First Self Modulation Instability Results from AWAKE: A Proton Driven Plasma Accelerator

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AWAKE is a proton driven plasma wakefield experiment at CERN [1]. A ten meter vapor source is used to create rubidium with a precise and tunable baseline density of $7*10^{14}$ cm^{-3}, with an associated singly ionized plasma skin depth (c/wp) of 1.2 mm. Because the 400 GeV proton beam from the super proton synchrotron (SPS) is significantly longer than the plasma skin depth, AWAKE must rely on the transverse self-modulation instability (SMI) to apply feedback on the proton beam, causing modulation at the plasma skin depth and thereby allowing it to resonantly drive the wakefields to create GV/m fields. Furthermore, SMI must compete with other plasma instabilities so it must be seeded by igniting the plasma within the proton beam with a 4.5 TW laser pulse. In this presentation, I will discuss the first results of the measurements of SMI at AWAKE, the physics of SMI and that of the ionization required to seed it, the nature of the plasma source, the diagnostics used to measure SMI, and the planned future of AWAKE.

References

[1] E. Gschwendtner, et al AWAKE, The Advanced Proton Driven Plasma Wakefield Acceleration Experiment at CERN, Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment, Vol 829, 1 September 2016, Pages 76-82, ISSN 0168-9002, https://doi.org/10.1016/j.nima.2016.02.026.