Lee Teng Internship, FNAL, Summer 2013

Midterm Report

Student: Reynier Cruz Torres (University of Florida)

Mentor: Dr. Jayakar Charles Thangaraj

Microwave Measurement of eCloud using Resonant Cavity Technique in the Main Injector (MI) is a long-term project that started at Fermilab several years ago. The original technique comes from UC Berkeley. In 2004, DeSantis proposed this method that consists of sending a microwave through the accelerator pipe to measure its phase shift and therefore, measure the electron cloud density (ECD). The problem with this method is that, even though one finds a big signal in the receiver, this signal is unlocalized, due to reflections from undesired parts of the pipe. Fermilab scientists proposed the installation of absorbers to avoid microwaves coming from other sections of the pipe. This way one gets a localized signal, but very small. Ultimately, another method was proposed at Fermilab by C. Tan, consisting of the installation of reflectors rather than absorbers to obtain a big and at the same time localized signal.

 After some years of bench-top of experiments and using dielectrics to simulate electron clouds, two detectors were installed in a small (13 meters) section of the main injector, containing to dipoles in between. Each detector consists of two horizontally oriented antennas and one ear behind each antenna. The ears serve technically three functions. Firstly, they act as the previously mentioned reflectors. Secondly, they close the pipe in the sense that creates a cavity-like setup. And thirdly, they protect the antennas from beam loss. With this said, we are performing the measurements using an Agilent E4428C signal generator (Bandwidth of 250kHz to 6.0GHz), a 40-dB-gain power amplifier (Bandwidth of 2MHz to 2GHz), and an Agilent N9020A spectrum analyzer (Bandwidth of 20Hz to 13.6 GHz). Calibration of the equipment and measurements of microwaves with no beam are currently being performed. We are currently waiting for the proton beam to perform further measurements.