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Indirect Proton Beam Self-Modulation Instability Measurements

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AWAKE, the Advanced Proton-Driven Plasma Wakefield Acceleration Experiment, is a proof-of-principle R&D experiment at CERN using a 400GeV proton beam from the CERN SPS (sigmaz=12mm) which will be sent into a 10m long plasma section with a nominal density of ~7e14 1/cm^3 (plasma wavelength lambda=1mm).
A proton beam with a length much longer than the plasma wavelength experiences a self-modulation instability (SMI) when going through a plasma cell and consequently produces a train of micro-bunches. These micro bunched protons drive the plasma wake resonantly with strong longitudinal and transverse electric fields, which are then used for electron beam acceleration.
In the AWAKE experiment the defocusing of the proton beam at an angle of around 1mrad is a clear indication of this fully developed SMI. Therefore the observations of the proton beam defocusing will be used in the AWAKE experiment as an indirect measurement of the SMI. By using 2imaging screens at a distance of ~8m it is possible to measure both the beam size and its angular divergence.
The layout of the measurement setup and the design of the detectors is shown, the simulations of the expected signals are presented.

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