Update on Attenuation Length Measurement

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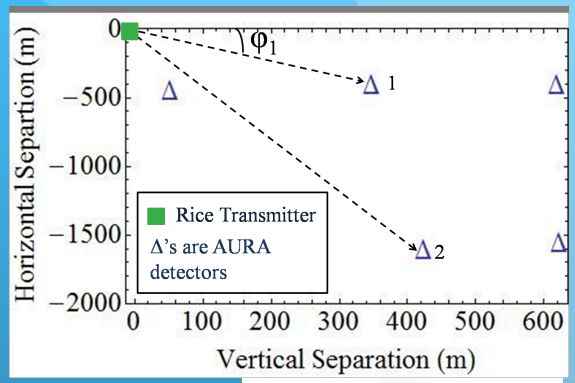
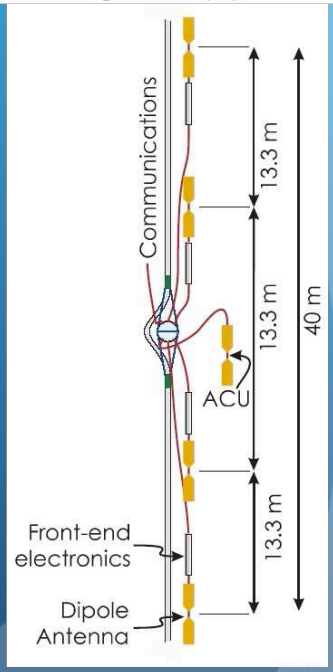
Attenuation Length

- Look at the power received in multiple clusters to calculate the attention length.
- Principle of attenuation length measurement

$$\frac{P_1}{P_2} = \frac{r_2^2}{r_1^2}\frac{cos^4(\phi_1)}{cos^4(\phi_2)}e^{\lambda_{att}(r_2-r_1)}$$

- For actual measurement need to use simulation input / ray tracing
- Data quality for measurement focus of this talk
  - Examining the runs to get an idea of the data quality
  - Checking for a reliable power extraction

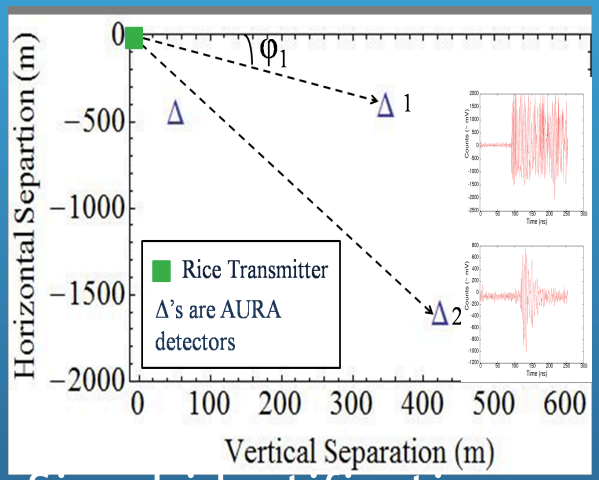




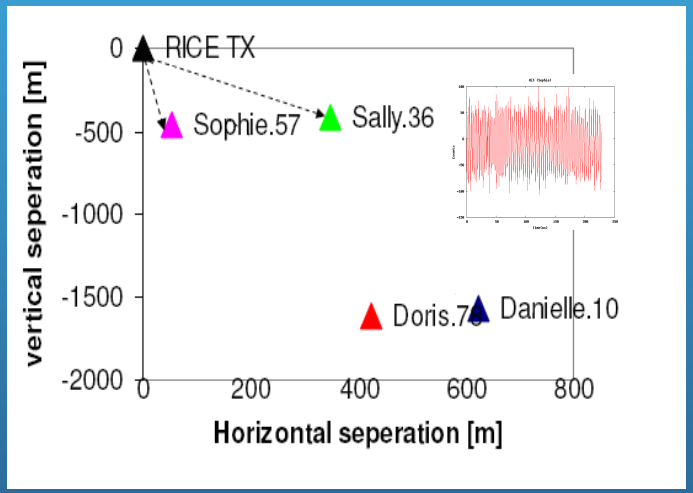
Signals

Rely on the Rice Surface Transmitter (RICE-TX)

Pulses



CW



Signal identification

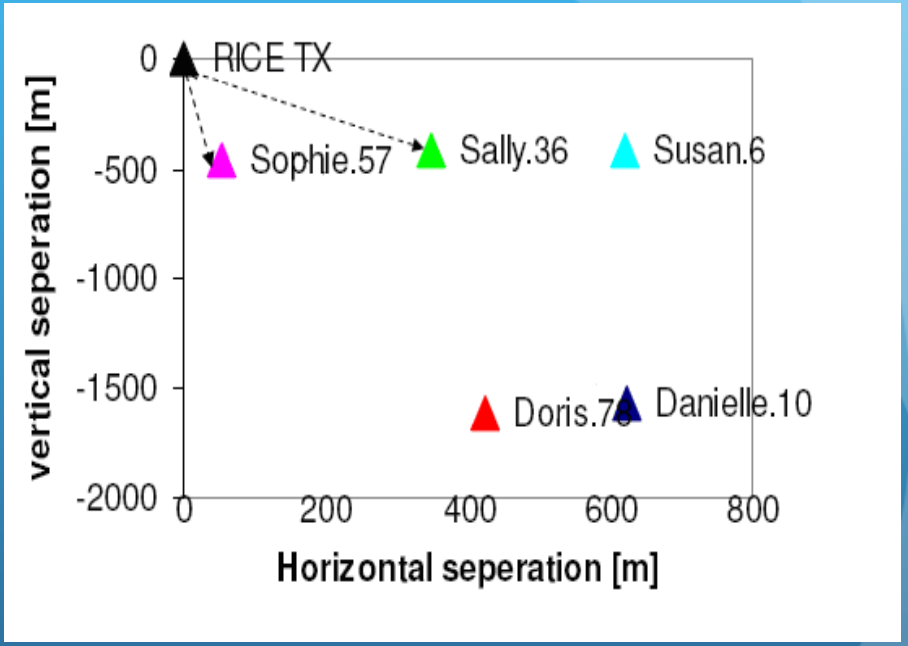
Saturation

Data Selection

- Pulser runs:
  - Run 13411-13419 (July 2009) Surface Transmitter
- CW runs:
  - KU
    - Run 13398-13401 (July 16, 2009)
  - Rice Surface TX:
    - Run 13402 – 13407 (July 16, 2009)
      - Cover different transmitter power settings (72, 66, or 60 dBmV) and frequencies (300,500MHz) and look clean
    - Run 57722-57724 (Feb 5 , 2010)
      - Single power setting

Setup - CW

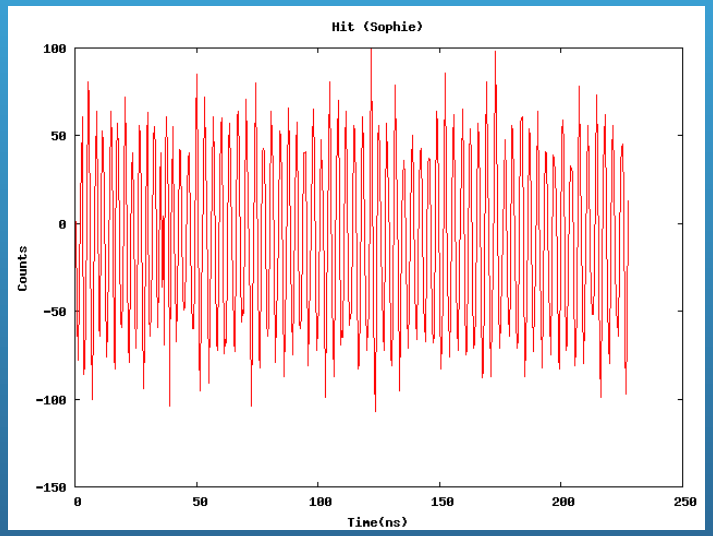
- Transmitter:
  - RICE surface
- Receivers:
  - Focus on Shallow Clusters
    - Sophie and Sally
      - Show clean CW signals - Ignore channel 3, which is broken in both
    - Susan … all but one channel broken
  - No signal observed in deep clusters
    - Danielle, Doris



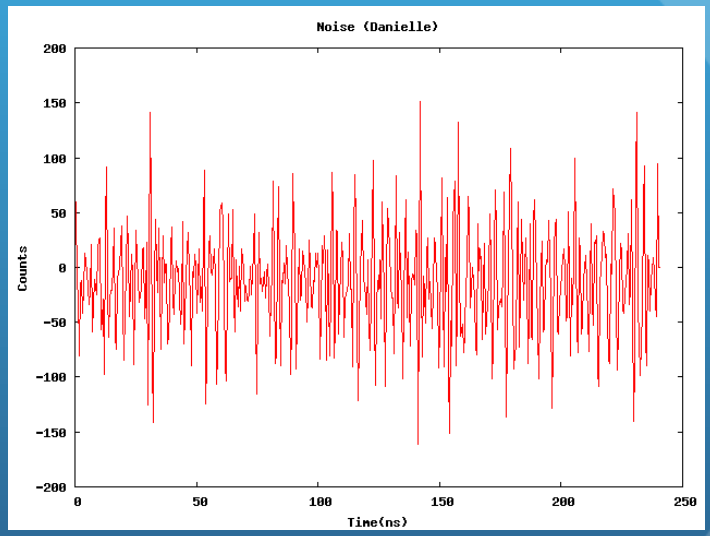
Example signal

- Run 13402-13407

"cw signal"



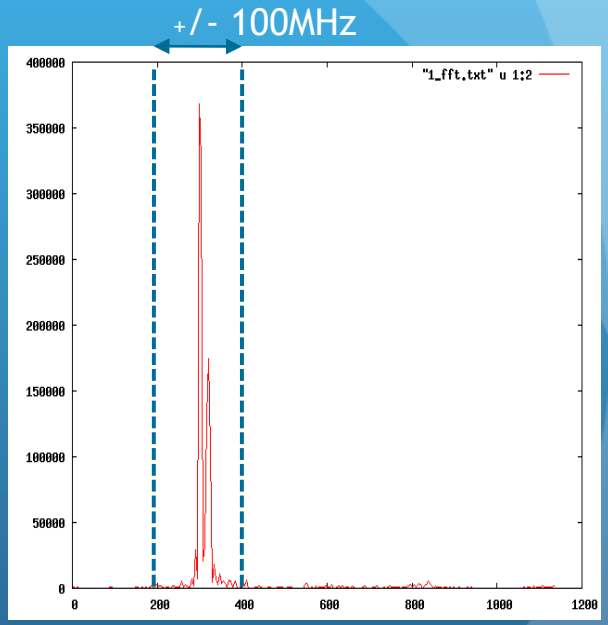
"noise"



Calibration: Counts to mV:
-0.58 (Sally, Danielle)
-1.08 (Sophie, Doris)

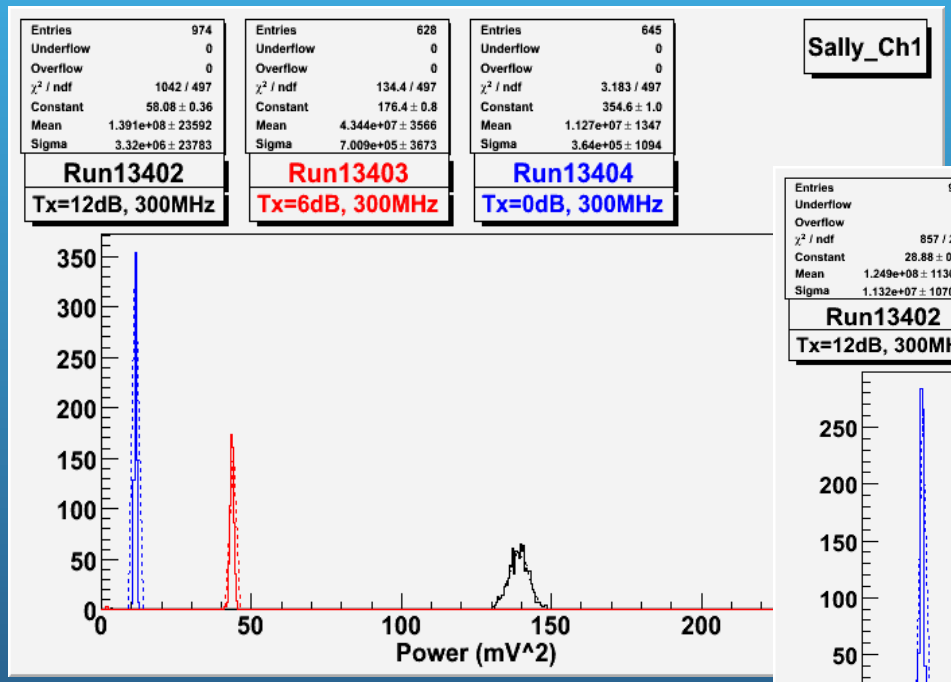
Power calculation

- The power is calculated in the frequency domain. For each hit, we integrate the signal in a window whose lower edge is 100 MHz lower than the Tx setting and whose upper edge is 100 MHz greater than the Tx setting.

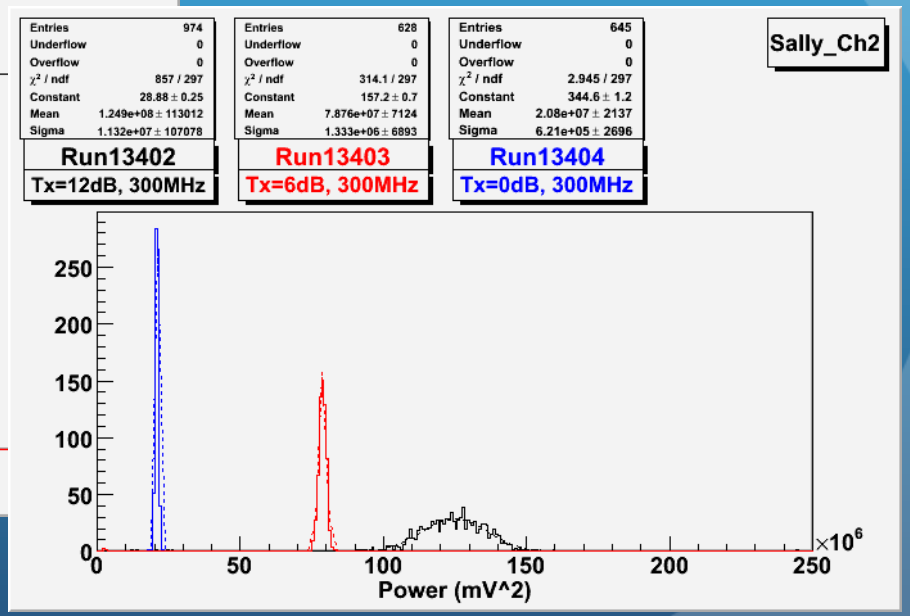


Power observed in Sally

- Run 13402-13404 – 300Hz differ by 6db



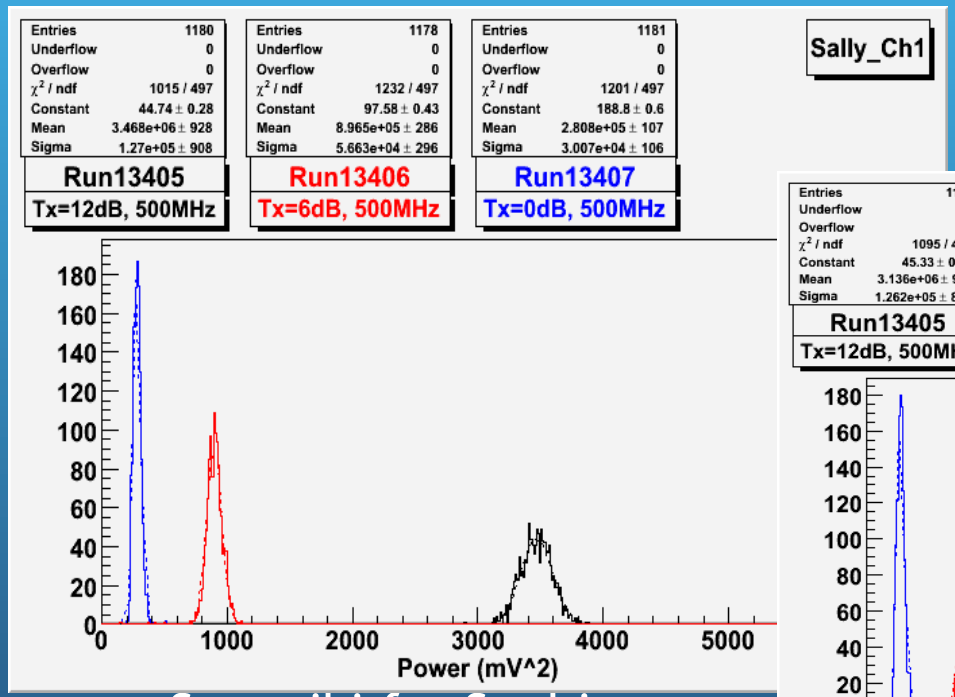
All hits in a run are histogrammed to obtain the power distribution.



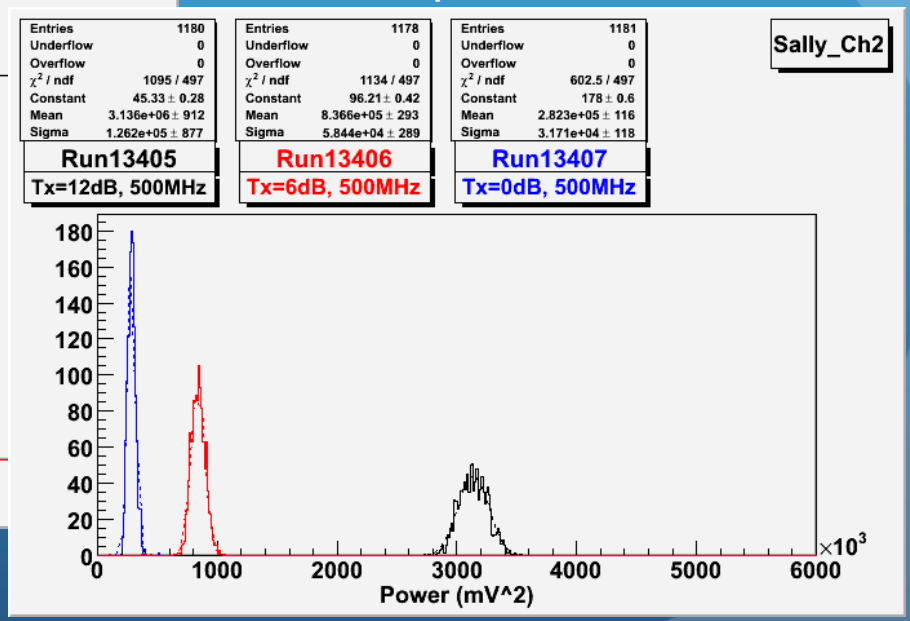
- See wiki for Sophie

Power observed in Sally

- Run 13405-13407 – 500Hz differ by 6db



All hits in a run are histogrammed to obtain the power distribution.

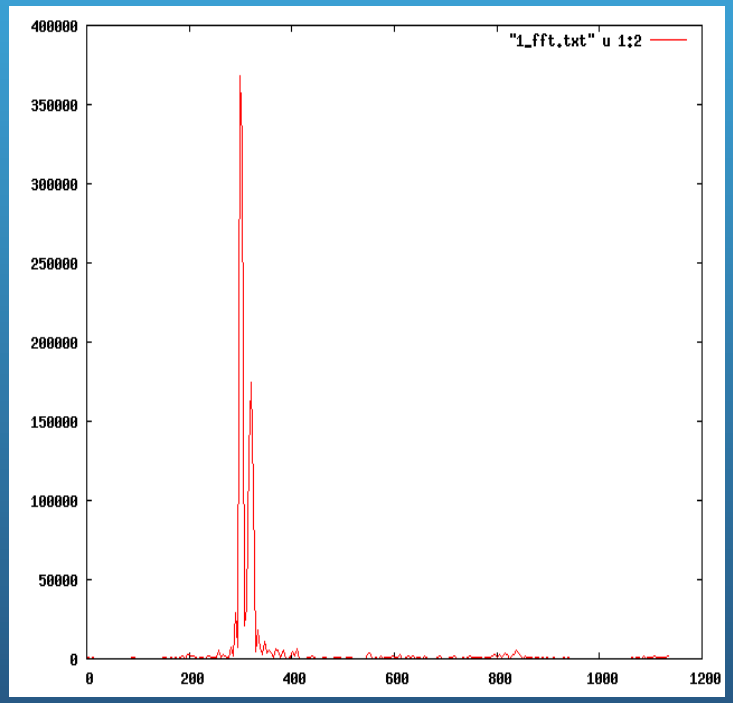


- See wiki for Sophie

Average FFT

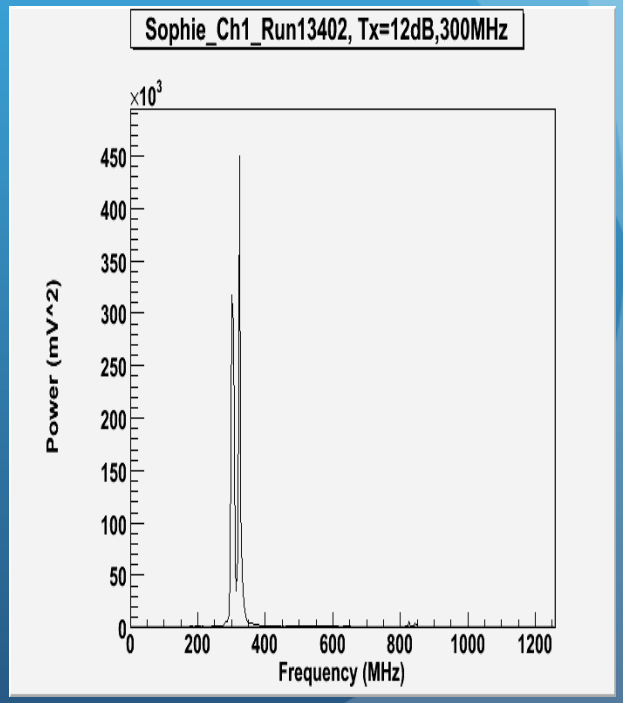
- The average FFT for a run

Single event

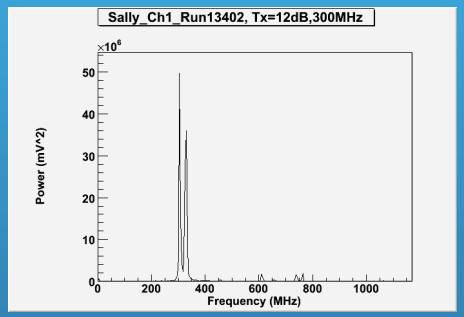
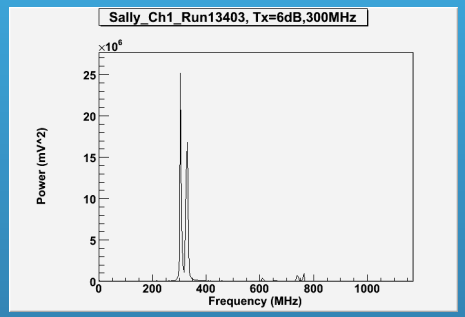
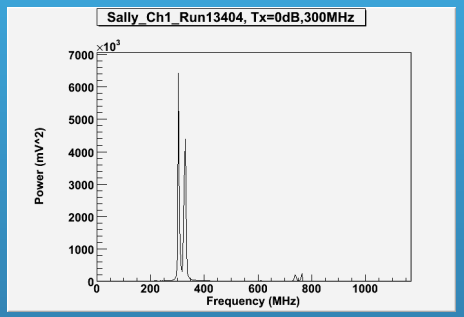
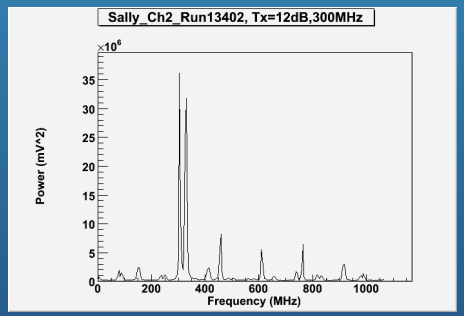
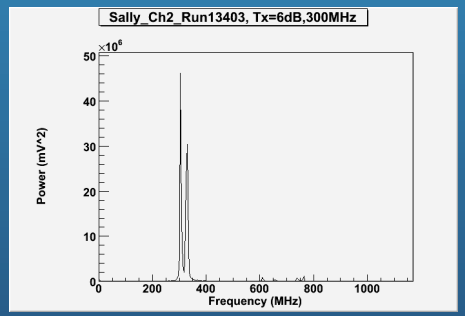
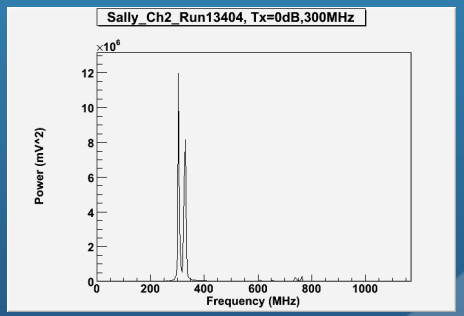


calibration

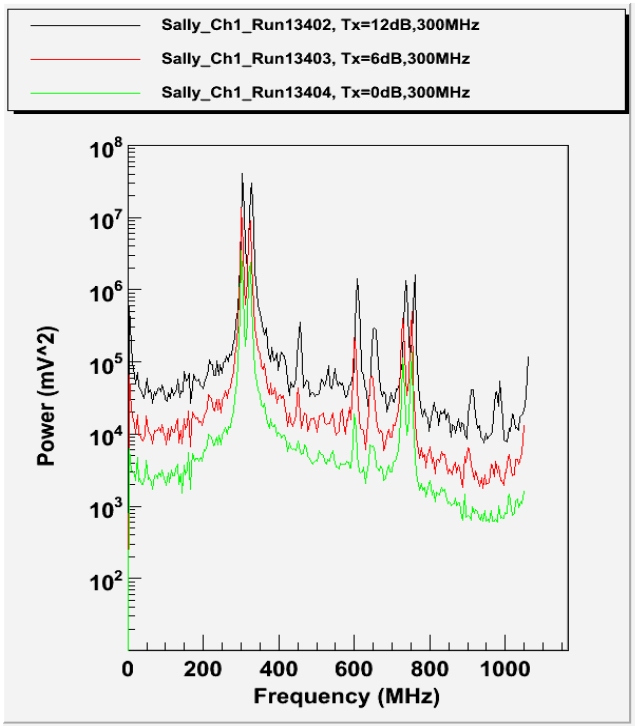
Averaged over a run

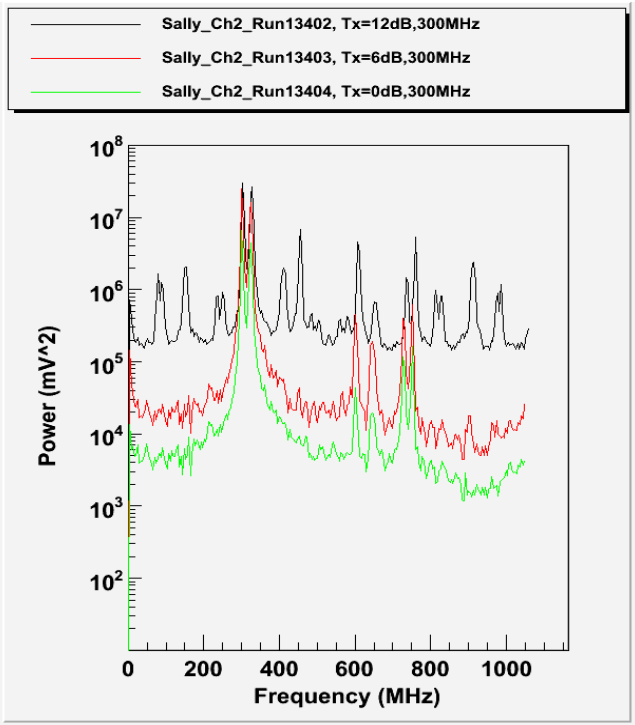


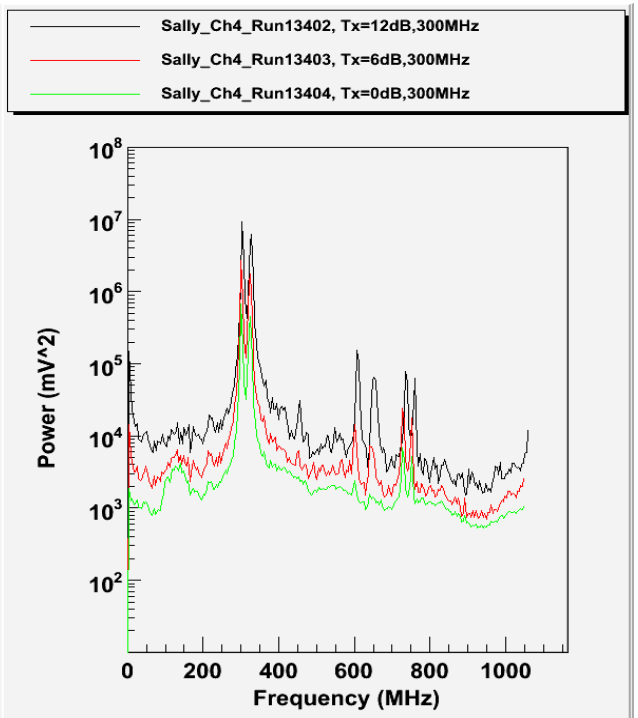
Example FFT

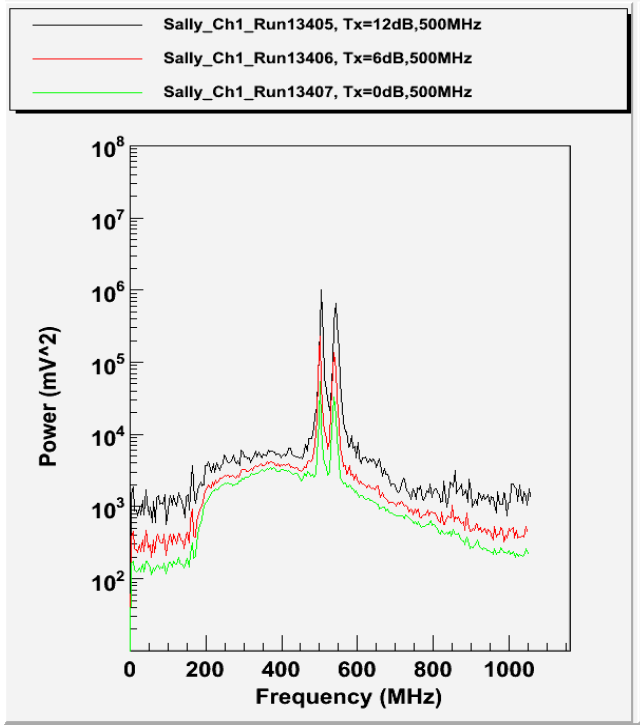
	Run13402 -12db	Run13403 -6db	Run13404 0
Ch1			
Ch2			

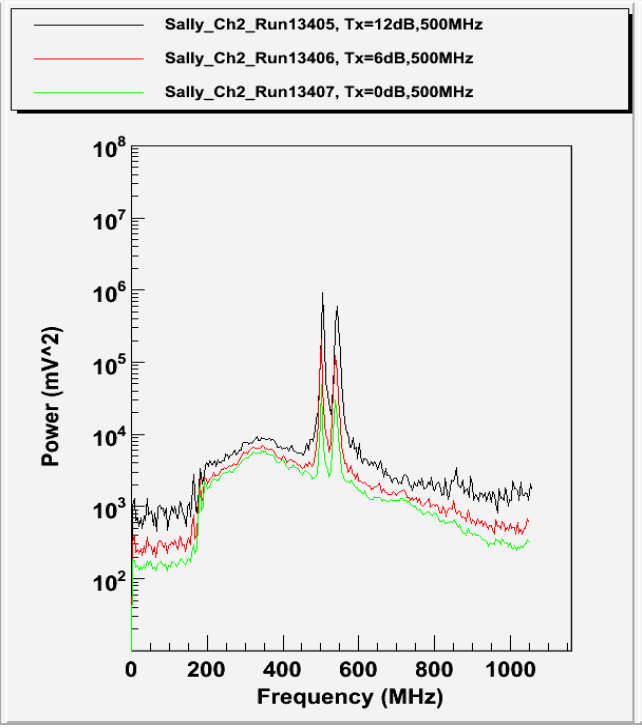
See wiki for more details

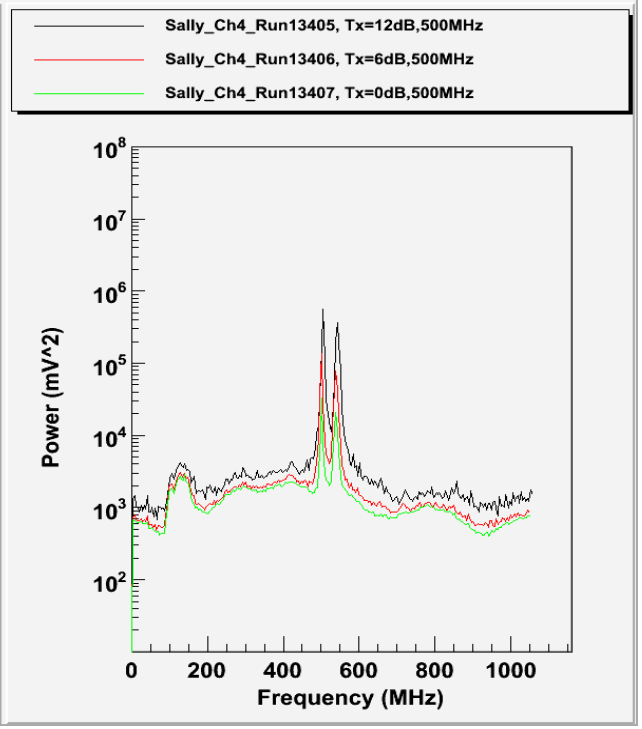

Sally_Ch1_Run13402, Tx=12dB,300MHz
Sally_Ch1_Run13403, Tx=6dB,300MHz
Sally_Ch1_Run13404, Tx=0dB,300MHz
Power (mV^2)
Frequency (MHz)


Sally_Ch2_Run13402, Tx=12dB,300MHz
Sally_Ch2_Run13403, Tx=6dB,300MHz
Sally_Ch2_Run13404, Tx=0dB,300MHz
Power (mV^2)
Frequency (MHz)


Sally_Ch4_Run13402, Tx=12dB,300MHz
Sally_Ch4_Run13403, Tx=6dB,300MHz
Sally_Ch4_Run13404, Tx=0dB,300MHz
Power (mV^2)
Frequency (MHz)

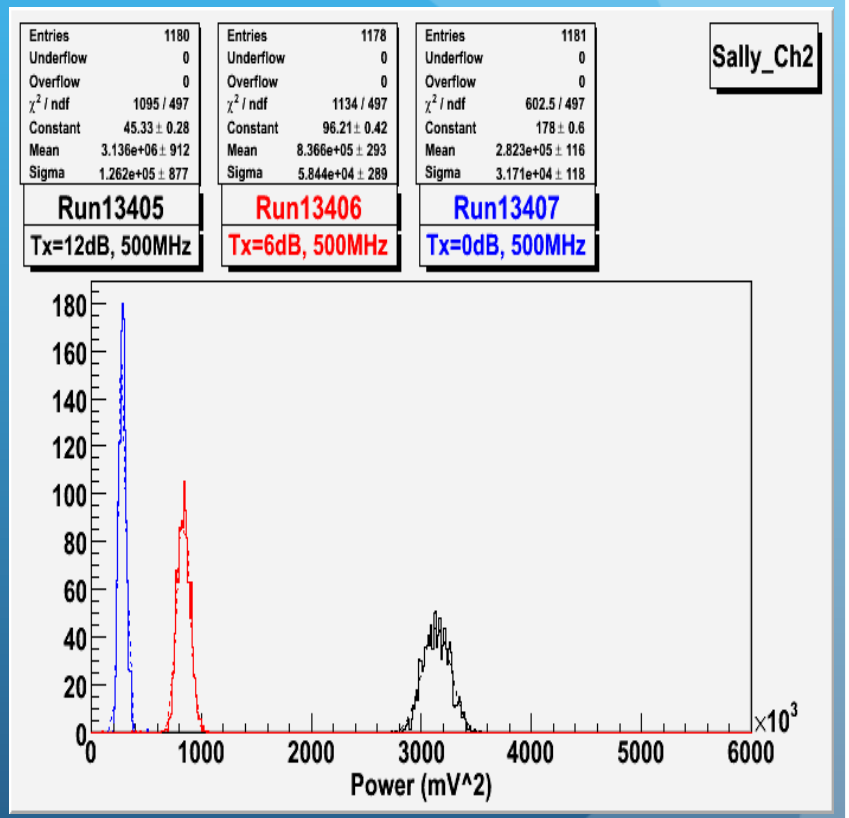

Sally_Ch1_Run13405, Tx=12dB,500MHz
Sally_Ch1_Run13406, Tx=6dB,500MHz
Sally_Ch1_Run13407, Tx=0dB,500MHz
Power (mV^2)
Frequency (MHz)


Sally_Ch2_Run13405, Tx=12dB,500MHz
Sally_Ch2_Run13406, Tx=6dB,500MHz
Sally_Ch2_Run13407, Tx=0dB,500MHz
Power (mV^2)
Frequency (MHz)

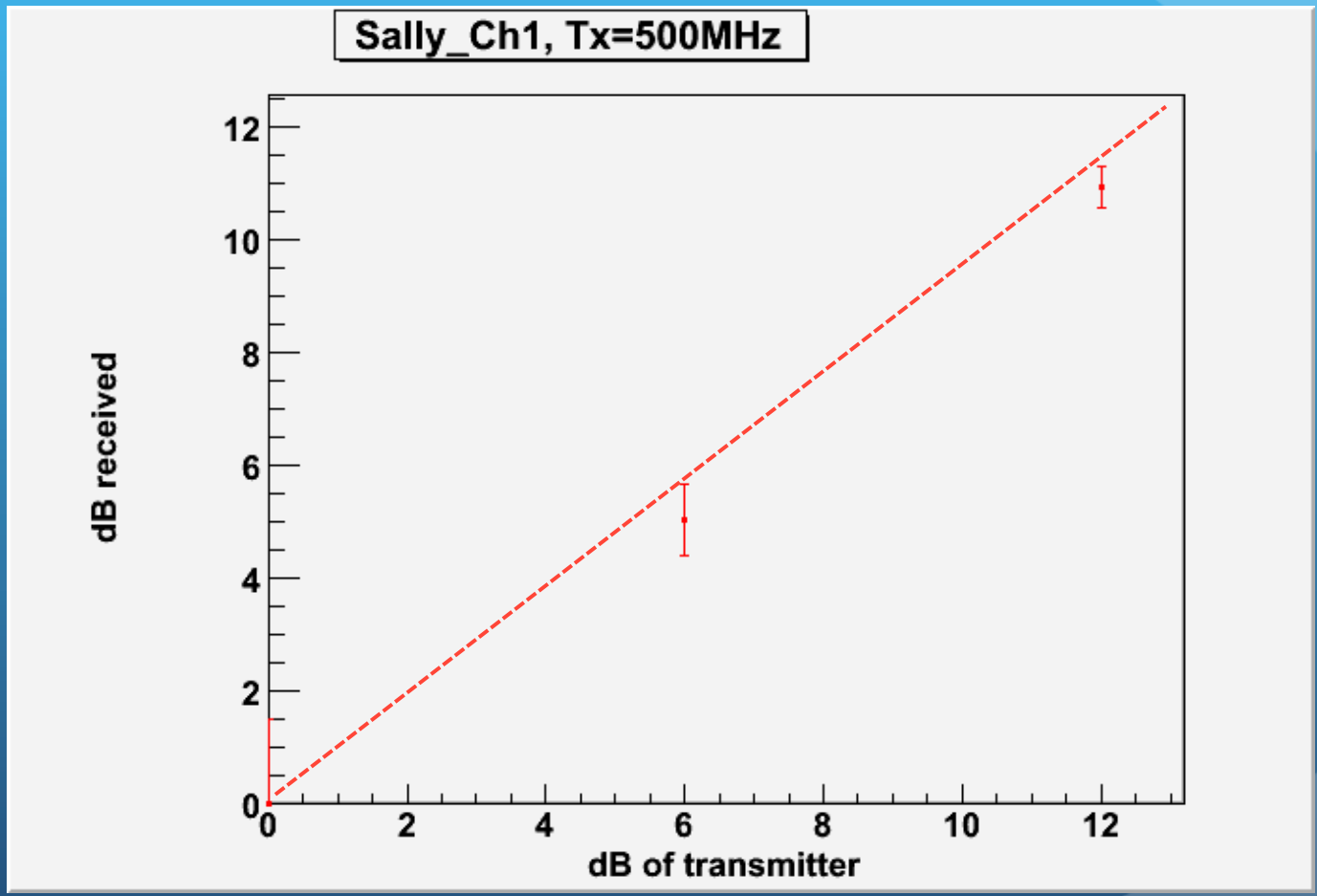

Sally_Ch4_Run13405, Tx=12dB,500MHz
Sally_Ch4_Run13406, Tx=6dB,500MHz
Sally_Ch4_Run13407, Tx=0dB,500MHz
Power (mV^2)
Frequency (MHz)

Scaling cross check

- The power received in a cluster should scale linearly with the power setting of the transmitter
- The power received for a run is taken as the mean of the Gaussian fit from the power histogram for that run.
- Error correspond to the width of the Gaussian

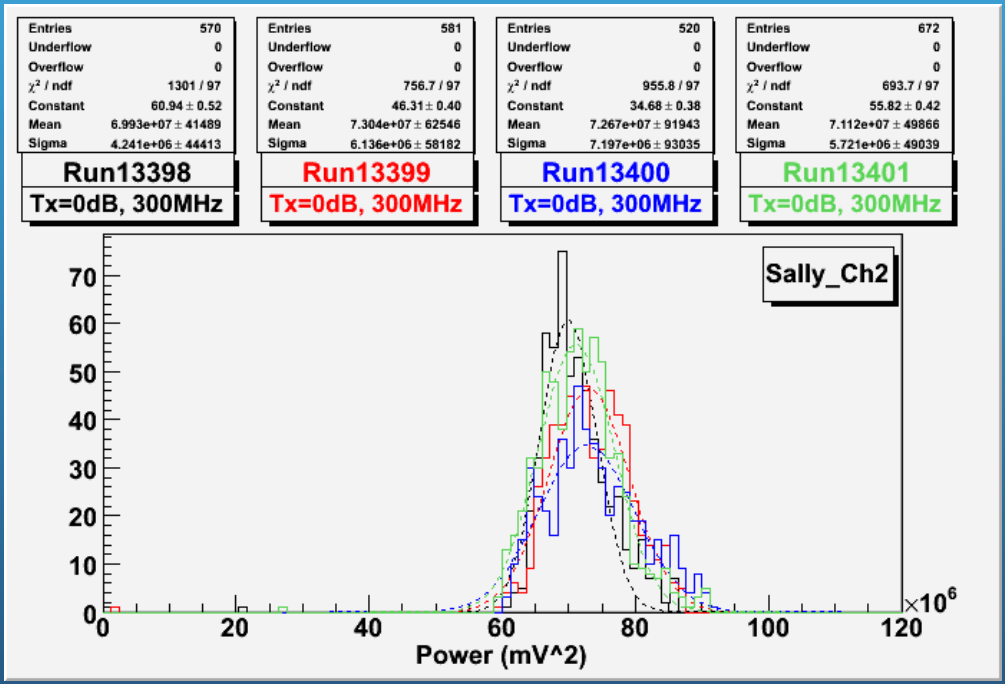


How well can we determine the power ?



Run to Run variations

- Example KU (signal observed in Sally and Sophie)
  - CW 300MHz



Conclusions

- Performing data quality checks on CW data
- Different power settings show scalability of power calculation
  - Expect to further improve after further optimizing the frequency window and add noise subtraction
- Current focus on systematic of power computation
  - Transmitter ← → Receiver
- Setup associated systematics (cable shadowing, antenna tilt, …)
- Details see:
  - http://wiki.icecube.wisc.edu/index.php/Aura_atten_progress