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A Possible Proton Beam Self Modulation Experiment at Fermilab

C. JOSHI, W. AN, W. MORI, UCLA, J. THANGARAJ, C. PARK, J.D. LEWIS, P. SPENTZOURIS, Fermilab — Recently the proton beam driven PWFA has attracted much attention because the multi-TeV proton bunches can be used as the drive beam to accelerate leptons in a single PWFA stage to hundreds of GeV energy level. Unfortunately the existing beams all have a ~ 10 cm pulse length, which is much longer than the ideal PWFA drive beam requirement ($\sim 50 \mu\text{m}$). However such a long beam may be self modulated when propagating in a long plasma column, which will generate a string of micro bunches and excite a large amplitude plasma wave. Fermilab has a 120 GeV proton beam, which is available for demonstrating the beam self modulation in the plasma. The typical energy modulation of the protons after traversing a few meters of plasma is on the order a GeV and a high resolution spectrometer is needed to detect this beam modulation directly. Fortunately a portion of the Tevatron ring can be used as a spectrometer for detecting this energy modulation. The PIC code Osiris and QuickPIC are used for simulating the proton beam self modulation. The beam particle data can be also imported into another accelerator code for testing the spectrometer design. Preliminary simulation results show that 0.5 GeV energy modulation can be observed for reasonable beam parameters using a 2 meter long plasma.

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