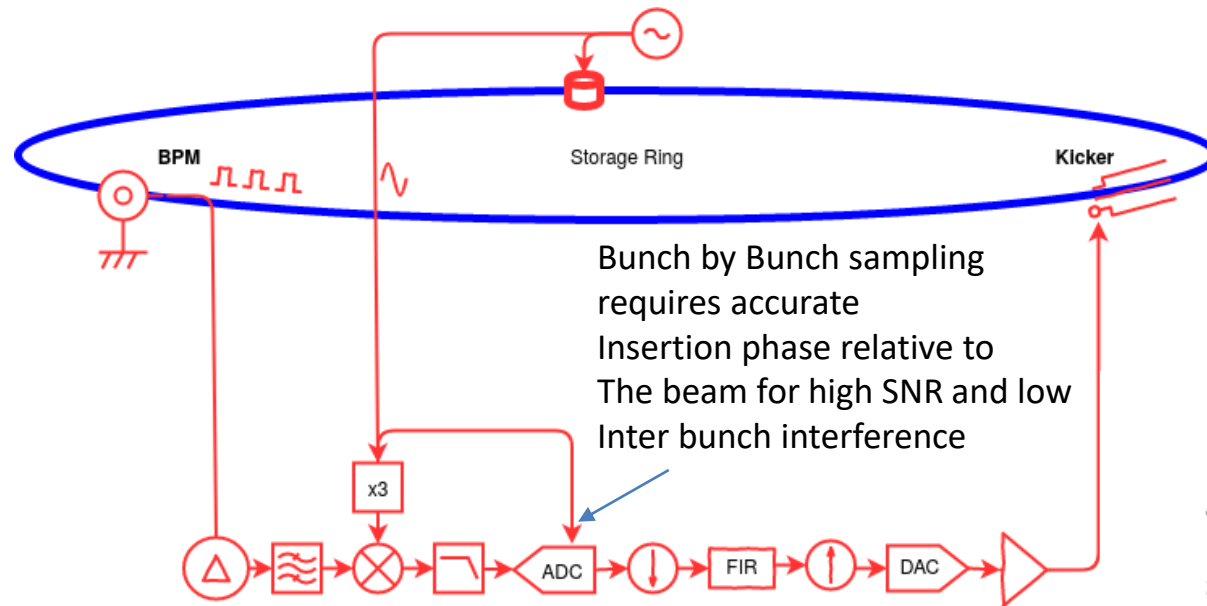


Doris: A beam Locked loop for Multibunch Feedback

Alan Tipper

Phase Sensitivities in MBFB



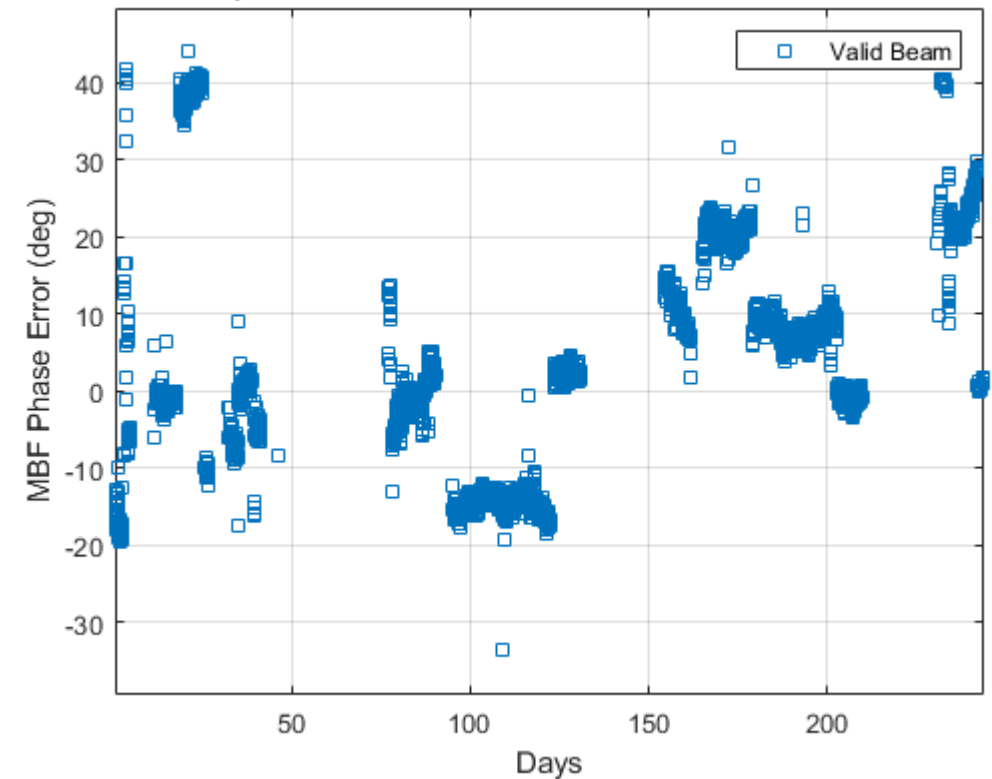
3rd harmonic Homodyne detection requires accurate Insertion phase relative to The beam for high SNR

Beam to Ref Clock phase variation ~ -30/+40 Degrees over a year of operation.

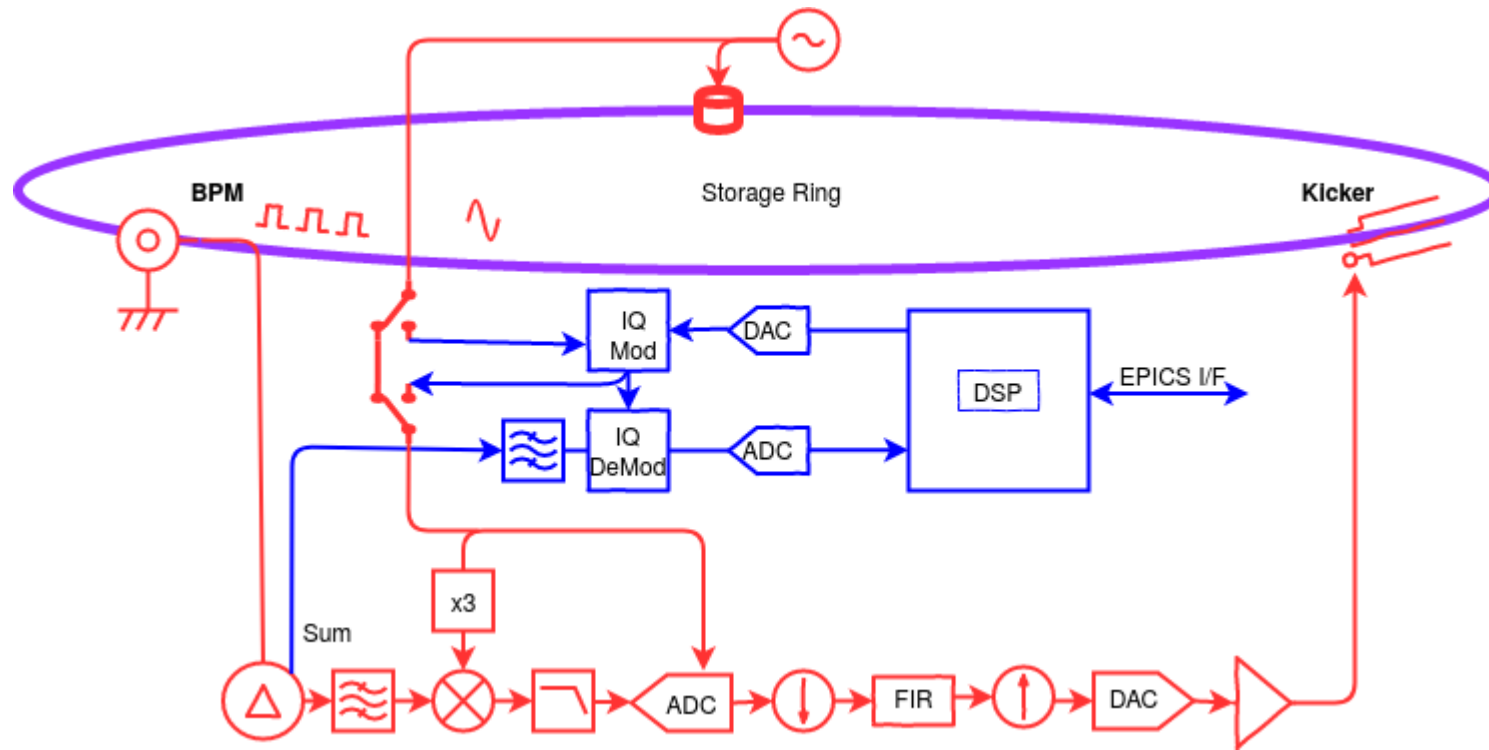
For more detail on the MBFB system see:
Architecture of Transverse Multi-Bunch Feedback Processor at Diamond
M.G Abbott, G.Rehm, I.S Uzun Proc ICALEPCS2015 MOPGF097

**Regular phase adjustment
Needed to maintain
high performance**

Operation of MBF Prior to Installation of the BLL



Solution: Beam Locked Loop



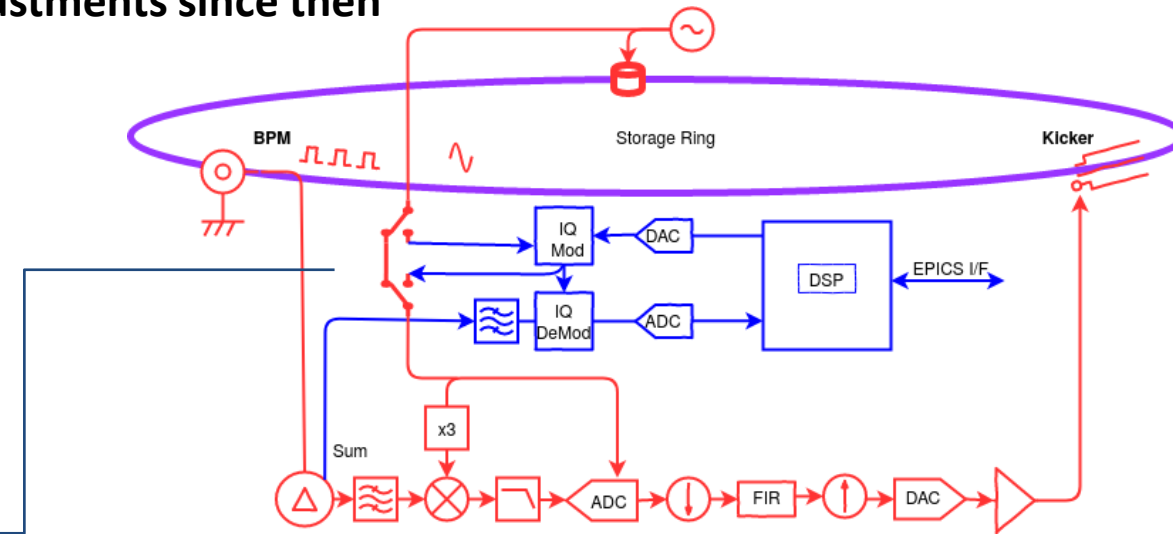
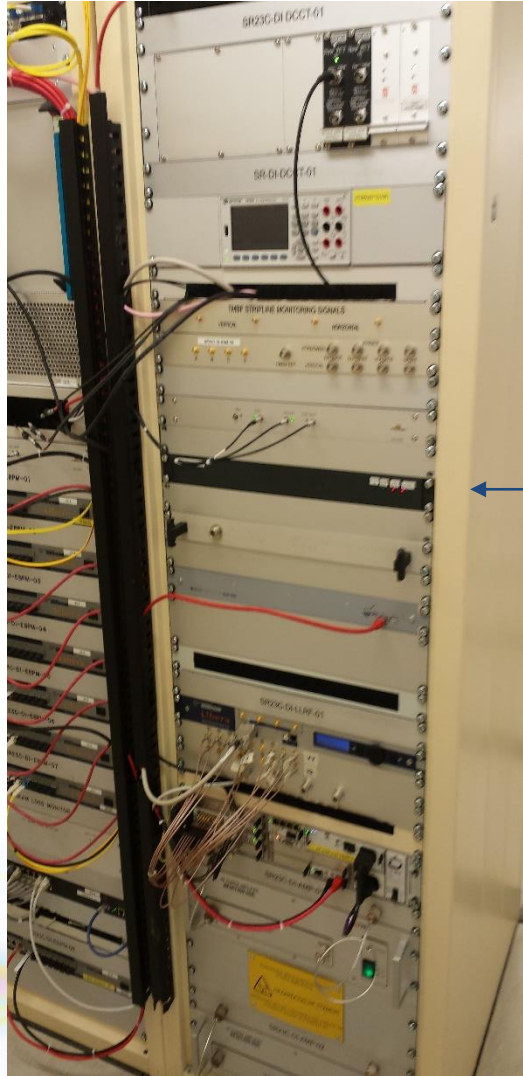
A standalone “Beam Locked loop” intercepts the reference clock and phase locks it to the beam using the sum output of a BPM hybrid.

No changes to the MBF subsystem

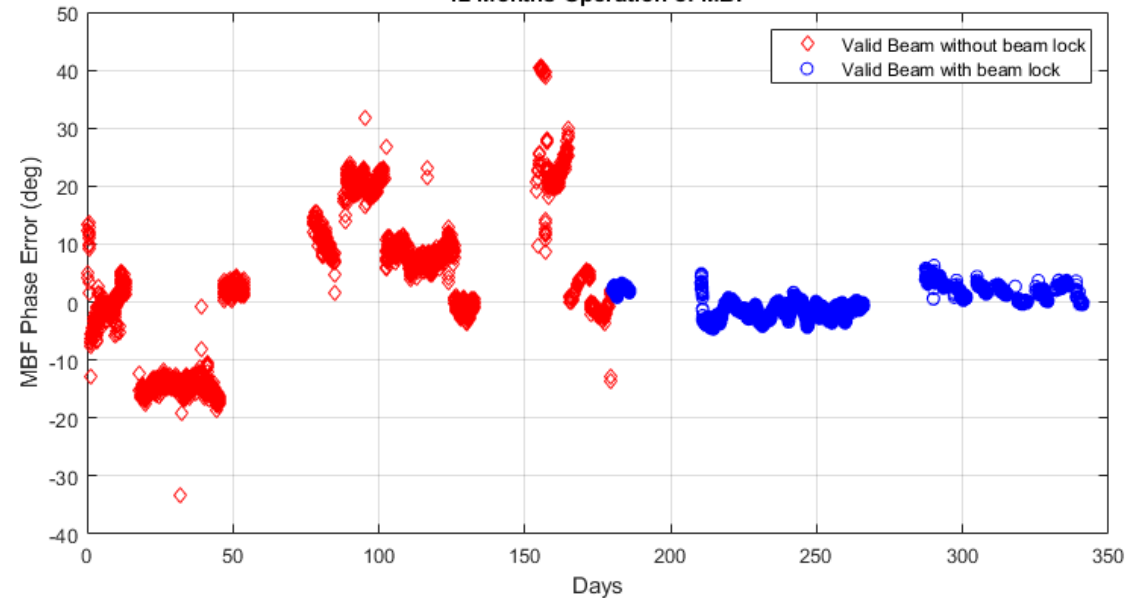
12 Months operation in the SR

Installed in diamond SR Oct 2019 & Fully operational from Dec 2019

No manual phase adjustments since then



12 Months Operation of MBF



Summary

- Current MBF requires regular adjustment due to operational changes to beam phase
- Tracking Frequency Reference Phase Changes via BPM measurement enables phase lock to the beam i.e “Beam lock”.
- A standalone EPICS managed beam locking solution has been packaged in a 1U shelf without any changes to the existing MBF system.
- Beam locking has been demonstrated to Improve phase stability of the MBF system over 12 months live operation with no operator adjustment.
- Published results at IBIC 2020
 - [A. Tipper, M. G. Abbott, and G. Rehm, “Tracking Frequency Reference Phase Changes at Point of Use Based on BPM Measurements”, presented at the 9th Int. Beam Instrumentation Conf. \(IBIC'20\), Santos, Brazil, Sep. 2020, paper THPP23.](#)