HIGH FREQUENCY SINGLE MODE TRAVELING WAVE STRUCTURE FOR PARTICLE ACCELERATION

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Abstract
The new high frequency travelling wave with single TE01 slow mode is studied. The structure is composed of a metallic tube with an internally coated low conductive thin layer. It is shown that the impedance of the internally coated metallic tube (ICMT) has a narrow-band single resonance at a high frequency. The resonant frequency corresponds to synchronous TM01 mode excited by the relativistic charge. The dispersion properties of the fundamental and high order modes of ICMT structure are analysed. Proof-of-principle experimental set-up at AREAL facility is given. The potential of the new structure for the particle acceleration and generation of monochromatic radiation in THz region are discussed.

REFERENCES

Eigenvalue equation for TM modes

\[
\frac{1}{j} \left( \frac{J_1(\xi_0)}{J_0(\xi_0)} \right) = \frac{1}{k^2 ad}
\]

High Frequency region
Thin inner layer

Fig. 2. Real (solid) and imaginary (dotted) parts of 
and purely real TM modes
(dashed) transverse eigenvalues versus frequency.

In a frequency range \( k > k_0 \)
Transverse eigenvalue - purely imaginary \( \nu_{ph} < c \)

In a frequency range \( 0 < k < k_0 \)
Transverse eigenvalue - purely real \( \nu_{ph} > c \)

At synchronous frequency \( k = k_0 \) \( \nu_{ph} = c \)

Longitudinal Monopole Impedance:

\[
Z_0(\omega) = \frac{R}{1 + jQ \frac{\omega_0 - \omega}{\omega_0}}
\]

\( \omega_0 = c k_0 \) - resonance frequency

Wake function

\[
W_\| (s) = - \frac{Z_0 c}{m} \epsilon^{-a s} \left[ \cos(k_a s) - \frac{\alpha}{k_a} \sin(k_a s) \right]
\]

\( d = 200 \text{mm} \)

Experimental Set-up

1- Electron Beam, 2- AREAL Beam pipe, 3- two-layer waveguide, 4- Network analyser, 5- conical screen, 6- plane metallic screen, 7- photoplate, 8- radiation from the open, 9- e-beam extraction

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