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Streak camera diagnostics for a self-modulated proton bunch

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The AWAKE experiment relies on the self-modulation instability of a long (ns) proton bunch in a plasma. The self-modulation of the bunch is responsible for resonantly driving the plasma wakefields. The proton bunch develops a density sub-structure with a scale on the order of the plasma wavelength (~1.2 mm) and thus scales with the square root of the plasma density. To detect this sub-structure one needs a diagnostic capable of detecting ~4-5ps periodic density modulation. Optical transition radiation (OTR) provides a prompt light source to diagnose the sub-structure of the bunch with a time resolved measurement using a streak camera. The diagnostic consists of an OTR screen from which the incoherent light is coupled to a streak camera. The ability of the streak camera to detect the ps modulation of the light signal was tested using beating laser beams. Test results and plans to apply the diagnostic to the AWAKE experiment will be presented.

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