

# Low Level RF Workshop 2022



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## Startup Sequencer for Tuning and Starting up High Power RF into 50 MHz accelerator cavity

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The two cyclotrons at the High Intensity Proton Accelerator (HIPA) at PSI are equipped with eight high-power CW RF cavities at 50 MHz and one flat-top cavity at 150 MHz with input power levels up to 500 kW.

The purpose of the startup sequencer is to establish continuous (CW) high power RF operation as safe, fast and reliable as possible from both cold and warm cavity initial states. Precise impedance matching and resonance frequency tuning are mandatory pre-conditions before continuous high power is allowed. Due to multipactoring, the cavity is forbidden to operate in certain levels between zero and nominal power. For this reason, slow RF ramping is not possible and a pulsed startup scheme is used. Pulses with fast transitions through the forbidden regions help suppress the multipactoring effects and guarantee smooth measurements of RF phase and amplitude during the startup.

The new type digital LLRF startup sequencer has integrated diagnostics and exception handling for debugging purpose. Two fast RF feedback controllers for the startup and nominal operation are implemented with smooth transition.

Real RF-experience and testing has been done on the test stand with the cavity.

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