STABILITY OF ELECTRON ENERGY IN THE FERMILAB ELECTRON COOLER*

A.Shemyakin#, K. Carlson, L.R. Prost, G. Saewert
FNAL, Batavia, IL 60510, U.S.A.

A powerful electron beam (4.3 MeV, 0.1 A DC) generated by an electrostatic accelerator has been used at Fermilab for three years to cool antiprotons in the Recycler ring. For electron cooling to be effective, the electron energy should not deviate from its optimum value by more than 500 eV. The main tool for studying the energy stability is the electron beam position in a high-dispersion area, thus using one of the bending magnets as a spectrometer. The energy ripple (frequencies above 0.2 Hz) is found to be less than 150 eV rms and caused mainly by the fluctuations of the chain current. The energy drift (frequencies less than 0.2 Hz) was initially of the order of a few keV. This drift is traced to two main sources. First, it is in part due to the combination of the finite high voltage regulation loop gain and the concurrent drift of the chain current. This is corrected by implementing a software loop that keeps the chain current constant. The second reason for the energy drift is the temperature dependence of the generating voltmeter reading. This effect was alleviated by stabilizing the temperature and implementing another software loop, which adjusts the high voltage set point based on beam position measurements. The paper describes the efforts carried out to reach the required level of energy stability as well as the setup, diagnostics, results of measurements, and operational experience.

* Operated by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the United States Department of Energy

#shemyakin@fnal.gov