The Booster Neutrino Beamline experiment requested a new secondary electron emission multiwire profile monitor installation. The device had to be able to endure high radiation conditions and mounted within a large 10 foot square steel barrel for installation near the beam target. Previous iterations of multiwires suffered radiation damage to both the connections and wires. To ensure accurate horizontal and vertical beam profile measurements, the BNB multiwire utilizes 3 mil diameter gold-plated tungsten sense wires soldered to vertical alumina-96 ceramic planes, 50 wires per plane. Radiation hard Kapton insulated 30 gauge wires carry the output signals. Profiles are readout through charge integrator electronics. This paper will detail the design and functionality of the BNB target multiwire and present relevant beam profile data.

The Booster Neutrino Beamline Target Multiwire for Horn 5 is a new unique beam profile monitor design of Fermilab utilized specifically for profile measurements of high intensity beams, up close to the experimental target [2]. This presents many engineering challenges, but also opportunities to improve and craft a very survivable and effective design. This project has been a joint effort between the Fermilab Accelerator Directorate Instrumentation, Electronics & Target Systems groups. The BNB multiwire operates on the principle of secondary electron emission, much the same as all other SI multiwire monitors at Fermilab. The resultant signal is expected to be proportional to the amount of beam particles striking the wires [1].

The multiwire is mounted on a mechanical assembly and aligned with precision instrumentation. The assembly drawing is shown below in Figure 1. The mounting assembly is sealed completely airtight and placed near the beam target. Due to the close proximity to the beam target and the high radiation hazard, access to the internals of the unit for repairs or modifications is very difficult and time consuming. All alignment and testing is done to the highest of standards to reduce the risk of failures.

The environment which the BNB target multiwire is installed is considered a high radiation area, due to its proximity to the beam target. Exact radiation measurements are not known but are enhanced by close to the center peak of the profile.

The mounting assembly is beyond the scope of this document. Theceramics are 4.5 x 4.5 inch with a center hole of diameter 1.25 inch. The ceramics are 6 x 6.5 inch with a center hole of diameter 2.5 inch. They have 50 pads for signal wires, and 100 pads for gold plated tungsten [2] sense wires across the center hole. There are three titanium foilss of .005 inch thickness, which act as bias planesto assist in maintaining the correct orientation and one horizontal. The multiwire consists of two alumina-96 ceramic planes, one of vertical orientation and one horizontal. The mounting assembly is sealed completely airtight and placed near the beam target. Exact radiation measurements are not known but are enhanced by close to the center peak of the profile.

Function and Application

The primary challenge when working with the small diameter kapton wire was the tendency for the wires to bend and fall. Some research and testing has given into the possibility of using ceramics to encase the wires and future installations of target multiwires. The ceramic coated wire allows for the wires to maintain its shape even when manipulated, bent or straightened. Ceramic coated wires are much better than the kapton film, but the ceramic can be stripped with a simple small blade. Ceramic also has benefits of more radiation tolerance than kapton. This is a future endeavor to use ceramic coated kapton for the multiwire installation.

The data pictured above is not from the BNB target multiwire, as this device is recently installed and has not yet seen beam. The image above is a screen capture from a similar device, a standard multiwire SMM. This is the horizontal and vertical display showing expected results with a Gaussian fit. The histogram plot has each wire voltage value represented as a blue bar. The center of beam is ideally close to the center peak of the profile.

REFERENCES