ID de la contribución : **20** Tipo : **no especificado**

Electromagnetic design of a re-entrant cavity-BPM for the ILC Main Linac

martes, 16 de septiembre de 2025 15:00 (15)

For future particle colliders, cavity Beam Position Monitors (cBPMs) are considered the optimal solution for precise beam position measurements, which are essential for guiding and stabilizing high-energy beams with nanometer accuracy, thereby maximizing luminosity at the interaction point. In this work, we present the electromagnetic design of a re-entrant cBPM for the ILC Main Linac, detailing the successive steps undertaken to achieve the required performance targets. The design optimization has been carried out through electromagnetic simulations using CST Microwave Studio and Ansys HFSS. In addition, tolerance studies have been performed to ensure that the final component meets the operational specifications within realistic manufacturing limits.

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Clasificación de la sesión : Electrónica

Clasificación de temáticas : Electrónica