HamSCI's Meteor Scatter QSO Party 2025

A Study of HF Meteor Scatter Propagation Using the MSK144 Digital Mode

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Abstract

The Meteor Scatter QSO Party 2025 is an on-the-air experiment designed to study meteor scatter propagation on HF bands below 30 MHz using the MSK144 mode in the digital communication software WSJT-X. The primary goal is to generate dense, geographically diverse datasets to analyze the feasibility of HF meteor scatter for future scientific research. The experiment will be conducted during the Perseids meteor shower in August 2025, with a secondary event planned for the Geminids meteor shower in December 2025.

Introduction

Meteor scatter propagation has long been a subject of interest in both amateur radio and scientific communities. When meteors enter Earth's atmosphere, they create ionized trails that reflect radio signals, enabling communication over long distances. While meteor scatter has been extensively studied on VHF bands (e.g., 2 meters), its potential on HF bands (below 30 MHz) remains underexplored. This experiment aims to fill this gap by leveraging the MSK144 mode in WSJT-X software, which is well-suited for short-duration meteor scatter contacts due to its extremely short transmission bursts of 72 milliseconds (ms) while transmitting code word lengths of 128-bits.

The study is motivated by the following open questions:

1. What is the geographical extent of propagation enhancements due to meteor scatter at HF frequencies, and how long do these effects persist?

2. What is the typical duration of HF meteor scatter reflections, and how does it vary with meteoroid size and velocity?

3. What factors influence the strength of HF meteor scatter reflections?

4. Can meteor scatter signals on HF provide data for propagation forecasting?

We aim to address these questions and contribute to a more comprehensive understanding of meteor scatter propagation by conducting a large-scale, structured experiment during major meteor showers.

Method/Experiment

Experiment Planning & Execution
The experiment will be conducted during the Perseids (August 2025) and Geminids (December 2025) meteor showers to maximize meteor activity.

Mode Selection & Band Planning
- **Primary Mode: MSK144, chosen for its 72 ms transmission bursts and fast data rates, ideal for short-duration meteor scatter reflections.**
- **Primary Band: 10 meters (28–29.7 MHz), accessible to most amateur radio license holders.**

Data Collection & Logging
Using WSJT software, participants will submit ADIF-formatted logs of two-way contacts while also sending reception reports to the PSKReporter database.

1. **Timestamped QSOs (two-way contacts)**
2. **Signal reports (signal to noise ration)**
3. **Geolocation data (grid squares for transmitters and receivers)**

Data and Analysis

Data Collection

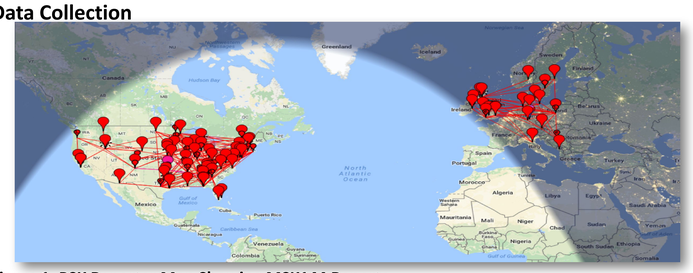
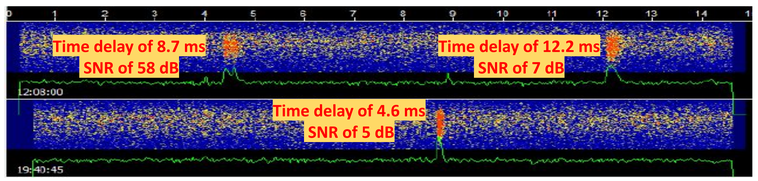


Figure 1: PSK Reporter Map Showing MSK144 Reports

Data will be collected from participants across a broad geographic region, focusing on the 10-meter band. The logs will include timestamped QSOs, signal reports, and location data. This data will be used to analyze the duration and quality of HF meteor scatter reflections and regional differences in propagation.

Analysis
The collected data will be processed using automated scripts to extract meaningful statistics. Key metrics will include:
1. Duration of meteor scatter reflections,
2. Signal strength and quality, and
3. Geographic distribution of successful QSOs.

Plots and visualizations will be created to illustrate the findings, including heat maps of QSO density and signal strength over time. The data will be compared to existing VHF meteor scatter studies to identify similarities and differences.



Results

A preliminary analysis of the data collected during the Perseids meteor shower will be conducted. The focus will be on the viability of HF meteor scatter for future scientific research. The results will be used to refine the methodology for the December 2025 Geminids event.

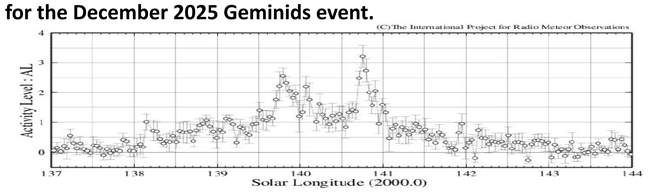


Figure 3: Activity Level Index (AL) from worldwide radio meteor observations during the Perseids 2024 meteor shower. The graph shows three distinct peaks in meteor activity.

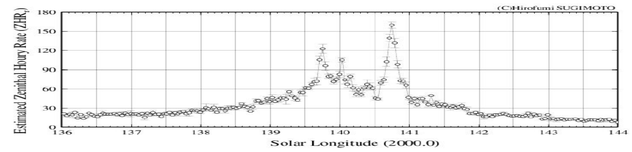


Figure 4: Estimated Zenithal Hourly Rate (ZHRr) from worldwide radio meteor observations during the Perseids 2024 meteor shower. The graph highlights the intensity of meteor activity.

Conclusion

Major Results
The experiment is expected to yield valuable insights into the viability of HF meteor scatter propagation. Key findings will include the duration of HF meteor scatter reflections, the geographic extent of the ionospheric region affected by meteor scatter, and the potential for using HF meteor scatter signals for propagation forecasting.

Relation to Theory
The results will be compared to existing theories on meteor scatter propagation models, particularly those developed for VHF bands. The study will contribute to the broader understanding of how meteor scatter behaves on lower frequencies.

Future Work
The findings from this experiment will inform future research on HF meteor scatter. Additional studies could explore other digital modes for meteor scatter. The methodology developed here could also be applied to other meteor showers, providing a more comprehensive understanding of meteor scatter propagation across different conditions.

References

S. J. Franke and J. H. Taylor, "The MSK144 protocol for meteor-scatter communication," QEX - ARRL Experimenters' Exchange, vol. 2017,, Sep./Oct. 2017. .

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