Microchannel Plate Detector System Time of Flight Measurements

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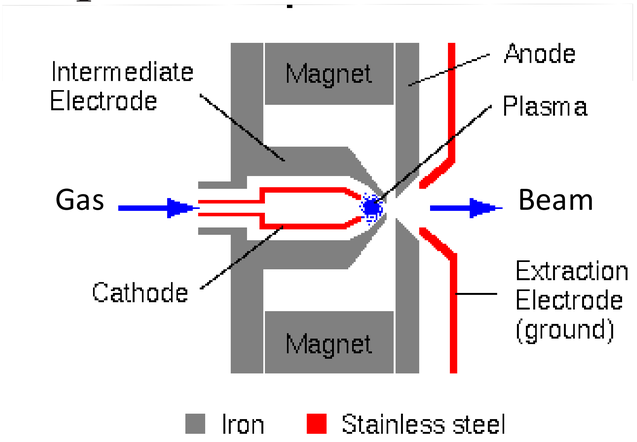
Objective

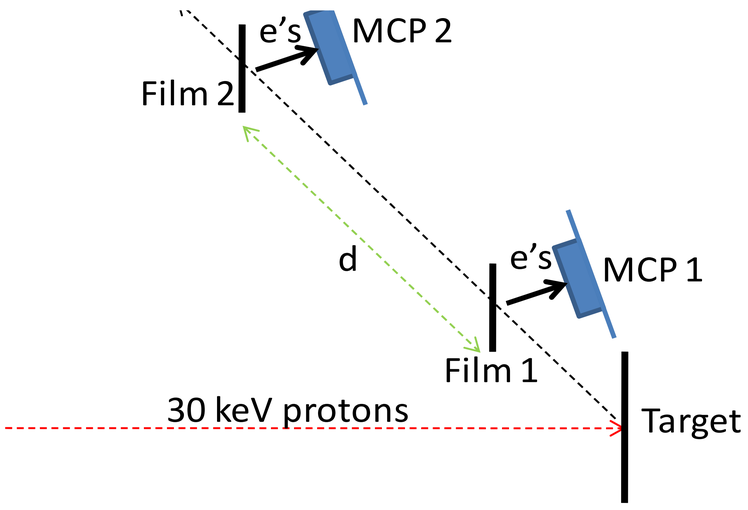
A microchannel plate (MCP) detection system was assembled and tested for use with the existing 30keV Duoplasmatron ion source. A time of flight experiment will be performed to calibrate this system by verifying the energies of approximately 5.0-MeV alpha particles from their measured velocities.

Duoplasmatron Ion Source



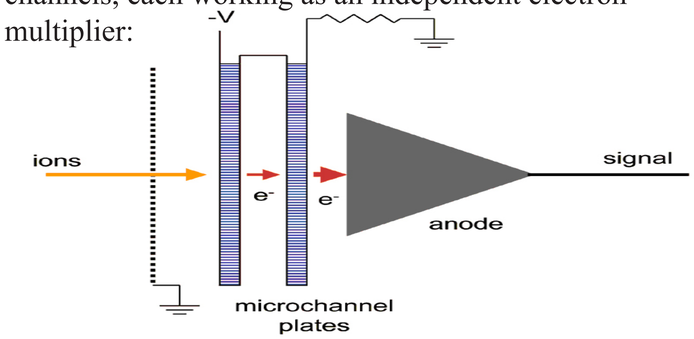
Motivation

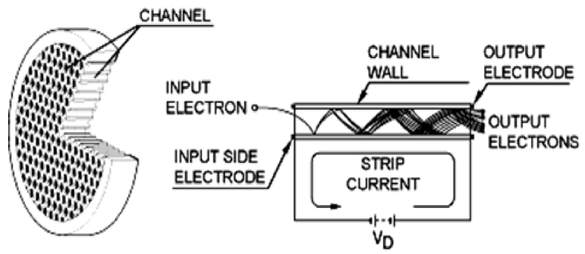
The energy of 30 - keV protons is too low for the common surface barrier charged particle detectors. For ions in this energy range, time of flight measurements can be used to determine the kinetic energy of the particles. A microchannel plate detectors (MCP) are used to amplify the incoming signal of the low energy particles.



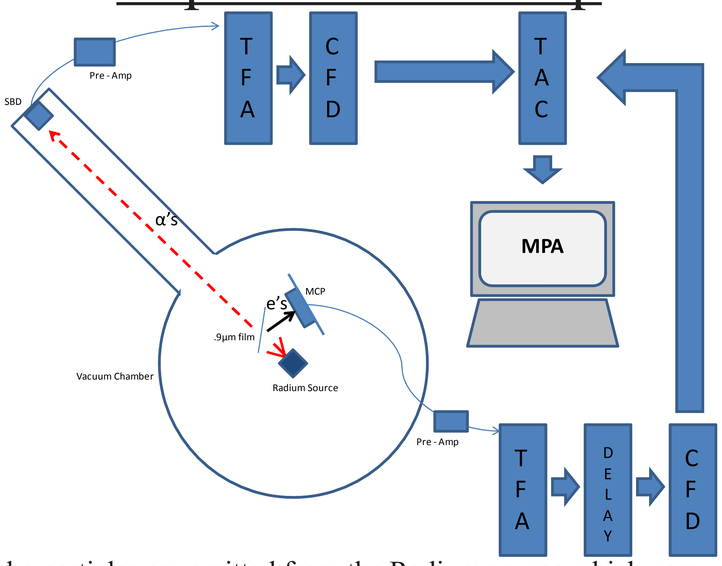
Microchannel Plate Detector

A MCP is a series of specially fabricated plates which amplify an input signal through several million channels, each working as an independent electron multiplier:

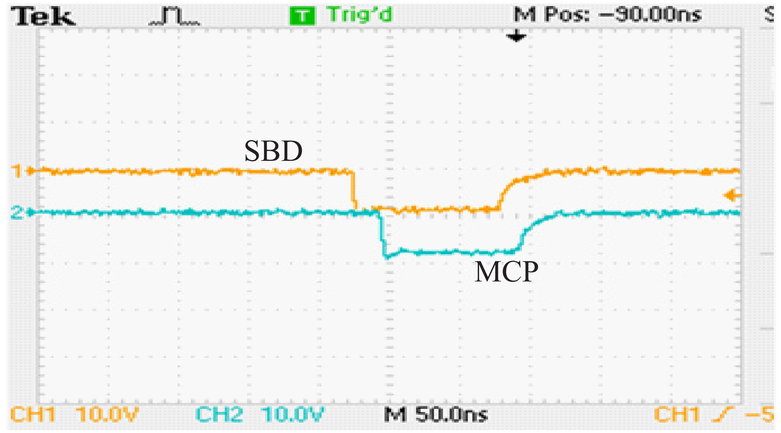




Experimental Setup



Alpha particles are emitted from the Radium source which pass through the .9µm mylar film. Electrons are emitted by the film and are collected by the MCP. The alpha particles continue through the film, and are captured by a surface barrier detector (SBD). Timing filter amplifiers (TFA) and constant fraction discriminators (CFD) are used to shape the initial pulse. The SBD signal is our start signal, and our delayed MCP is the stop signal for the TAC (Time to Amplitude Converter).

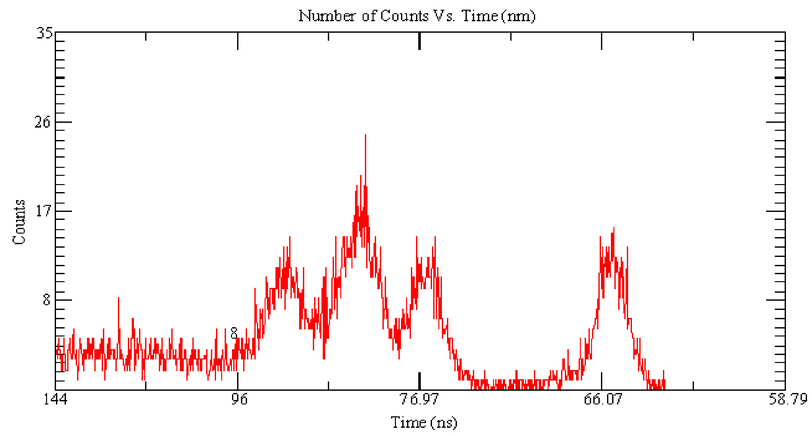


The above shows is the output of the Constant Fraction Discriminators with a test signal input. You can clearly see the delay between the signals. The SBD is the start trigger for the TAC and the MCP is the stop trigger. The time difference in the signals is then used to determine the energies of the particles using:

$$K.E. = \frac{1}{2}mv^2$$

Expected Results

The output of the TAC goes into an MPA whose output is shown below. The plot below indicates the number of counts input to the MPA from the TAC at the given time values. The time values are then used to determine the number of particles at the various energy levels.



Looking Ahead

After calibration, this system will be able to detect and identify the energy levels of particles in a given reaction. Eventually this system will be used in conjunction with the duoplasmatron ion source to determine the energies of particles given off during reactions.