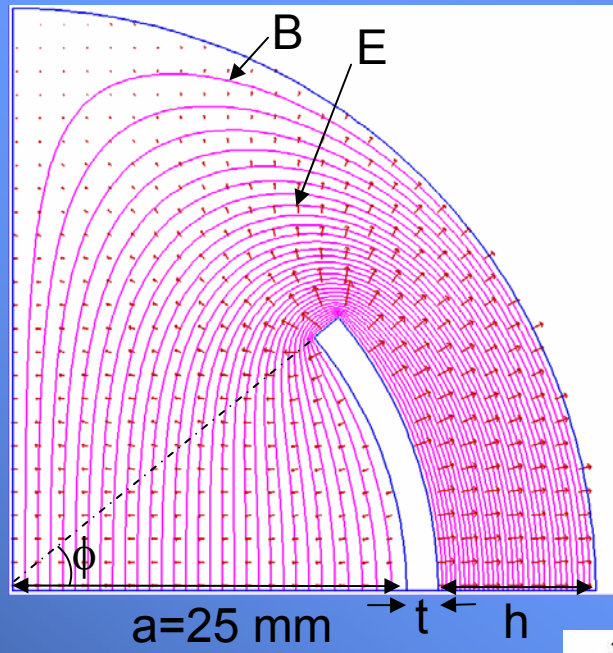
\* *F. Marcellini, P. Raimondi, S. Guiducci, L. Ficcadenti (Univ. Rome), B. Spataro*

# OUTLINE

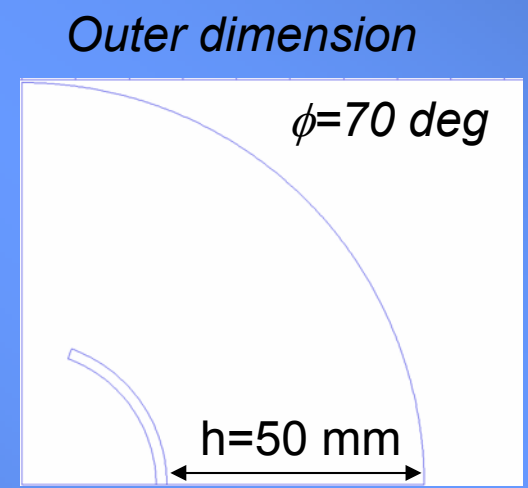
- 1) General considerations on circular stripline kickers;
- 2) Correction of the deflecting field flatness using tapers;
- 3) DAΦNE stripline kickers design;
- 4) Time schedule for kickers construction and HV tests @ LNF;

# 1) General considerations: transverse field profile properties

## a) CIRCULAR TRANSVERSE SECTION

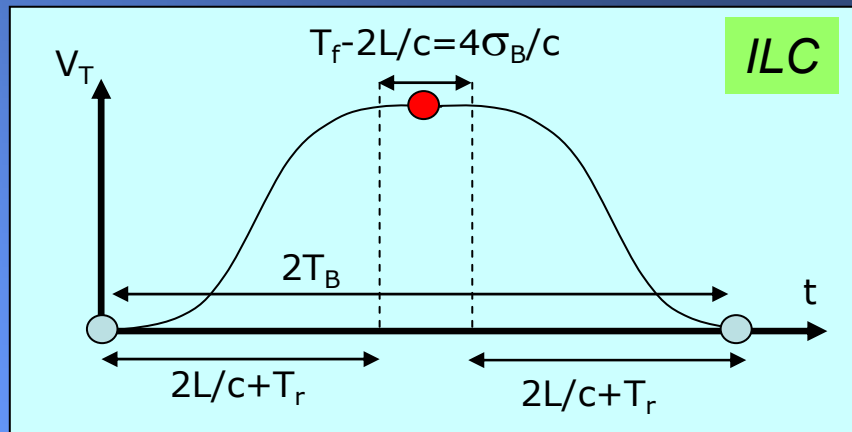
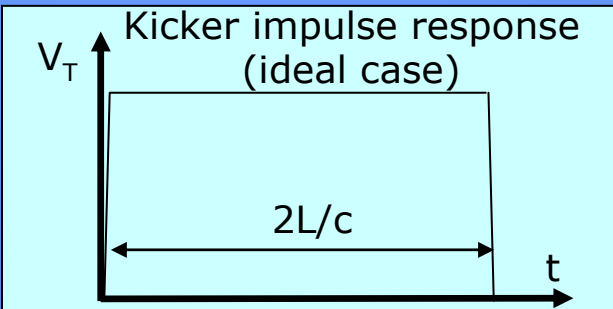
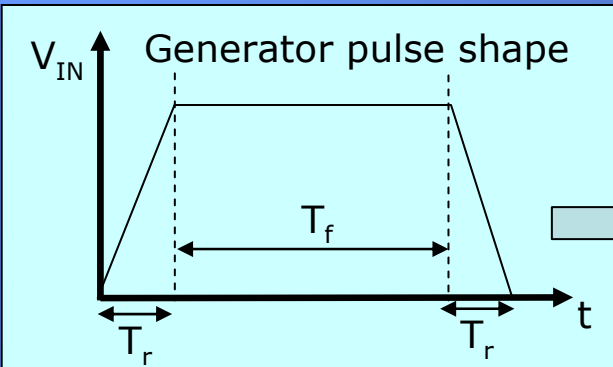


Near the strip  
Center of the kicker

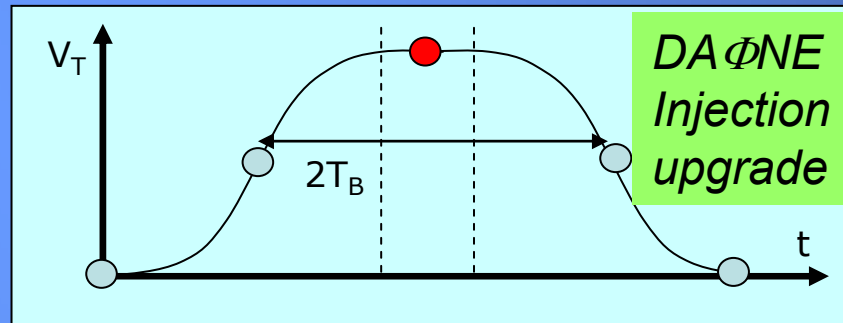


# 1) General considerations: kicker length and pulse length (1/2)

$L$ =kicker length  
 $T_r$ =rise time length  
 $T_f$ =flat top length  
 $\sigma_B$ =bunch length  
 $T_B$ =bunch spacing



● *Injected bunch*  
○ *Stored bunches*



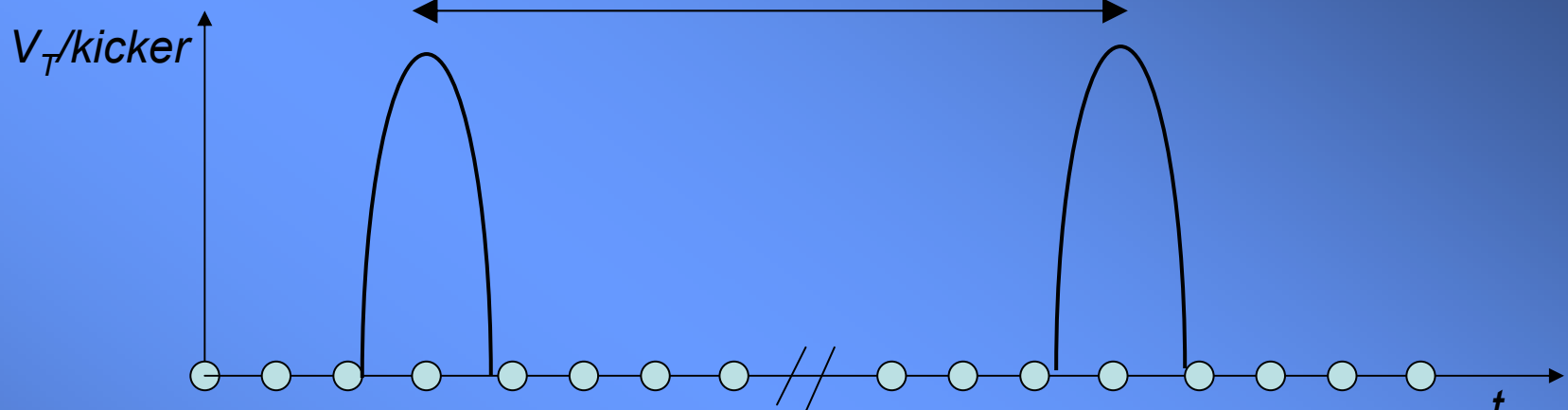
assuming  $T_r=300\text{ps}$

	ILC DR	DAΦNE
<b>E [GeV]</b>	5	0.51
<b><math>T_B</math> [ns]</b>	6.15	2.7
<b><math>\sigma_B</math> [mm]</b>	6	35
<b>Defl. [mrad]</b>	0.5	5
<b>L [cm]</b>	87	73
<b><math>T_f</math> [ns]</b>	5.9	5.3
<b><math>\sigma_x</math> [mm] @ septum and kicker</b>	5	2
<b><math>\sigma_y</math> [mm] @ septum and kicker</b>	1	1

$V_T=2.5\text{ MV}$

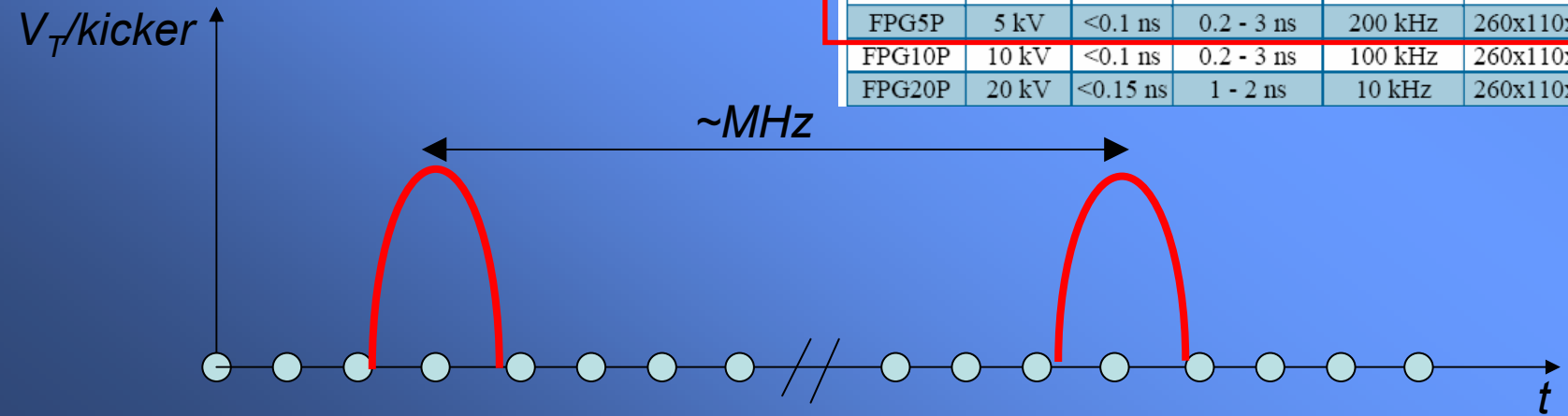
# 1) General considerations: kicker length and pulse length (2/2)

a)  $DA\Phi NE$



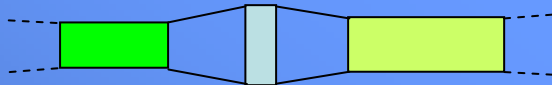
Pulsar	Output voltage	Rise time	Pulse width	Pulse repetition frequency	Size (mm)	Delivery (months)
FPG1	1 kV	<0.7 ns	1 - 2 ns	500 kHz	260x110x260	3
FPG5	5 kV	<0.7 ns	1 - 2 ns	200 kHz	260x110x260	3
FPG10	10 kV	<0.7 ns	1 - 2 ns	100 kHz	260x110x260	3
FPG20	20 kV	<1 ns	1 - 10 ns	10 kHz	260x110x320	4
FPG50	50 kV	<1 ns	1 - 10 ns	2 kHz	340x140x310	4
FPG100	100 kV	<1 ns	1 - 3 ns	1 kHz	340x140x310	4
FPG2P	2 kV	<0.1 ns	0.2 - 3 ns	300 kHz	260x110x260	3
FPG5P	5 kV	<0.1 ns	0.2 - 3 ns	200 kHz	260x110x260	3
FPG10P	10 kV	<0.1 ns	0.2 - 3 ns	100 kHz	260x110x260	3
FPG20P	20 kV	<0.15 ns	1 - 2 ns	10 kHz	260x110x320	4

b) ILC (SuperB)

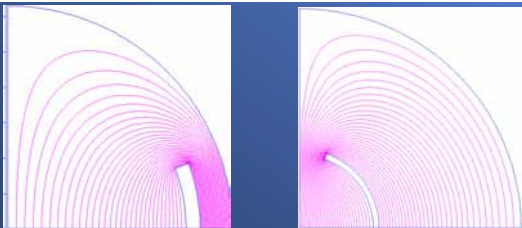
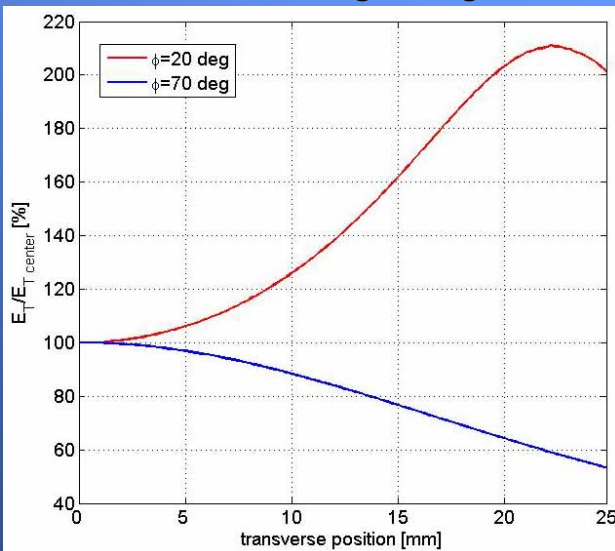


## 2) Correction of the deflecting field flatness using tapers (1/2)

a) The use of **tapers** between the accelerator components **reduces the intensity of wakefield** and HOM (impedance of the machine) with respect to the case of abrupt steps (large use in DAΦNE because of the high current and low energy)

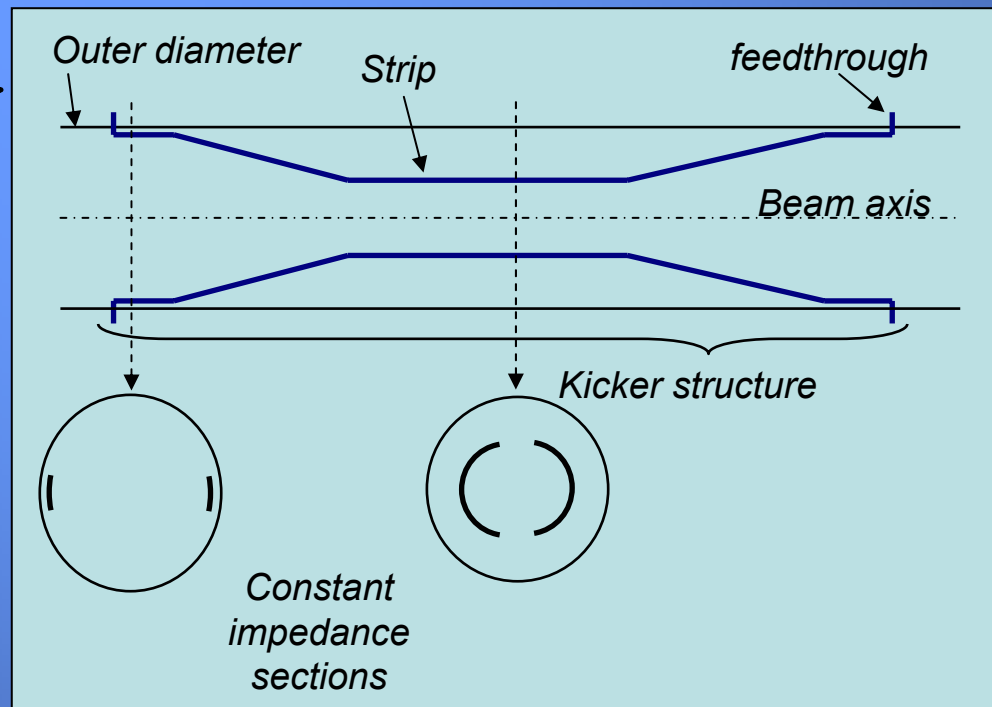


b) The **uniformity of the deflection** varies with different coverage angles

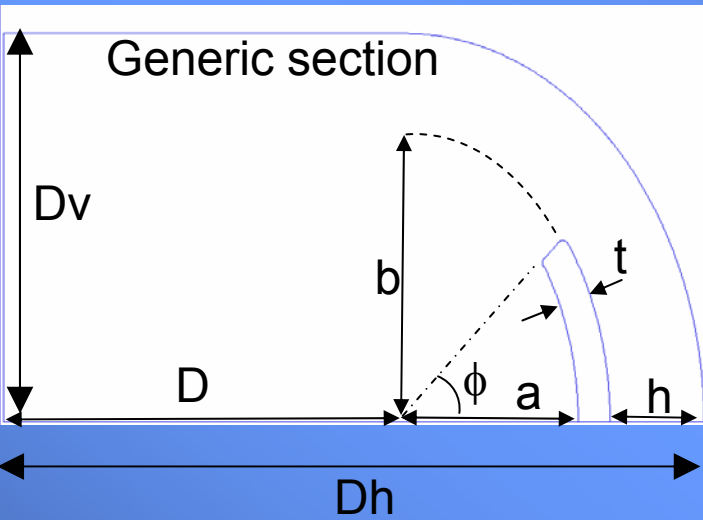


**Possibility of simultaneously achieve:**

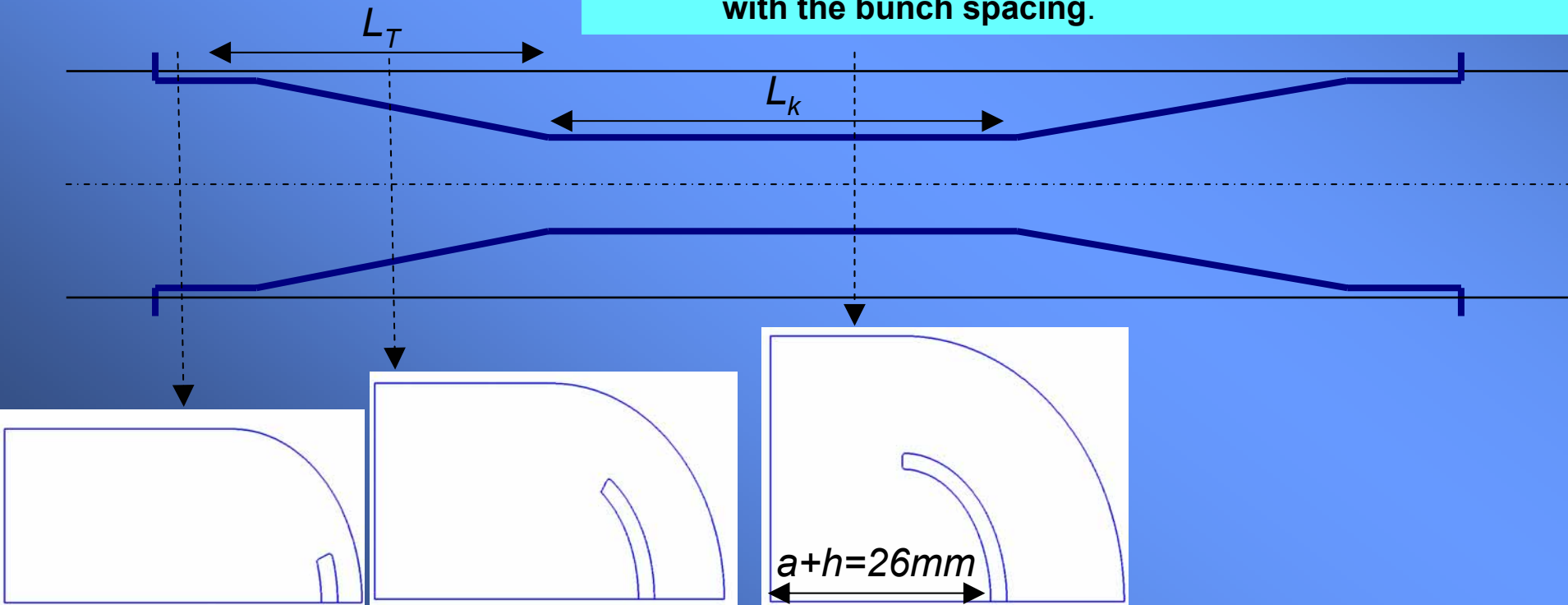
- a) **uniform transverse deflection as a function of the transverse position;**
- b) **tapered transition between the beam pipe and the kicker structure.**



### 3) DAΦNE stripline kickers design: transverse and longitudinal profile geometry



- Elliptical geometry** has been chosen to have a minimum variation of the vertical dimension of the beam pipe between the dipole region and the injection one (that is after the dipole);
- Each sections has the same  **$Dh$**  and different  **$Dv$** ;
- The value of  $\phi$  in each section has been optimized to have  **$50 \Omega$**  (output impedance of the pulsers);
- The value of  **$a$**  and  **$b$**  are the same for each sections and have been optimized together with the length  **$L_k$**  and  **$L_T$**  in order to contemporary achieve:
  - the **optimum deflecting field uniformity** over the horizontal coordinate;
  - a total “**effective length**” of the kicker compatible with the bunch spacing.

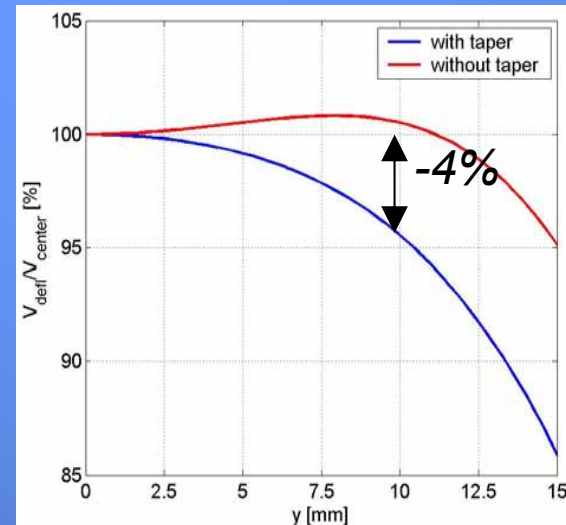
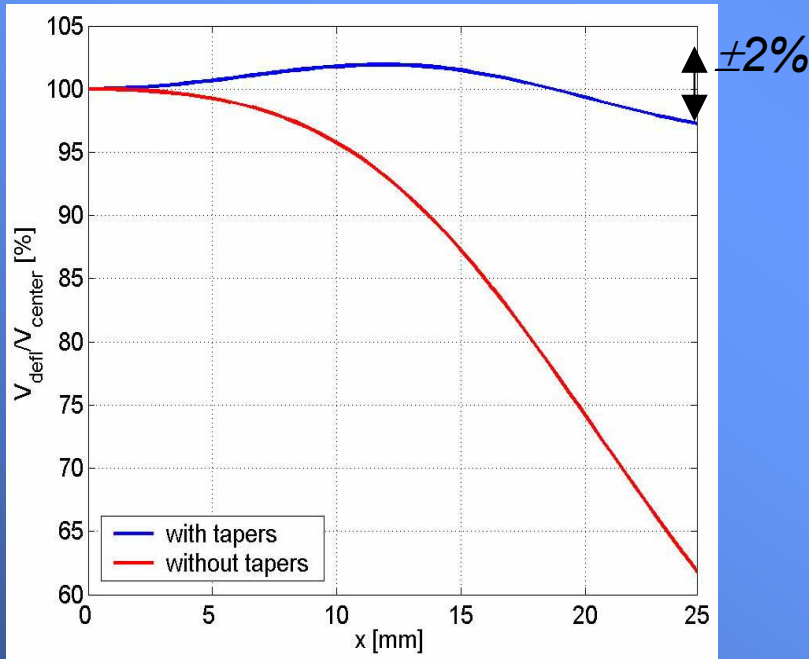
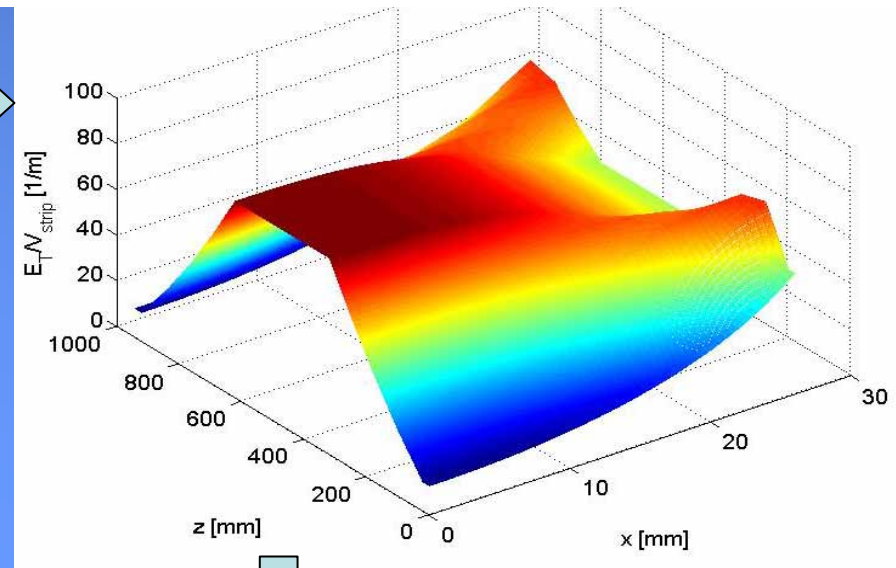
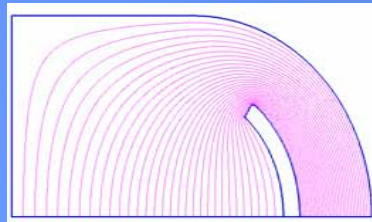


# 3) DAΦNE stripline kickers design: optimization procedure

## a) $L_T/L_k$ optimum ratio

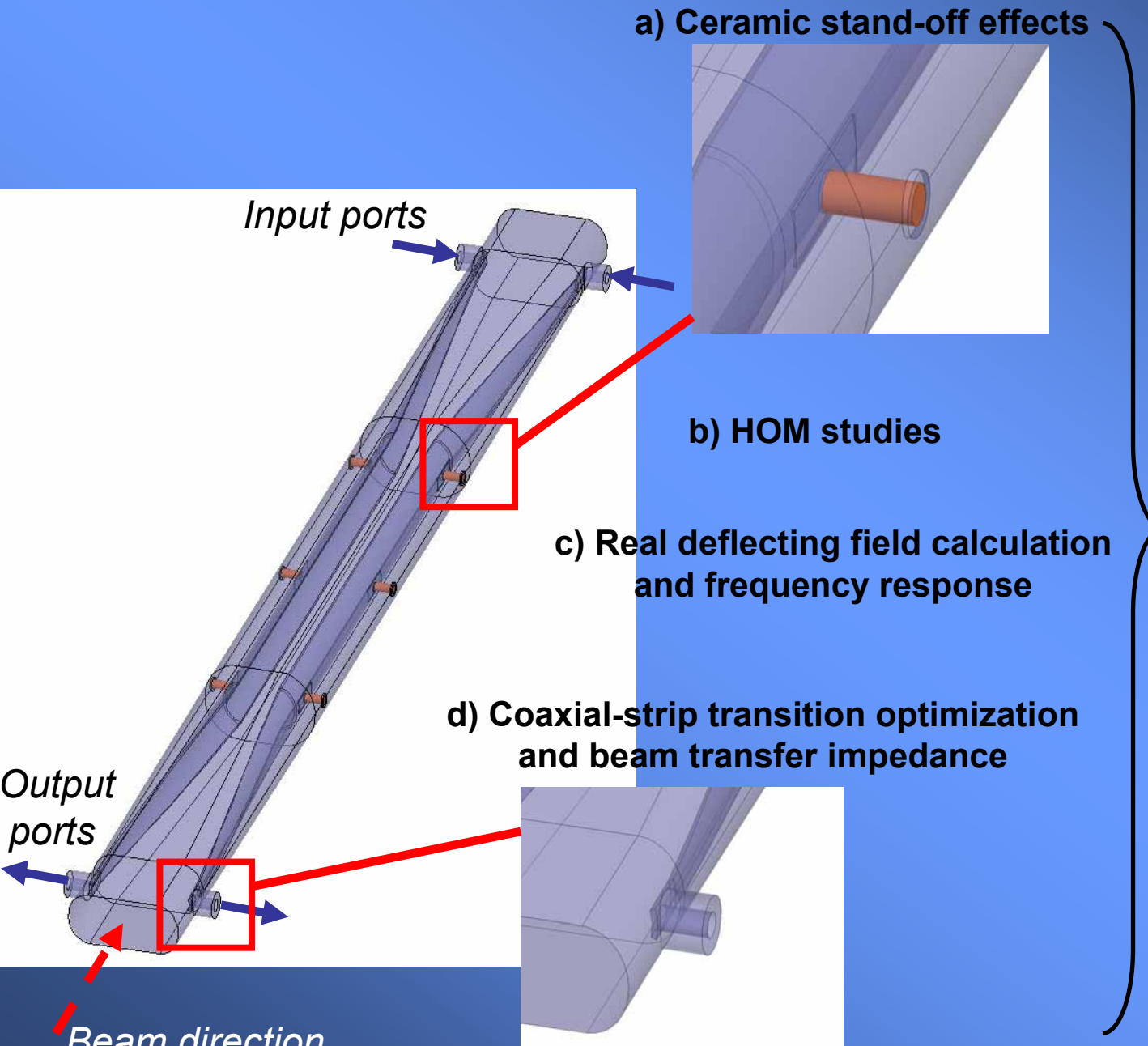
## Construction of 3D map of the deflecting field

2D simulations of different sections using Poisson-Superfish



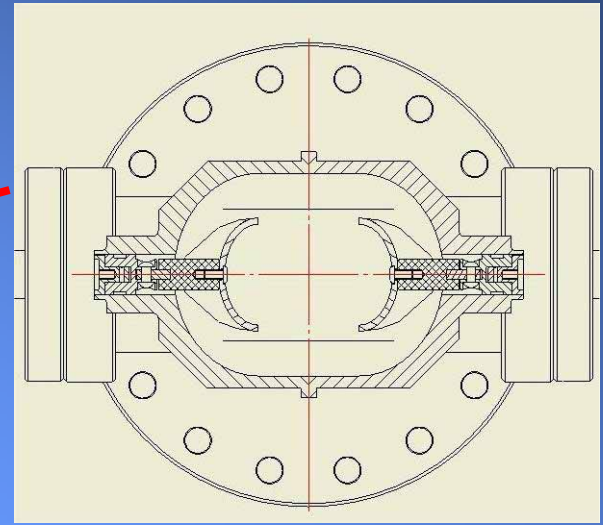
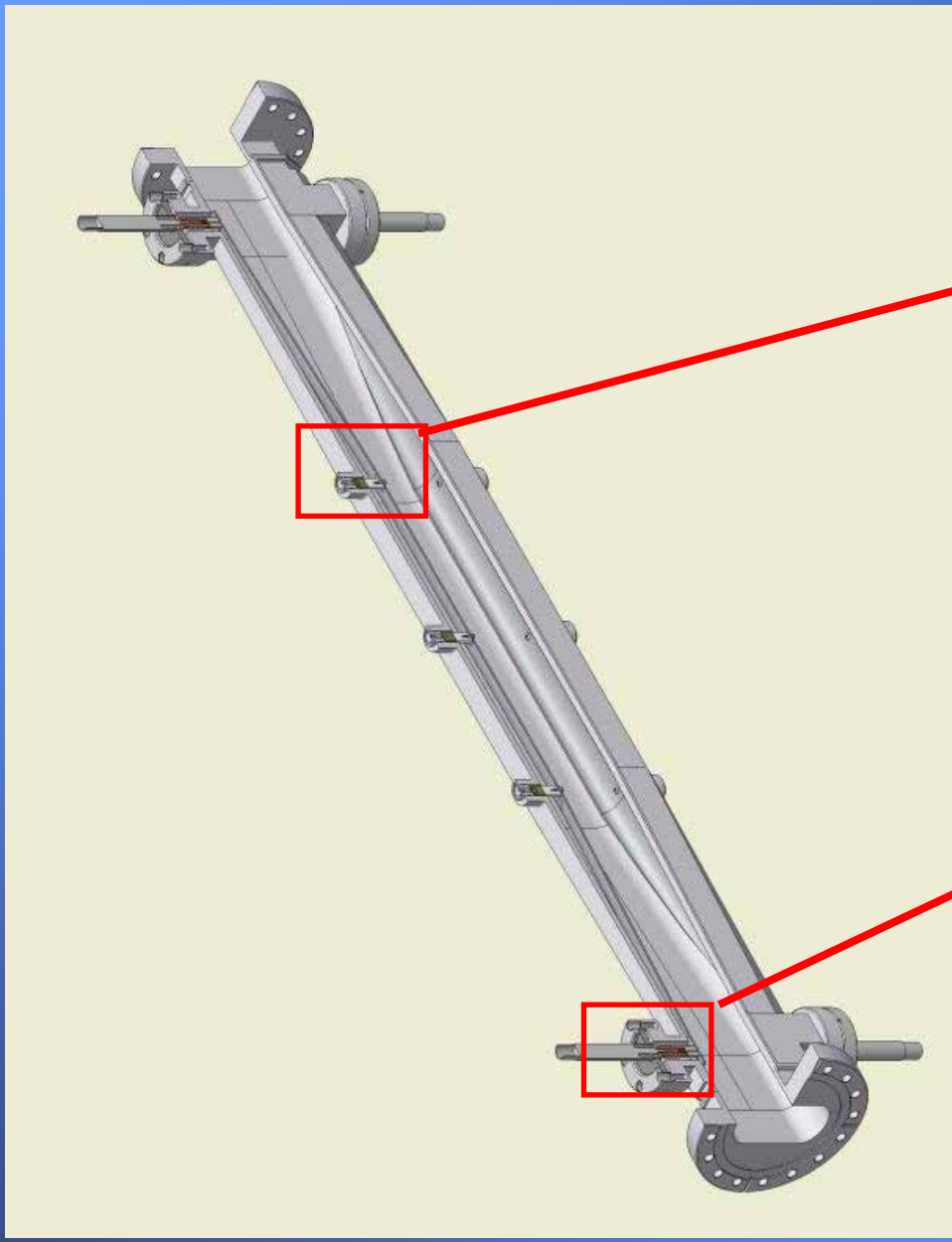


### 3) DAΦNE stripline kickers design: 3D electromagnetic model




Optimization of the whole structure

### 3) DAFNE stripline kickers design: mechanical drawings



*50  $\Omega$  HV feedthrough*

## 4) Time schedule for kickers construction and HV tests @ LNF

	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
<b>Pulser and feedthrough tests</b>								
<b>Construction of the 1<sup>st</sup> kicker</b>								
<b>HV test on the 1<sup>st</sup> kicker</b>								
<b>Construction of other kickers and installation</b>								

# CONCLUSIONS

- 1) **General considerations** on **circular** stripline kickers have been done showing in particular:
  - a) variation of the efficiency of the deflecting field as a function of the coverage angle;
  - b) variation on the uniformity of the field as a function of the coverage angle;
- 2) **Parallelism between the DAΦNE injection kicker system and the ILC** one from the point of view of pulse and kicker length, kicker aperture and total deflecting voltage;
- 3) **Correction of the deflecting field flatness** using **tapers**: general principle and application to the DAΦNE new injection kicker design;
- 4) **Time schedule** for kickers construction and HV tests @ LNF;
- 5) ***Tests of other pulser are welcome!***