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Advanced Low Level RF system for IFMIF and LIPAc particle accelerators

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The International Fusion Materials Irradiation Facility (IFMIF) aims to develop a structural materials database for future nuclear fusion reactors. In order to validate its final accelerators concept and technologies, the IFMIF Linear Prototype Accelerator (LIPAc) is commissioned at Rokkasho (Japan) in the framework of the IFMIF-EVEDA project.

CIEMAT (Spain) leads the Engineering Design of the IFMIF RF Power System as well as integrates and provides the RF Power System for LIPAc, including the Low-Level Radio Frequency system (LLRF).

LIPAc is an innovative accelerator (125mA, 9 MeV D+beam, C.W.). Its challenging requirements lead to a high level of uncertainty and thus a flexible and reconfigurable high performance LLRF is required.

LLRF systems use to be analog or digital-analog, since they use, at least, analog front-ends for intermediate frequency (IF) conversion before or after digitalization. However, the LIPAc LLRF, developed by CIEMAT and SEVEN SOLUTIONS, is an innovative fully digital system. No analog frequency conversion is performed, which increases the measurement bandwidth and simplify the analog front-end design. This LLRF also integrates White Rabbit (WR) protocol for timing synchronization (sub-nanosecond) and Master Oscillator distribution. The first units have been tested with full power LIPAc RF amplifier chains performing better than expected.

Summary

On the IFMIF/LIPAc innovative fully digital advanced LLRF developed by CIEMAT and SEVEN SOLUTIONS

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