# ELENA Schottky

**RF vs. BI, two sources will be available (after LS2) for Schottky in ELENA/LEIR:**

**RF will**:
- In ELENA use there in magnetic PU, sample this with a VXS based system and send raw data to an obxBOX, From where the data can be treated with in FESA (This is planed to be an extension on the FESA used last year in LEIR and ELENA by BI). The DSP in the VXS will be able in parallel to treat the data.

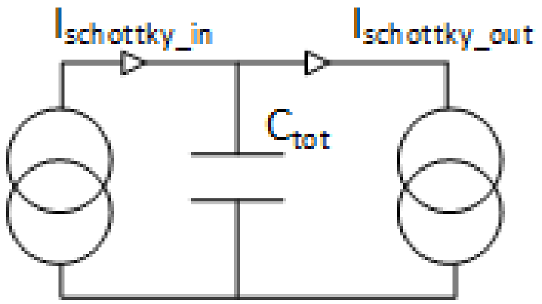
**BI** will
- Update (HW already in place, Jun 19) LEIR Schottky to have a faster read out time (VME interface changed to PCIExpress interface) The same FESA class as last year will be (updated) used.
- Dismount the LEIR system copy system in ELENA.
- Use the 20 orbit pickup sum signals coherently integrated to generate longitudinal Schottky, this output will be send to either a separate obsBox or the RF obsBox and then treated in the same FESA class (with the goal that the interface for applications will be the same in LER and ELENA, AD)

# Correlation in Schottky signals (un-bunched longitudinal) ?

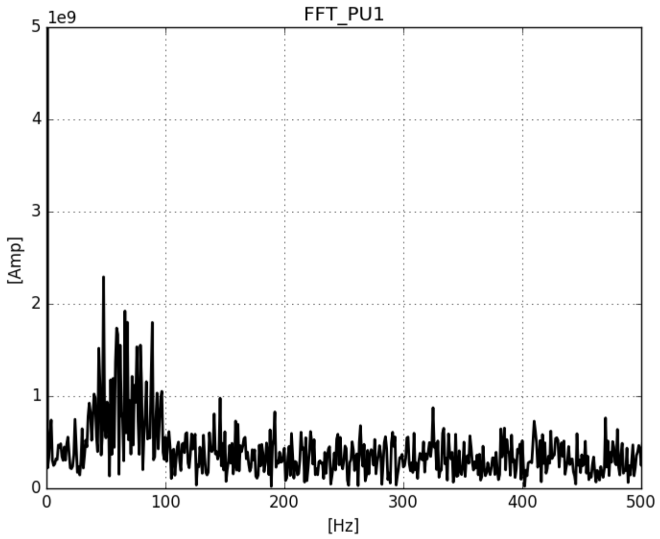
- ***"Normal"*** approach would be summing power spectra (non-coherent integration ) …. But if high correlation better SNR can be obtained (coherent integration).

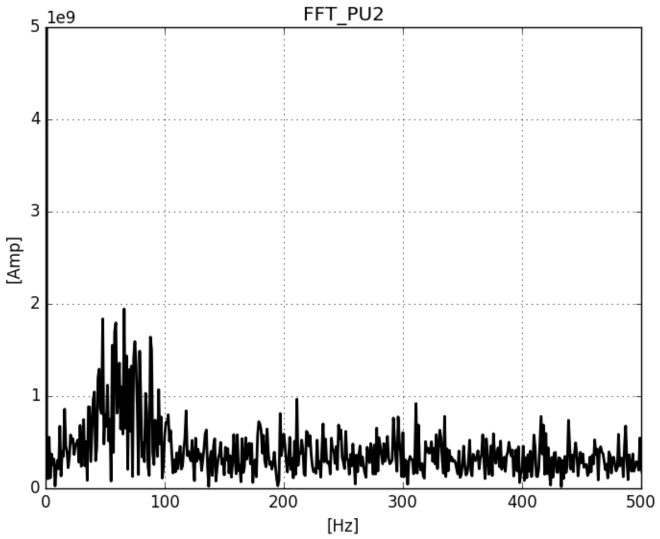
- Looking at the spectra of a un-bunched beam i.e. FFT(change in charge in PUs) … will this be the same in different PUs or **is it "*just*" noise**.

- Example: Sampling raw (down mixed) data from two PUs (ELENA 110, 125), here plotting the individual PU signals FFT'ed:




$$C_{tot} = C_{PU} + C_{cable}$$



# Correlation in Schottky signals ?

Compensating for PU positions:

**Expected value**:

$$\Delta\varphi = 2\pi \cdot f_{Schottky} \cdot \Delta t = 2\pi \cdot h_{Schottky} \cdot f_{revolution} \cdot \Delta t$$

$$f_{Schottky} = h_{Schottky} \cdot \frac{\beta c}{l_{ELENA}} \quad \text{and } \Delta t = \frac{l_{distance\_between\_PUs}}{\beta c}$$

LNA.BPMEB0110 to LNA.BPMEB0125 is 3858mm,
ELENA 30.4m and looked at harmonic 2

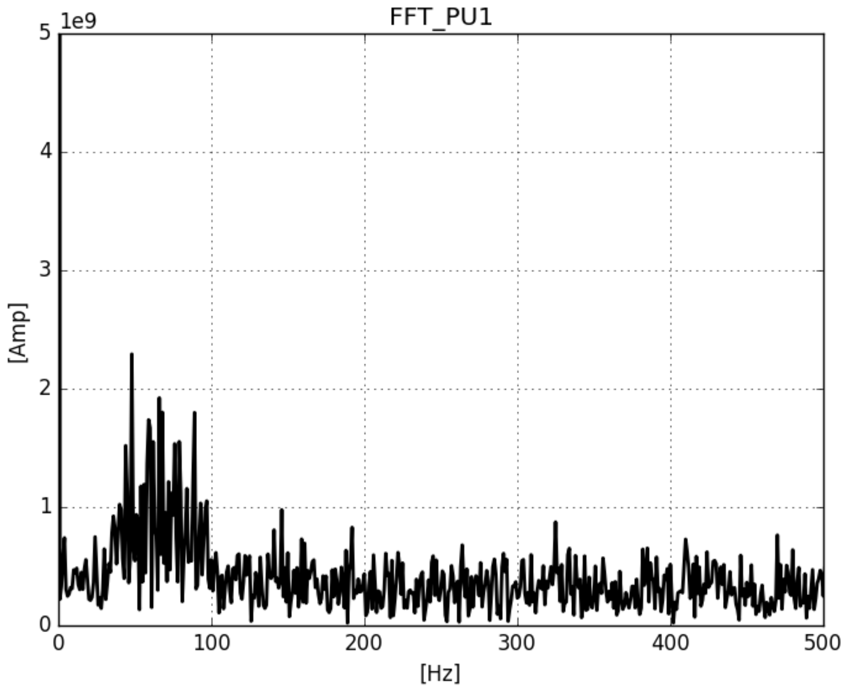
$$\Delta\varphi = 2\pi \cdot h_{Schottky} \cdot \frac{l_{distance\_between\_PUs}}{l_{ELENA}} = 2\pi \cdot 2 \cdot \frac{3.858}{30.4} = \qquad 1.59\, rad \quad (91.3°)$$

Dependent on harmonic, but independent of revolution frequency! (measurement of $\frac{\Delta f}{f}$ not affected)

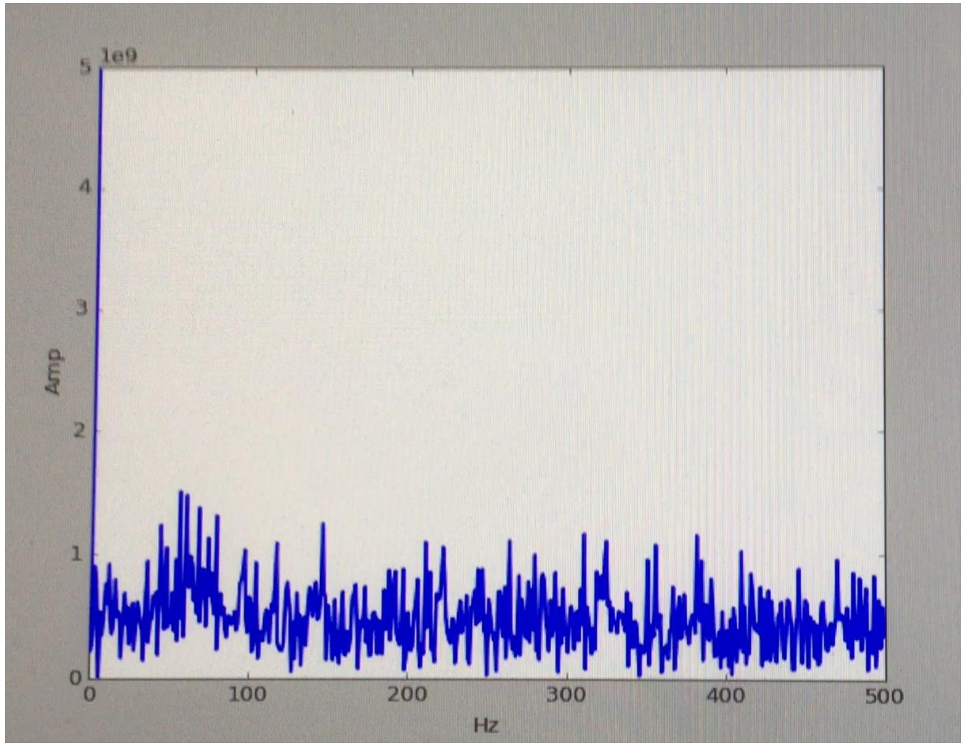
**Measured value:**
Cross Correlation between raw sampled data from two PUs, results in a phase *1.69 rad* *(96.8°)*
(1.66, 1.69, 1.68, 1.77, 1.67 rad from 5 sets of data)

# Correlation in Schottky signals ?

Comparing PU1 with PU1·$e^{j\omega\Delta t}$ + PU2:




Sweeping the phase through +/- 180° (20° steps):




At correct phase signal is increased. @ 180° off signal is suppressed (at least to noise), i.e. high correlation.

With high correlation SNR, can be increased, for 20PUs theoretical SNR increase is 13dB …To be confirmed