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Digital direct RF feedback for beam loading reduction at ALBA

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A direct RF feedback loop has been implemented in the digital LLRF of ALBA aimed to reduce the effective impedance of the RF cavities and so, reduce the beam loading effects. A sample of the cavity voltage signal is added to the PID loop generated signal with adjustable gain and phase shift. The resulting signal is then feed back to the amplifier by means of a DAC and an up-conversion stage. Taking advantage of this digital implementation, the phase and amplitude of both the PID and the direct RF feedback control signals can be easily monitored and adjusted to match desired feedback loop gain. The result of this digital loop is the effective reduction of the longitudinal cavity impedance seen by the beam, and therefore of the tune shift due to beam loading. This method has been implemented and validated at ALBA reaching a direct RF feedback gain Af=1, thus reducing the cavity impedance seen by the beam, and therefore the tune shift, by a factor 2. Conceptual design of the feedback loop, adjustment of the cavities, and synchrotron tune measurements are presented in this contribution confirming the effectiveness of the digital implementation of a direct RF feedback loop.

Keyword

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