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## Relative Timing Issues and Mitigations in SwissFEL RF System

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The relative timing between different subsystems of SwissFEL is critical for a fast recovery of operation after a machine shutdown or a restart of any subsystem. For the LLRF system, deterministic phase measurements and stable macro-pulse timing w.r.t the trigger are critical for stable beam acceleration with pulsed RF stations. The phase and macro-pulse timing uncertainties are introduced either by the frequency dividers in the local oscillator and clock generator or the racing conditions between the trigger and clock. The relative timing between the RF and the Gun laser is another issue affecting the beam performance. Re-locking the Gun laser to the RF reference may cause the electron-bunch timing to jump to a different RF bucket, resulting in errors in the RF fields seen by the beam. Multiple measures have been developed to mitigate these issues, including reference tracking, trigger-clock race handling, Gun laser bucket detection and correction, and beam-based feedback. The issues, mitigations, and test results at SwissFEL will be reported in this contribution.

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