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## A Cavity Synchronization System For Heavy Ion Synchrotrons Based on DSP, DDS and FPGA Technology

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A cavity synchronization system has been realized which allows the synchronization of the gap signals of different cavities. The system is designed in such a way that the cavities may run at different harmonics. In future it will also be possible to synchronize the cavity with the beam, i.e. to realize closed-loop beam phase control.

In order to fulfill these requirements, the overall system is based on different scalable modules which can flexibly be used in completely different applications. The key modules are the following ones:

- DSP System: This subsystem is used for high-precision phase and amplitude detection and fast closed-loop control algorithms. It includes analog preprocessing in the IF range, ADC and DAC modules, suitable digital interfaces and comfortable diagnostics features.
- FPGA Interface Board (FIB): This module provides an interface to the central control system and several other interfaces which are used as a standard in the GSI synchrotron RF group. The interface protocols are realized by an FPGA which allows one to implement routing, control and signal processing applications.
- DDS unit: This module is used for the generation of RF master signals and can also be used as actuator in a closed loop RF control. Furthermore, it will be used in future to realize the functionality which is currently performed by an analog offset LO (local oscillator). The DDS module is realized by combining an FIB with a dedicated piggyback PCB.

These key modules are described here. Furthermore, the status of the following applications is reported:

- Digital cavity synchronization for single-harmonic operation
- Dual harmonic operation

Finally, an outlook to other applications is given.

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