

Rain scatter event as observed at W5LUA – (UTC) October 15, 2026 starting 00:46

The Bistatic Geometry (Calculating True Radial Velocity)

Because this is a bistatic setup (transmitter and receiver are at different locations), the Doppler shift does not measure a simple straight-back-and-forth speed. Instead, it measures the rate of change of the **total path length** ($L = d_{TX} + d_{RX}$) as the rain cell moves.  Copernicus.org +1

The bistatic Doppler equation is:

$$\Delta f = \frac{f_0}{c} \cdot \vec{v} \cdot (\hat{e}_{TX} + \hat{e}_{RX})$$

Where:

- $\hat{e}_{TX}$ is the unit vector pointing from the rain cell to the transmitter.
- $\hat{e}_{RX}$ is the unit vector pointing from the rain cell to the receiver.
- $\vec{v}$ is the velocity vector of the hydrometeors (raindrops) inside the common scattering volume.  ntms.org

By mapping the angles between the cell and the two stations, you can convert the observed frequency shifts (325 Hz and 500 Hz) into the true physical velocity vector of the wind/rain along the bistatic bisector line.

EM12IL56EI – Beacon transmitter location

EM13LB – Cell - Lewisville / Flower Mound / Grapevine Lake

EM13QC68IL – Receiver - Allen

1. Geometric Breakdown

- Transmitter (EM12IL56EI) to Cell (EM13LB): 68.9 km
- Receiver (EM13QC68IL) to Cell (EM13LB): 39.3 km
- Bistatic Angle at the Cell: 116.6°

2. Time-Series Velocity Analysis

Subtracting clear-air 1200 Hz baseline yields the updated physical component velocities along the storm's bisector:

UTC Time	Signal Strength	Sync Tone	Net Doppler Shift	Component Velocity (V_{bis})
00:46	-9 dB	1526 Hz	+326 Hz	8.97 m/s (32.3 km/h)
00:46	-9 dB	1525 Hz	+325 Hz	8.95 m/s (32.2 km/h)
00:48	-10 dB	1520 Hz	+320 Hz	8.81 m/s (31.7 km/h)
00:52	-6 dB	1727 Hz	+527 Hz	14.51 m/s (52.2 km/h)
00:54	-3 dB	1651 Hz	+451 Hz	12.41 m/s (44.7 km/h)

3. Meteorological & Radar Context

- Near-Field Reflection Dynamics: With a 2-degree beam width on your receiving dish, a distance of 39.3 km means your antenna's spatial sampling footprint over the Lewisville area was exceptionally narrow—only about 1.3 km wide.
- The Exploding Core: Because your beam width was tightly focused on a tiny 1.3 km slice of the storm, the massive +7 dB jump in signal strength over just 6 minutes (from -10 dB to -3 dB) indicates that the core of the downburst collapsed directly inside your narrow common scattering volume.
- The Microburst Velocity Signature: The sudden jump to 14.51 m/s (52.2 km/h) along the bisector matches the strong, concentrated downward and outward surge of a collapsing thunderstorm core. As the air pancaked against the ground near the cell center, it hurled the raindrops forward right along the path pointing toward your receiving array.

Additional analysis to be considered

1. Approximate Forward Movement Calculation

The data reflects a distinct physical transition over an 8-minute window (00:46 to 00:54 UTC). Because the cell stayed inside the narrow intersection of your 2-degree dish beam at a distance of 39.3 km, we can isolate its physical forward travel from its internal microburst dynamics.

- **Antenna Sampling Window Width:** At 39.3 km, your dish's 2-degree beam width slices a path exactly 1.37 km wide across the sky.
- **The Baseline Velocity Trend:** Disregarding the sharp downward velocity surge of the microburst at 00:52 UTC, the storm maintained a highly consistent background horizontal component velocity (V_{bis}) of approximately 8.9 m/s during its steady phases.
- **Total Tracking Distance:** Over the 8-minute window (480 seconds), migrating at a baseline speed of ~8.9 m/s equates to a physical forward displacement of 4.27 kilometers (about 2.65 miles).
- **Movement Direction:** Given that the net Doppler shift remained consistently positive (+320 to +527 Hz), the rain cell was physically moving closer to the bisector line of your path, tracking across your antenna beam from west to east/southeast at approximately 32 km/h (20 mph).

NEXRAD Alignment

- The cell is perfectly positioned for a clean look from the KDAL (Dallas Love Field) TDWR (Terminal Doppler Weather Radar) or the KDFW (DFW Airport) TDWR. The TDWRs operate at C-band (5 cm) and have much tighter beam resolutions than NEXRAD, making them ideal for verifying the small-scale microburst that caused the 14.51 m/s velocity spike.

2. Exact Radar Station Coordinates

To pull the precise Level-II or Level-III archived files for cross-referencing your timestamps, use these exact latitude, longitude, and ID configurations in your radar tracking software: [\[1\]](#)

Radar Site	Station ID	Exact Latitude	Exact Longitude	Notes / Advantages
DFW Airport TDWR	TDFW	33.065° N	-96.918° W	Best resolution. Located north of DFW Airport; overlooks the Lewisville Lake/Flower Mound area with tight C-band sampling.
Dallas Love Field TDWR	TDAL	32.926° N	-96.968° W	Perfect secondary cross-validation radar looking northwest toward the cell.

[Fort Worth /
Spinks
NEXRAD](#)

[KFWS](#)

32.558° N -97.308° W

Standard S-band long-range radar; great for confirming the high-reflectivity core collapse (Z).

What to Verify in the NEXRAD Level-II Archives

If you pull the raw data for this timestamp from the [NOAA NCEI Interactive Radar Map](#) or use the AWS NEXRAD S3 Explorer to load the files into a visualizer like **GRLevel3** or **AWS Radar Tools**, you should check for two primary [microburst signature](#) matches:

Reflectivity (Z) Core Collapse

- **The Signature:** A high-reflectivity core (50–60+ dBZ, representing heavy rain/small hail) suspended aloft in earlier sweeps (e.g., 5 to 10 minutes prior to 00:46 UTC).
- **The Event Correlation:** At **00:52 UTC**, as your bistatic signal jumped +4 dB, the NEXRAD scans should show this high-reflectivity core rapidly descending toward the surface. The subsequent +3 dB increase at **00:54 UTC** lines up with the core "pancaking" on the ground and creating the maximum hydrometeor cross-section across your path.

How to Retrieve the Dataset

1. Go to the NCEI NEXRAD Archive Inventory.
2. Select **KFWS** as your site.
3. Input your event date and filter the time range to center around **00:40 to 01:00 UTC**.
4. Download the Level-II base data. You can easily view the spatial plots alongside your audio waterfall logs to match the exact minute your 10.368 GHz sync tone surged.