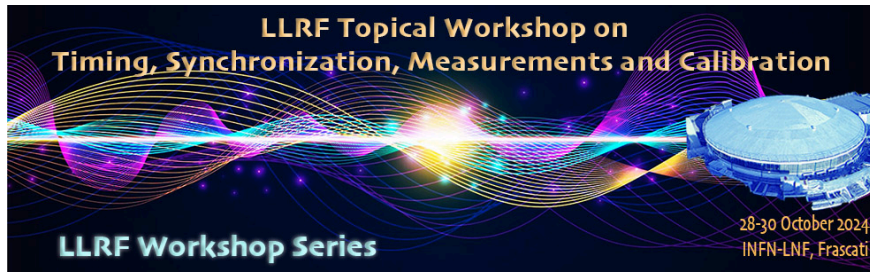


# LLRF Topical Workshop - Timing, Synchronization, Measurements and Calibration



Contribution ID: 26

Type: Oral

## On-line Beam Synchronous Phase Measurement Using Deep Learning Models

*Tuesday, 29 October 2024 14:55 (25 minutes)*

The traditional method for determining the synchronous phase (SP) of beam typically relies on “phase scan method”. Despite its high precision and reliability, this method requires a significant amount of runtime. Processes such as phase drift caused by environmental disturbances or rapid recovery after cavity faults (such as Quench) necessitate repeated execution of the phase scan procedure. In modern large-scale accelerator facilities, which often contain dozens or even hundreds of radio-frequency (RF) cavities, the time-consuming nature of phase scanning severely reduces machine availability. This fact highlights the necessity of developing online beam information measurement algorithms. Recently, we introduced an AI-based beam information measure model that uses transient beam loading information as input while simultaneously predicting beam intensity and SP. This method employs Long Short-Term Memory (LSTM) to extract multi-dimensional RF time-series signal features and incorporates an attention mechanism to evaluate the weights of RF waveforms at different times. The method can work in complex operating conditions such as open-loop, closed-loop, and with or without cavity detuning, and has higher precision and stronger generalization capabilities compared to other online calibration method of SP (such as those based on cavity differential equations or RF beam vector).

**Primary author:** YANG, Lijuan (Institute of Modern Physics, Chinese Academy of Sciences)

**Co-authors:** Dr QIU, Feng (Institute of Modern Physics, Chinese Academy of Sciences); Prof. HE, Yuan (Institute of Modern Physics, Chinese Academy of Sciences); Dr ZENG, rihua (European Spallation Source)

**Presenter:** YANG, Lijuan (Institute of Modern Physics, Chinese Academy of Sciences)

**Session Classification:** Measurements and Calibration

**Track Classification:** Measurement and calibration