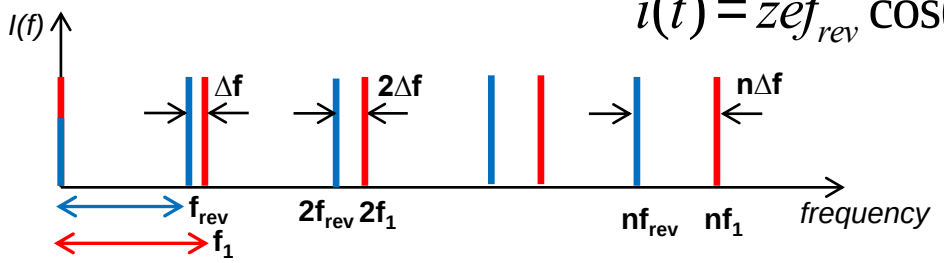
Unbunched long. Schottky Signals

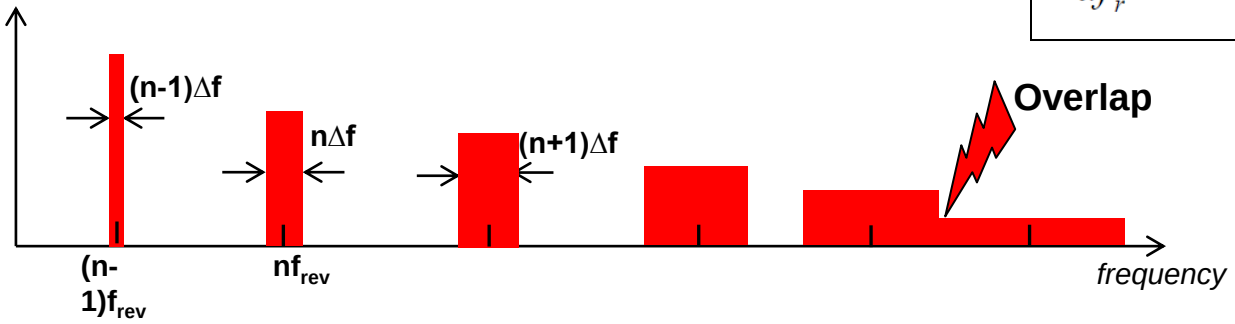
- **2 particles with different f_{rev}: $f_1 = f_{rev} + \Delta f$**

$$i(t) = zef_{rev}\cos(2\pi f_{rev}t) + zef_1\cos(2\pi f_1 t)$$



- **Spectral density of the n^{th}-band of N particles with random initial phase and a revolution frequency spread $f_{rev} + \Delta f/2$:**

$$\frac{d\langle I_n\rangle^2}{df_r} = 2e^2 f_r^2 \left(\frac{dN}{df_r}\right)$$



Bunched long. Schottky Signals

- **Time difference τ to the synchronous particle (f_{rev}) due to synchrotron motion of *n=1…N* particles:**

random amplitude

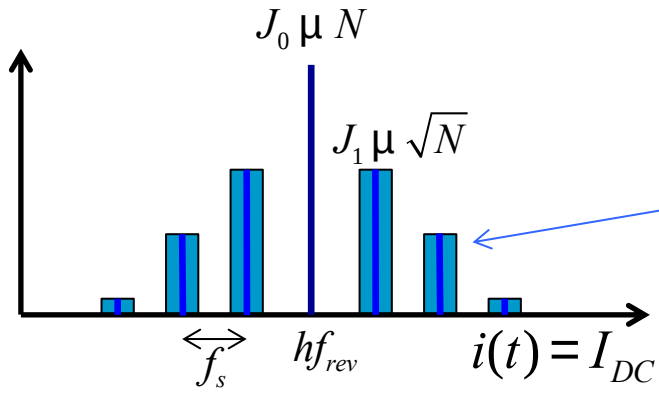
$$\tau_n(t) = \hat{\tau}_n \sin(2\pi f_s t + \Upsilon_n)$$

random phase

- **Schottky signal of the n^{th} particle under phase modulation**

$$i_n(t) = zef_{rev} + 2zef_{rev} \sum_{h=0}^{\infty} \cos\{2\pi h f_{rev}[t - \hat{\tau}\sin(2\pi f_s t + \Upsilon)]\}$$

  - **causes sidebands around each $h\,f_{rev}$ for bunched beams**



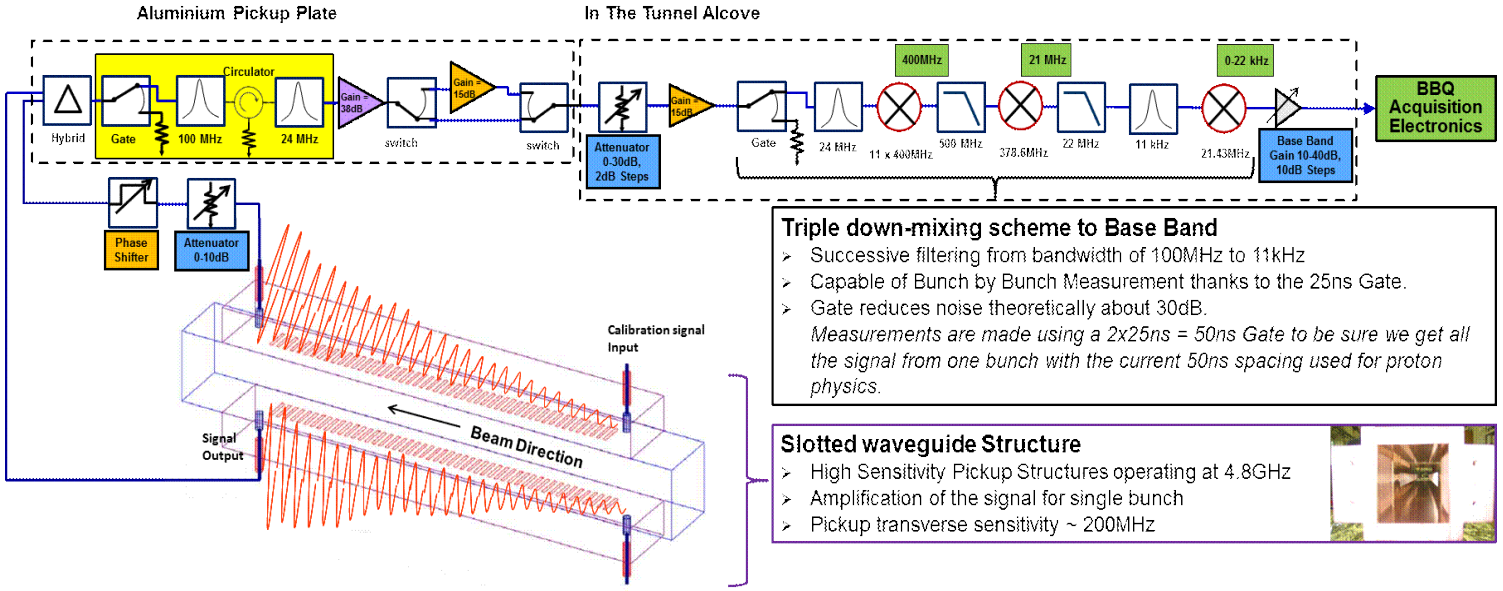
$$i_h = 2I_{DC} \sum_{n=1}^{N} \sum_{p=-\infty}^{\infty} J_p(2\pi h f_{rev}\hat{\tau}_n)\cos(2\pi h f_{rev} + 2\pi f_s t + p\Upsilon_n)$$

Lines may broaden due to spread of f_s

$$I_{DC} = Nzef_{rev}$$

$$i(t) = I_{DC} + 2I_{DC} \sum_{h=1}^{\infty} \sum_{n-1}^{N} \sum_{p=-\infty}^{\infty} J_p(2\pi h f_{rev}\hat{\tau}_n)\cos(2\pi h f_{rev} t + 2\pi p f_s t + p\Upsilon_n)$$

Ion Schottky Signals at the LHC



- **Observed stable, high level Schottky signals at all ion runs!**
- **Plan to modify the Schottky pickup using the sum signal port**