Past, present and future of Beacon signal transmission for meteor radio observation in Japan

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Outline of the dawn of amateur space communications

・**Reception** of signal from **Sputnik 1** and **Explorer 1** by **amateur** in **1957/1958.** Request from National Astronomical Observatory in Japan.

・**Lunar reflection communication (EME ; Earth Moon Earth)** by amateur in **1960**

・**Launched first amateur satellite OSCAR-1** in **1961**
★ 1961 published by **“Meteor Science and Engineering” By J.W.R McKenley**
・Mutual **Intercontinental communication** using **OSCAR-3** by amateurs in **1961**

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After 10 years
・**Launched amateur satellite AMSAT-OSCAR-6** in **1972**
Thousands of amateur radio operators enjoyed satellite communications.
Amateur radio experimenters have advanced the radio technology and also have increased interest in space communications.

Histrory of Ham Radio Beacon Transmssion for Meteor Radio Observation (HRO)

- We took the lunch by chance at Kyoto University's open lecture in **Sep. 1995**.
  Researcher of the middle and upper layer atmosphere
  Amateur meteor observers and Amateur satellite experimenters

- **Meeting at Shigaraki**, Shiga Japan (MU Radar site) in **1995 Dec.**
  About 20 people meteor observation, satellite experimenters gathered.

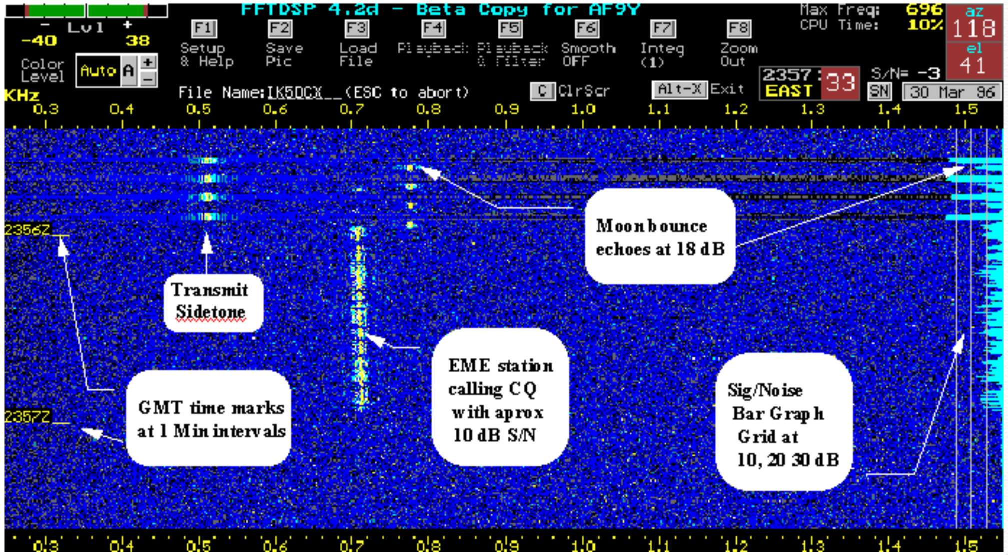
- **Test Transmission** from Kimio Maegawa, JA9BOH in Apr. 1996

- **Continuous Beacon Transmission** from radio research group of
  National Institute of Technology, Fukui College, JA9YDB, at 53.750 MHz.
  from Aug. 1996 and continuing to the present.
  It **has been continuing** for **more than 20 years since we started.**

JA9YDB Beacon Transmission Antenna
ビーコン送信アンテナ

FFTDSP - See weak signals with your PC and Sound Card !!

FFTDSP is a PC program which can detect weak radio signals in real time.
- Uses the PC's soundcard and advanced signal processing techniques.
- Extracts and displays weak signals from the receiver audio.



The example output screen shows a typical two minute period of moon bounce (EME) operation. Near the top are four "echo" test transmissions. The transmit signal is shown just above 500 Hz and the receive echos at 780 Hz. The first echo was the strongest at just under 20 dB S/N. Starting at 2356z, IK5DCX is shown calling CQ at 700 Hz with a fairly good signal (approx 10 dB S/N).

FFTDSP Demo Version 42y now available:

NEW [fftsp42y.zip (410 K Bytes)]

If using the "FIND" mode, here is the latest eme.ws file:

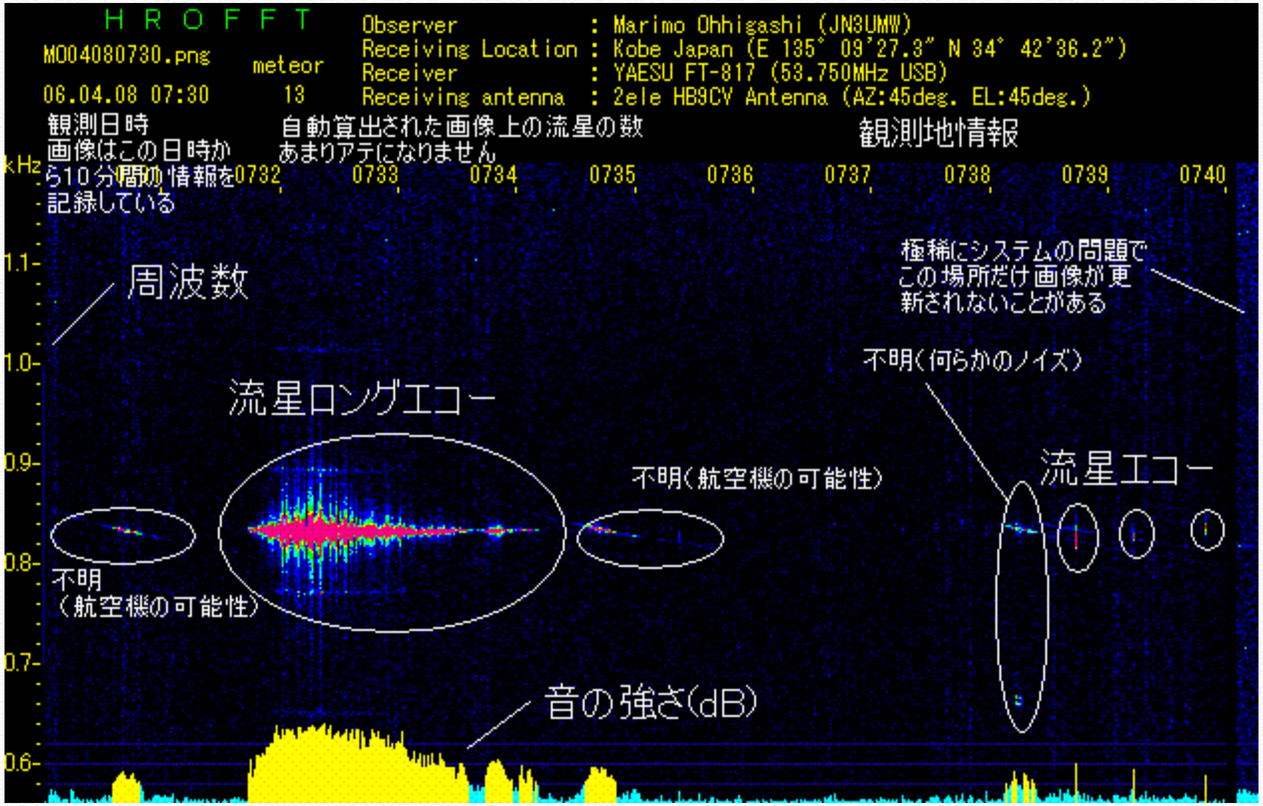
NEW [emews.zip (12K Bytes)]

Key Features of FFTDSP42 are:

Initially, We used FFTDSP created by Mike Cook, AF9Y.
We responded so as to operate continuously.

We regularly held a meeting to read the radio chapter of the MacKenley's book.

http://www.hyogo-c.ed.jp/~hyogo-hs/bukatu/tenmon/hro.html



After that, HROFFT was created by Kazuhiko Okawa. He contributed to the spread of HRO.

After that, he advanced the experiment of the interferometer at "kumanoki" in Tochigi pref. in Japan.

We printed 500 copies of the brochure as a group, and we distributed it.
One year later, in 2002, we was able to publish the "Meteor Radio Observation Guidebook" from CQ publisher, a prominent publisher of amateur radio in Japan. Some astronomical publisher was not interested it.

Meteor radio observation meeting held every February,

people sending radio waves,

people receiving it for obserbation, and

people thinking about new observation methods, etc.

gathered and discussed.

However, 2009 was the last year to be held. It has not been held for several years.

Mr. Maegawa received the **astronomical service award (long-term achievement) from the Japan Astronomical Society** in 2012.

"Contribution to meteor radio observation through long-term radio beacon transmission”

上田昌良氏作成http://meteor.chicappa.jp/HRO2009meetingreport.htmlより

- There is little interaction in the field of radio observation in Japan now.

- It still does not evolve from observation methods over 20 years ago. However advances in wireless technology are remarkable.

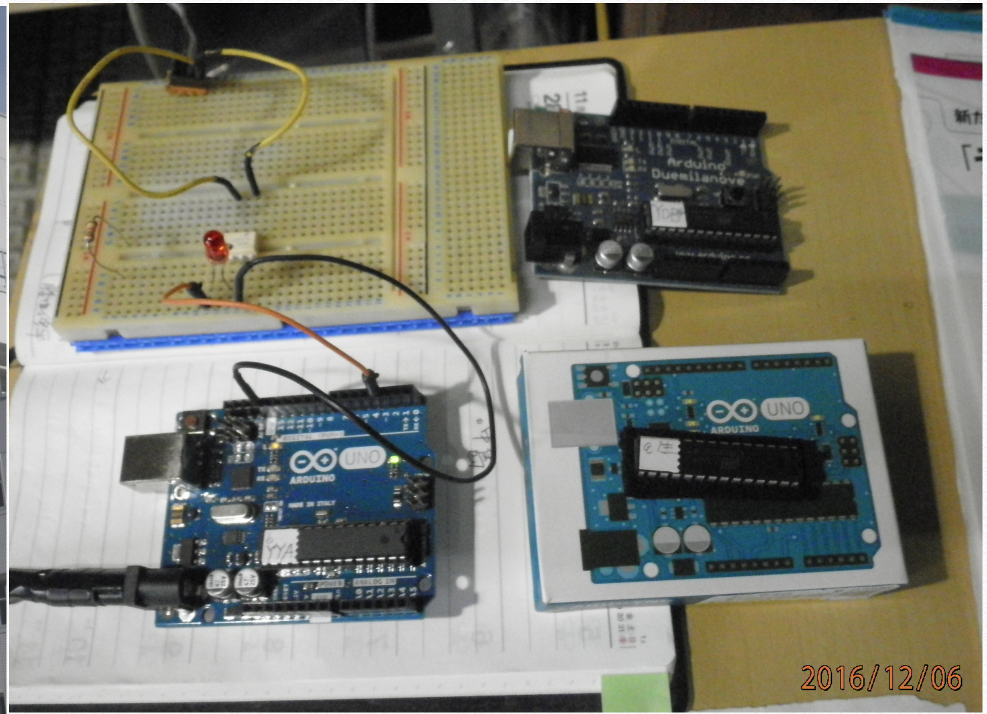
- Continuous transmission is not so easy. It needs lot of skill.

- Depending on the purpose at research or education, usually It can be sent for only several days.

- It is not always possible to send from JA9YDB.

From **Fukui Prefectural University Amateur Radio Observation Research Group** JH9YYA, transmission started at 53.755 MHz (5kHz separated frequency, about 20 km apart from JA9YDB) from December 2016.

It was transmitted until the middle of June 2017, but it is currently stopped due to equipment failure. Scheduled to resume after repair.



JH9YYA ビーコン送信アンテナと
識別符号送信装置

Outlook for amateur meteor radio observation in the feature

- Continue transmission so that the same observation as before can be done — **same type beacon** —

- Beacon signal with **new observation method**

- **amateur service**

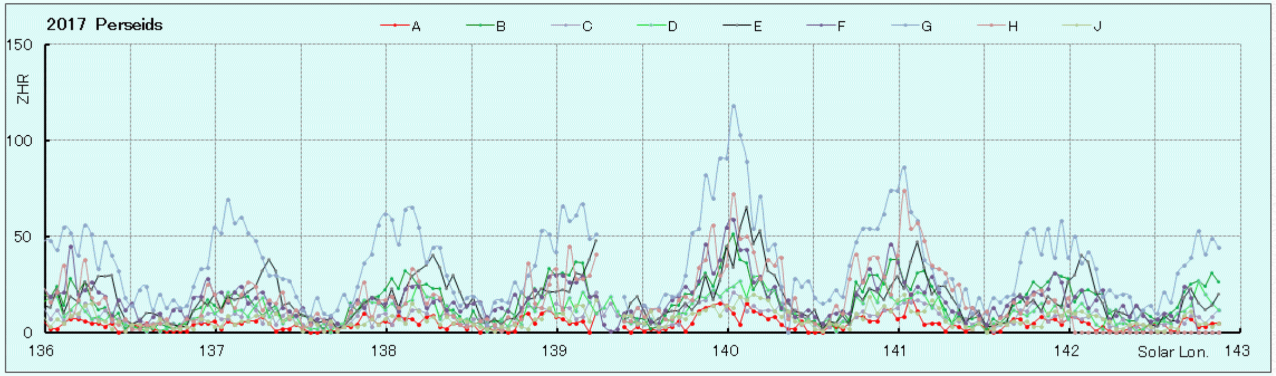
A radio communication service for the purpose of self-training, intercommunication and technical investigations **carried out by amateurs**, that is, by duly authorized persons interested in radio technique solely with **a personal aim** and **without pecuniary interest.**

- **49.990MHz in Europe — non amateur band in Europe**
  Should it be the same way in Japan?
  How about using both the amateur station and
  the experimental testing station?

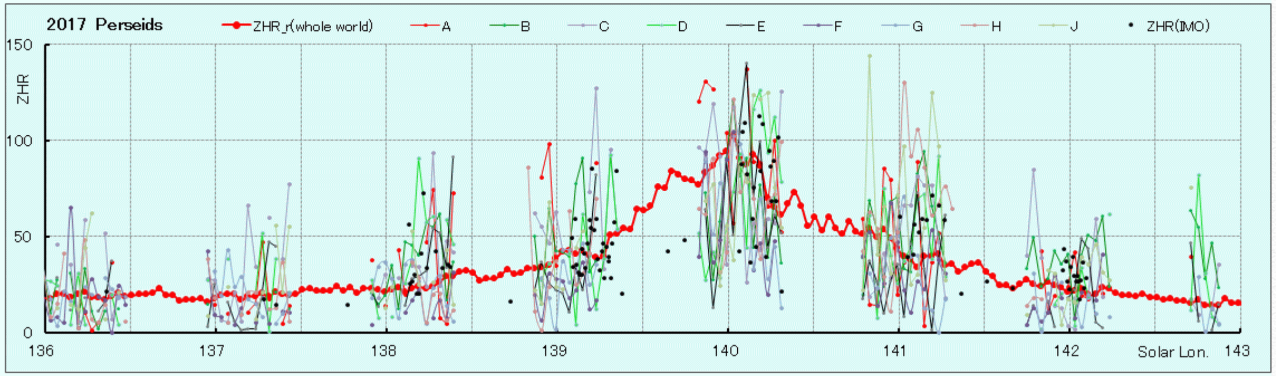
- GRAVES radar big signal **143.050MHz**
  Is there a similar signal to Japan?

2017 Perseids Radio results

* Source data (Only in Japan)



* Each ZHR_r(Only in Japan) & ZHR_r average of the whole world



METHOD ; http://meteornews.org/the-new-method-of-estimating-zhr-using-radio-meteor-observations/

Observation result by beacon of JA9YDB of Mr. Hirofumi Sugimoto who is a enthusiastic observer in Japan. http://www5f.biglobe.ne.jp

Meteor scatter communication in Europe

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2m MS Report

DH6DAO, JO41CN, wkd 2m MS:

Date	UTC	Call	Loc	QRB
11/12/12	17.21	RA3LE	KO64AT	1.620km
	22.05	S51ZO	JN86DR	796 km
12/12/12	06.56	SP9DSD	JO90KG	761 km
	19.00	SM4GGC	JO69RK	935 km
13/12/12	06.46	RA3WDK	KO81BR	1.915 km ODX
	19.23	UA2FT	KO04LT	922 km # dxcc
14/12/12	06.18	UR7D	KO18JT	1.080 km
	12:35	RU1MS	KO48VR	1.647 km
02/01/13	19.54	YO5LD	KN17WW	1.191 km
03/01/13	06.55	IC8TEM	JN70CN	1.305 km
	18.50	OH1UM	KP01UL	1.372 km
	19.12	YL2AJ	KO16OX	1.140 km
	19.53	9A9T	JN76WA	832 km
	21.53	YO3FAI	KN34AL	1.535 km
	22.12	OM5CM	JN98DF	810 km
	22.28	EW3AA	KO12TC	1.058 km
04/01/13	16.29	YL2GD	KO37ML	1.376 km

Rig.: 160 W and 9 ele tonna. Tnx for report Ray!

70cm MS Report

There is some regular activity in the main showers on 70cm FSK MS. In Geminids on Dec. 13/14, 2012 LX1DX (KN22TS) wkd S54AA (JN76), OK1TEH (JO70) and S51WX (JN75OS). S51ZO (JN86) wkd RA3LE (KO64).

In Quadrantids on Januar 3, 2013 OK1TEH (JO70) wkd UX0FF (KN45), RD3FD (KO05) and IK0BZY (JN61). SM7GVF (JO77) wkd IK0BZY (JN61).

DUBUS 4/2014 p.9

Analysis of Meteor Scatter Pings Part 1: The Scattering Process

by Klaus von der Heide, DJ5HG

1. Introduction

Meteor scatter (MS) is the most popular propagation mode for radio contacts on VHF over distances between 1000 km and 2000 km. Usually we only differentiate between the short pings and the longer bursts. Bursts occur if the ionization of the meteor trail is as high that it can reflect the waves up to the frequency in use. The reflected waves coming from different parts of the trail then heavily interfere. This usually leads to a signal with chaotic fast fading which can last for many seconds.

If the inonization does not reach this level (so called underdense meteor trail), then there is no reflection, but the charged free particles along the linear trail are forced to oscillate in any incoming electromagnetic wave the same way as a parasitary element in a Yagi antenna. The absorbed energy then is radiated out again. The scattered wave is the superposition of this individual radiation. The duration of the signal depends on many parameters. It is a fraction of a second only. The scattered signal of an unmodulated carrier sounds like a stroke on a bell which led to the term *ping*. Underdense meteor trails are not observable by the naked eye. Bursts are rare, and - in the usual procedure of MS - they do not transport more information than a single ping of 200 milliseconds. Therefore, this paper will only analyse the scattering by underdense meteor trails. It will be published in three subsequent parts. The first part discusses the general scattering process of a meteor trail. The second part concentrates on the development of scattered signals in more detail, and the third part discusses the radiation patterns of scattered signals and gives hints for meteor scatter operation in practice. This paper mainly is based on the excellent survey of George R. Sugar [1]. Further bibliography may be found in the internet, for example [2].

2. The Formation of the Meteor Trail

2.1. The Meteor Velocity

The velocity of the meteors varies between 11.3 and 72 km/s. The lower limit is the escape velocity of the Earth. Any object with lower speed must be a satellite of the Earth, and is not of interplanetary origin. The upper limit is the sum of the Earth's velocity of 30 km/s in it's orbit around the Sun plus the escape velocity of the solar system at the Earth's position (42 km/s). Collisions with molecules of the upper atmospere lead to local heating and evaporation of material of the meteor. Each single hit shoots many atoms off the meteor at a speed comparable to that of the meteor. The massloss by this evaporation is much larger than the sum of the masses of all colliding molecules of the atmosphere. As a consequence, the velocity of the meteor remains nearly constant until the meteor is nearly evaporized.

2.2. The Initial Trail Radius

The ionization of the trail results from collisions of the evaporized atoms with molecules of the atmosphere. The ionized zone therefore is not a simple straight line, but is something like a cylinder with radius equal to the range of the ionizing action of the evaporized atoms. The density of ionization has a Gaussian bell form. The radius means the standard deviation of the ionization. Two physical phenomena have to be distinguished: (1) The initial formation of the ionized trail, which occurs locally in less than a millisecond, and (2) the following blow-up of the ionized region by diffusion. The radius of the ionized region is the main issue for scatter by underdense meteor trails (see Chapter 5). Figure 1 shows the initial radius as a function of the height.

- Proposal / implementation of **modulation format** for **meteor scatter communication** for example FSK441 PSK2K MSK144

- Using **Coherent signal** (Multiple frequencies in rationality ratio)

- Observation to **install equipment at multiple (many) points**

- **Integration** of **amateur ”observation”** and **”communication”**

- 40 years from FRO (using FM broadcasting) and
  20 years from HRO (using Ham Radio Beacon) in Japan
  What and How is the road ahead for amateur radio observation ?