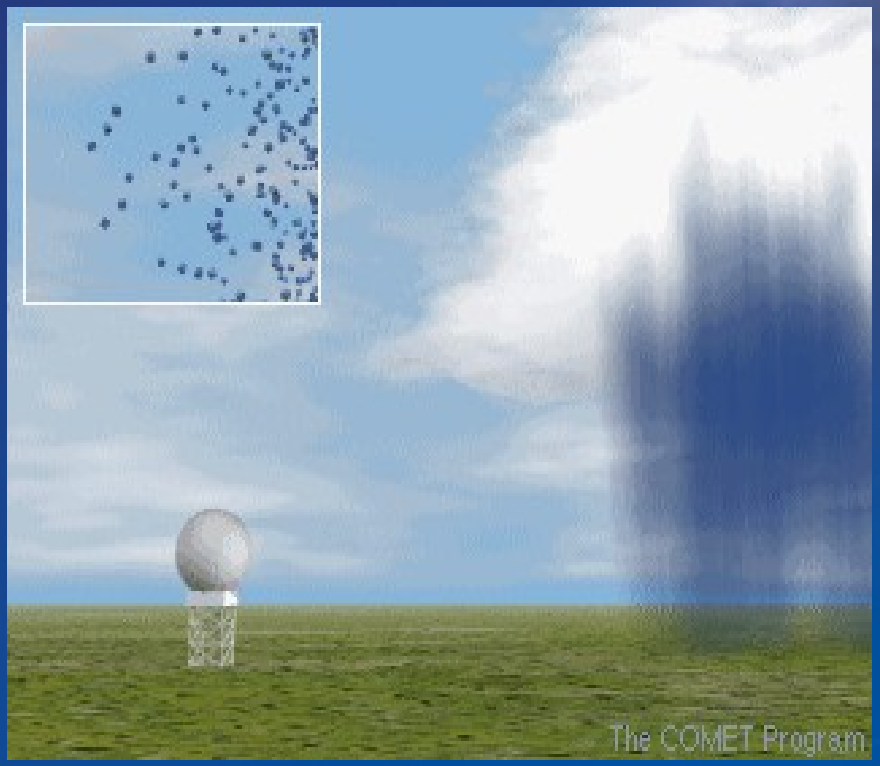
Is Spectral Processing Important for Future WSR-88D Radar?



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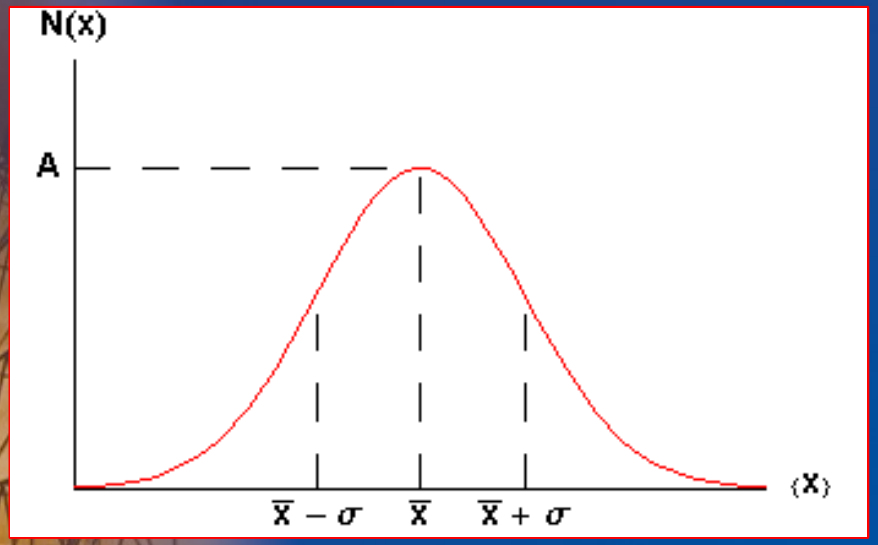
Mentor: Dr. Robert Palmer

Goals

- Determine if Actual Doppler Spectra have a Gaussian shape



Definitions of Terms

- **Doppler Spectrum – power weighted *velocity distribution within resolution volume of the radar***
- **Clutter- *unwanted echoes that interfere with the observation of signals on a radar***
- **Range gate – *the volume encompassed by one pixel of radar data***

KOUN Research WSR 88D Radar

- Data from KOUN Radar at NSSL in Norman, Ok
- Gates – can be over 1000
- Data are Time Series (Level I)
- Necessary to convert to Frequency Domain with Fourier Transform using Matlab

Typical Parameters of WSR 88D

Outputs (Level II):

- Reflectivity (Z)
- Radial Velocity (Vr)
- Spectrum Width (W)

Parametric Modeling of Doppler Spectrum

Assumed

- Gaussian shape
- Equation = $\frac{S}{\sigma\sqrt{2\pi}}\exp\left(-\frac{(x-\mu)^2}{2\sigma^2}\right) + Noise$
  - μ = Radial Velocity
  - σ = Spectral Width
  - S = Power

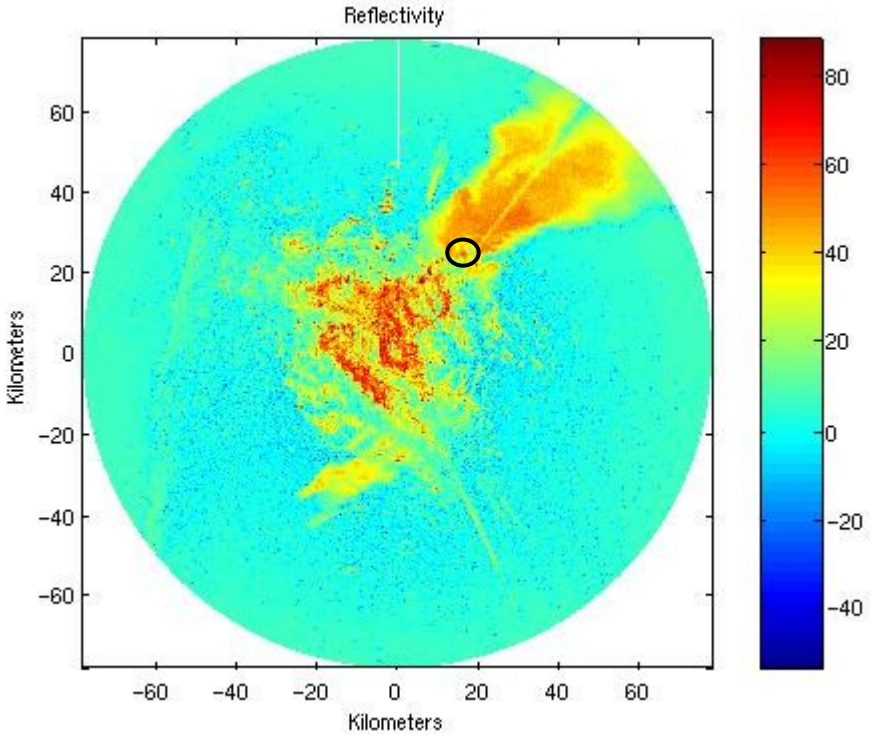
Parametric Modeling of Doppler Spectrum

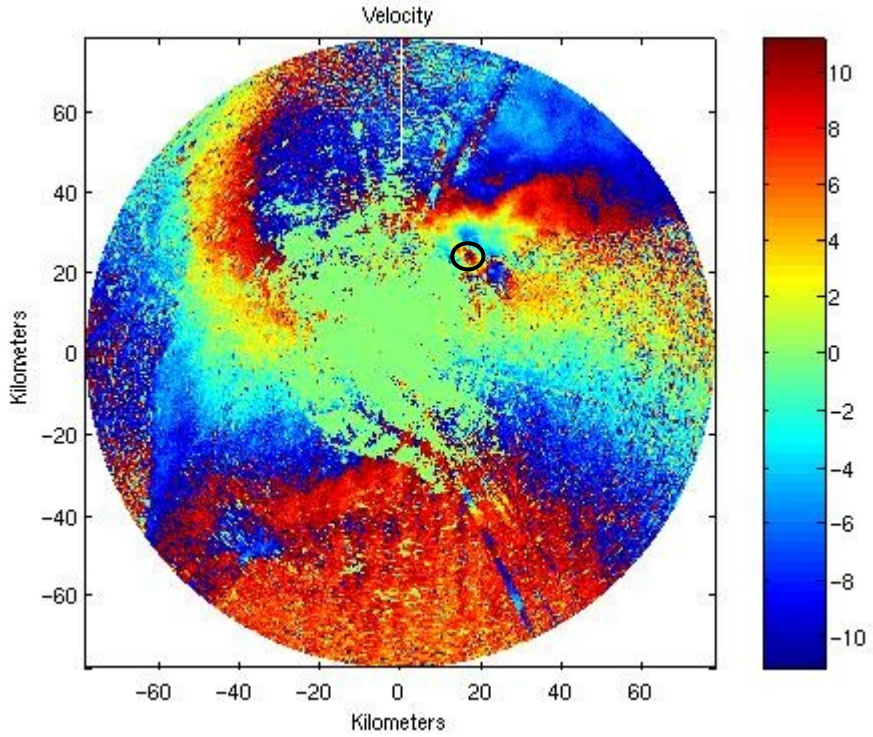
$$v_a = \pm \frac{\lambda}{4T_s}$$

$$DopplerSpectrum = fft\left(\frac{1}{N} \left| \sum_{t=1}^{N} y(t) e^{-iwt} \right|^2 \right)$$

Reflectivity and Velocity

313 x 24



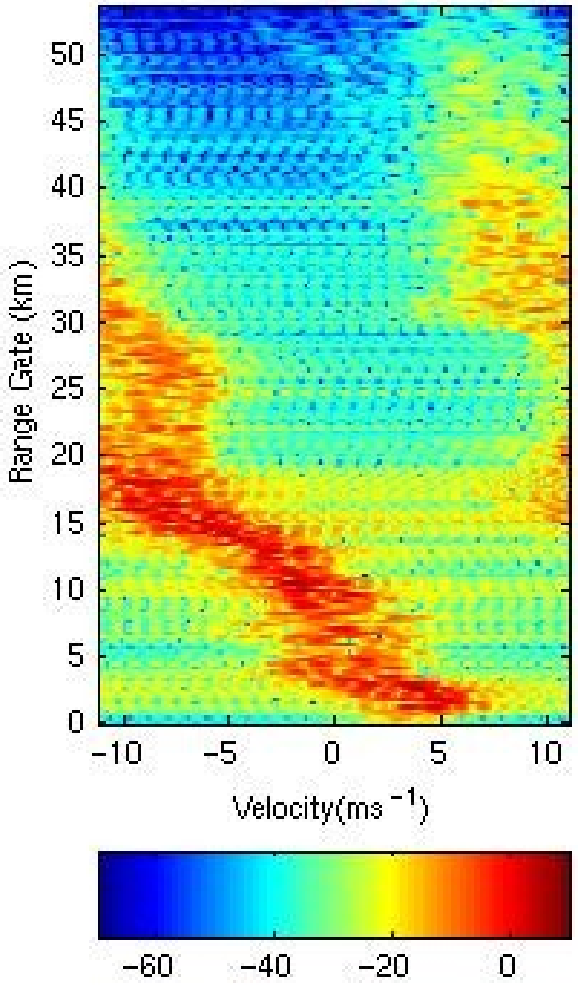


F4 Tornado

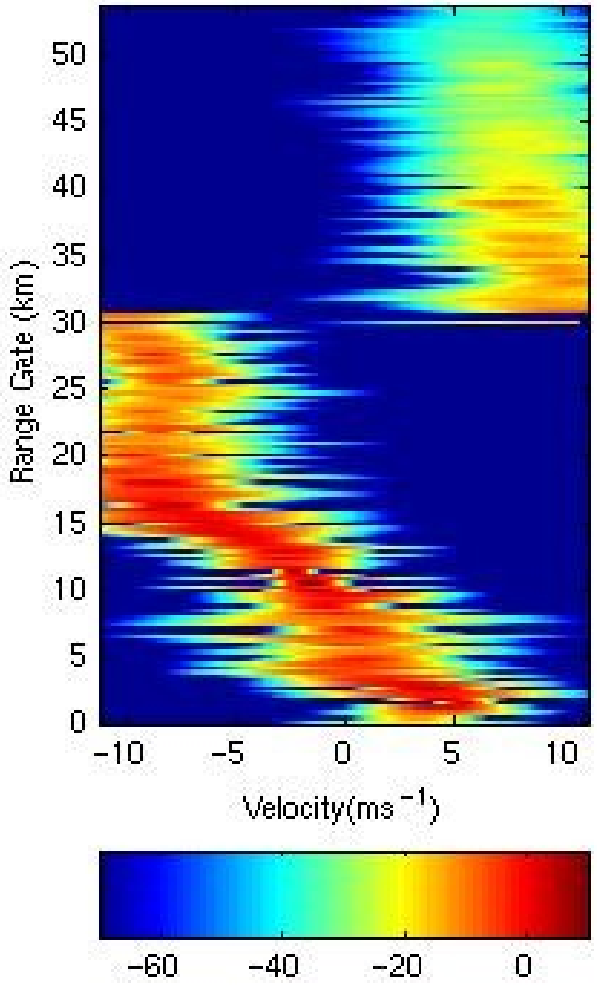
May 8,2003 in Moore, Southeast Oklahoma City and Choctaw, Oklahoma.

Spectral Analysis and Gaussian Fit

Actual Doppler Spectrum

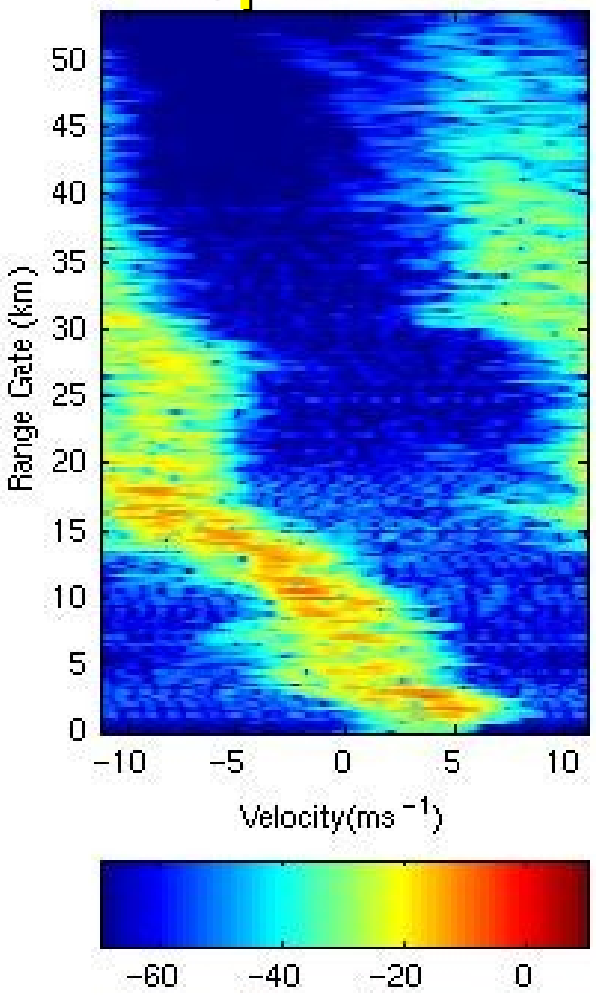


Gaussian Model Fit

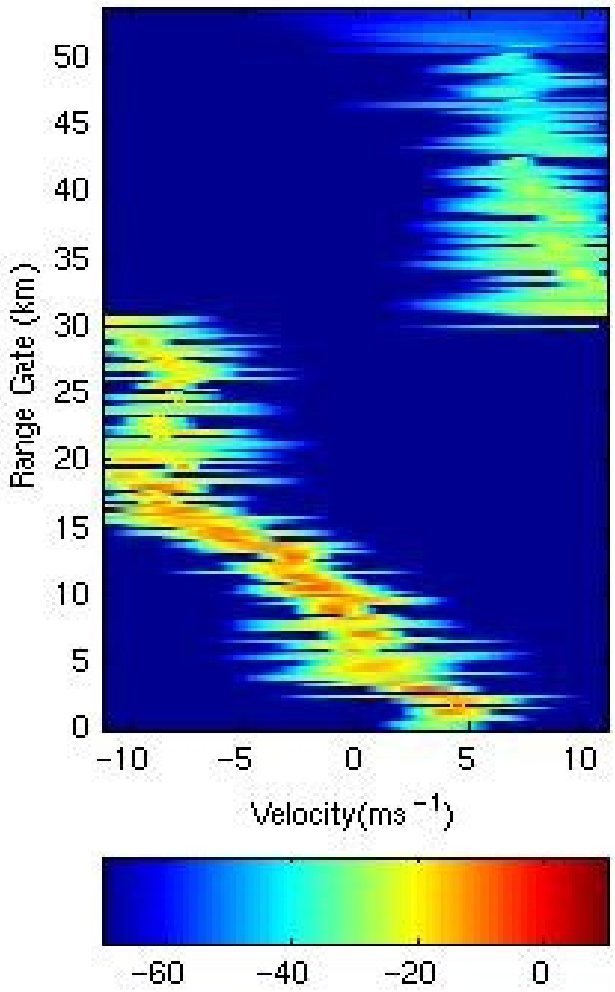


Improved Spectral Analysis

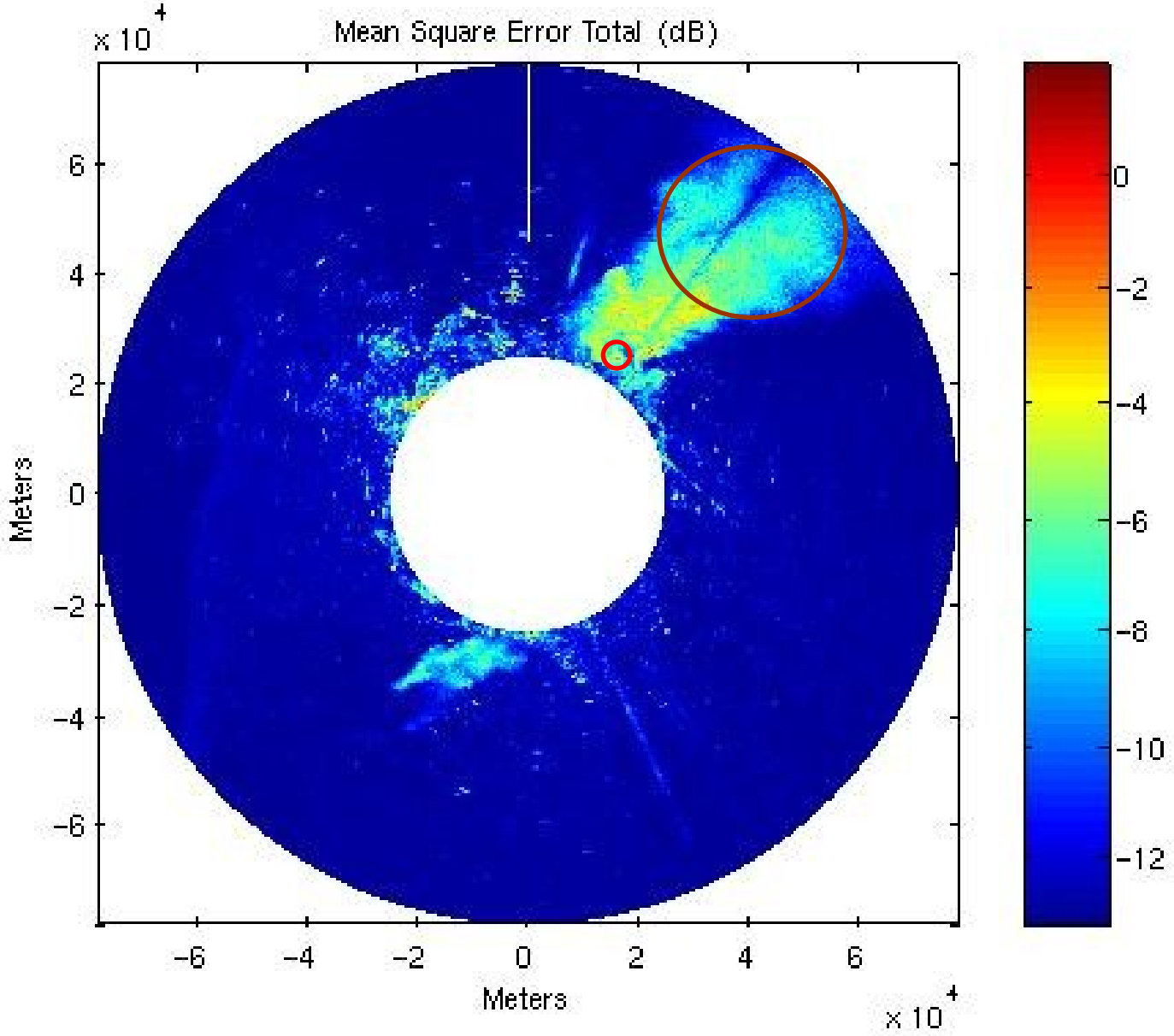
Actual Doppler Spectrum



Gaussian Model Fit

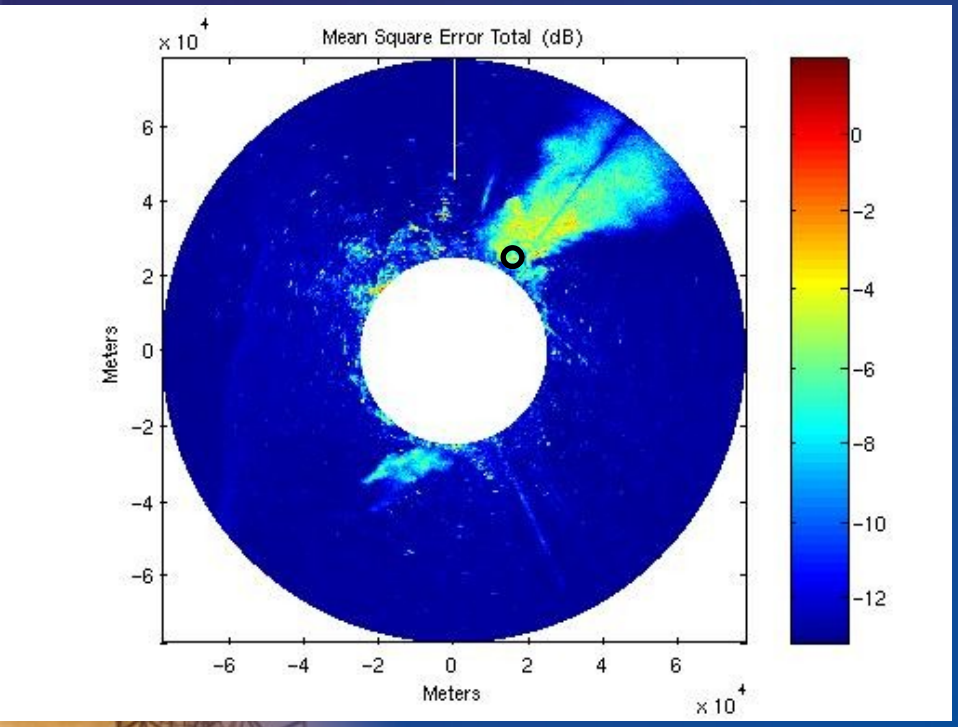


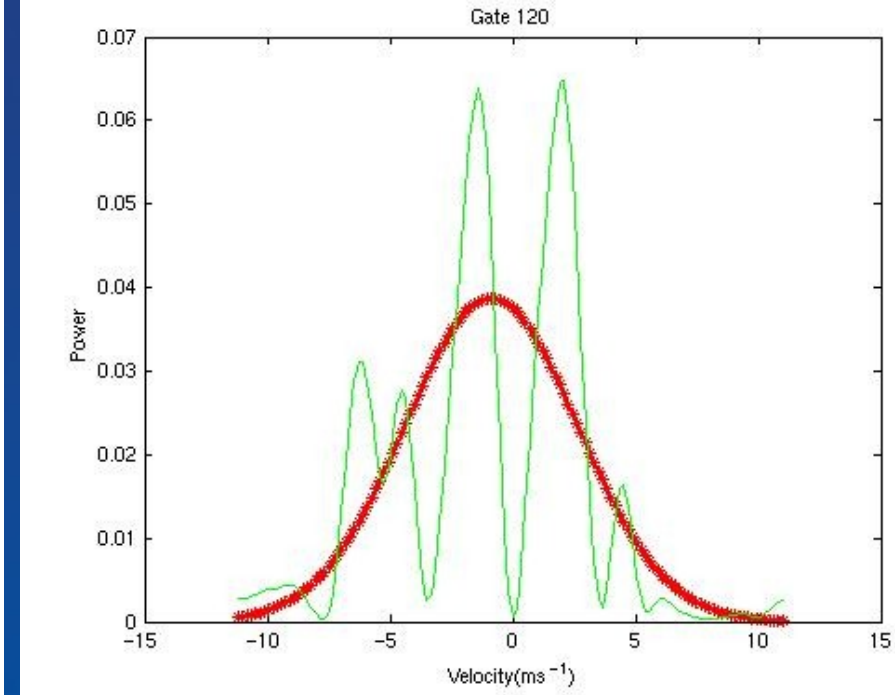
How Close is Gaussian Model?



Example of Spectra

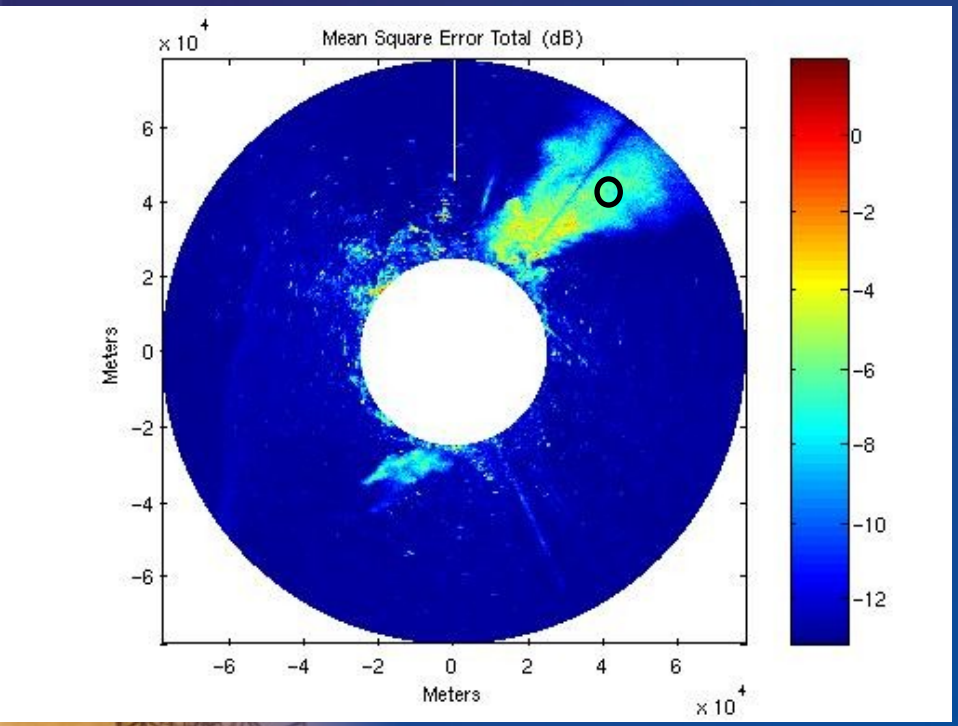
Azimuth 32.4º

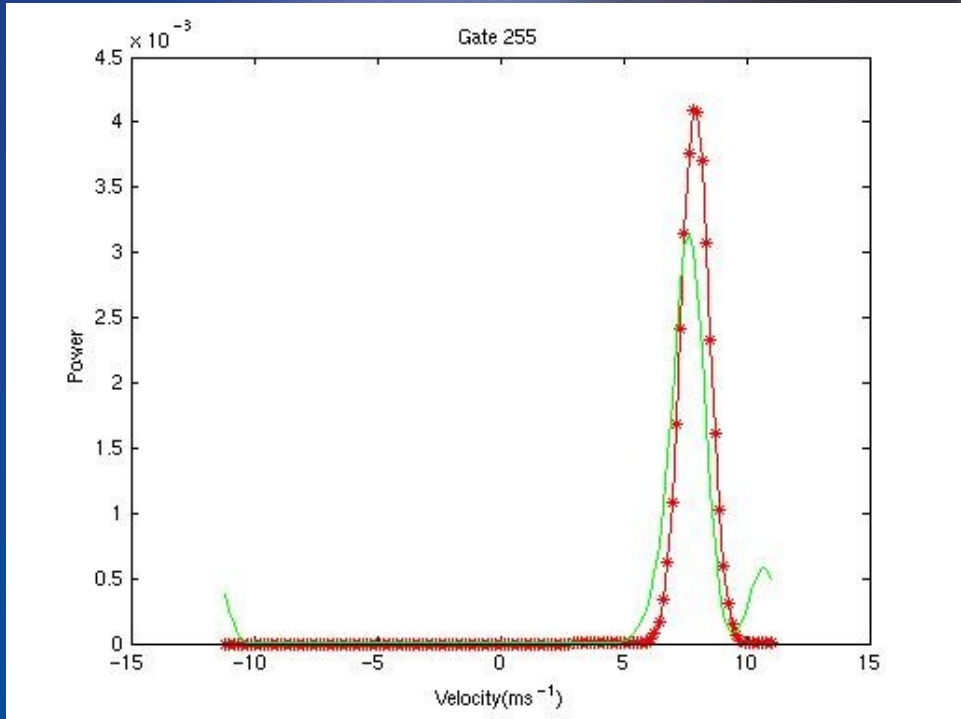




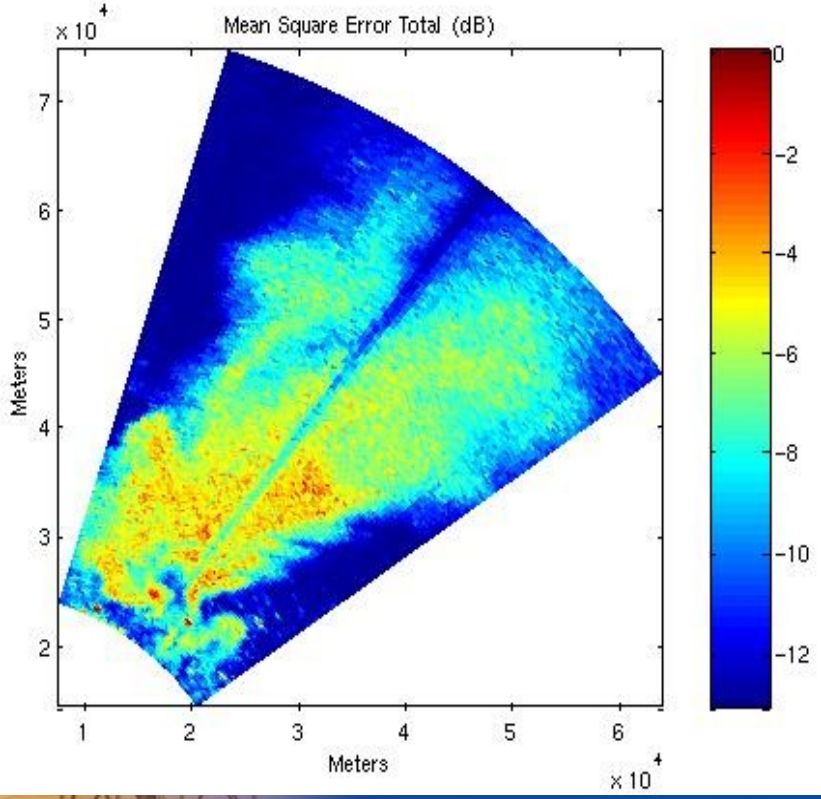
Examples of Spectra

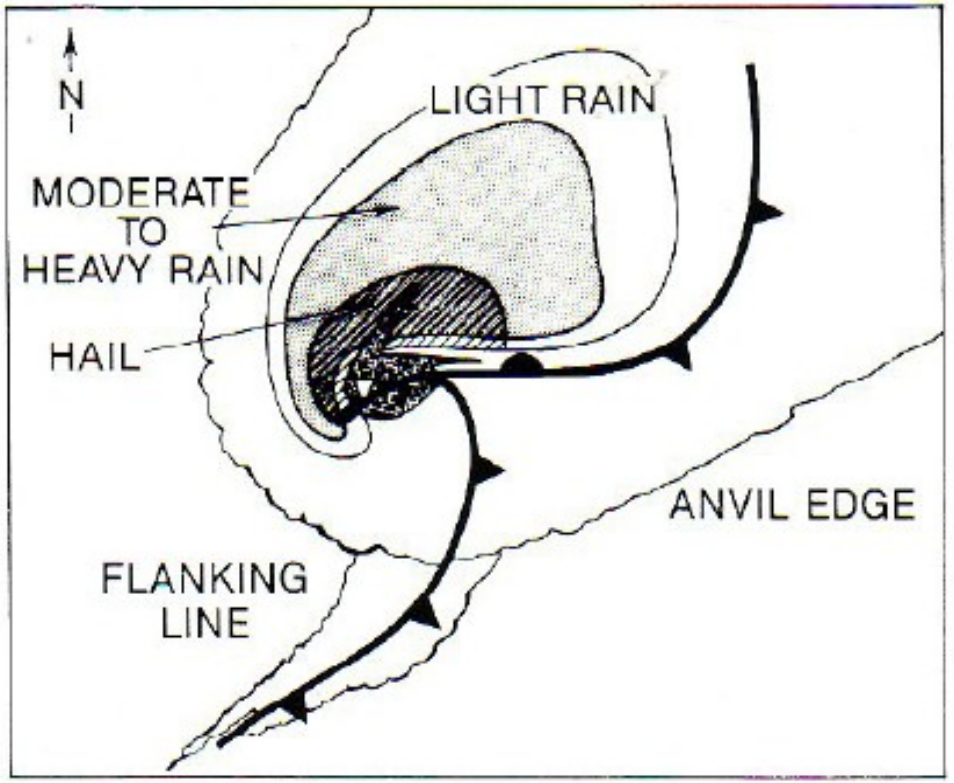
Azimuth 39.9º





Comparison to Storm Structure





Conclusions

- The Supercell Storm has largest MSE near updraft region
- The outflow region shows nearly Gaussian Doppler Spectra (low MSE)
- Investigation of other storm types is necessary
- Is Spectral Processing Important for Future WSR 88D Radar?

YES!!!!!!