**LLRF Control and Synchronization System of the ARES Facility.**

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**Abstract**

The linear accelerator ARES (Accelerator Research Experiment at SINBAD) is a new research facility at DESY. Electron bunches with a maximum repetition rate of 50 Hz are accelerated up to 155 MeV. The facility aims for ultra-stable sub-femtosecond arrival-times and high peak-currents at the experiment, placing high demands on the reference distribution and field regulation of the S-band RF structures. In this paper, we report on the current status of the RF reference generation, facility-wide distribution, and the LLRF systems of the RF structures.

**ARES Injector Overview**

**RF Synchronization System**

**MicroTCA.4 based LLRF System**

**First LLRF Measurements**

**Current RF-gun Regulation**

- Optimized to 83% ADC dynamic range for max. operating point
- Currently operated at 70MV/m (63%)
- Pulse to pulse adaptation of the drive signal
- Calibrated probe signal as regulation signal
- First results:
  - Beam position as time of interest
  - Average of 51 sampling points
  - Expected noise bandwidth < 2.45 MHz (factor 10 higher than gun BW)
  - Slow drifts are corrected
- Achieved probe stability of 0.013% and 0.016 deg by pulse to pulse adaptation

**Current TWS Regulation**

- Optimized to 100% ADC dynamic range for max. operating point
- Currently operated at 75MV/m (75%)
- Pulse to pulse adaptation of the drive signal
- Regulation signal:
  1. Calibrated 1st probe signal or
  2. Sum of 5 calibrated probe signals to minimize temperature effects along the structure
- Stability analysis for the 2 regulation concepts as next topic

**Conclusion & Outlook**

- LLRF systems for gun and TWS1/TWS2 operational
- RF chain analysis does not show larger noise sources
- Systems calibrated with beam and optimized on digital level
- Passive RF distribution and direct laser to RF synchronization sufficient for first commissioning
- MO upgrade to reduce amplitude/phase noise (Polam-X LLRF system will be installed)
  - Up-conversion module from 3 GHz to 12 GHz
  - Down-conversion module from 12 GHz to 3 GHz
- Upgrade REFM for interferometric transmission line stabilization
- TWS1 and TWS2 regulation optimization
- Activate and optimize intra-pulse feedback

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**RF Synchronization**

- Passive RF distribution (only short distances)
- Reference Modules (REFM) in each rack
  - Currently for signal amplification and distribution
  - Upgrade option for interferometric transmission line stabilization