Measuring Longitudinal Bunch Shape in the Fermilab Linear Accelerator with a Feschenko Bunch Shape Monitor

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A Feschenko Bunch Shape Monitor (or bunch length detector) has existed in the 400 MeV section of the Fermilab Linear Accelerator (Linac) for approximately twenty years. Bunch length detectors are a useful and physically simple tool for monitoring the health of a particle beam via longitudinal bunch shape measurements. Secondary electrons in the H^- beam are accelerated away from the beam by a wire supplied with a negative high voltage into a radio frequency deflecting cavity to transform a time profile measurement into a spacial profile measurement. We discuss the operational methods of a bunch length detector and the different types of hardware and how they are controlled to allow for bunch length measurement. Unfortunately, measurements in the Fermilab Linac were not possible because the Accelerator Division schedule did not allow an access to the Linac tunnel until the last week of this project. Some unresponsive hardware was suspected to be malfunctioning in the tunnel throughout the summer; we were able to identify these with an access opportunity during the last week, allowing for measurements to occur soon. Therefore, our discussion also includes methods which allow for testing the bunch length detector in preparation for taking actual measurements from the beam. We also discuss methods for the development of an X-ray based version of a bunch length detector, as opposed to the secondary electron method of our bunch length detector. This method is a future research and development effort towards Fermilab's future accelerator program.

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