CERN LINAC4 Stripline signals
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For the future Linac4 at CERN the measurement of position, intensity and phase of low beta H-beams are foreseen using either button BPMs or shorted stripline BPMs. The very small available space limits the choice of BPM type. At low relativistic beta the transverse sensitivity of a stripline BPM varies with beta and frequency and must be taken into account, as shown by R. Schafer.

Low beta effects

\[ R/L_{dB} = \frac{160}{\text{Ln}(10)} \left(1 + G\right) \frac{\sin(\phi)}{\phi} \frac{x}{b} \]

\[ G = 0.138 \left(\frac{\alpha b}{\beta c}\right)^2 - 0.0145 \left(\frac{\alpha b}{\beta c}\right)^3 \]

Schafer theorem

\[ \nu_a(\omega) = \frac{\phi}{\sqrt{2\pi}} \left| l_y \right| A(\omega) \text{Sinh} \left[ \frac{\alpha f}{2c} \left( \frac{1}{\beta e} + \frac{1}{\beta_s} \right) \right] \]

\[ \left[ \frac{\alpha f}{2c} \left( \frac{1}{\beta e} + \frac{1}{\beta_s} \right) \right] = \frac{\pi}{2} \]

\[ l_{opt} = \frac{1}{2} \frac{v_s}{f} \quad \text{For } v_s \ll c \]

\[ l_{opt} = \frac{1.01 \times 10^8}{2352 \times 10^8} = 42.6 \text{mm} \]

Much shorter than free space quarter wavelength, but beta change along the linac!!!

Present 3D electromagnetic field solvers does not consider low beta beams and the question was how to simulate low beta beams. A new Microwave Studio package now gives the possibility for simulating low beta beams.