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The World Above 50 MHz

Meteor Scatter: A Burst of Excitement

Meteor scatter is extraordinary; it involves bouncing your signal off of the ionized trails of meteors as they enter Earth's ionosphere — a phenomenon that happens all of the time.

There are literally tons of meteors entering Earth's atmosphere every day. Meteors are dust trails left by comets. They are tiny, ranging from the size of grains of sand, to no bigger than a grain of rice. Upon entering the atmosphere, those meteors burn and ionize the E layer of the ionosphere in trails around 12 miles long for a few seconds to a minute or more.

Figure 1 depicts this process. The orange lines represent the ionization, with some meteors creating more ionization than others due to their larger size and/or greater velocity. The yellow lines represent the transmitted signal, with some of it reflecting off of the ionized meteor trails. Ideally, they reflect sufficient RF toward the desired receive location.

The best time for meteor-scatter propagation is early morning. There is about three times more propagation at 6:00 AM than at 6:00 PM local time. This is because Earth's orbit around the sun drives it into the meteor stream in the morning, while at dusk, the meteor stream trails behind Earth's orbital path.

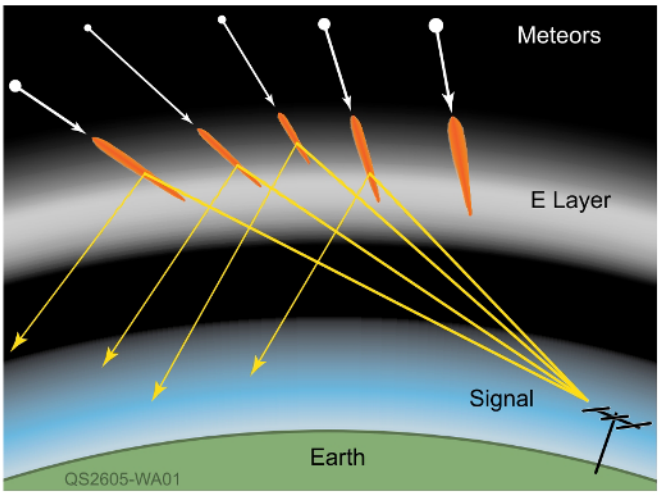

Figure 1 — Graphic of how meteor scatter works. The meteor trails ionizing the E layer are shown in orange, and radio signals reflect off of those ionized trails.

Table 1 — Major Meteor Showers

Meteor Shower	Date Range	Peak Date
Quadrantid	January 1 – 6	January 3 – 4
Eta Aquarid	April 21 – May 12	May 4 – 5
Arietid	May 29 – June 19	June 7
Perseid	July 23 – August 20	August 12
Orionid	October 2 – November 7	October 20
Geminid	December 4 – 16	December 13

During meteor showers, ionization is further increased. Showers are predictable comet trails that have a high concentration of meteors every year (see Table 1).

The term *scatter* implies that the transmitted signal hits the ionized trails and reflects forward. This, in turn, means that the receiver will pick up small bursts of the transmitted signal. The ham radio term for this is *ping* because that's the way they sound in the receiver.

WSJT-X MSK144 — Making Meteor-Scatter Contacts

In the early days of ham radio meteor scatter, operators often used CW and eventually very-high-speed CW. They would record the received signal, slow it down, and then capture the call sign and signal report.

Since the introduction of *WSJT* and *WSJT-X*, computer signal processing has been used to achieve the same goal. The early FSK441 mode, introduced in 2001, and the newer MSK144 mode, introduced in 2017, both essentially transmit hundreds of messages within a few seconds (a 15-second transmission duration is currently standard).

Figure 2 shows the *WSJT-X* **FAST GRAPH** display for MSK144. You can see the ping right at the 3-second mark. The **BAND ACTIVITY** window shows it at 3.1 seconds with an amplitude of 15 dB, which is a very strong decode. The brighter and longer the ping, the stronger the signal.

MSK144 pings are decoded in real time, unlike FT8, where you wait the full 15 seconds for the decode. The MSK144 message is 70 milliseconds and repeated as many times as possible during the standard 15-second transmission.

Getting on the Air with MSK144

So, how do you set up *WSJT-X* for MSK144 contacts? The settings in *WSJT-X* are generally the same as those you would normally use for FT8, such as rig control, audio, and so on. Under the **GENERAL SETTINGS** tab, select **ENABLE VHF AND SUBMODE FEATURES** and choose **MSK144/Q65: TX UNTIL 73 IS**

RECEIVED. In the decode menu, select **DEEP**. The **F TOL** setting on the main screen should be set to 200, 300, or higher, depending on your computer's processing capacity. A lower setting does not improve decoding; it simply excludes signals outside the tolerance range, which you might actually want to hear. **RX** is always at 1500 Hz, and **T/R** is set to 15 seconds. It's important to match these settings to the station you're trying to work.

I strongly recommend using RRR in your sequence instead of RR73. *WSJT* logs the contact after you've sent RR73. But with meteor scatter, it's unlikely that a single RR73 transmission will get through. You can use RRR as often as needed to get the other station's confirmation that the contact is complete. However, the setting **TX UNTIL 73 IS RECEIVED** should help you overcome this challenge.

When coordinating contacts via a chat room, letting the other operator know you received their RRR is sufficient for a valid contact. A 73 is not needed, but it serves as a courtesy.

Meteor-Scatter Operating Protocol

Meteor scatter has had an operating protocol that began long before *WSJT* arrived on the scene, and it has since expanded. Keep the following points in mind:

- Operating frequencies: 50.260, 50.265, and 144.150 MHz.
- Operating times: Early mornings are the best.
- Transmission sequence: When pointing east, transmit during the first sequence. When pointing west, transmit during the second sequence.
- Contest mode: Although often used on 6 meters, CM+SH is used on 2 meters. When SH is checked, the final messages are hashed. These are 50 milliseconds long instead of the standard 70 milliseconds, thereby facilitating completion at the higher frequencies.
- Coordinate contacts: Use the *Ping Jockey Central*, the VHF-Chat on Slack, and the ON4KST chat rooms to coordinate your contacts. Random meteor-scatter contacts are rare.

When you're transmitting CQs and not hearing anything, PSK Reporter (**www.pskreporter.info**) can be very helpful. Enter your call sign and select the band you want to use, and it will display the stations receiving your signal. It also provides useful information about your signal level and frequency. It is not limited to MSK144, as it can decode and display all digital signals. Give it a try if you haven't already.

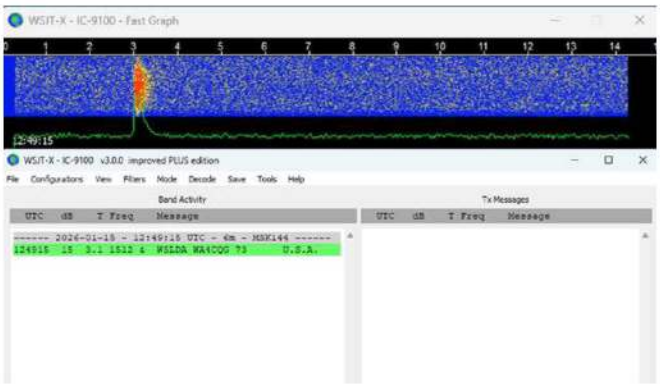

Figure 2 — *WSJT-X* **FAST GRAPH** display for MSK144, with a strong ping at the 3-second mark. The **BAND ACTIVITY** window shows 3.1 seconds and an amplitude of 15 dB.

Meteor-Scatter Gear

You've probably realized that a dipole and a 5 W rig won't work with this mode. Instead, you'll need a directional antenna and at least 100 W on 6 meters and more power on 2 meters. High power can be advantageous, and a preamplifier is usually necessary on 2 meters.

Interestingly, having too much antenna directivity can be a problem for meteor scatter. Joe Taylor, K1JT, suggests a 16-degree beamwidth for long paths and a 32-degree beamwidth for shorter ones. There are also offset azimuth settings to better align with the meteor path. For example, the *WSJT* window displays the direct "Az," or azimuth, in degrees, versus a "B" or "A" offset heading that indicates an offset in degrees. It provides a recommended elevation, too.

The Basics, Covered

Hopefully, this is enough information to point you and your antenna in the right direction to make some meteor-scatter contacts. Watch for the showers and try to operate when the conditions are optimal. The folks on *Ping Jockey Central* and other chat rooms can help. Good luck, and I hope to work you on MSK144.