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Achieving Tight Synchronization in Plasma Wakefield Accelerators at EuPRAXIA@SPARC_LAB

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Plasma wakefield acceleration (PWFA) is the most promising candidate for next-generation compact accelerators. An efficient and reproducible operation of a plasma wakefield accelerator facility relies largely on a tight synchronization among all the accelerator sub-systems impacting the beam longitudinal phase-space and time-of-arrival. One of the big disturbances affecting the beam characteristics is the RF power station phase noise. An effective solution is using a fast feedback loop to stabilize its phase. SPRAC_LAB had implemented this technique since 2008 and recently several innovations have been realized on this feedback loop to achieve extremely stable synchronization for PWFA. The experimental results demonstrate the phase jitter of RF line is successfully reduced to 15 fs RMS with respect to the reference master oscillator. This marks a notable improvement over the original setup and makes a meaningful step toward meeting the strict RF stability requirements of advanced plasma accelerators.

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