

# NWSTC RADAR Pre-Course Material

## The 88D RADAR and Products

# Topics covered in this section

Introduction to the WSR-88D System

Radar Beam Characteristics

Weather Radar Equation

Transmitting & Receiving Characteristics

Non-Standard Beam Consequences

Data Collection

Introduction to Base and Derived Products

Base Reflectivity (Z)

Base Velocity and Storm-Relative Velocity Map (V & SRM)

Base Spectrum Width (SW)

Correlation Coefficient (CC)

Differential Reflectivity (ZDR)

Specific Differential Phase (KDP)

# Introduction to the WSR-88D System

This section gives you a big picture of the system, The system drawing is for an operator, don't hold on it too tight.

Points to focus on are:

## RADAR Data Acquisition Unit (RDA)

- Transmitter

- Antenna

- Receiver (dated photo, but function is correct)

- Signal Processor (There is an issue with the image (wrong component), but the ideas are correct)

## Wideband Communications

- Understand that this is between the RDA and RPG (RADAR Product Generator)

## RADAR Product Generator

- Understand that this is the product generator

## Master System Control Function

- Understand that this is the remote-control terminal for the RPG

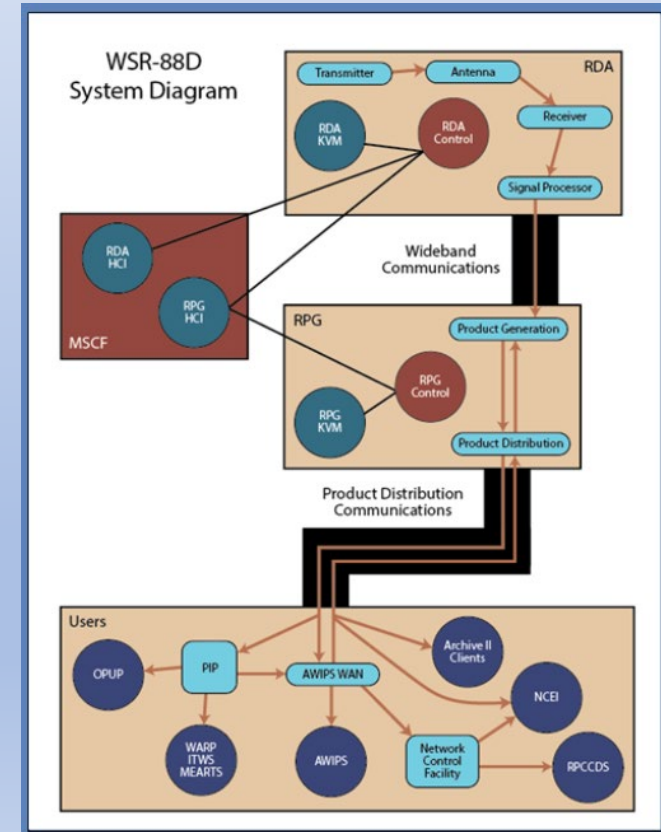
# Introduction to the WSR-88D System (continued)

The system drawing used in this system shows the users in the bottom of the drawing. Don't focus on this drawing. Relationships are covered elsewhere.

The class will address the product distribution, don't focus on this.

The quiz is optional and not tracked by the RADAR class for maintenance technicians

<https://training.weather.gov/wdtd/courses/rac/intro/88d/story.html>



# Radar Beam Characteristics

This provides a discussion of how the weather RADAR signal interacts with targets

Points to focus on are:

Discrete Pulses

Beam Width

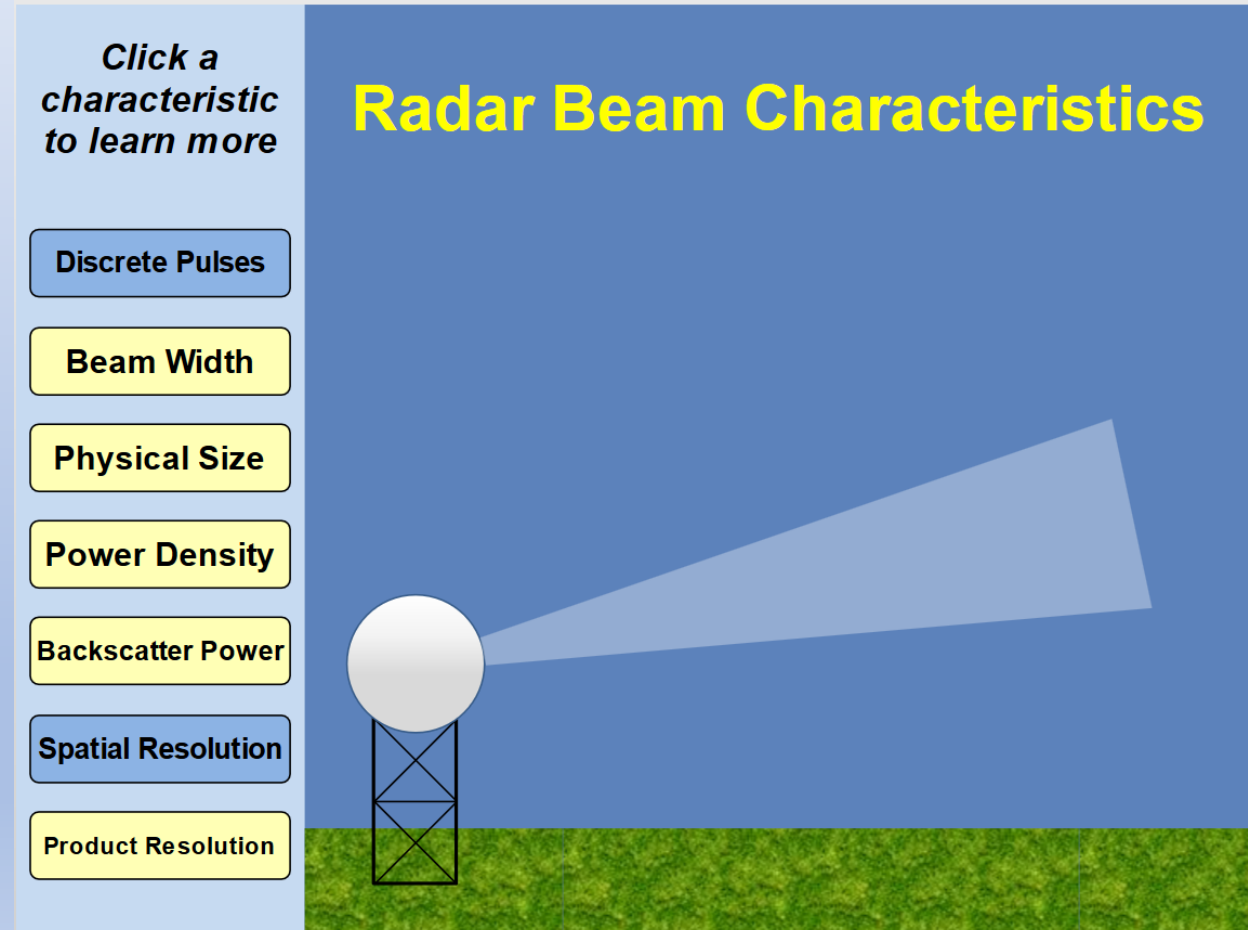
Physical Size

Power Density

Backscatter Power

Spatial Resolution

<https://training.weather.gov/wdtd/courses/rac/principles/beam-char/story.html>



The diagram features a vertical sidebar on the left with a light blue background. At the top of the sidebar is the text "Click a characteristic to learn more". Below this are eight buttons: "Discrete Pulses" (blue), "Beam Width" (yellow), "Physical Size" (yellow), "Power Density" (yellow), "Backscatter Power" (yellow), "Spatial Resolution" (blue), and "Product Resolution" (yellow). To the right of the sidebar is a large blue rectangular area. At the top of this area, the title "Radar Beam Characteristics" is written in yellow. Below the title is a 3D illustration of a radar antenna on a lattice tower. The antenna is a white sphere, and a light blue, cone-shaped beam extends from it across the blue background. The bottom of the illustration shows a patch of green grass.

# Weather Radar Equation

This shows the variables in measuring precipitation reflectivity.

Don't sweat the math.

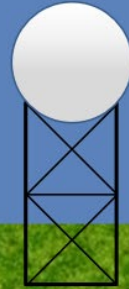
Some students want to know what "Z" is in the dBZ scale.

The equation uses values measured by technicians

Transmitted power and Pulse Width are measured

## Weather Radar Equation

$$P_r = \left[ \frac{P_t G^2 \theta^2 H \pi^3 K^2 L}{1024 (\ln 2) \lambda^2} \right] \times \frac{Z}{R^2}$$



### Radar Constant

- Transmitter Power
- Antenna Gain
- Beamwidth
- Pulse Width
- Dielectric Constant
- Wavelength

Notice how the math attempts to make targets at different ranges show as the same power. This is shown in "Range Effects"

<https://training.weather.gov/wdtd/courses/rac/principles/radar-eqn/story.html>

# Transmitting & Receiving Characteristics

Range and Velocity measurement trade offs.

“The Doppler Dilemma”

Points to focus on are:

Pulse Repetition Frequency (PRF)

Pulse Repetition Time (PRT)

Doppler Dilemma

Long and short pulse operation

Range Folding

## Transmitting

PRF / PRT

$R_{\max} / V_{\max}$

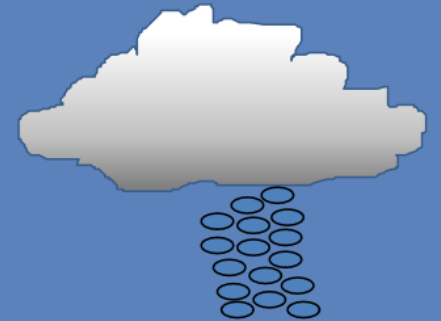
Doppler Dilemma

## Receiving

Pulse Duration

Range Folding

## Transmitting & Receiving Characteristics



# Non-Standard Beam Consequences

How side lobes and the beam heights effects RADAR returns.

This section explains why the RADAR can present targets in the wrong places.

There are no points to focus on in this section.



<https://training.weather.gov/wdtd/courses/rac/principles/non-std-beam/story.html>



# Data Collection

Clear Air and Precipitation Modes. Volume Coverage Patterns. Waveforms are processing modes

Points to focus on are:

Clear Air Mode

Precipitation Mode

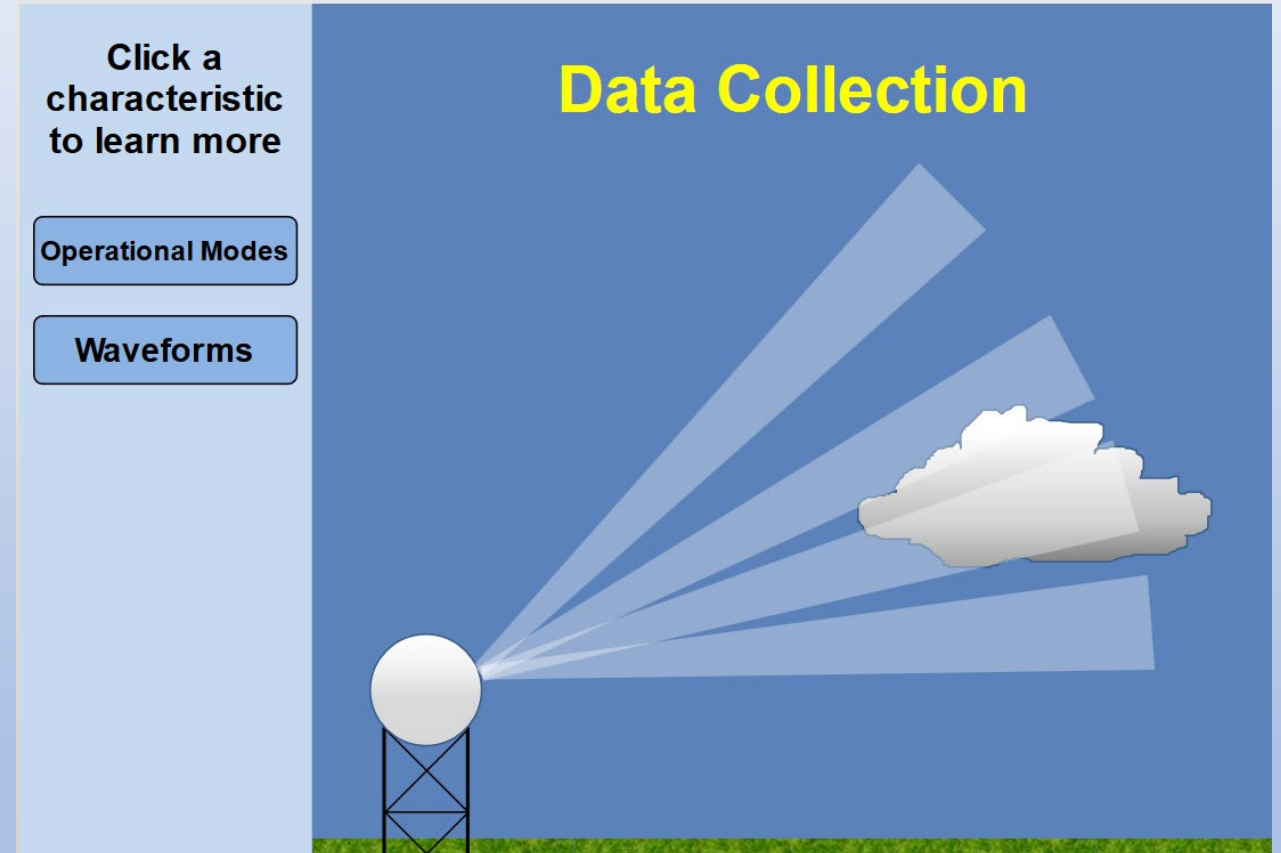
Volume Coverage Patterns VCP (general concept, not numbers)

Contiguous Surveillance (CS) (Low PRF, Maximum range)

Contiguous Doppler (CD) (High PRF, Maximum velocity measurement)

Split Cuts (CS rotation followed by a CD rotation)

Batch Cuts (alternating between long and short PRT/PRFs)



<https://training.weather.gov/wdtd/courses/rac/principles/data-collection/story.html>

# Introduction to Base and Derived Products

This is an introduction on what this RADAR produces

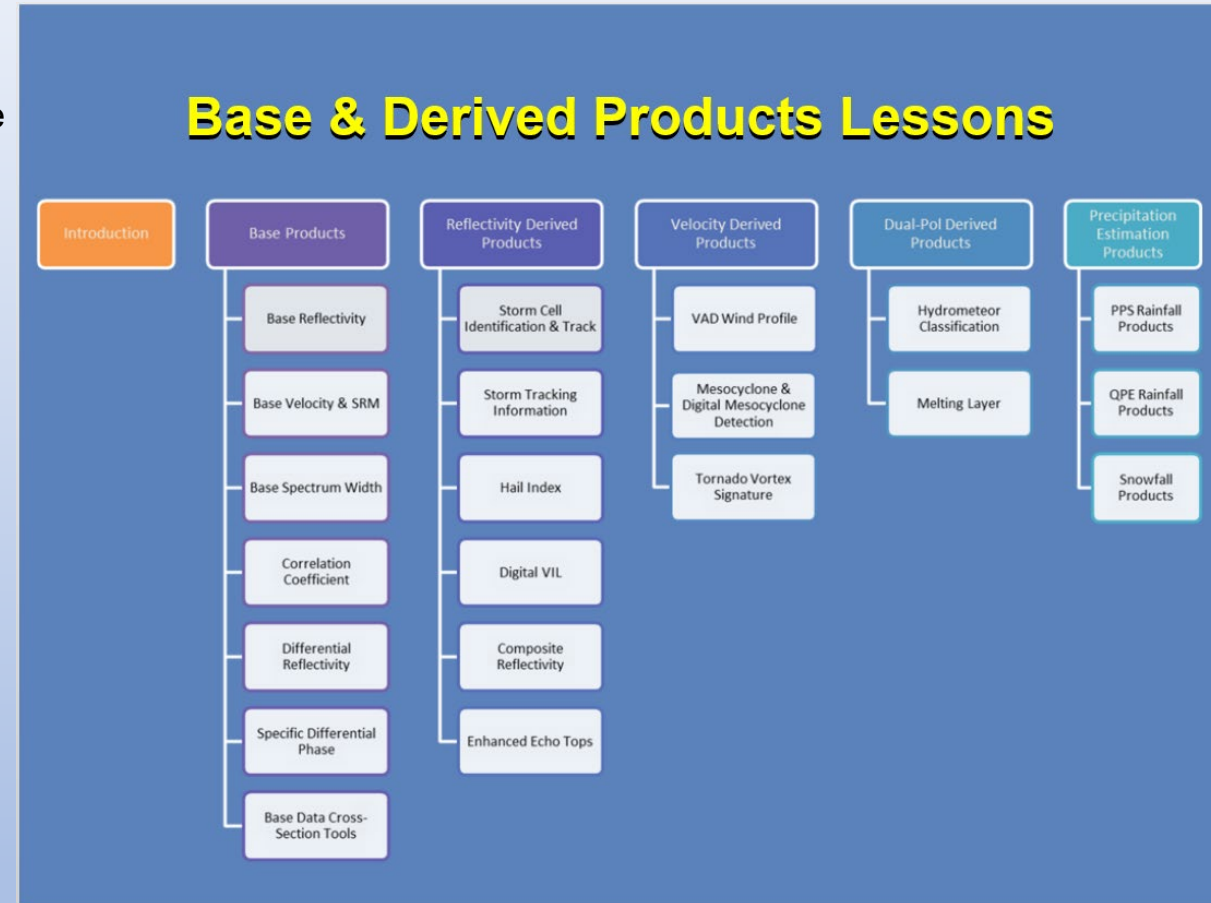
Note that we will not cover most of the product that are created, just the ones that explain the operation of the RADAR

Points to focus on are:

Base Vs Derived Products

Adaptable Parameters

Routine Product Sets (RPS) are outside the goal of us using this class



[https://training.weather.gov/wdtd/courses/rac/products/intro/presentation\\_html5.html](https://training.weather.gov/wdtd/courses/rac/products/intro/presentation_html5.html)

# Base Reflectivity (Z)

This explains how reflective is the target weather

Do not do the with the “Additional Info”, it is about AWIPS use

Points to focus on are:

What is “Z”?

What is “Z” used for?

## Base Reflectivity (Z)

Click to learn more:

- What is Z? ✓
- Why is it useful?
- Non-met signals

Reflectivity (dBZ)

20 40 50 60

# Base Velocity and Storm-Relative Velocity Map (V & SRM)

This is the apparent velocity of our target relative to the RADAR site

Do not do the with the “Additional Info”, it is about AWIPS use

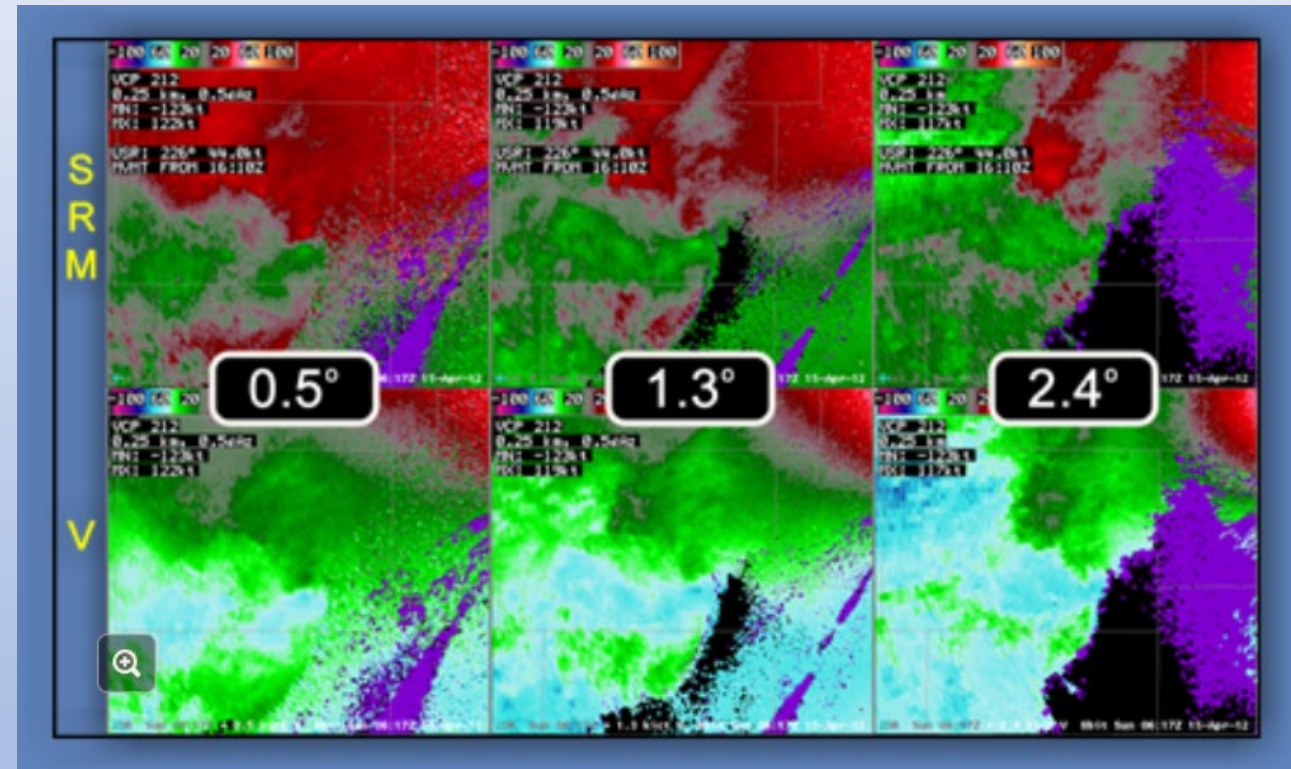
Points to focus on are:

Base Velocity (V)

Storm-Relative Velocity Map (SRM)

The wind is only true when the wind is directly to or from the RADAR

<https://training.weather.gov/wdtd/courses/rac/products/v-srm/story.html>



# Base Spectrum Width (SW)

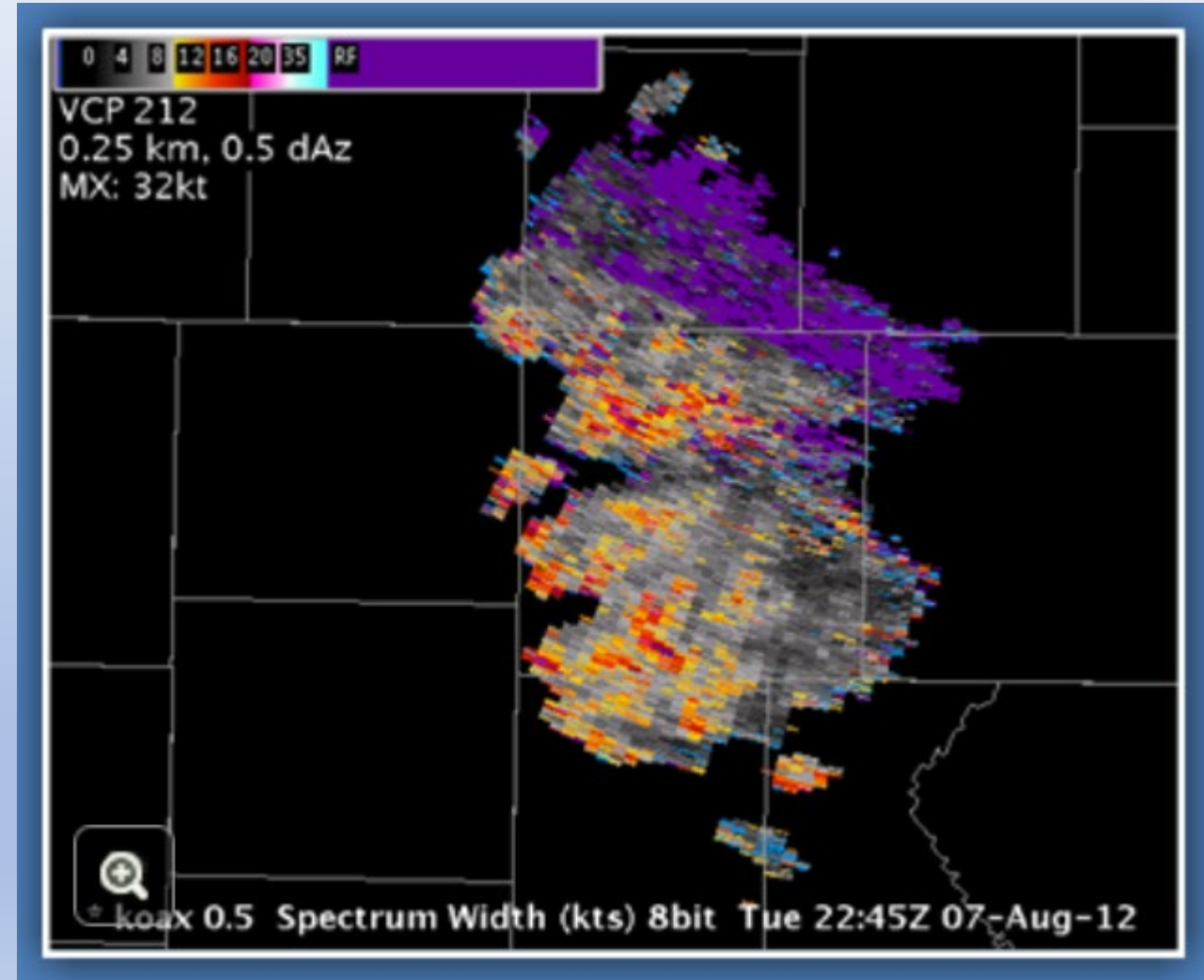
What is the range in apparent velocities of our target relative to the RADAR site

Do not do the with the “Additional Info”, it is about AWIPS use

Points to focus on are:

What is “SW”?

<https://training.weather.gov/wdtd/courses/rac/products/sw/story.html>



# Correlation Coefficient (CC)

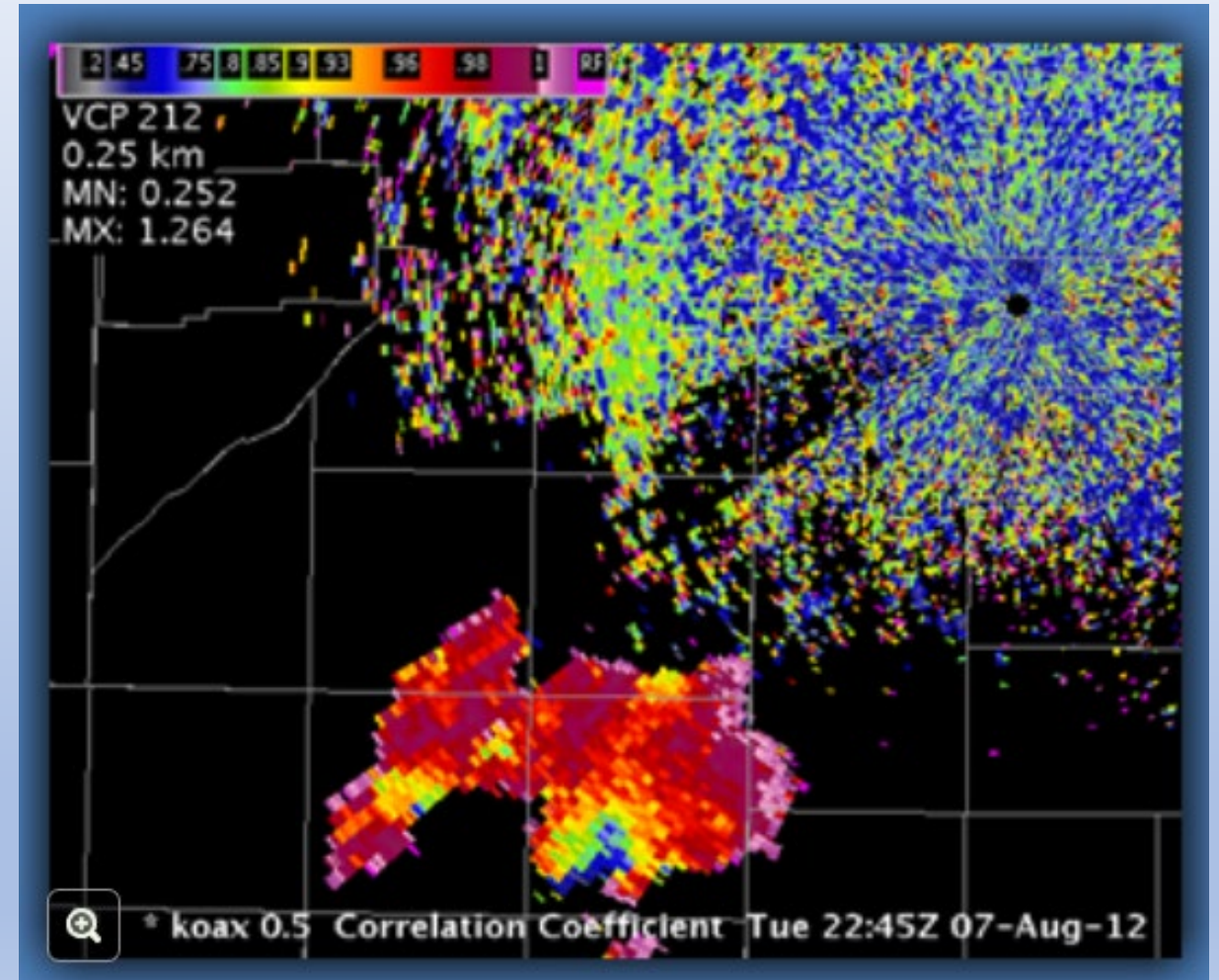
How similar are the RADAR targets to each other in an area of the atmosphere

Do not do the with the “Additional Info”, it is about AWIPS use

Points to focus on are:

What is Correlation Coefficient (CC)?

<https://training.weather.gov/wdtd/courses/rac/products/cc/story.html>



# Differential Reflectivity (ZDR)

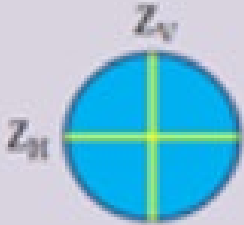
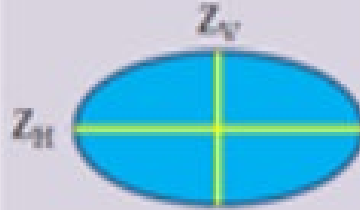


This is the relationship between the vertical and horizontal cross sections of our targets. The term ZDR is used a lot in dual polarization topics.

Do not do the with the “Additional Info”, it is about AWIPS use

Points to focus on are:

What is Differential Reflectivity (ZDR)?

<https://training.weather.gov/wdtd/courses/rac/products/zdr/story.html>

<u>Spherical</u> (drizzle, small hail, etc.)	<u>Horizontally Oriented</u> (rain, melting hail, etc.)	<u>Vertically Oriented</u> (i.e. vertically oriented ice crystals)
		
$Z_H \sim Z_V$	$Z_H > Z_V$	$Z_H < Z_V$
$Z_H - Z_V \sim 0$	$Z_H - Z_V > 0$	$Z_H - Z_V < 0$
 ZDR - 0 dB	ZDR > 0 dB	ZDR < 0 dB

# Specific Differential Phase (KDP)

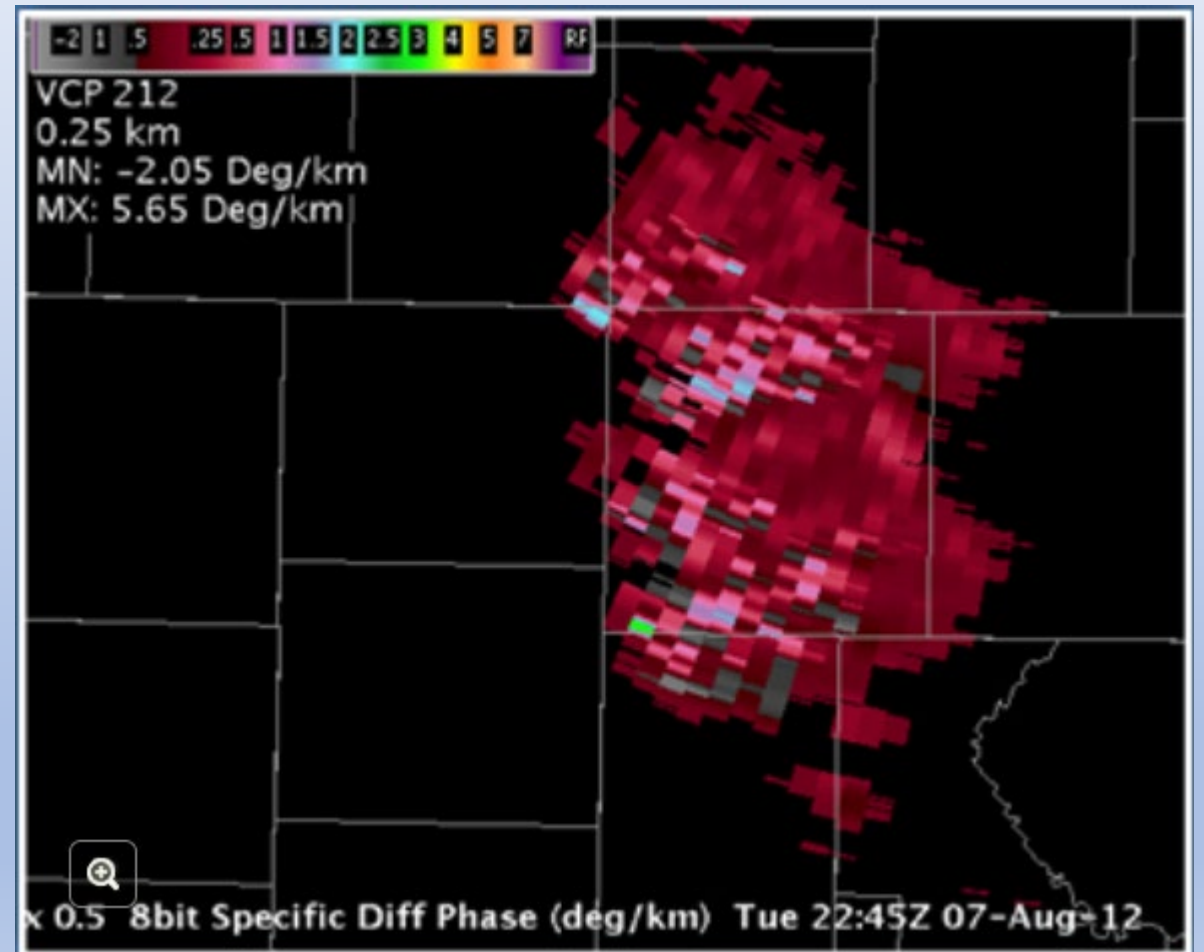
The relationship between the vertical and horizontal phase shifts created by targets

Do not do the with the “Additional Info”, it is about AWIPS use

Points to focus on are:

What is Specific Differential Phase (KDP)?

<https://training.weather.gov/wtd/courses/rac/products/kdp/story.html>





Do not do the with the “Additional Info”, it is about AWIPS use

The End