IMPEDANCE OF PS KICKERS FOR THE NEW CT: 1st ANALYSIS

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- **Measurement of the longitudinal impedance vs. transverse offset by F. Caspers and T. Kroyer (with the presence of FR) $\Longrightarrow$ Data sent to me on September 8, 2005**
- **Transverse impedance deduced from Panofsky-Wenzel theorem**

Kicker 1

$\Longrightarrow$ 2 will be installed in the PS (SS 13 and 21)

$\Longrightarrow$ L = 0.666 m for 1 kicker

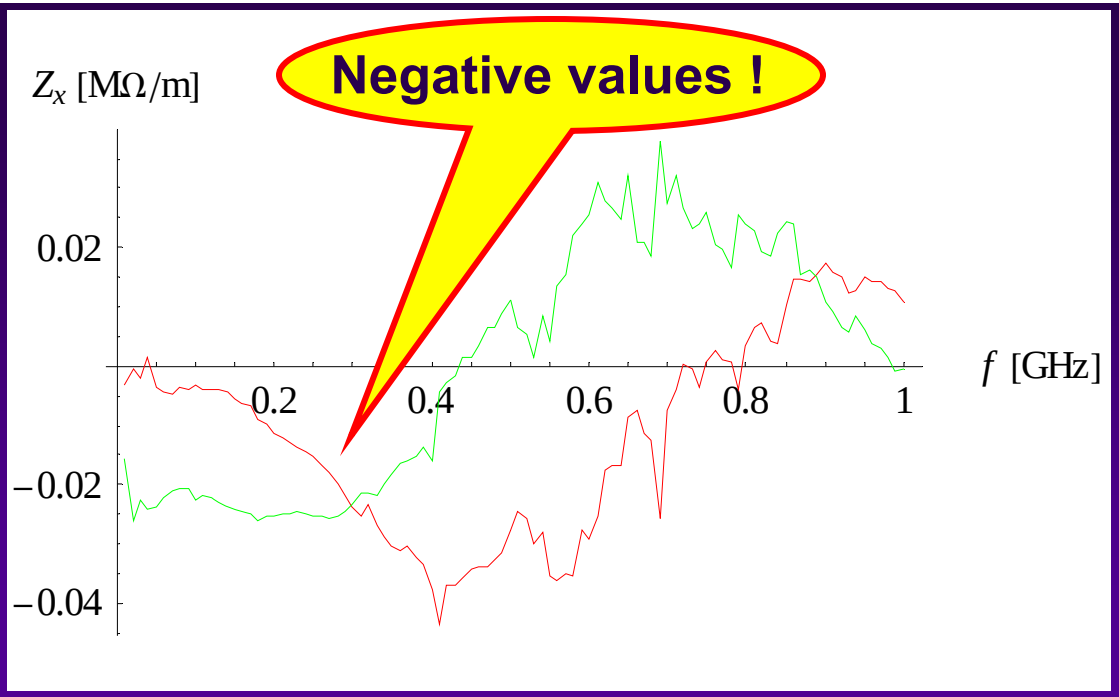
$\Longrightarrow$ It is the same type as the extraction kicker KFA 71 (but 4 times smaller)

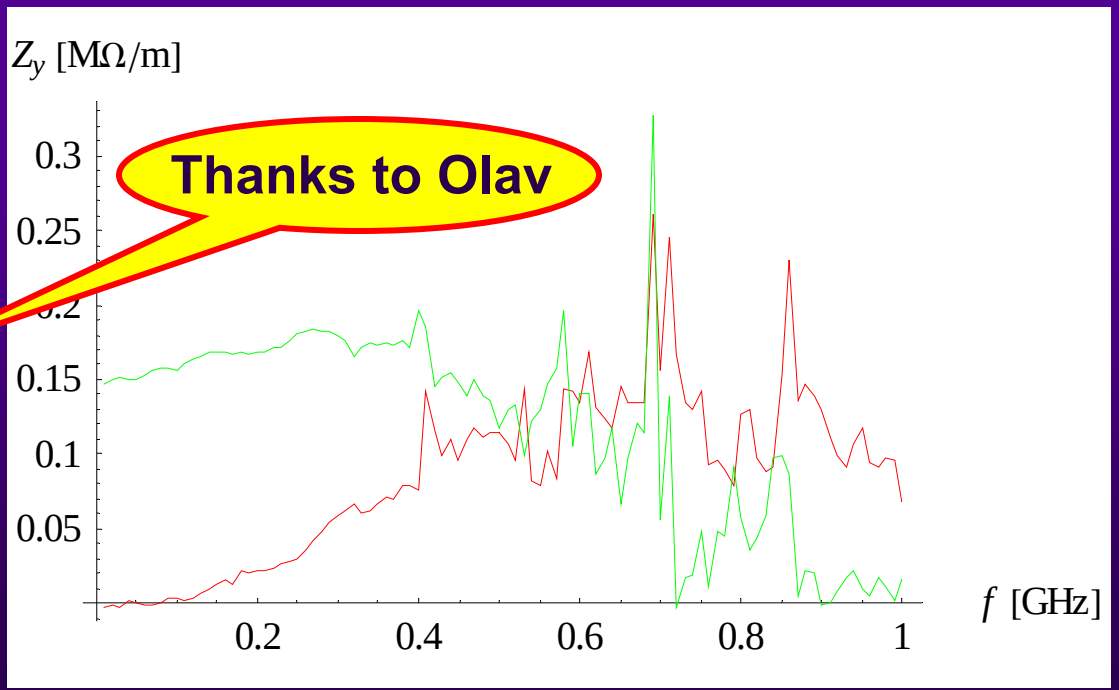
$$\beta_x^{13} \approx 22.1\,\mathrm{m}$$

$$\beta_y^{13} \approx 12.5\,\mathrm{m}$$

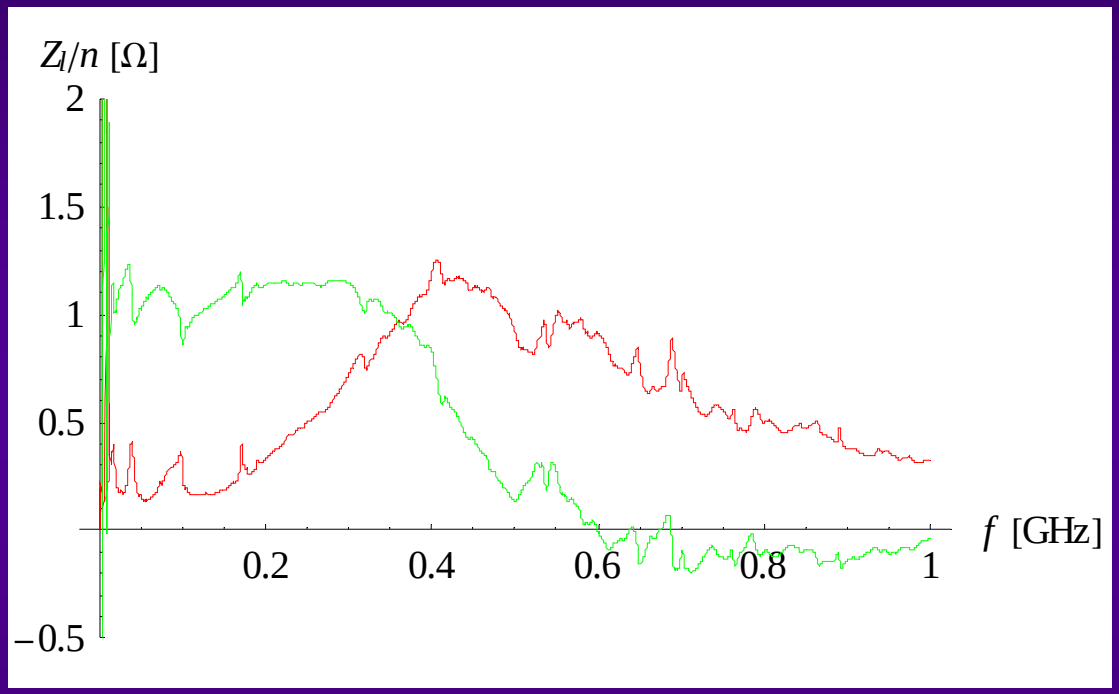
$$\beta_x^{21} \approx 20.4\,\mathrm{m}$$

$$\beta_y^{21} \approx 11.9\,\mathrm{m}$$





Kicker 1



Kicker 2

$\Longrightarrow$ 2 will be installed in the PS (SS 64 and 72)

$\Longrightarrow$ L = 0.615 m

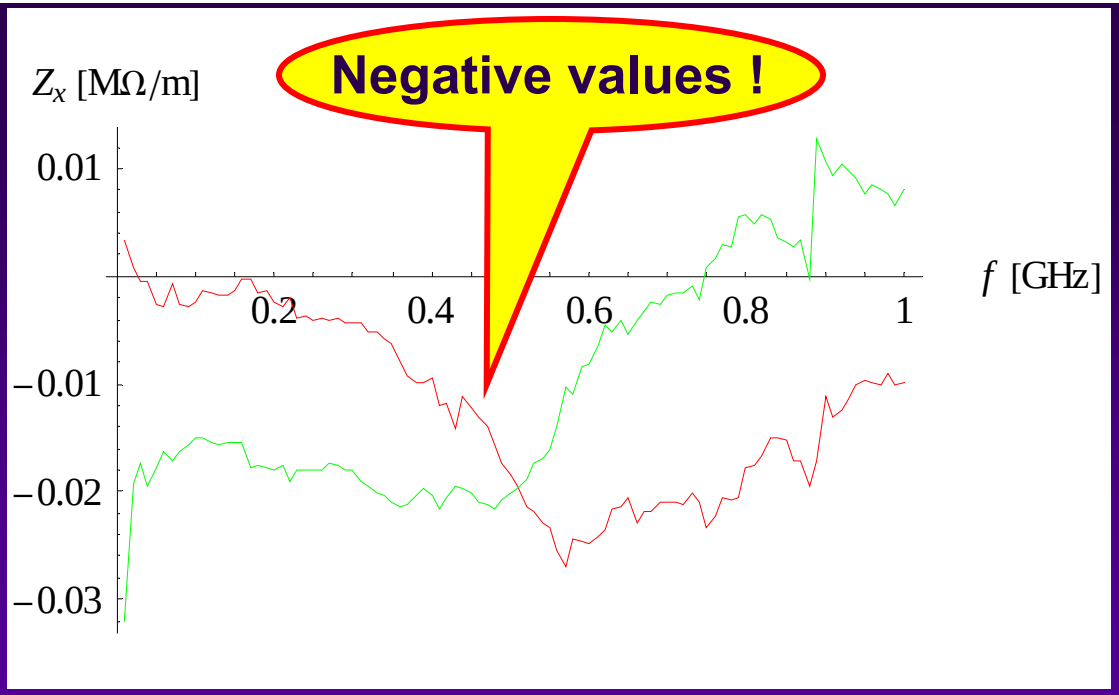
$\Longrightarrow$ Modules recuperated from the extraction kickers for leptons

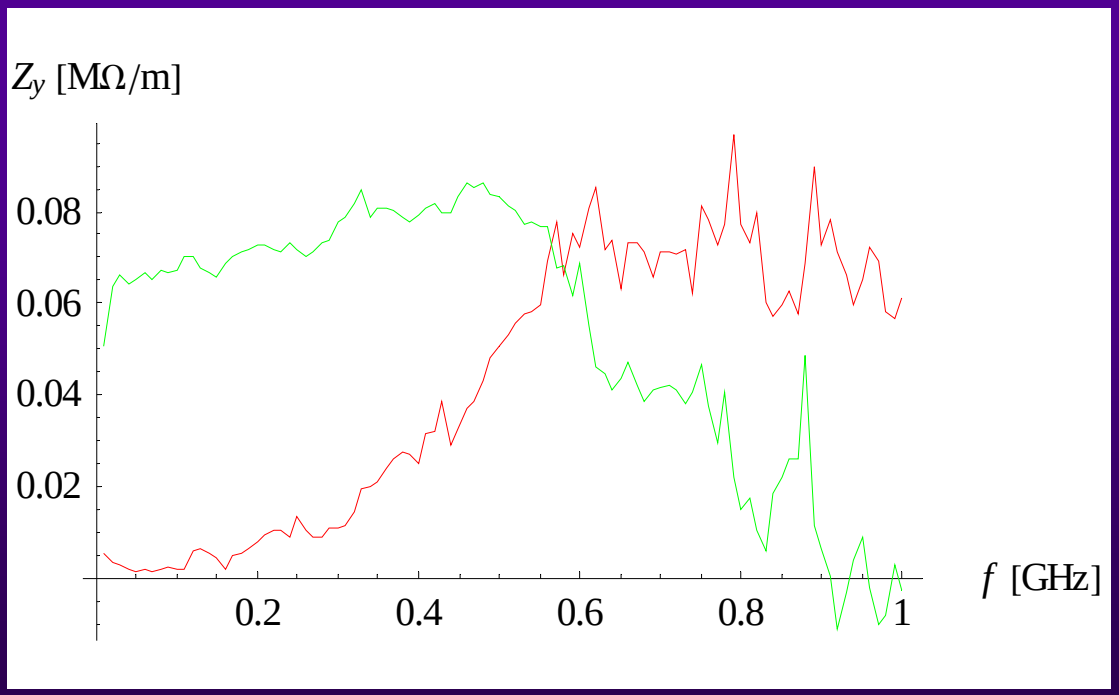
$$\beta_x^{64} \approx 12.7\ \text{m}$$

$$\beta_y^{64} \approx 21.7\ \text{m}$$

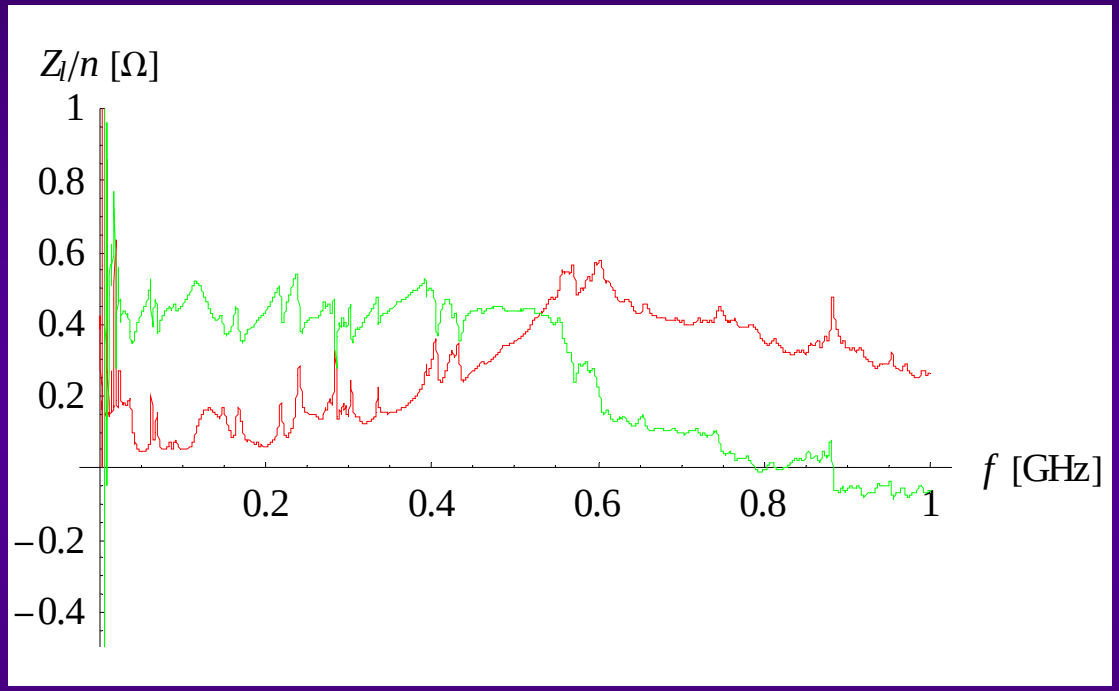
$$\beta_x^{72} \approx 11.9\ \text{m}$$

$$\beta_y^{72} \approx 22.1\ \text{m}$$





Kicker 2



Conclusions (1/3)

- **The Broad-Band impedance of the PS machine is**

$$\mathrm{Im}\left[Z_l^{BB} / n \right]_{l.f.} \approx 20\,\Omega$$

$$R_x \approx 1\,\mathrm{M}\Omega/\mathrm{m} \qquad R_y \approx 3\,\mathrm{M}\Omega/\mathrm{m}$$

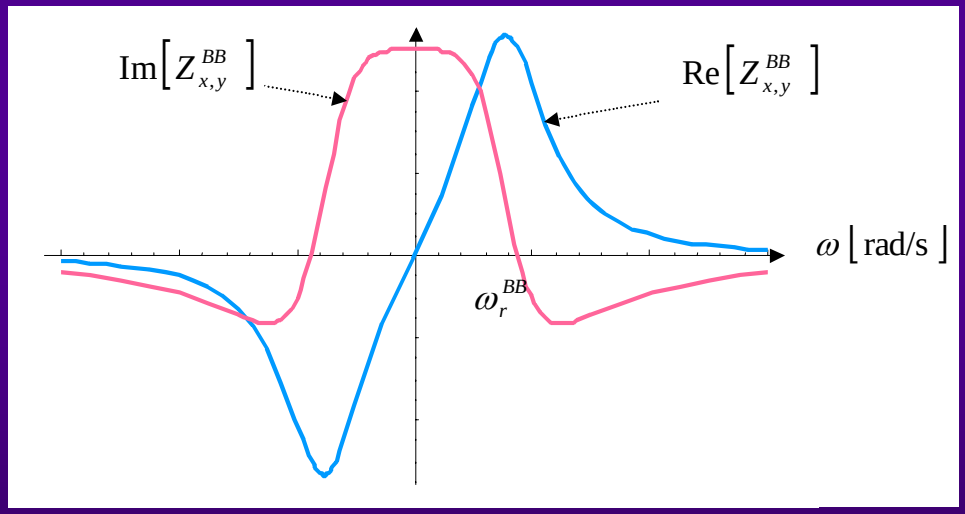
$$\frac{Z_l^{BB}}{n} = \frac{\Omega_0}{\omega} R_l \Big/ \left[1 - jQ\left(\frac{\omega_r}{\omega} - \frac{\omega}{\omega_r} \right) \right]$$

$$Z_{x,y}^{BB}(\omega) = \frac{\omega_r}{\omega} R_{x,y} \Big/ \left[1 - jQ\left(\frac{\omega_r}{\omega} - \frac{\omega}{\omega_r} \right) \right]$$

$$\omega_r = 2\pi f_r = 2\pi \times 1.4\,\mathrm{GHz}$$

$$Q = 1$$

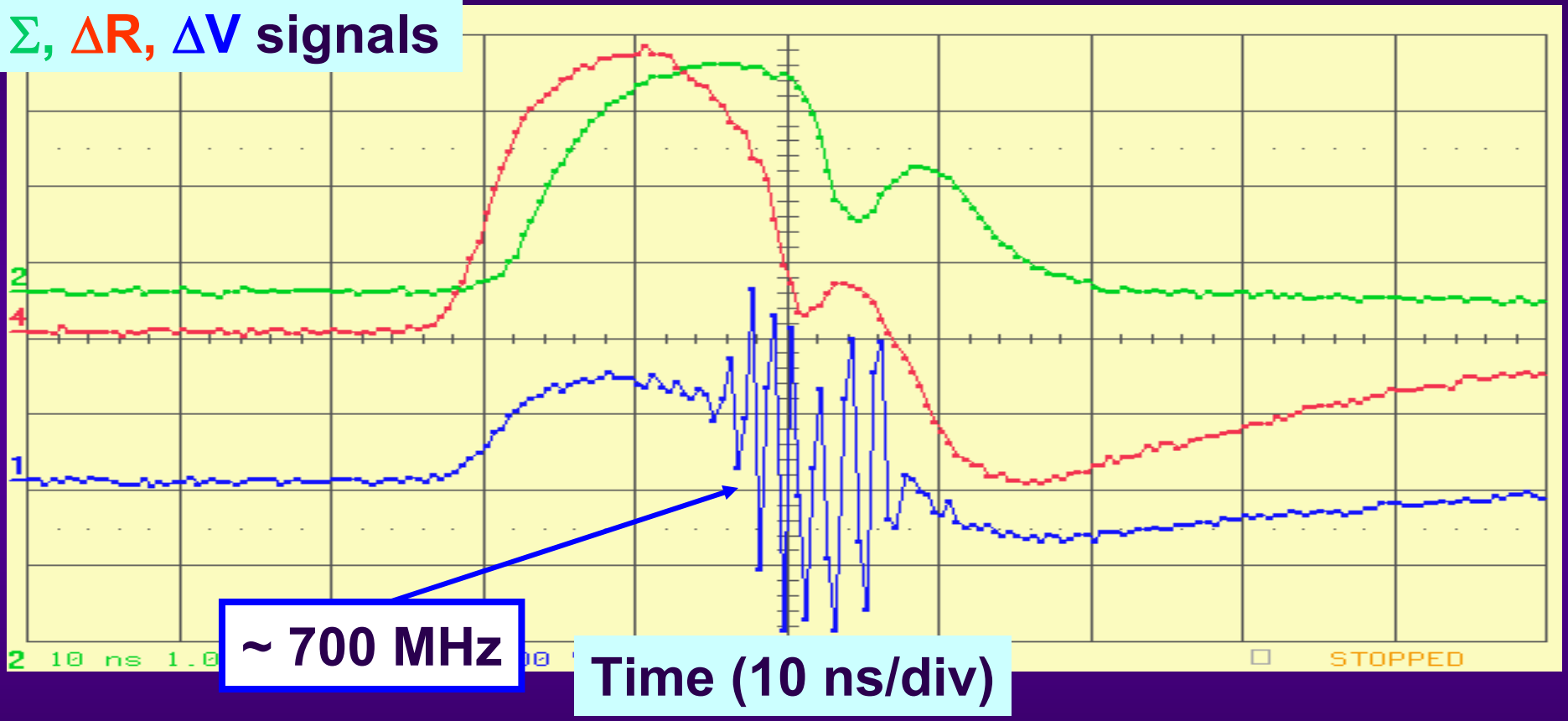
$$R_{x,y} \approx \mathrm{Im}\left[Z_l^{BB} / n \right]_{l.f.} \times \frac{2R}{\beta b_{eq}^2}$$



- **The vertical plane is the most critical ⟹ We will add ~ 0.4-0.5 MΩ/m to the ~ 1.5 (at ~ 700 MHz) already present ⟹ Increase of ~ 30% ⟹ Will be more critical at transition for nTOF**

Conclusions (2/3)

Fast vertical single-bunch instability at the CERN PS near transition (~ 6 GeV total energy)



⟹ Instability suppressed by increasing the longitudinal emittance to ~ 2.2 eVs ⟹ The longitudinal emittance will have to be increased to ~ 2.5-3 eVs

Conclusions (3/3)

- **For the longitudinal impedance, it will be increased by ~ 15%**
  $\Longrightarrow$ Check beam stability in particular for LHC

APPENDIX (1/2)

1. **The following kickers are installed presently in the PS machine**
   a. **Injection kicker in section 45**
   b. **Extraction kicker in sections 71 and 79**
   c. **BFAs (pedestal and staircase) in sections 9 and 21**
   d. **Injection kicker for ions in section 28**

2. **The following kickers will be installed for the first stage of the novel multi-turn extraction**
   a. **Two new kickers in sections 13 and 21. The modules are similar to those of the extraction kicker**
   b. **Two new kickers in sections 64 and 72. The modules are recuperated from the extraction kickers for leptons**
   c. **All the kickers mentioned under the point 1. will be also present**

3. **For the second stage it is foreseen to**
   a. **Decrease the rise-time of the kickers in section 13 and 21. At the same time a new design of the modules could be made so to reduce the impedance seen by the beam**
   b. **The BFA in section 21 will be removed**
   c. **The BFA in section 9 will stay in the machine**
   d. **Injection kickers (section 28 and 45) and the extraction kicker (sections 71 and 79) will, of course, remain in the machine**

APPENDIX (2/2)

Name	Magnet type No. of cells × l (mm)	Element	mech. Aperture hor×ver (cm) of 1 magnet module	magn. Aperture w×h (cm²)	Air field (Gauss)	leff (cm)	Int.Bdl (Gauss m) in SS	Rise - Fall time (5-95)% ns	Flattop µs
Pedestal	Lumped L	BFA 9/21 P	15.8 × 5.25	15.8 × 5.25	478.5	50	239.2	131	12.6
Staircase	Lumped L	BFA 9/21 S	15.8 × 5.25	15.8 × 5.25	765.6	39	298.6	260	12.6
Kicker 28	Lumped L	KFA 28	15.9 × 7.0	15.9 × 7.0	251.2	92.5	232.4	255	0.6 - 6.8
TIK Proton	Delay line 8×25	KFA 45	15.0 × 5.3	15.0 × 5.3	355.5	22.1 × 4	314.2	39	2.6
FAK71/79	Delay line 9×24	KFA 71/79	14.7 × 5.3	14.7 × 5.3	628.0	22.2 × 12	1671.9	68 - 70	0.1 - 2.1
PS e+/e- inj.	Delay line 24×24	KFA 72/94	11.2 × 7.4	11.2 × 7.4	424.3	61.5	261.0	87 - 90	0.1 - 2.1