February 2026 CARMELo report

by CARMELo network
(Cheap Amatorial Radio Meteor Echoes Logger)

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Introduction

February is one of the least active months in terms of meteor showers, with no particularly significant showers occurring. We therefore took the opportunity to qualitatively analyze the diurnal variation in the number of meteors intercepted by Earth.

Methods

The CARMELo network consists of SDR radio receivers. In them, a microprocessor (Raspberry) performs three functions simultaneously:

1) By driving a dongle, it tunes the frequency on which the transmitter transmits and tunes like a radio, samples the radio signal and through the FFT (Fast Fourier Transform) measures frequency and received power.

2) By analyzing the received data for each packet, it detects meteoric echoes and discards false positives and interference.

3) It compiles a file containing the event log and sends it to a server.

The data are all generated by the same standard, and are therefore homogeneous and comparable. A single receiver can be assembled with a few devices whose total current cost is about 210 euros.

To participate in the network read the instructions on this page.

February data

In the plots that follow, all available at this page, the abscissae represent time, which is expressed in UT (Universal Time) or in solar longitude (Solar Long), and the ordinates represent the hourly rate, calculated as the total number of events recorded by the network in an hour divided by the number of operating receivers. The time resolution is 15 minutes.

In *fig.1*, the trend of signals detected by the receivers for the month of February.

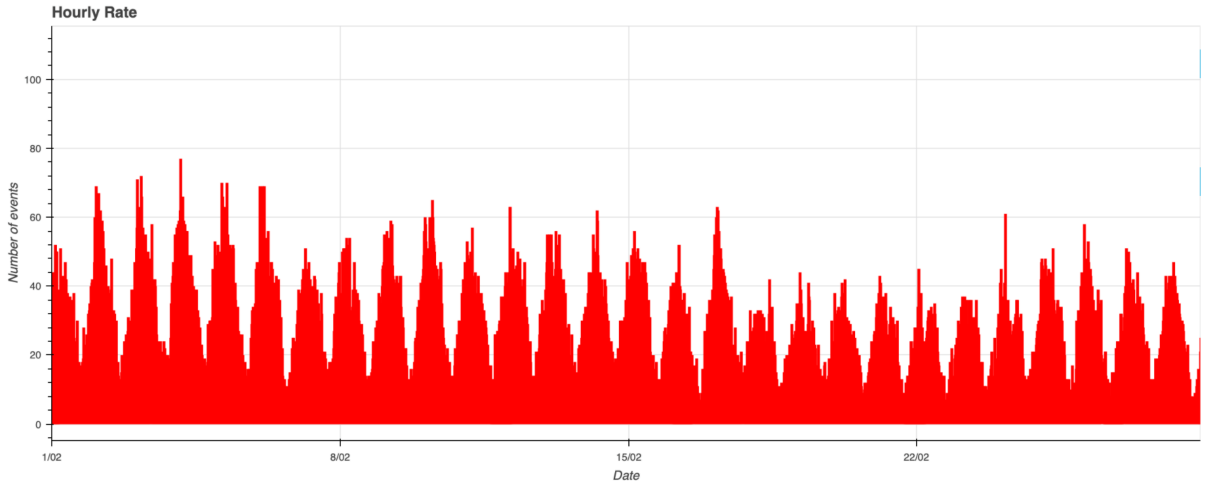

Fig. 1: February 2026 data trend.

The diurnal variation of meteors

One of the most obvious effects in meteor observations is the diurnal variation in the frequency of recorded events. The number of meteors observed is not constant throughout the day, but shows a systematic trend with a maximum around 6 a.m. and a minimum around 6 p.m.

The daily variation in meteor frequency is a direct consequence of the Earth's motion through space. This effect was first explained in 1867 by Giovanni Virginio Schiaparelli in his work on the astronomical theory of shooting stars (1). At that time, it was not yet universally accepted that meteors were a cosmic phenomenon: many astronomers believed them to be atmospheric events. With an extraordinary combination of observations and geometric reasoning, Schiaparelli demonstrated instead that they are bodies coming from space and that their apparent distribution in the sky depends on the motion of the Earth.

In his study, he showed how the number of meteors observed depends on the direction in which the Earth moves in space, identifying a fundamental point in the sky: the *apex* of the Earth's motion. The apex is the point in the sky toward which the Earth moves in its orbit around the Sun. In other words, it represents the "frontal" direction of the Earth's orbital motion.

As the Earth travels along its orbit at approximately 29 km/s, it continuously passes through interplanetary space, encountering dust particles and small cometary debris. These particles, upon entering the Earth's atmosphere, produce meteors.

The phenomenon of daily variation in the frequency of recorded events can be understood with a simple analogy:

- An aircraft flying at high speed intercepts objects approaching head-on more easily;
- It will be much more difficult for it to be hit by objects approaching from behind, because these must be faster than the aircraft itself in order to catch up with it.

The same applies to Earth:

- In front, in the direction of the apex, we intercept meteors of all speeds;
- Behind, in the opposite direction (*antiapex*), we can only intercept those that are faster than Earth.

Due to the Earth's rotation, the direction of the apex changes continuously relative to the horizon of an observer on the Earth's surface. Schiaparelli demonstrated that the frequency of intercepted meteors depends on the height of the apex above the horizon. When the apex is high in the sky, the Earth intercepts a greater number of meteoroids; when it is below the horizon, the frequency decreases.

In his work, he derived a mathematical relationship that describes precisely this periodic variation in the observed frequency. In particular, he showed that the maximum occurs when the apex culminates in the observer's sky, which happens at around six in the morning, while the minimum occurs at around six in the evening (1).

It is therefore a true daily sine wave, determined exclusively by the geometry of the Earth's motion:

- At around 6 a.m., the observer is facing the direction of the Earth's motion: that is, looking towards the apex. In this case, the Earth "sweeps" the space in front of it and intercepts the maximum number of meteoroids.
- At around 6 p.m., the observer is on the opposite side of the Earth from the direction of orbital motion: they are therefore looking towards the anti-apex. In this configuration, only the fastest meteors are intercepted.
- At midnight and midday, the observer is in an intermediate position and the number of meteors observed is average.

This behavior is illustrated in the diagram in *Fig. 2*.

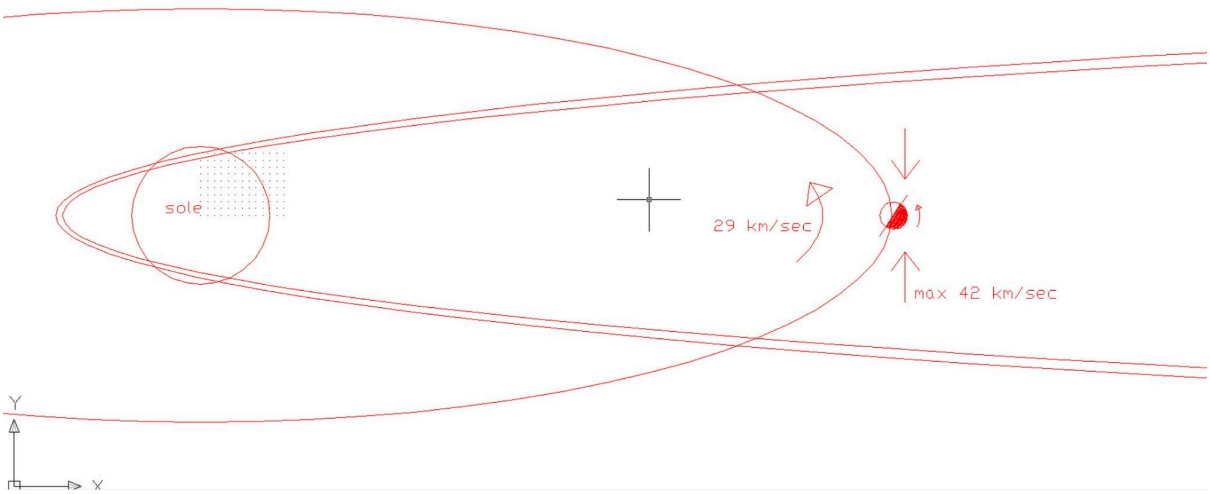

Fig. 2: Schematic view of the Earth's orbit around the Sun, with its inclined axis of rotation, and the direction of the apex and antiapex.

Modern radio observations of meteors allow these theoretical predictions to be verified with great precision. The Hourly Rate (HR) graph obtained from the CARMELo network (in *Fig. 3*) clearly shows a wave pattern with a period of 24 hours.

The number of meteors recorded peaks in the morning, around 6 a.m. local time, and drops to a minimum in the evening, around 6 p.m. This pattern corresponds exactly to the theoretical prediction made by Schiaparelli over a century and a half ago.

However, the meteor frequency graph is not the only interesting piece of data. The second graph (also in *Fig. 3*) shows the average power of the radio signals from the detected meteors. Since the energy of the meteor event depends on the mass and speed squared of the meteoroid, this parameter can be considered a good indication of the average speed of the observed meteors.

What can be observed in the CARMELo data is:

- When the number of meteors is at its maximum (in the morning), the average power is lower;
- When the number of meteors is at its minimum (in the evening), the average power is higher.

The two graphs are therefore in counterphase. This behavior is perfectly consistent with the theory:

- In the morning, looking towards the apex, we observe meteors of all speeds: both slow and fast;
- In the evening, looking towards the anti-apex, we can only intercept those faster than Earth, i.e., the most energetic ones.

Consequently, even though the total number of meteors decreases, the average speed of the observed events increases, producing an increase in the average power detected.

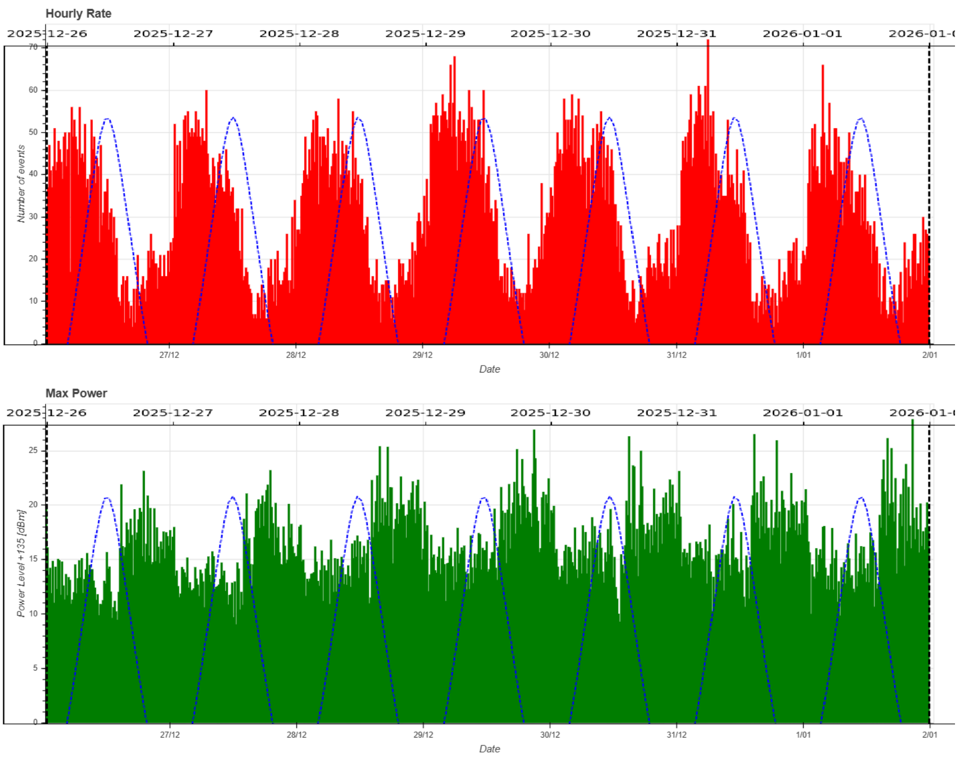

Fig. 3: Hourly Rate and average power of events recorded by the CARMELo network between the end of December 2025 and the beginning of January 2026.

The comparison between the two graphs therefore provides clear observational verification of the theory proposed by Schiaparelli in 1867. The daily variation in the frequency of meteors and the opposite variation in their average energy are both direct consequences of the geometry of the Earth's motion in space.

It is fascinating to observe how a theoretical argument developed with little observational data in the 19th century is now precisely confirmed by the automatic and continuous observations of a radio network such as CARMELo.

The CARMELo Network

The network currently consists of 16 receivers located in Italy, the UK, Switzerland and the USA. The European receivers are tuned to the Graves radar station frequency in France, which is 143.050 MHz. Participating in the network are:

- Lorenzo Barbieri, Budrio (BO) ITA
- Associazione Astrofili Bolognesi, Bologna ITA
- Associazione Astrofili Bolognesi, Medelana (BO) ITA
- Paolo Fontana, Castenaso (BO) ITA
- Paolo Fontana, Belluno (BL) ITA
- Associazione Astrofili Pisani, Orciatico (PI) ITA
- Gruppo Astrofili Persicetani, San Giovanni in Persiceto (BO) ITA
- Roberto Nesci, Foligno (PG) ITA
- MarSEC, Marana di Crespadoro (VI) ITA
- Gruppo Astrofili Vicentini, Arcugnano (VI) ITA
- Associazione Ravennate Astrofili Rheyta, Ravenna (RA) ITA
- Mike German, Hayfield, Derbyshire UK
- Mike Otte, Pearl City, Illinois USA
- Yuri Malagutti, Comano (TI) CH
- Leslie Fry, Trawscoed Ceredigion, Wales UK
- Brian Coleman, Redenham Observatory, Andover, England UK

The authors' hope is that the network can expand both quantitatively and geographically, thus allowing the production of better quality data.

Bibliography:

(1) Giovanni V. Schiaparelli (1867): "Teoria astronomica delle stelle cadenti". *Stamperia reale Firenze*