SOP To Run Test Setup of Sixteen-Element Four-Beam FPGA based Narrowband Beamformer
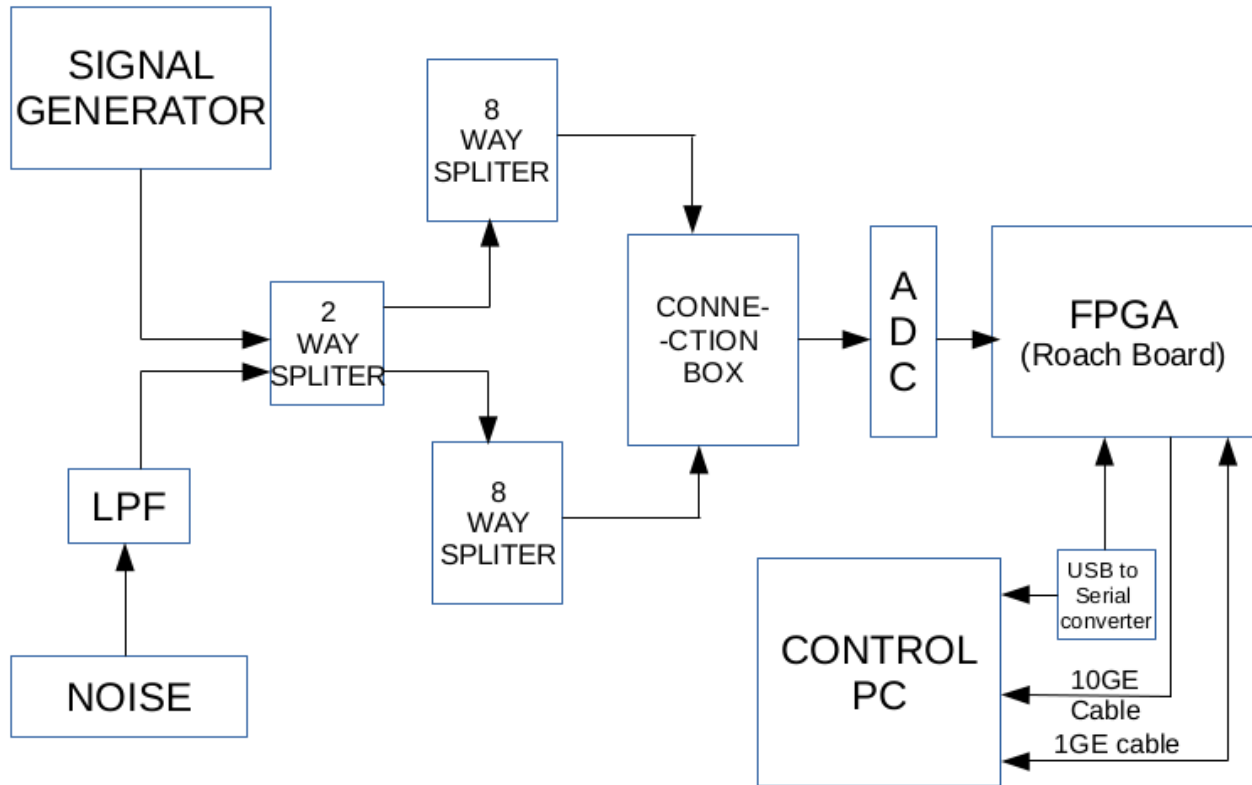
TEST SETUP :

Fig 1. Block-diagram of Test Set-up

- This is general test set-up for doing experiments using LOFAR-FPA system with FPGA based beam-former system.

- To do the basic test, we can use any one of above method as shown in test set-up block-diagram.

1. Interconnections :

Check following things:
- USB to Serial port converter connected to ROACH serial port, converter not to be touched by metal or wire-connect usb of serial converter.
- Connect reset pin of ADC(jumper connection of J13) to ROACH board.
- Connect 10GE cable from ROACH to PC.
- Connect 1GE ethernet cable ROACH to PC.
- Inputs from x64 chassis to ADC.

2. Steps to Boot Roach Board and PC :

- Login into egmrt server

  username : kaushal@192.168.5.46

  password : @KDB1234

- Open terminal and use SUDO rights to open minicom interface

  -----Type 'sudo minicom'

  `kaushal@egmrt-srvr:~/siddhesh$ sudo minicom`

  -----Type Password 'Login password'
  -----You will find text "welcome to minicom, press cntrl-A Z"

- Turn on fan for cooling and power on ROACH only after that.
- Turn on ROACH board by pressing power button in front panel of ROACH.
  *[Note – Stop the counter by pressing any key-board and run below command]

- Use below command for NFS boot

  -----Type 'run netboot'

  ```
  Hit any key to stop autoboot:  0
  => run netboot
  ```

  --wait for a minute, you will find 192.168.160.227 ip assigned to ROACH
  --After complete booting we get following message

  `roach login:`

- Use another terminal to run the scripts for test.

3. Power ON and instrument settings :

A] Test with Signal Generator :

- Now Switch ON the signal generator and do the following settings as INPUT to ROACH boards : Freq = Not more than 32MHz , Power = Not more than -20 dbm, Set "Mod to OFF and RF to ON".

4. Initialization :

-(Open new terminal by pressing "Ctrl+Shift+T")
- Type following command :- 'cd /home/kaushal/siddhesh'

Follow these steps to initialize the ROACH board and load the design :

```
kaushal@egmrt-srvr:~/siddhesh$ ./poco_init.py 192.168.160.227 -b x64_beam_61_2017_Oct_16_1512.bof
```

- In this step we initialize ROACH board and load .bof file through python script.
- Also this scripts will set the parameters.
  < Python script >< Roach IP >< -b >< Bof file >

5. Check Autocorrelation of Inputs :

-(Open new terminal by pressing "Ctrl+Shift+T")
- Type following command :- 'cd /home/kaushal/siddhesh'
For A to G inputs type following command -

```
kaushal@egmrt-srvr:~/siddhesh$ ./x64_auto_A_G.py 192.168.160.227 -C 1024
```

-(Open new terminal by pressing "Ctrl+Shift+T")
- Type following command :- 'cd /home/kaushal/siddhesh'
For H to P inputs type following command -

```
kaushal@egmrt-srvr:~/siddhesh$ ./x64_auto_H_P.py 192.168.160.227 -C 1024
```

- Run the above scripts to check auto correlation of 16 inputs, which are divided in to two groups. Each group shows autocorrelation of 8 inputs.
- To find autocorrelation, in command line we have to mention parameters with python script. Format given below,
  "< Python script >< Roach IP >< -C >< FFT channels >"

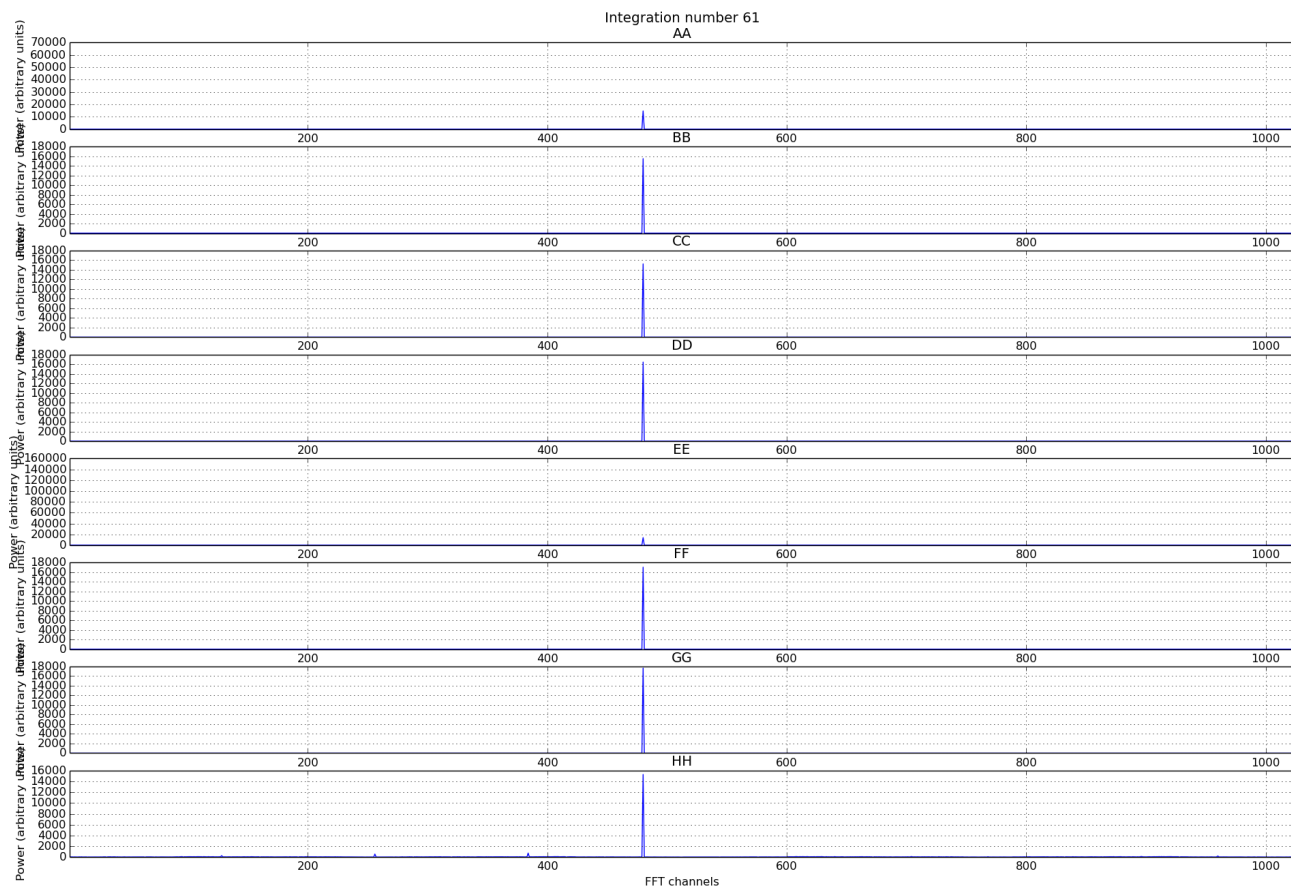SOP For Sixteen-Element Four-Beam Narrowband Beamformer
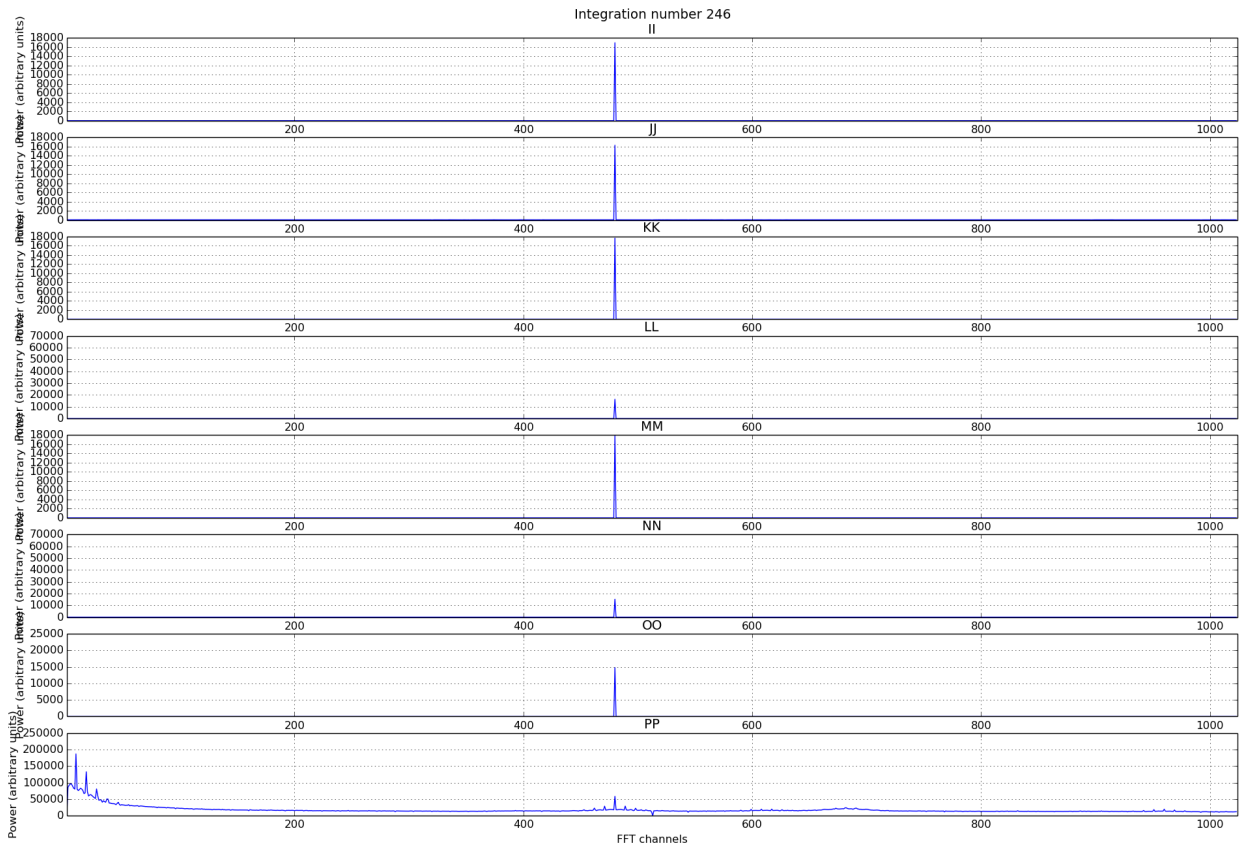
Fig 2. Autocorrelation plot of A to H inputs

Fig 3. Autocorrelation plot of I to P inputs

6. Check Crosscorrelation between pairs :

-(Open new terminal by pressing "Ctrl+Shift+T")
- Type following command :- 'cd /home/kaushal/siddhesh'

```
kaushal@egmrt-srvr:~/siddhesh$ ./x64_cross_ab.py 192.168.160.227 -C 1024 -c ab
```

- After autocorrelation, next step is to check crosscorrelation between different pairs of input signals.
- While checking crosscorrelation between pair of two inputs, take 'a' as a reference input and select another input from remaining fifteen inputs.
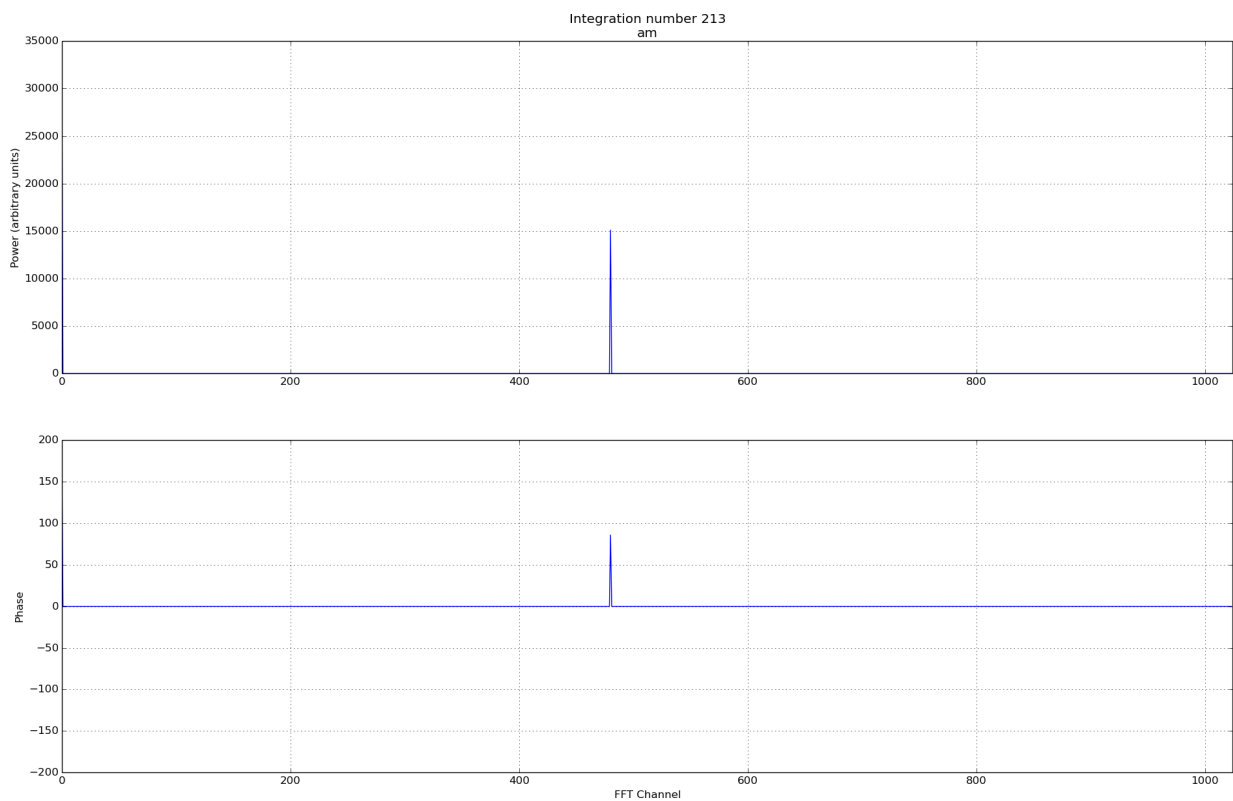 "< Python script >< Roach IP >< -C >< FFT channels >< -c >< Pair name >"

Fig 4. Cross Phase Between Pair Of Two Inputs

7. Record and store cross phase value :

-(Open new terminal by pressing "Ctrl+Shift+T")
- Type following command :- 'cd /home/kaushal/siddhesh'

```
kaushal@egmrt-srvr:~/siddhesh$ ./x64_beam_16ip.py 192.168.160.227 -C 1024 1
```

- In this step we plot beam and parallel record and store cross phase values in file for further use.
- We use this cross phase to correct the phase input signals,so we get maximum correlation between inputs.
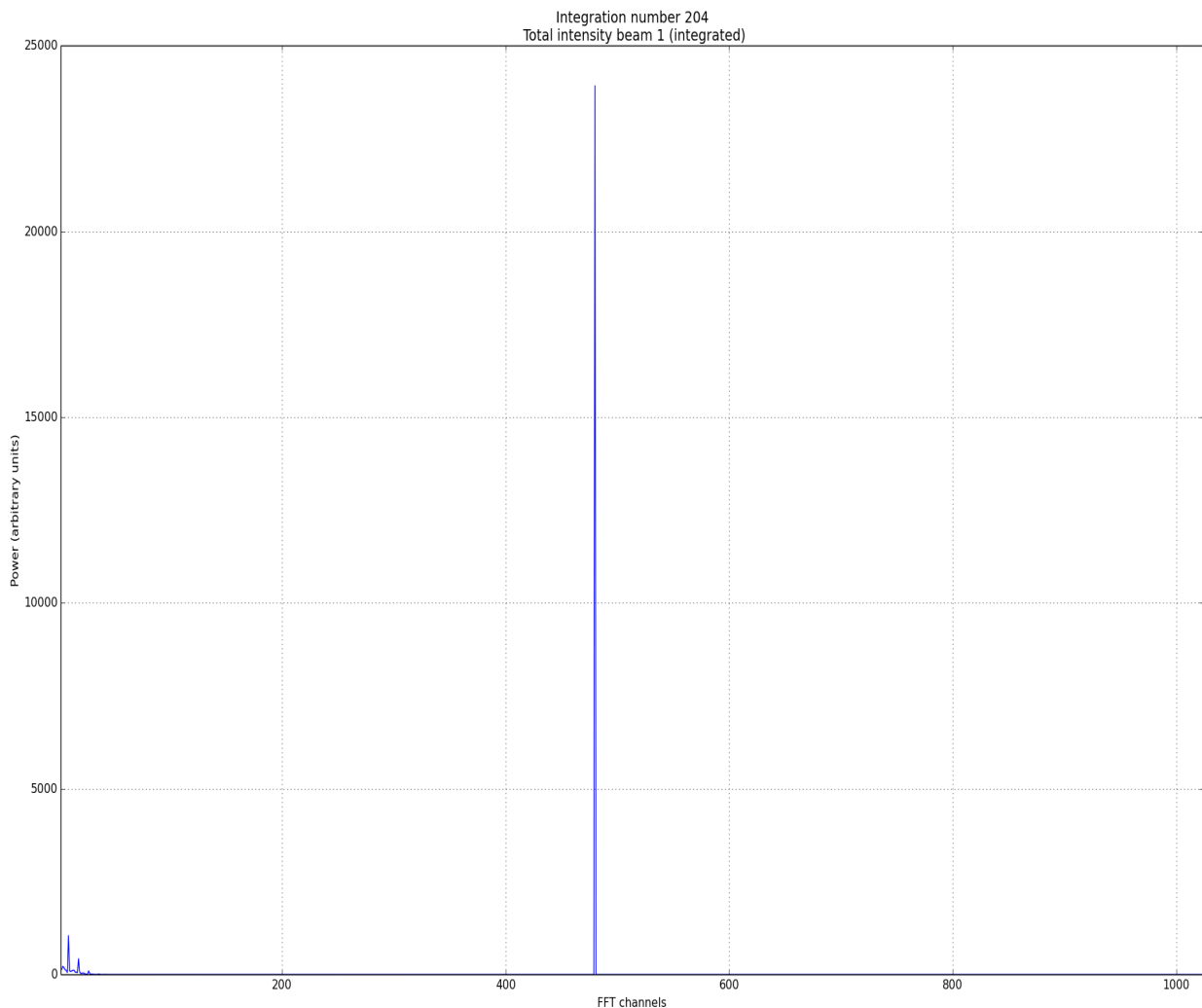 "< Python script >< Roach IP >< -C >< FFT channels >< Beam Number >"

Fig 5. Beam Plot Before Phasing

8. Dumped phase value externally :

-(Open new terminal by pressing "Ctrl+Shift+T")
- Type following command :- 'cd /home/kaushal/siddhesh'

```
kaushal@egmrt-srvr:~/siddhesh$ ./x64_phasing_16ip.py 1024 1 0
```

- Run the above script for correcting phase between input signals. Mention fft channels, beam number and and put steering angle '0'.
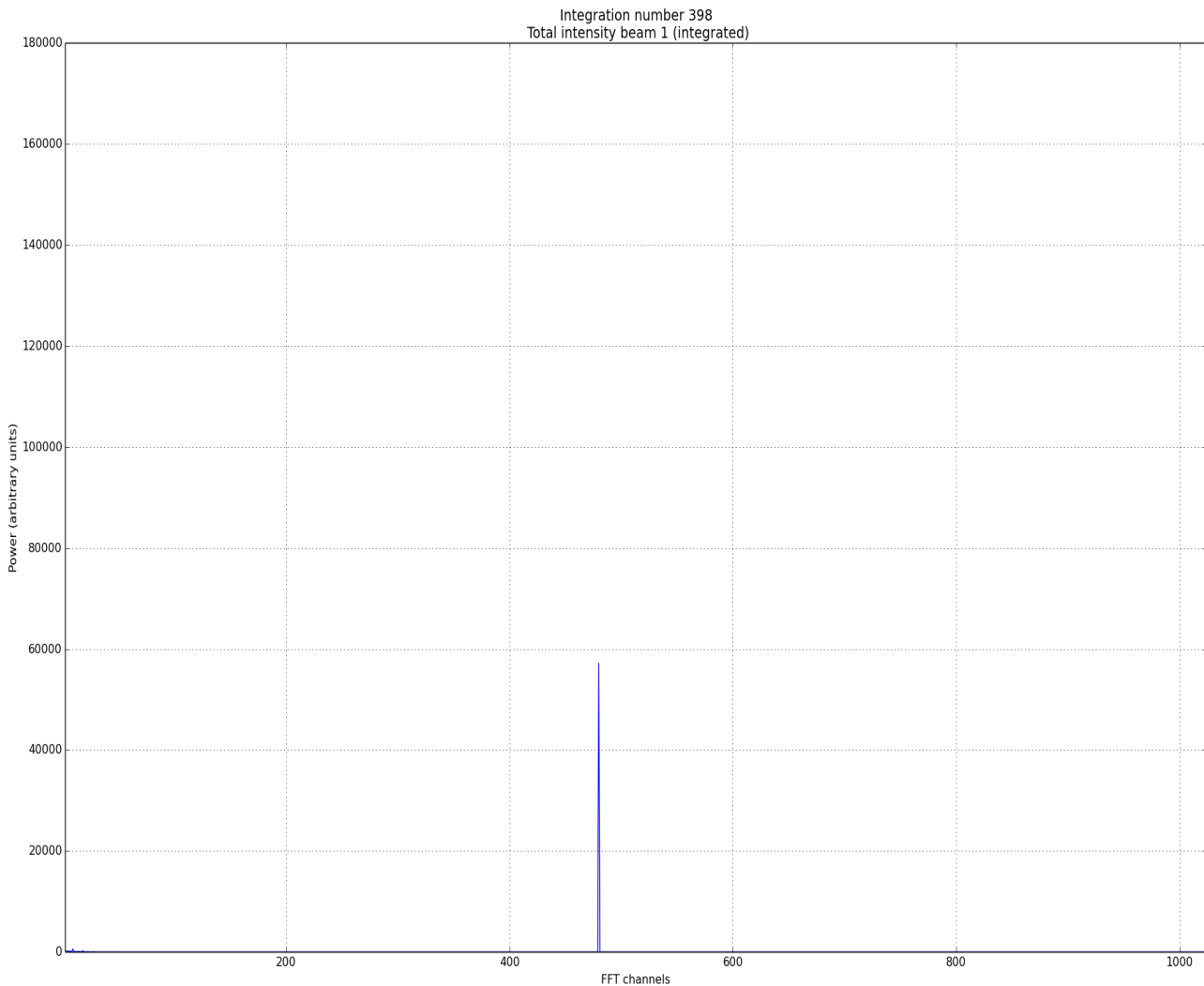- It will take cross phase values from stored file and update it in design for correcting phase. Format given below,
"< Python Script >< FFT channels >< Beam number >< steering angle >"

Fig 6. Beam Plot After Phase Correcting

9. Tapering :

-(Open new terminal by pressing "Ctrl+Shift+T")
- Type following command :- 'cd /home/kaushal/siddhesh'

`kaushal@egmrt-srvr:~/siddhesh$ ./x64_tapering_16ip.py 1024 1 1`

- In tapering, we are scaling amplitude of beam by four times of original amplitude.
- For tapering phased beam data take and initially scale by factor of 1.
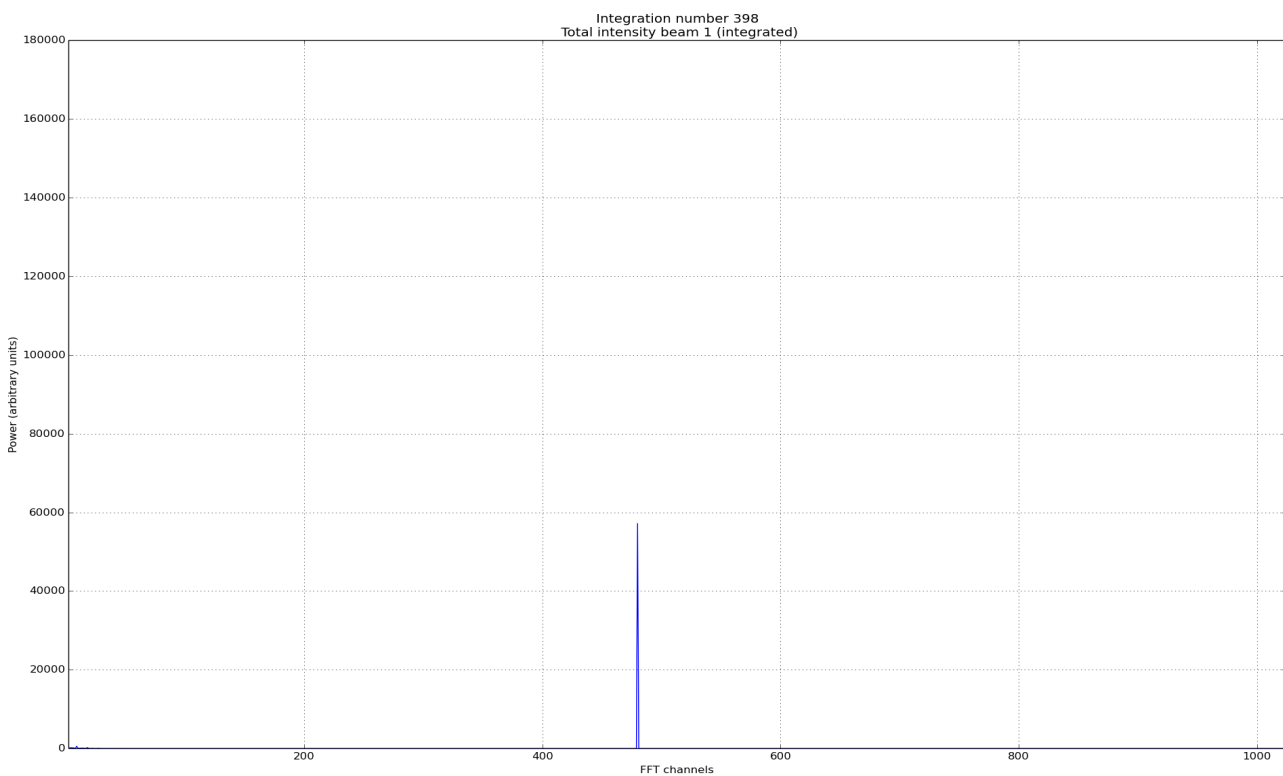
Format given below,
"< Python script >< FFT channels >< beam number >< Scaling factor >"

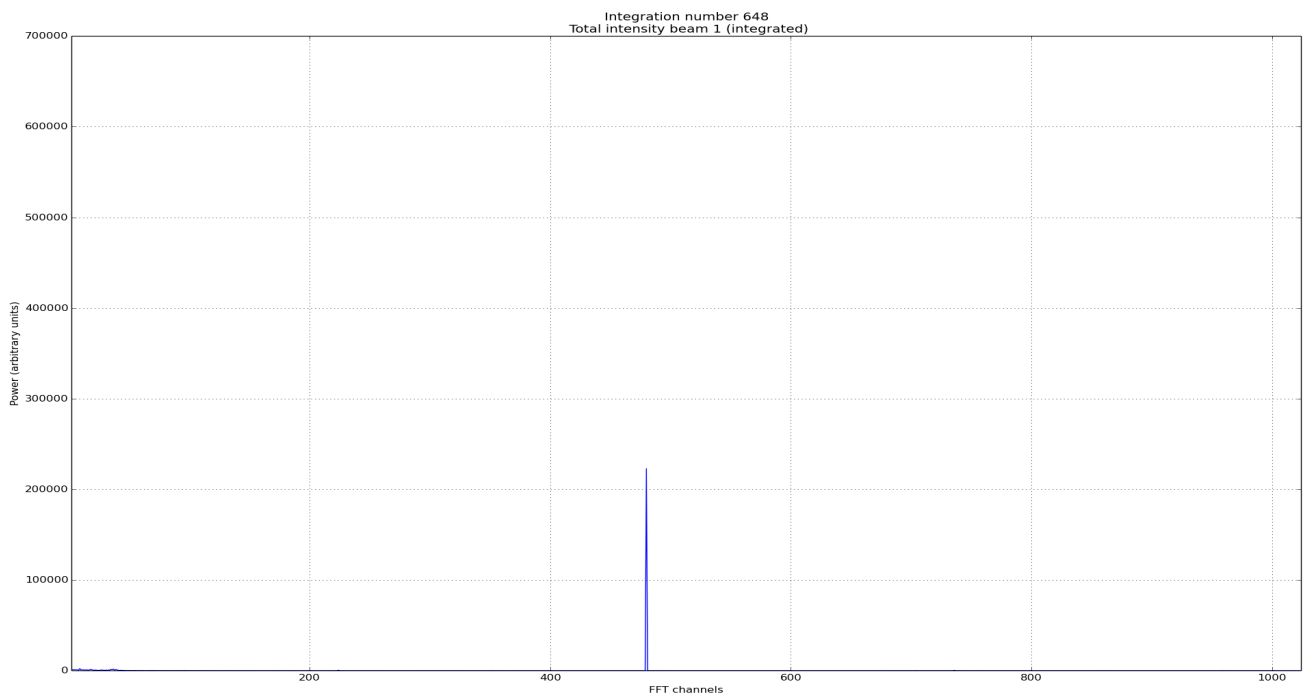Fig 7. Scaling Amplitude By Factor '1'
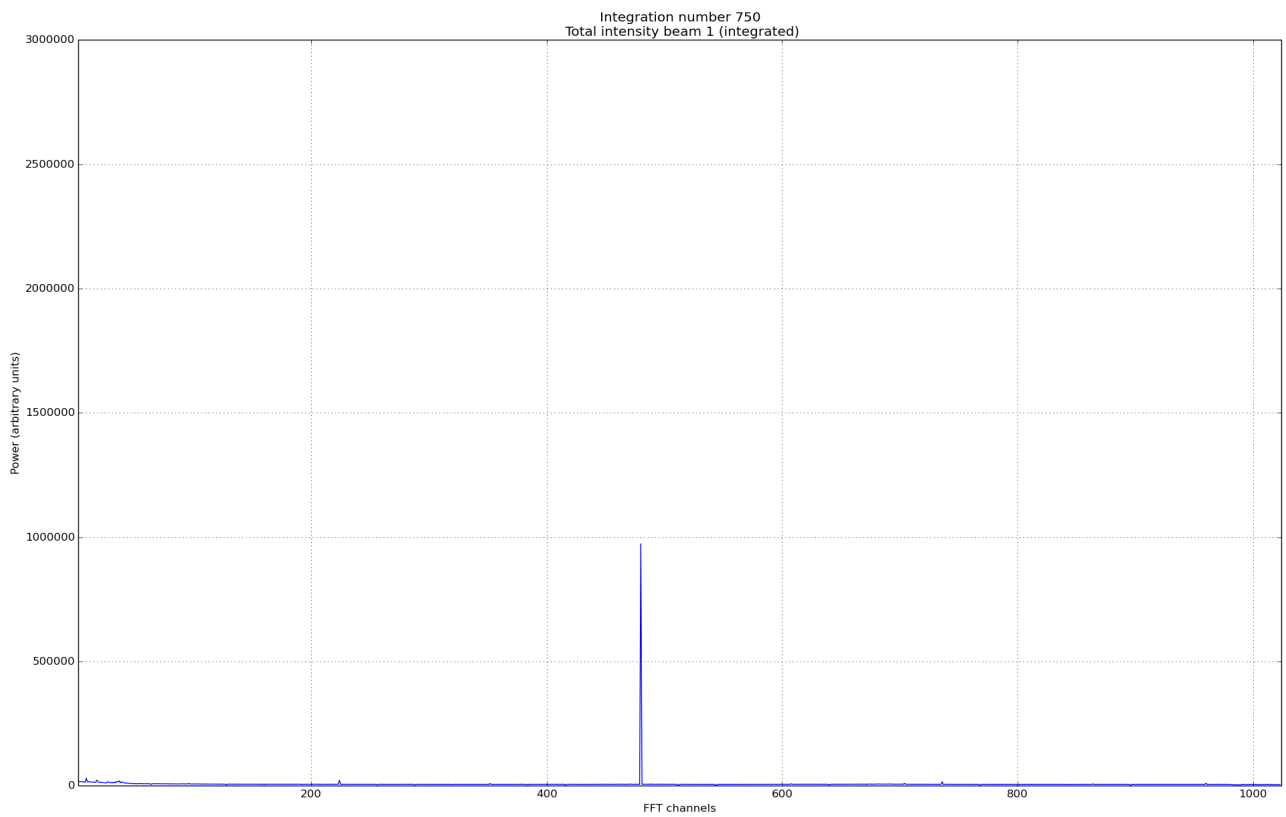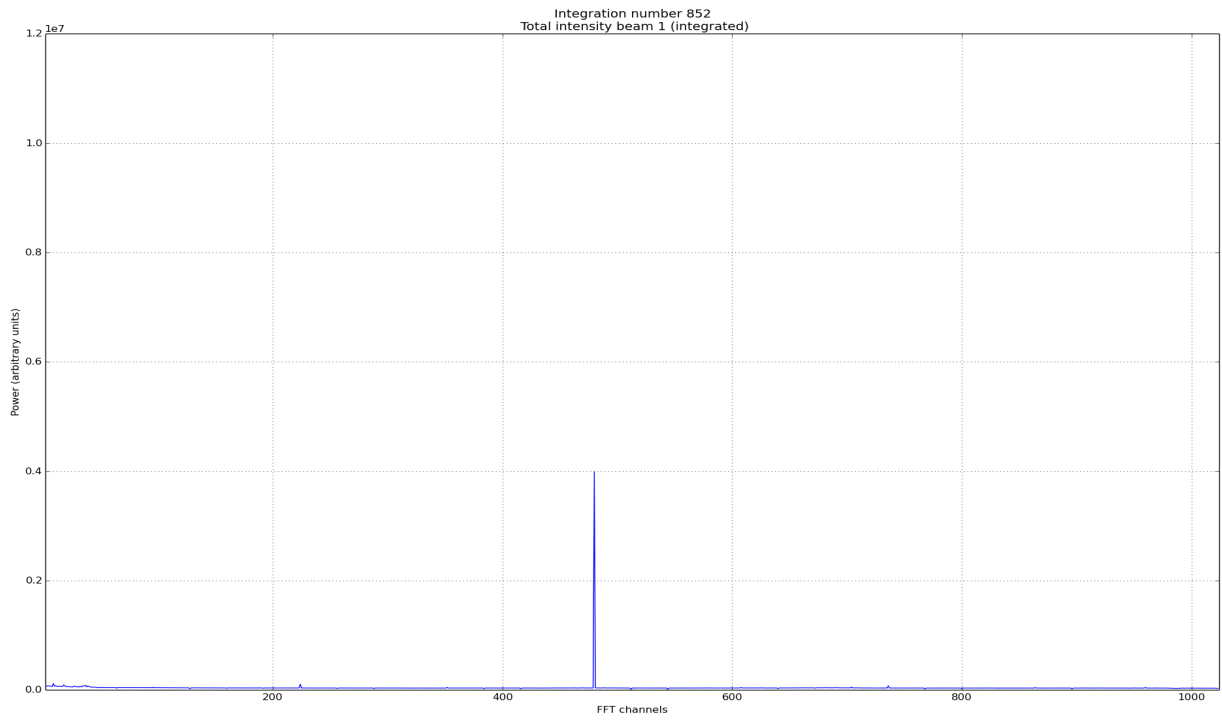
Fig 8. Scaling Amplitude By Factor '2'

Fig 9. Scaling Amplitude By factor '4'

Fig 10. Scaling Amplitude By factor '8'