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A diagnostic to measure rubidium vapor density during the AWAKE experiment at CERN

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For the AWAKE experiment, one needs an online and automatic rubidium (Rb) vapor density measurement device. Due to the laser tunnel-ionization of the Rb vapor, the plasma density is equal to the vapor density, which is measured instead. The diagnostic consists of a Mach-Zehnder interferometer built of single mode fibers and a fiber spectrograph. We use the hook method adapted from oblique to vertical fringes. Without vapor, the spectrum is sinusoidal. Anomalous dispersion due to the Rb transition line at 780.2412 nm (5^2S1/2 to 5^2P3/2) causes a change in the spectrum periodicity in the vicinity of the transition wavelength. The oscillation period becomes smaller the closer to the transition line and also the higher the density. The Rb vapor density is obtained by fitting these curves with the formula described in the literature. The Rb vapor density will be measured at both ends of the plasma source in order to measure and control the linear density gradient along the plasma source that will be used to optimize the accelerated electron bunch parameters.

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