

# Low Level RF Workshop 2022



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## Experimental characterization of the LLRF system performance at the HiRES accelerator

*Wednesday, October 12, 2022 3:09 PM (1 minute)*

The High Repetition rate Electron Scattering (HiRES) accelerator at LBNL uses a CW, normal-conducting RF electron gun and bunching cavity to deliver high-stability, high repetition rate electron pulses for scientific applications, such as ultrafast electron diffraction (UED) and FELs. Beyond-state-of-art stability is required for the electron beam energy in order to achieve femtosecond temporal resolution in experiments. The LLRF system has recently been upgraded, including minimization of channel crosstalk and optimized feedback bandwidth, resulting in short-term electron beam energy stability better than  $1E-4$ , to the benefit of the final temporal resolution in UED experiments. Furthermore, an ad-hoc timing system allows for heterogeneous data, including beam images, RF waveforms and scalars, to be acquired and stored synchronously and consequently used to train machine learning-based (ML) algorithms for high accuracy predictions of the beam energy and arrival time. We will present experimental results on stability of RF signals, beam energy and time of arrival, together with preliminary work on the development of a ML-based virtual diagnostic for energy and time of arrival.

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