Contribution ID: **84**

Type: **Poster (participant)**

An Analysis of Electromagnetic Wave Propagation in a Conducting Cylinder with a Small Aperture

Tuesday, 15 April 2025 17:10 (1h 30m)

This study investigates the propagation and reflection of electromagnetic waves in a conducting cylindrical cavity with a small aperture, analyzing the effects of boundary conditions on wave transmission and diffraction. Using a Green's function approach, we derive exact solutions for the electromagnetic potentials in the Lorentz gauge, incorporating the influence of conducting boundaries and image charges. The field distribution inside the cavity is expressed in terms of eigenmode expansions involving Bessel functions, satisfying Maxwell's equations and the cavity's boundary conditions. The presence of a small hole introduces diffraction effects, which are analyzed using Bethe's small-aperture theory and mode-matching techniques to quantify the transmitted field. For large apertures, the wave leakage is modeled through cylindrical waveguide modes, while for small apertures, the diffraction pattern follows a dipole-like radiation structure. Additionally, we examine the wakefields induced by a charged particle beam inside the cavity, illustrating their interaction with reflected and transmitted waves. The study provides a rigorous framework for understanding space-charge fields in accelerator structures and wave leakage in confined conducting environments, with applications in beam physics and electromagnetic field modeling.

Primary author: PARK, Chong Shik (Korea University, Sejong)

Presenter: PARK, Chong Shik (Korea University, Sejong)

Session Classification: Poster Session

Track Classification: Theory and simulations