COMMISSIONING OF THE ALBA FAST ORBIT FEEDBACK SYSTEM

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FOFB DESCRIPTION

- Description of the FOFB layout has been already presented on IBIC13
- A description of what have been done during the commissioning and the bottlenecks we have found is showed here

Correction Calculation CPUs

- Correction algorithm runs on 16 CPUs where the BPMs data is transferred to and the new setpoints for the correctors are computed
- FOFB time requirements were matched after distributing the different processes to the different CPU cores (4-cores): one core to do BPMs reading, another to perform correction calculation + power supplies interfacing and the others to take care of interruptions, OS, …

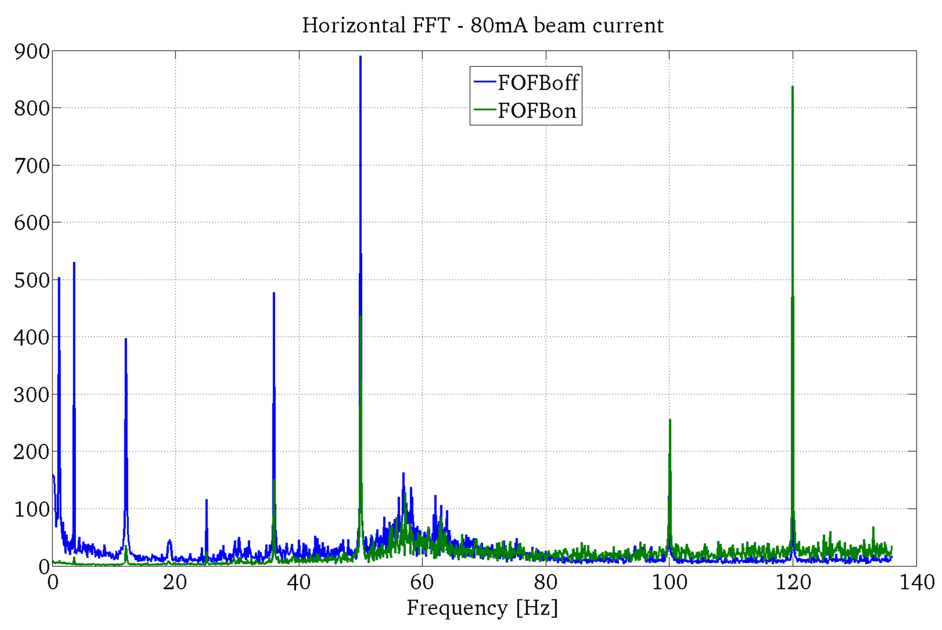
FOFB System Limitations

1. ALBA does **not** have independent **fast and slow correctors**
2. We **cannot have a readback of the correctors current**, since the time needed to handle the PCI interruptions occupies too much of the PCI bus time and spoils the performance of the correction loop
3. The FOFB system is based on the **assumption that the correction setpoint** sent to the power supply **is properly applied**
4. The electronics layout in the cPCI crate forces the **transfer of position data** to go **through two PCI bridges**
5. The use of **Burst mode data transfer** should allow this communication to be done in about 20us, but it **doesn't work**
6. ALBA FOFB system **can only warranty** that half of the BPMs data cycles are processed, reducing the **handling of position data** from 10kHz **to 5kHz rate**

CORRECTION RESULTS

TRIM COIL EXCITATION

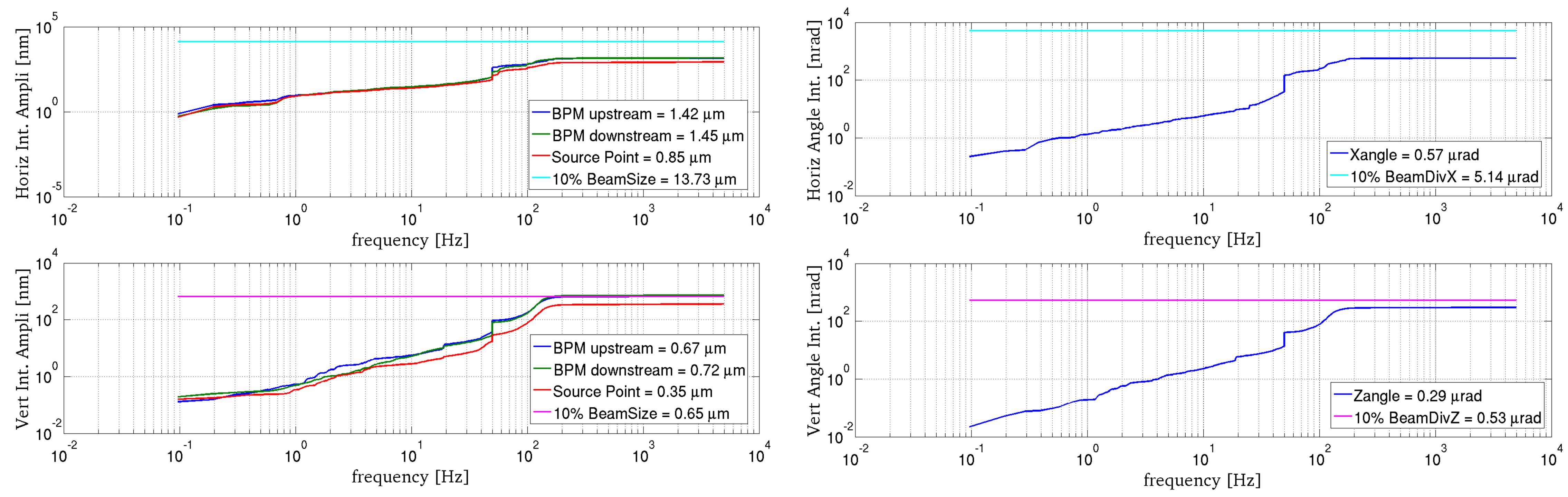
- A programmed waveform on a horizontal trim coil power supply has been used as beam excitation (combination of sinewaves at frequencies 1.2, 3.6, 12, 36 and 120Hz)



- FOFB properly reduces the low frequency components and starts to increase the amplitude of the frequencies above ~100Hz
- Perturbations at 19Hz and 25Hz are from the beam and their sources have not been yet found

CORRECTION OF ID PERTURBATION

- FOFB specifications commonly refer to position / angle stability below 10% of the beam size / divergence, at the source point
- For the particular test on XALOC beamline, that refers to position stability below 13.73um / 0.65um and angle stability below 5.14urad / 0.53urad for horizontal and vertical planes respectively

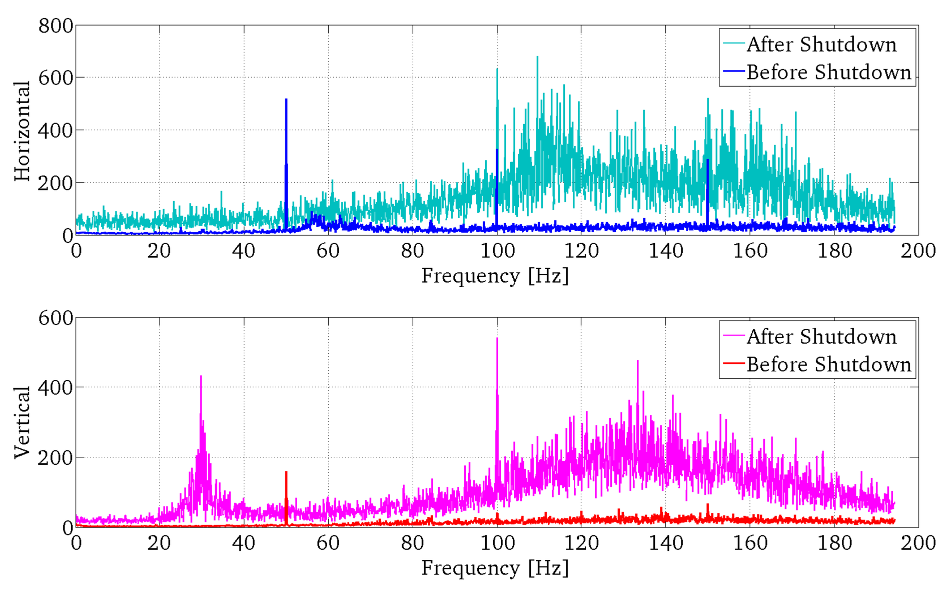


- Both position and angle stability specs at the source point are accomplished at any given frequency when using ALBA FOFB

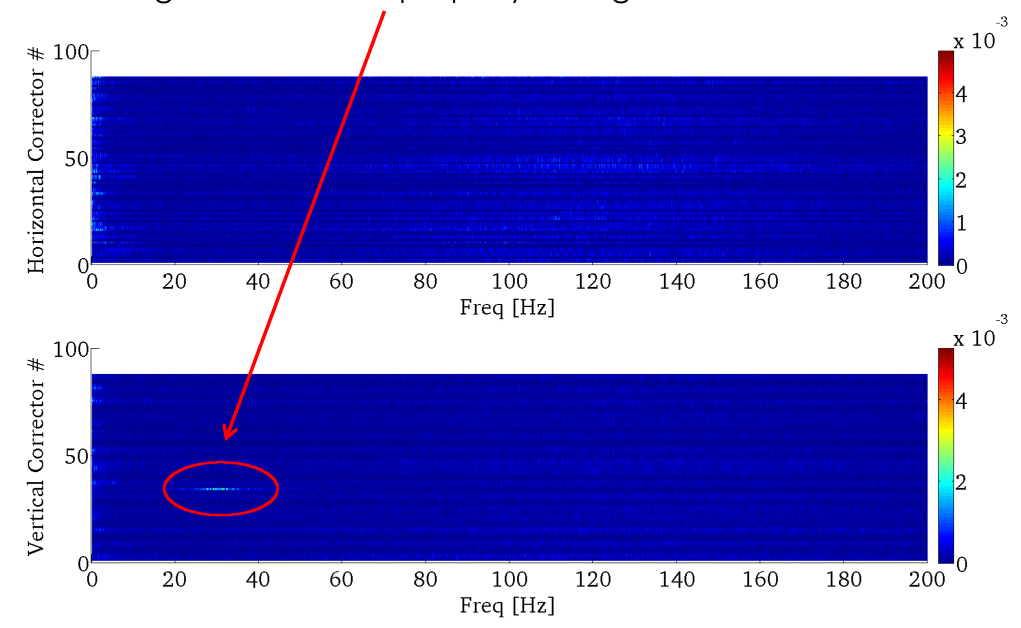
PROBLEMS AND IMPROVEMENTS

WRONG CORRECTOR SETTING

- After a long shutdown period in April'14, the FOFB behavior was completely spoiled for unknown reasons
- We did a tracking of all the correctors setpoints calculated by the FOFB (10 seconds of data on all 176 correctors at a 5kHz rate)

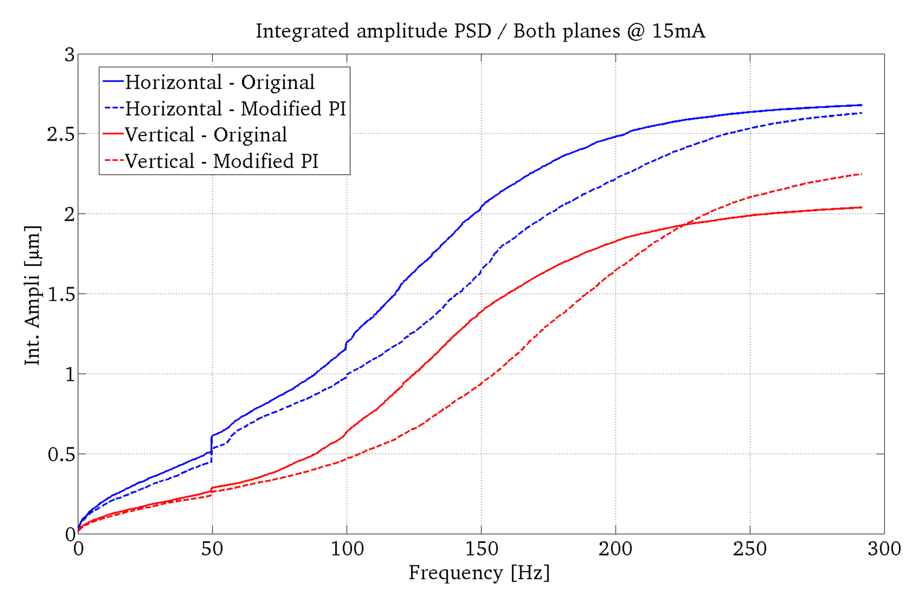


- The analysis of the data showed that one particular vertical corrector was introducing the perturbation to the beam on the region around 30Hz
- Deeper investigation on that corrector power supply confirmed that its internal PI regulator was not properly configured



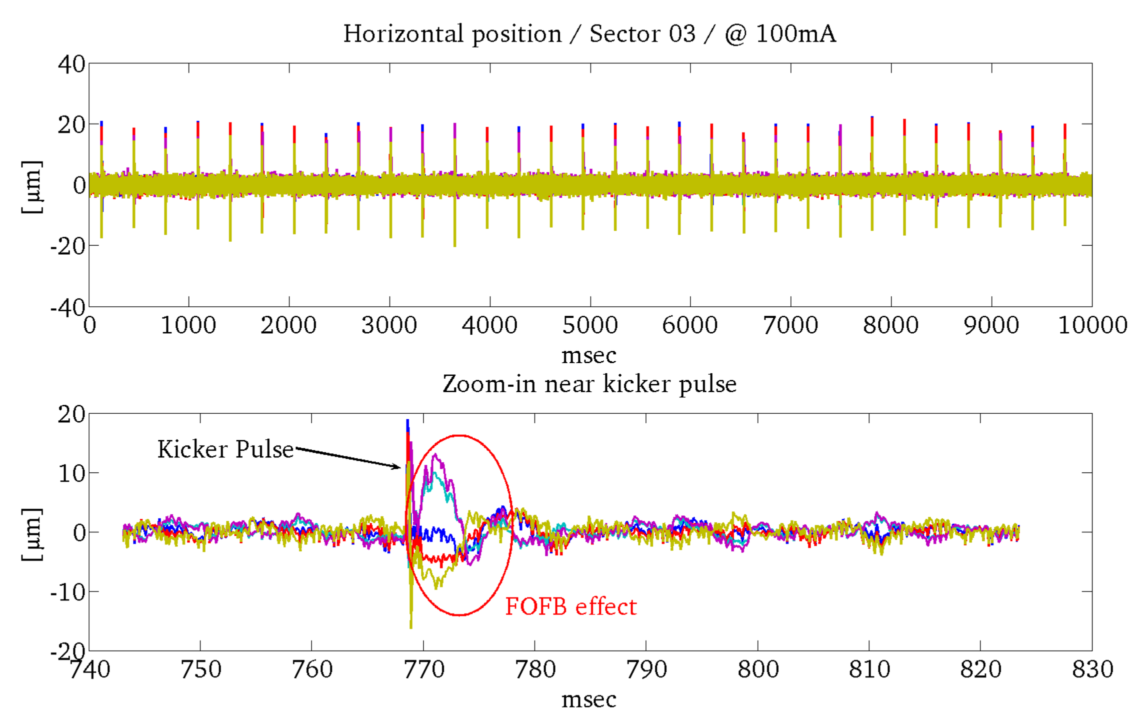
CORRECTORS BANDWIDTH

- Last improvement we have tried is the modification of correctors power supplies bandwidth
- Intention is to push a bit forward the correction capabilities of the FOFB. Improvement is little but confirms we are on the good way

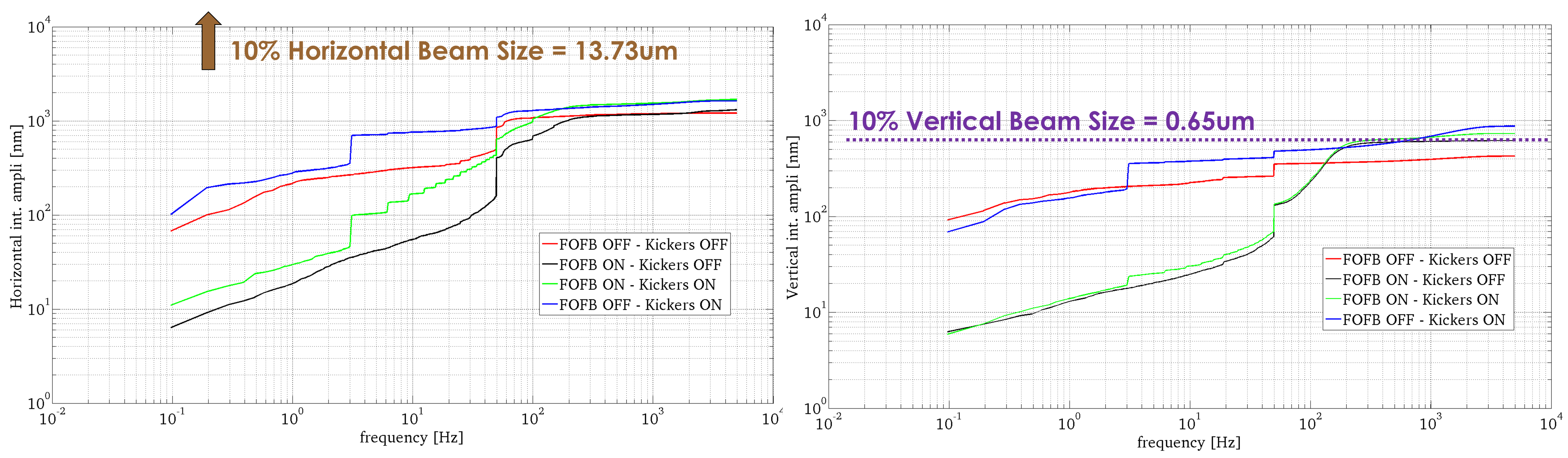


KICKERS PULSE SUPPRESSION

- Injection kicker magnets drive horizontal perturbations near the mm at some BPMs, especially when injection bump is not properly closed
- Tests of Top-up injection showed an orbit distortion after the kicker pulse due to the FOFB, which tries to correct the high freq. components



- The 3Hz injection signal and its harmonics can be clearly seen on the spectrum and are not properly corrected by the FOFB
- Even under these conditions, the FOFB is capable to correct the perturbations inside specs up to 200Hz (10% vertical beam size is 0.65um)
- We tried the system to ignore the kicker pulse by defining position limits beyond which the FOFB should not correct, but first attempts ran without success and just degraded the FOFB performance



FUTURE UPGRADE

Upgrade phase I

- Replacement of the BPMs reading board Micro-Research EVR-230 by the AFC2310-A0 board from IOxOS
- Tasks to be done:
  1) Integration of the Diamond Communication Controller in the new FPGA
  2) Migration of the correction computation from the CPU to the FPGA
- What we'll gain:
  1) Better FOFB redundancy and reliability since new electronics have 2 SFP ports to be used as optical links for BPMs position data transfer (current electronics do only have 1)
  2) More powerful and longer lifetime Xilinx Virtex-6T FPGA (current Virtex-II FPGA is obsolete)
  3) Increase of position transfer speed to 10kHz to have a higher FOFB bandwidth (now running at 5kHz)
  4) Two input ports could be used to synchronize the FOFB in all sectors and to disable the correction during the duration of the injection kicker pulses

Upgrade phase II

- Main purpose of the second phase upgrade will be the movement of the correctors controllers that are embedded on the IP modules to the new FPGA
- A modification on the cPCI crates has been done to use the backplane I/O connector to drive the correctors power supplies
- An intermediate board will be needed to change signals from electrical to optical
- All needed firmware and programming is to be done