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Next generation RF field detection with the carrier-suppression interferometer (CSI))

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With the help of complex control systems, today's FELs (e.g. the EuropeanXFEL at DESY) are able to provide light pulses with a duration of less than 100fs. The demands on the low-level RF (LLRF) control systems of such accelerators are high and the RF field detection in the superconducting cavities is crucial. To overcome the main limitations of today's LLRF receivers, such as the noise of the ADCs or RF mixers, the carrier-suppression interferometer (CSI) presented here is used as a receiver front-end to the conventional LLRF system and enables RF detection of highest precision. By taking advantage of the destructive interference of the carrier signal at 1.3GHz, the detection resolution with the CSI at DESY was enhanced by factor 500 to a timing jitter of 10.8as for the measurement band from 40Hz to 1MHz and a noise floor of -205 dBc/Hz.
Latest developments and future steps as, e.g., its application to CW-machines are reported. Thorough investigations on the resolution limits and key components are presented. The CSI can be used in future in combination with conventional RF receivers and enhances the state of the art of phase noise measurements to attosecond resolution and above.

Primary authors: Dr LUDWIG, Frank (DESY); SPRINGER, Louise (DESY); PRYSCHELSKI, Heinrich (DESY); Dr SCHLARB, Holger (DESY); Dr HOFFMANN, Matthias (DESY); Dr MAVRIC, Uros (DESY)

Presenter: Dr MAVRIC, Uros (DESY)

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