

# BPM summary

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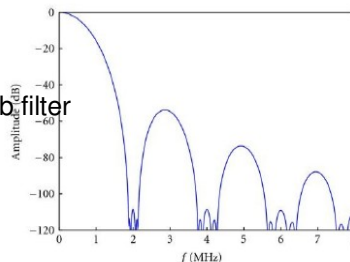
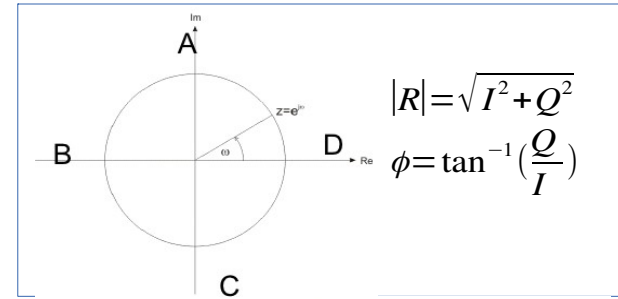
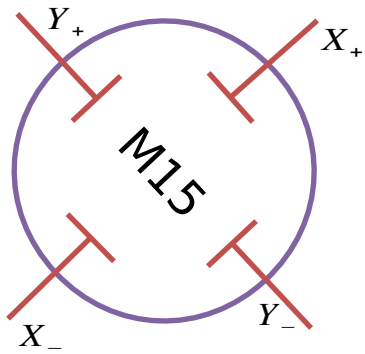
## Center position uncertainty (BPM)

| Date range | Gain type           | Run type             | Position uncert(mm) | Angle uncert(mrad) | comment  |
|------------|---------------------|----------------------|---------------------|--------------------|--|
| 3.3-3.6    | Autogain<br>fastbus | optics               | 1.2                 | 1.4                | Best situation                                   |
| 3.6-3.17   | autogain            | optics               | 1.8                 | 2.3                | Use div=3 calib<br>constant for<br>optics(div=4) |
| 3.28-3.29  | autogain            | optics               | 1.8                 | 1.8                |  |
| 3.29-3.31  | Fixed gain          | Optics<br>production | 2                   | 2.2                | Large pedestal<br>uncertainty                    |
| 3.31-4.10  | Fixed gain          | production           | 1.1                 | 1.2                |  |
| 4.11-4.26  | Fixed gain          | production           | 1.1                 | 1.2                |  |
| 4.26-4.30  | Fixed gain          | production           | 2                   | 2                  | BPM B<br>calibrated by<br>A and harp             |
| 5.3-5.7    | Fixed gain          | Production<br>optics | 1                   | 1.1                | Best situation                                   |
| 5.7-5.17   | Fixed gain          | production           | 1.2                 | 1.3                |  |

Uncertainty for each run please check sql database

backup

# New BPM Receiver

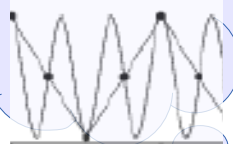


Cascaded integrator-comb filter

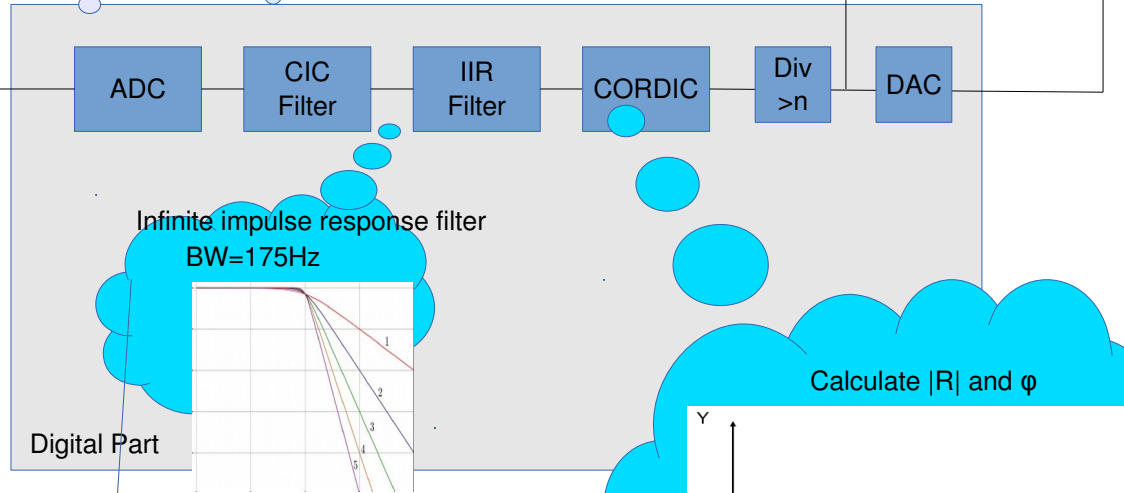
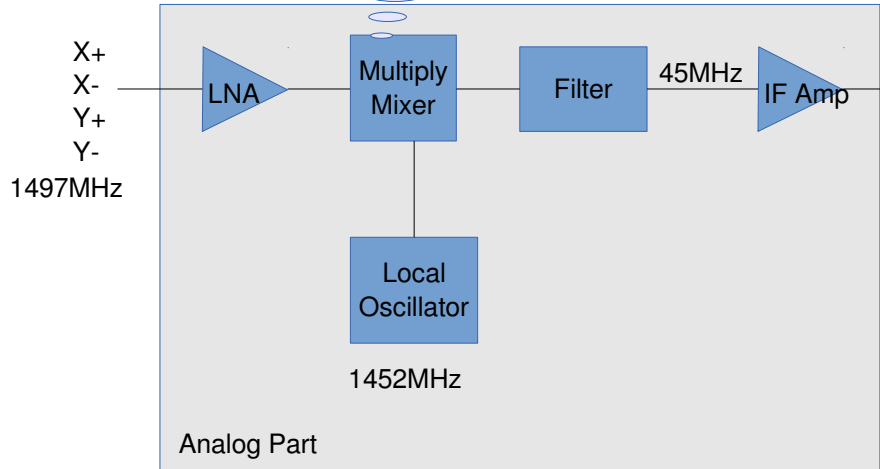
$$\int a \frac{d}{dt}$$

Noise limit  
exclude out-of-band signal

Harmonic sampling  
Sample Rate: 36MSPS



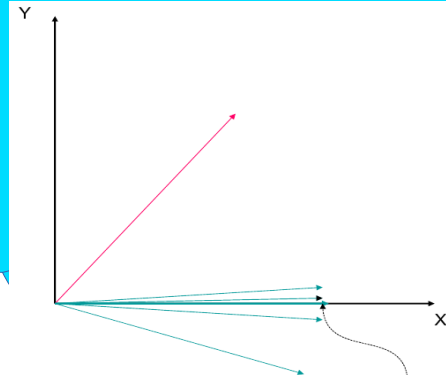
$$\sin \theta \sin \varphi = \frac{1}{2} \cos(\theta - \varphi) - \frac{1}{2} \cos(\theta + \varphi)$$



Infinite impulse response filter  
BW=175Hz



Calculate |R| and phi



We can not see fast raster signal

## BPM calibration

1. raw signal received in antenna VS recorded ADC data(linear region):

$$\phi = f(A_+ - A_{0+}) = a(A_+ - A_{+0} + b)$$

2. rewritten diff/sum value(temp value):

$$X_b = \frac{(A_+ - A_{0+} + b_+) - g_x(A_- - A_{0-} + b_-)}{(A_+ - A_{0+} + b_+) + g_x(A_- - A_{0-} + b_-)}$$

3. nonlinearity correction for diff/sum(temp value):

$$x = rX_b \left( \frac{1}{x_b^2 + y_b^2} - \frac{1}{\sqrt{x_b^2 + y_b^2}} \sqrt{\frac{1}{x_b^2 + y_b^2} - 1} \right)$$

4. Calibrate with harp data

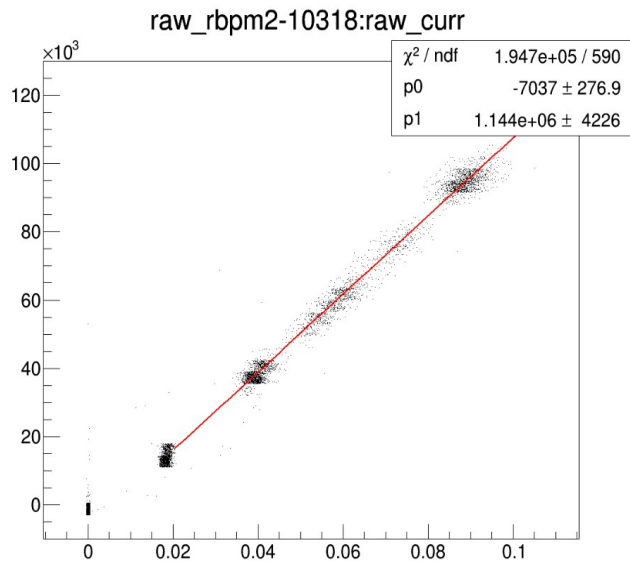
$$X_{harp} = c_0 + c_1 x + c_2 y$$

$$y_{harp} = c_0' + c_1' y + c_2' x$$

Position from harp, already transfered to BPM local coordinate(use survey data)

# Constants

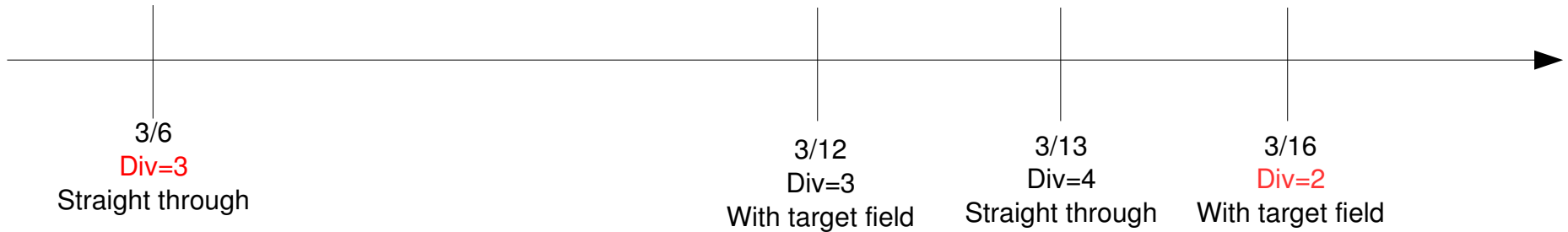
$$\phi = f(A_+ - A_{0+}) = a(A_+ - A_{+0} + b)$$



b: got from linear fit for current VS recorded ADC data

- Some bpm calibrations did the calibration for several currents
- Each harp scan position(one point) corresponding to several runs with different current(100nA,75nA,50nA)
- Assumption: those runs with different current have same beam position
- Influence: key parameter to eliminate the current effect, let calculated position immune to fluctuating current(50~100nA), especially for the difference of  $b_+ - b_-$

Calibration constant for optics runs near 3185(div=2)  
Difficulties: no straight through calibrations for div=2



The most closed result for div=2 calibration is 3/6 div=3  
Calibration for 3/6-3/28(autogain): without subtracting pedestal

3185 run position calculated by using 3/6 div=3 calibration const

-0.84mm(x) 2.39mm (y) at target

|                          |
|--------------------------|
| Fitted $X_{\text{beam}}$ |
| -3.5mm                   |

Compared with the fitted result x from optics