

First results with the live CAMRAS meteor reception

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EUCARA 2018

Stockert

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Overview

- * How to receive meteor signals from CAMRAS
- * What do we see – or- hear
- * Some interesting observations
- * ‘Manual’ counting
- * Automatic counting
- * What next?



How to receive CAMRAS

Bestand Bewerken Beeld Geschiedenis Bladwijzers Extra Help

Luister mee! - Dwingeloo Rad CAMRAS - WebSDR



websdr.camras.nl:8901

80%

Inbox (215) - frans.rjx... O ja! METEOTINES reg... (66) Replacing our Bat... Homepage | NOAA / ... VHF/UHF WebSDR at ... WebSDR on Gerbrand... Astronomical seeing V... Sony Xperia Z5 : Sony ... Mijn UWV / Werkmap ...



"Toptechniek voor iedereen"

70cm and 23cm EME signals recorded using the 25 m dish in Dwingeloo.

Currently, there is no live EME reception. Instead, we're playing a **recording** made during the [EME activation of the 300m Arecibo dish](#) during the [Echoes of Apollo](#) project. This recording was made on April 17, 2010, around 19:00 UTC, on 70 cm.

We're also playing a recording made during the 2009 EoA project. This recording (made on 23 cm) includes a QSO between PI9CAM (that's the callsign we use at the Dwingeloo dish when transmitting) and HB9MOON, around 1296.040 MHz.

2m receiver for meteor echoes

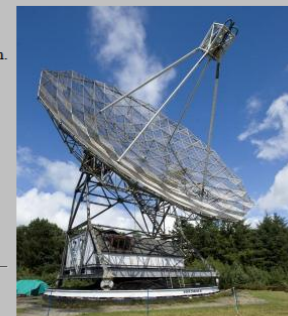
The 2 m band receiver uses a 5-element yagi antenna bearing south, 10 m above ground in the radio quiet zone near the radio telescope. Its aim is to listen for meteor echoes from the Graves radar system in France.

6m receiver for meteor echoes

The 6 m band receiver uses a 3-element yagi antenna bearing south, 5 m above ground in the radio quiet zone near the radio telescope. Its aim is to listen for meteor echoes from the Belgian beacons (Dourbes and Ieper).

More WebSDR receivers for other bands can be found via <http://www.websdr.org/>.

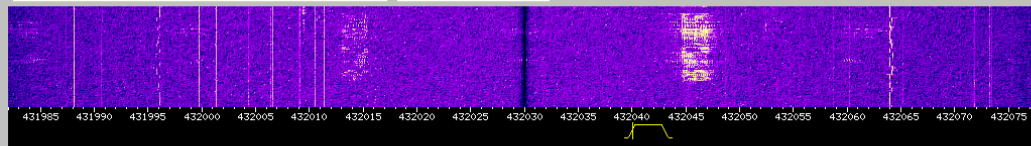
Your name or callsign: pe1rxj



View: ☐ all bands ☐ others slow ☒ one band ☐ blind

Allow keyboard: ☐

Waterfall: ☐ Java ☒ HTML5 Sound: ☐ Java ☒ HTML5



Frequency: 432040.00 kHz
Band: ☒ 70cm ☐ 23cm ☐ 2m ☐ 6m
Or tune by clicking/dragging/scrollwheel on the frequency scale.

Memories:
recall erase store (new)

Bandwidth:
2.49 kHz @ -6dB; 2.95 kHz @ -60dB.
wider CW-wide LSB USB AM FM
narrower CW-narrow LSB-nrw USB-nrw AM-nrw

Or drag the passband edges on the frequency scale.

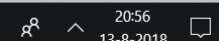
Waterfall view:
zoom out zoom in
max out max in
Or use scroll wheel and dragging on waterfall.
Speed: slow
Size: medium
View: waterfall
☐ Hide labels

-81.3 dB; peak -81.2 dB;
☐ mute ☐ squelch ☐ autonotch
Volume:
Audio recording: start
Signal strength plot: none

Logbook:
Call of station that you hear:
Comments, if any:
Note: time, frequency, your name/call, and DXCC information are added automatically.
View the [last 20 lines of the logbook](#), or the [entire logbook](#) (ctrl-click for new tab/window).

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17-9-2018





How to receive CAMRAS

Your name or callsign:

View: ☐ all bands ☐ others slow ☒ one band ☐ blind

Allow keyboard: ☐

143041 143042 143043 143044 143045 143046 143047 143048 143049 143050 143051 143052 143053 143054 143055 143056

GRAVES

Frequency: kHz

Band: ☐ 70cm ☐ 23cm ☒ 2m ☐ 6m

Or tune by clicking/dragging/scrollwheel on the frequency scale.

Memories:

(new)

Bandwidth:

2.49 kHz @ -6dB; 2.95 kHz @ -60dB.

Or drag the passband edges on the frequency scale.

Waterfall view:

Or use scroll wheel and dragging on waterfall.

Speed:

Size:

View:

☐ Hide labels

-96.1 dB peak -96.1 dB;

☐ mute ☒ squelch ☐ autonotch

Volume:

Audio recording:

Signal strength plot:

This WebSDR is currently being used by 3 user(s) simultaneously: ☐ compact view

431985 431990 431995 432000 432005 432010 432015 432020 432025 432030 432035 432040 432045 432050 432055 432060 432065 432070 432075

1295980 1295985 1295990 1295995 1296000 1296005 1296010 1296015 1296020 1296025 1296030 1296035 1296040 1296045 1296050 1296055 1296060 1296065

pe1rxj-2

pe1rxj-1

143000 143100 143200 143300 143400 143500 143600 143700 143800 143900 144000 144100 144200 144300 144400 144500 144600 144700 144800

pe1rxj



How to receive CAMRAS

Your name or callsign:

View: ☐ all bands ☐ others slow ☒ one band ☐ blind

Allow keyboard: ☐

143041 143042 143043 143044 143045 143046 143047 143048 143049 143050 143051 143052 143053 143054 143055 143056

Frequency: 1

Band: ☐ 70cm

Or tune by clicking/dr

Memories:

This WebSDR i

431985 431990

1295980 1295985 1295990 1295995 1296000 1296005 1296010 1296015 1296020 1296025 1296030 1296035 1296040 1296045 1296050 1296055 1296060 1296065

pe1rxj-2
pe1rxj-1

143000 143100 143200 143300 143400 143500 143600 143700 143800 143900 144000 144100 144200 144300 144400 144500 144600 144700 144800

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pe1rxj

5

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Warning:

The audiostream is of good quality!

The videostream is just a tuning indicator (= poor details, for bandwidth reasons).

So, use a secondary program to make signals visible.

\$9 +20dB +40dB +60dB

ak -96.1 dB;

quelch ☐ autonotch

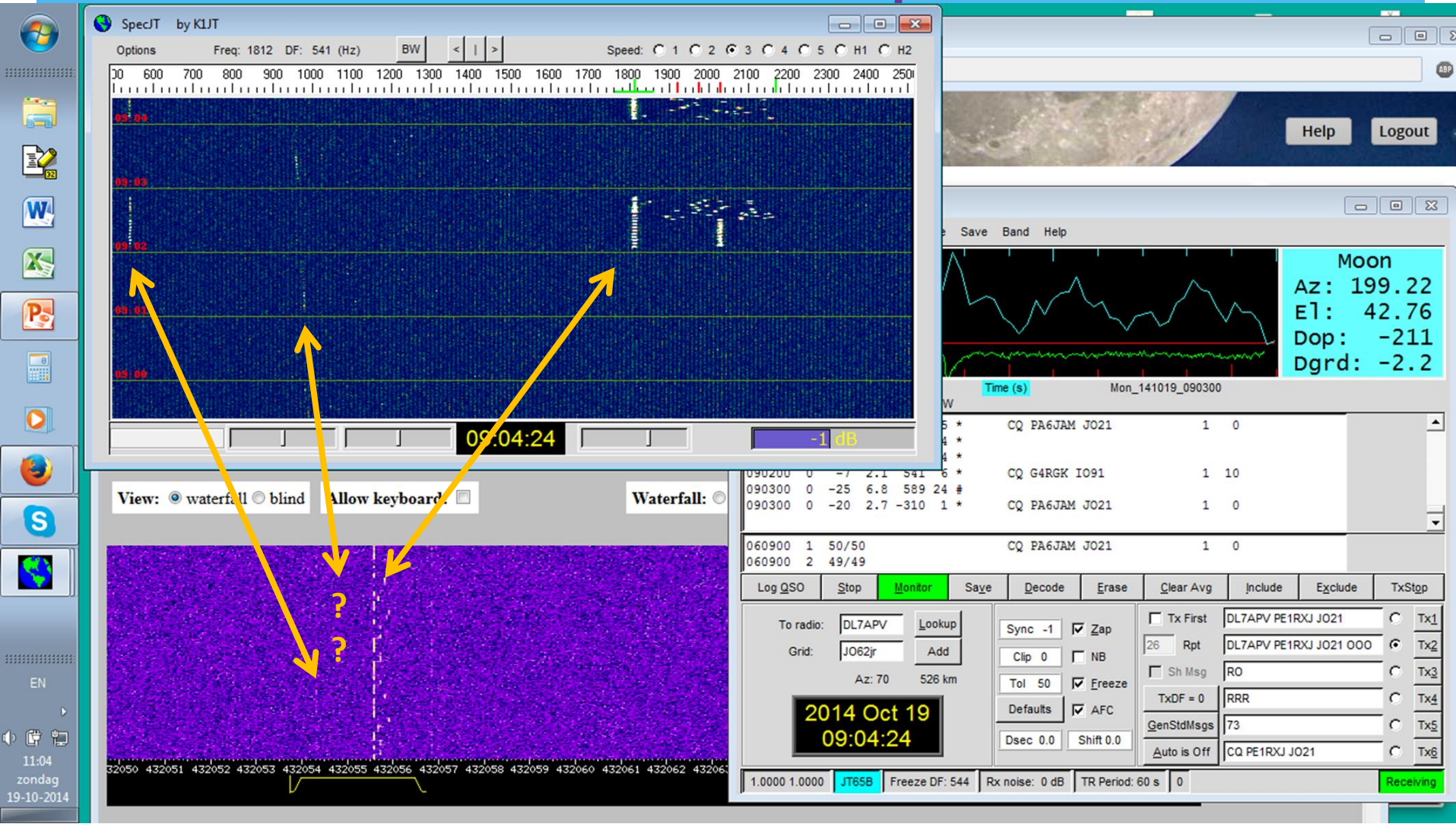
ling:

th plot:



How to receive CAMRAS – 2

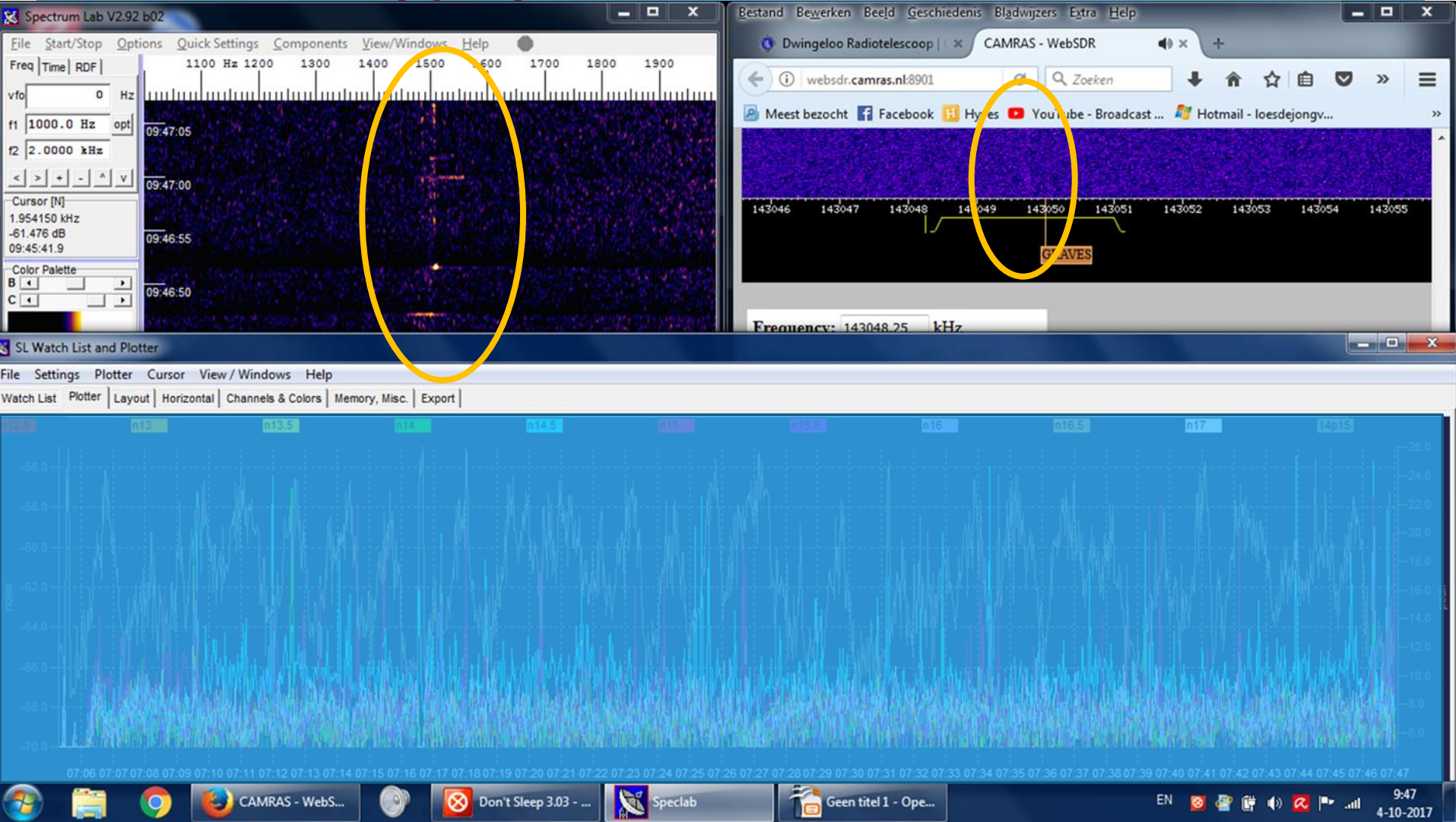
WSJT example





How to receive CAMRAS – 2

Using Spec-Lab for meteor

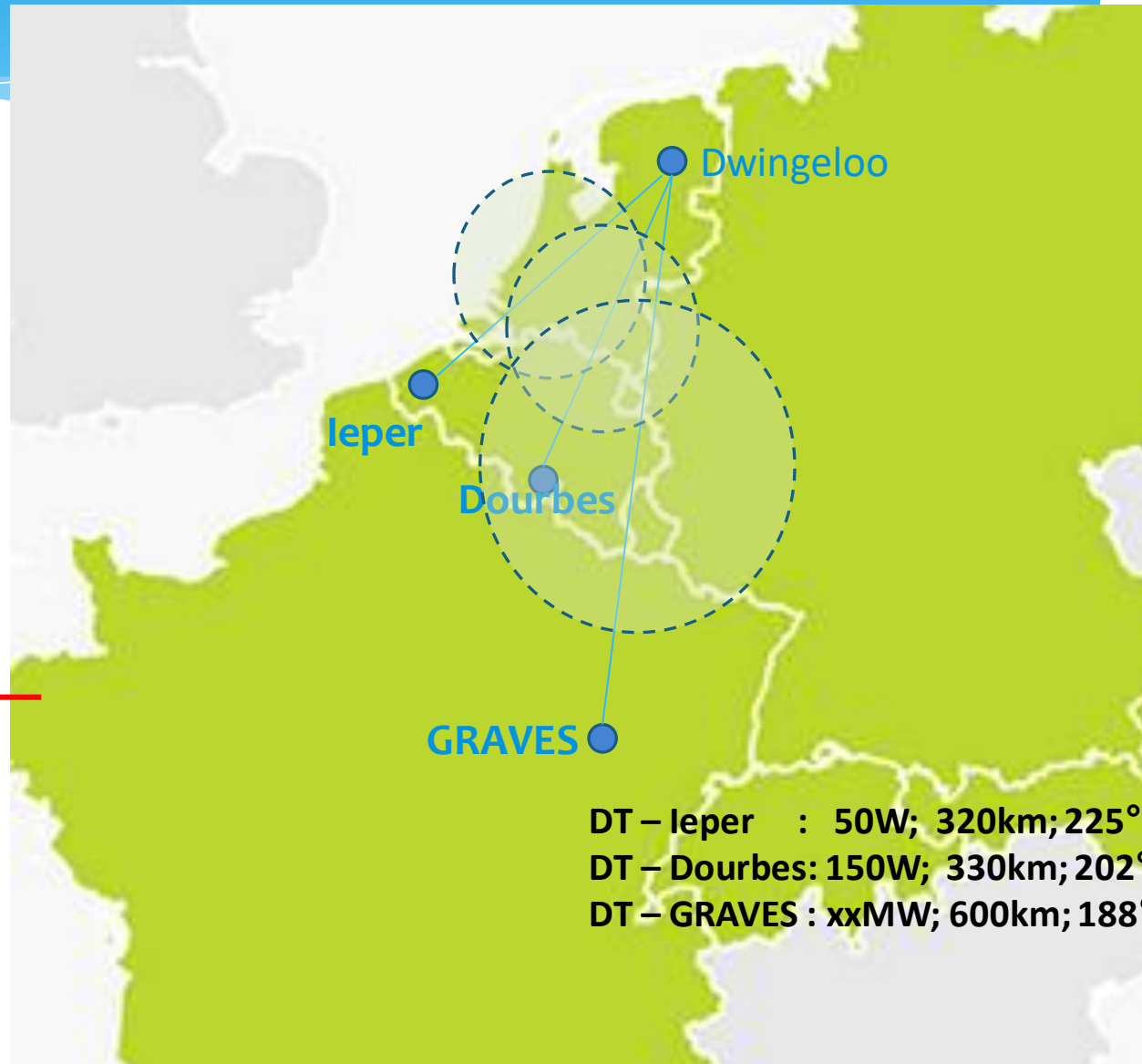
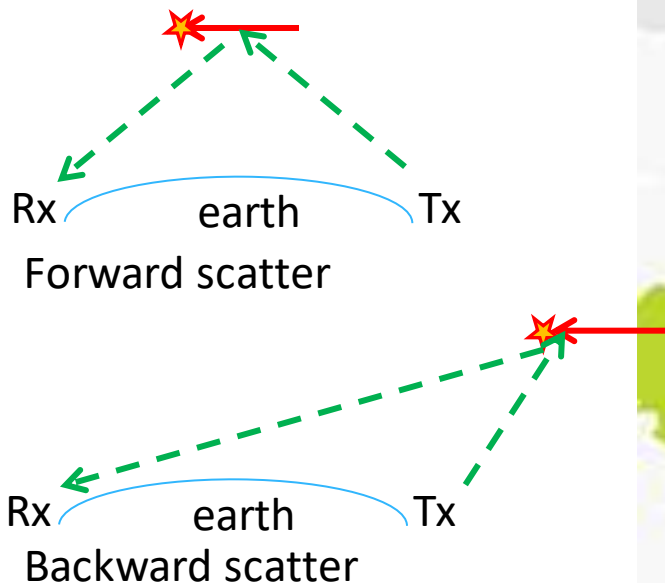




What do we see –or- hear

METEORSCATTER

Listen to radiosignals,
reflected against ionised
head clouds and trails
of meteors.



DT – Ieper : 50W; 320km; 225°
DT – Dourbes: 150W; 330km; 202°
DT – GRAVES : xxMW; 600km; 188°



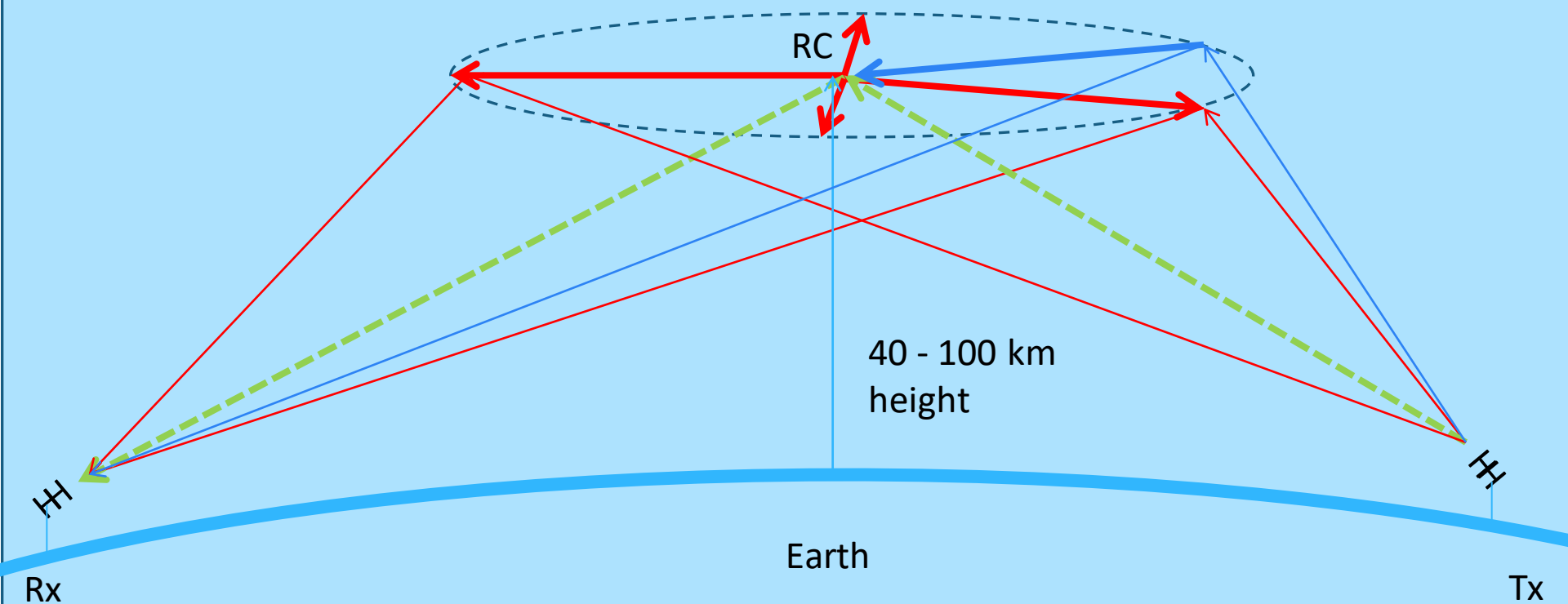
Path-length change induced Doppler-shift

Shortest path length: from TX via Reflection Center (RC) to Rx
(green dashed line)

Simple horizontal model:

all meteors towards RC shorten path length
(start with high pitch, lowering to carrier-tone)

all meteors away from RC lengthen path
(start with carrier-tone, further lowering pitch)





Calculate –max- Doppler shift

Meteor velocity (V_m) is 100km/s Doppler : $f_o = f_s (C / (C \pm V_m))$

f_o = freq(observer) f_s = freq(source) C = speed-of-light

If Signal duration 0.1 s $\rightarrow$ trail length is 10km

A: straight above Rx (or Tx) : path length change is 10km in 0.1 sec (rounded)

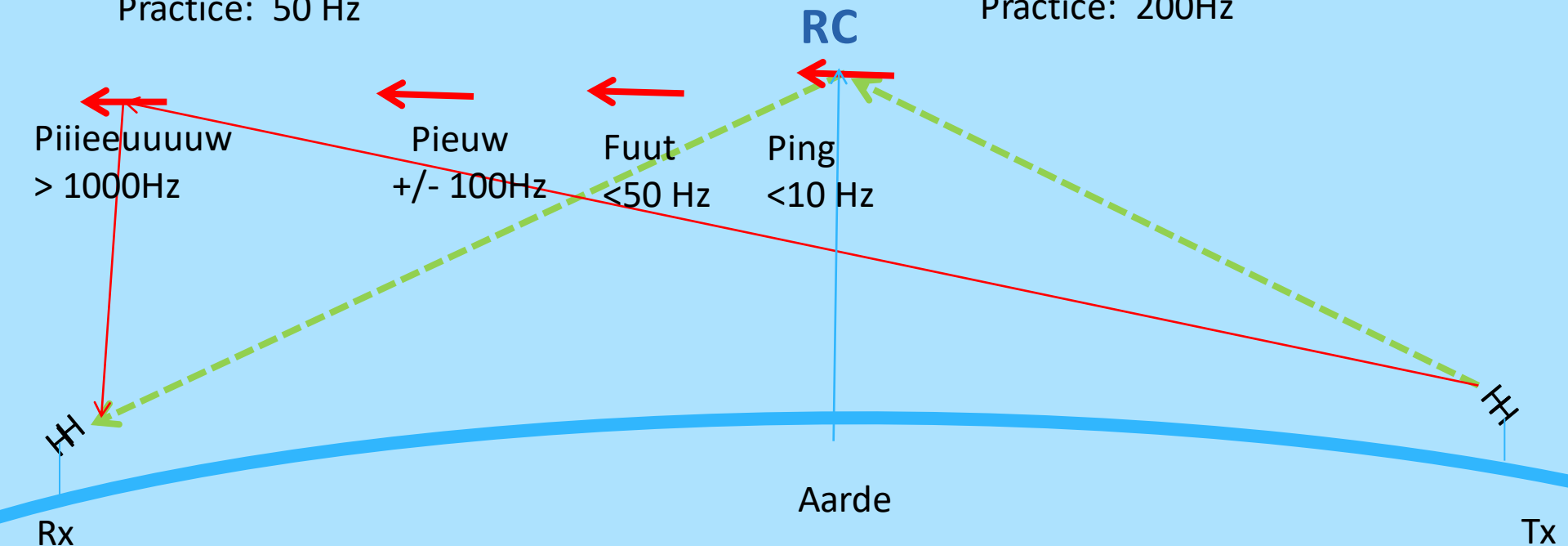
B: At RC there is no path length change (Doppler shift = 0)

Dourbes: 50MHz $\rightarrow$ max 1666 Hz

Practice: 50 Hz

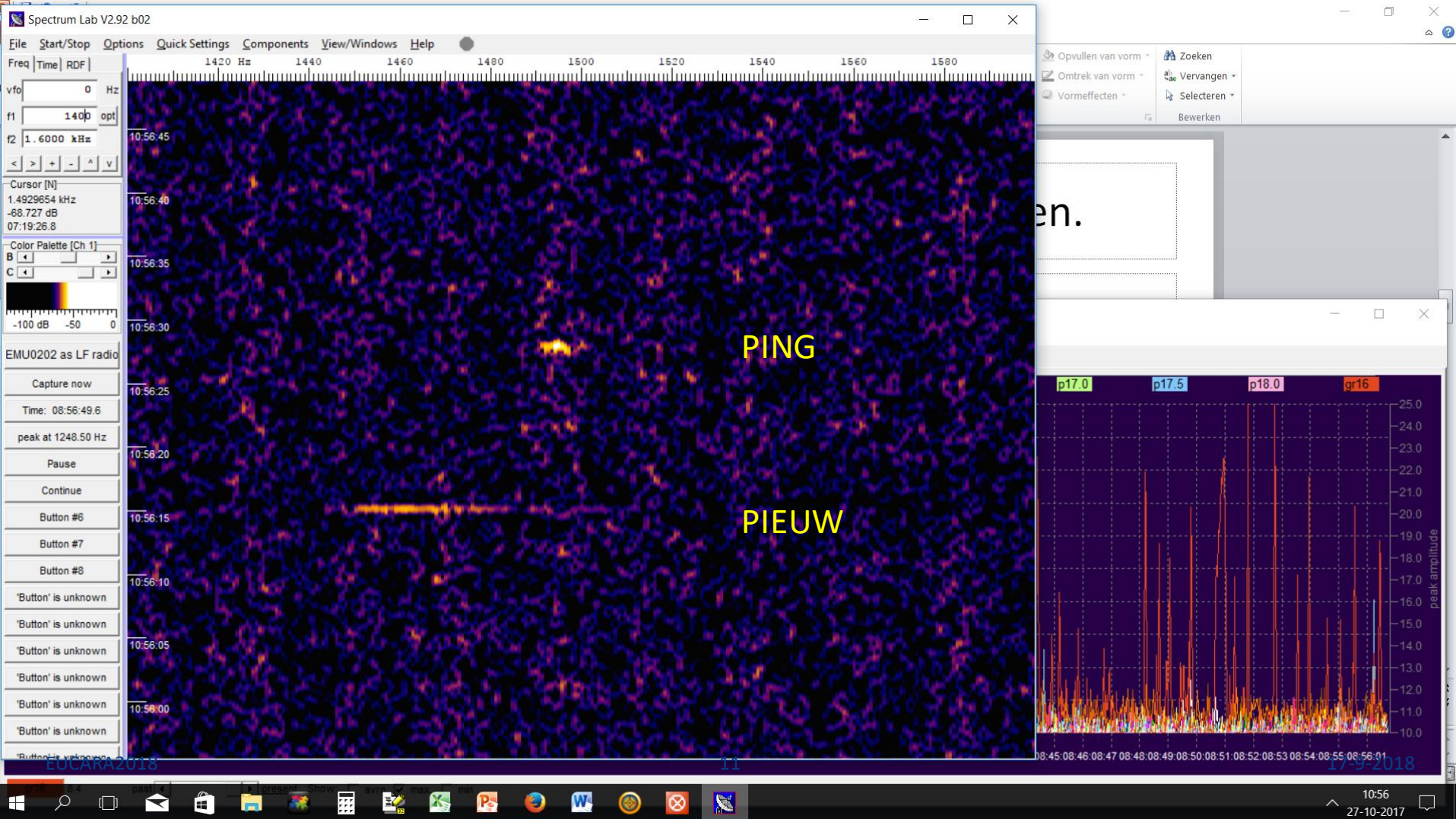
GRAVES: 143MHz $\rightarrow$ max 4767 Hz

Practice: 200Hz





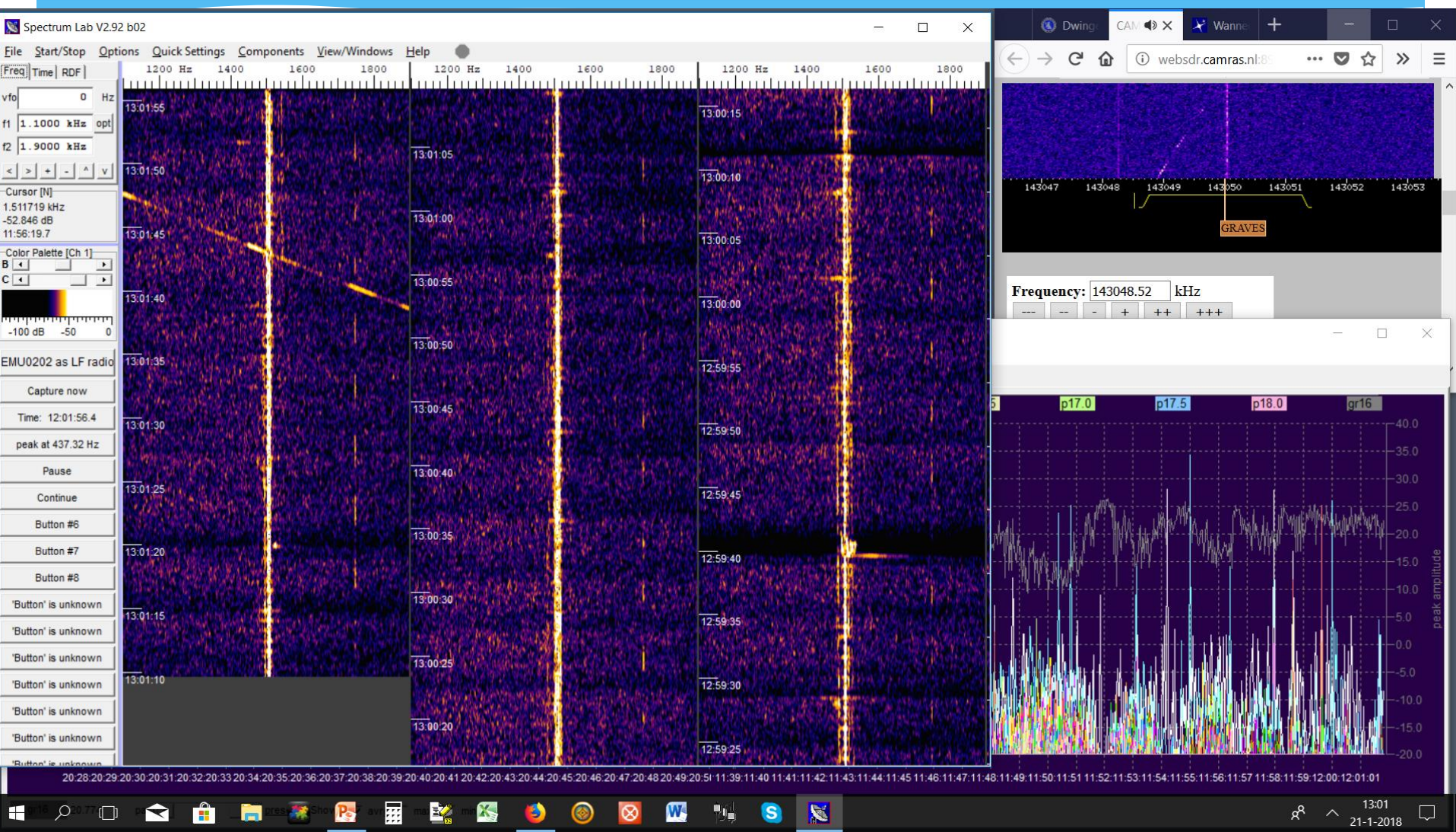
Some interesting observations





Some interesting observations

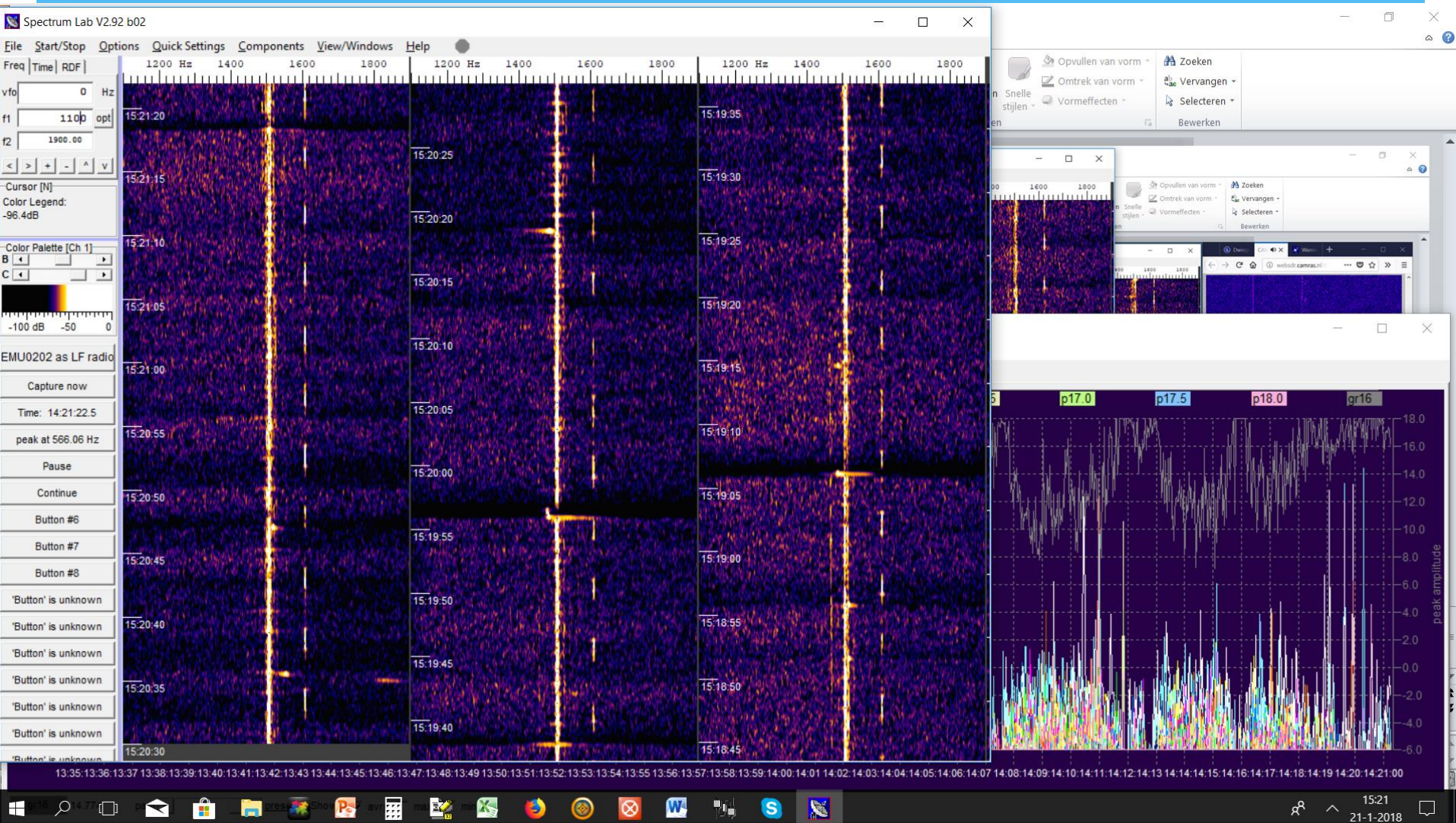
Graves: Planes, Iss trail, meteors and moon





Some interesting observations

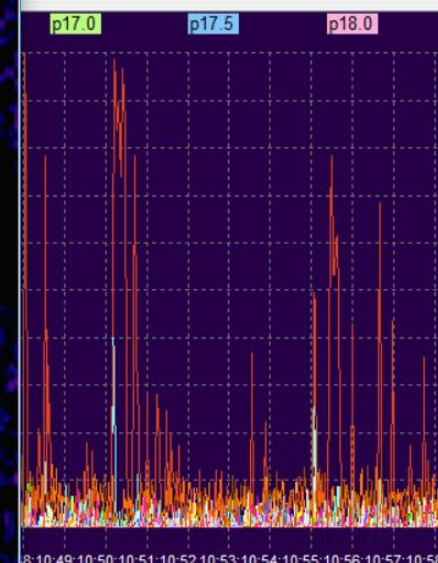
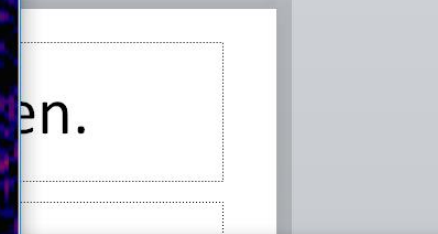
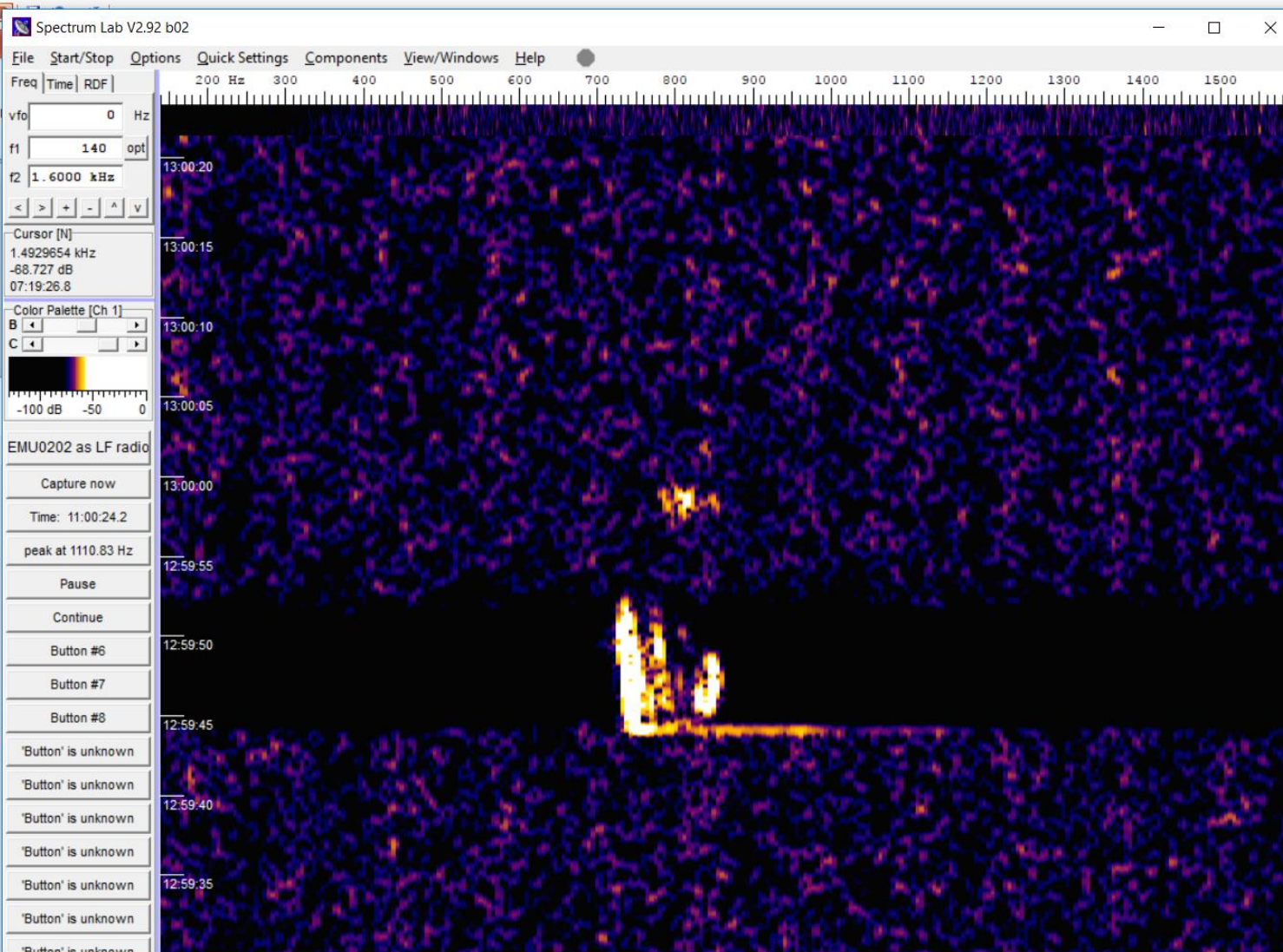
Note: moon doppler change





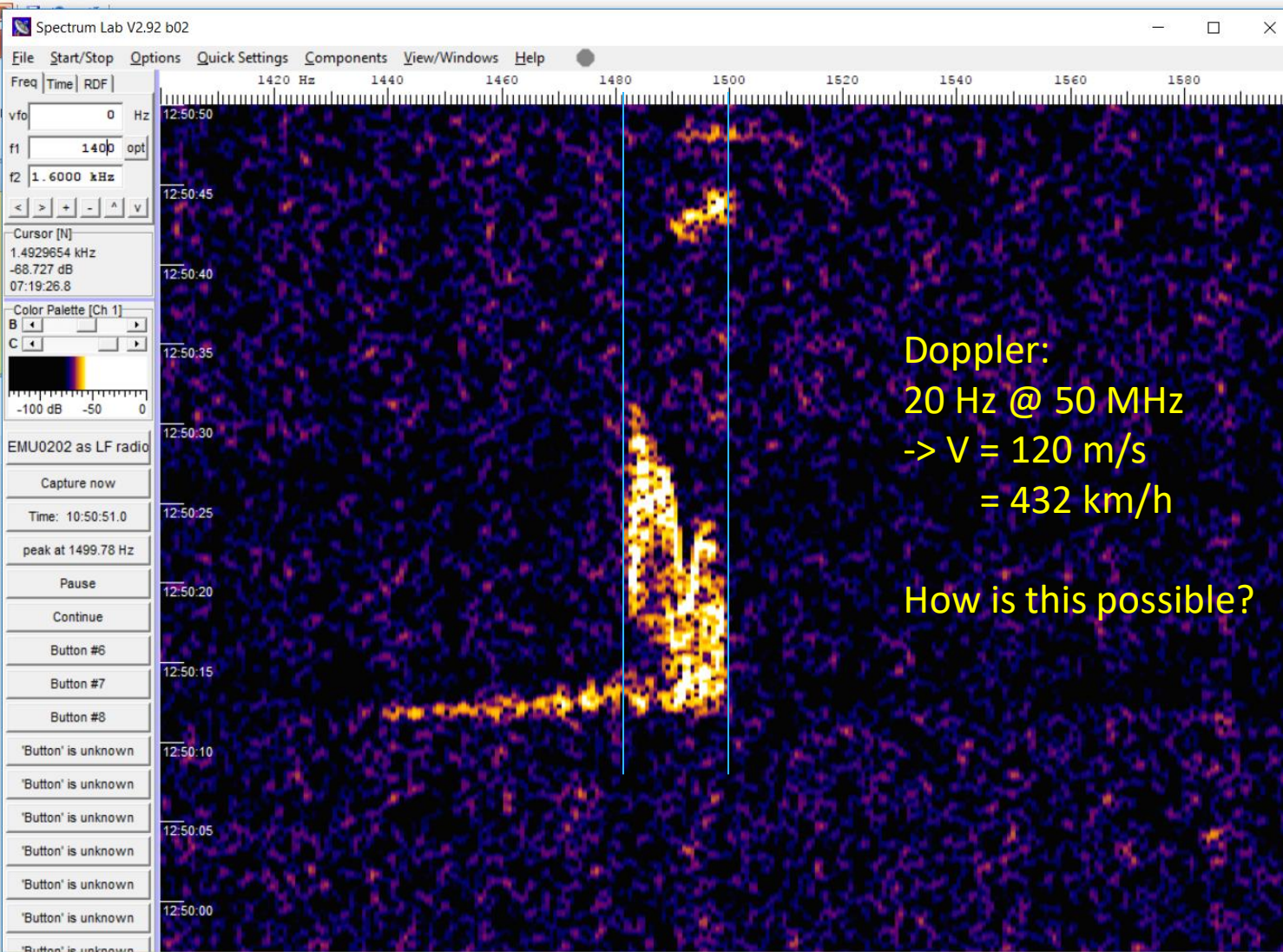
Some interesting observations

Fast head echo and trailing ionised clouds



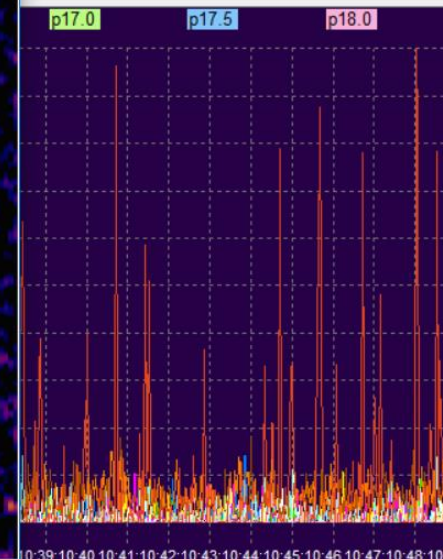
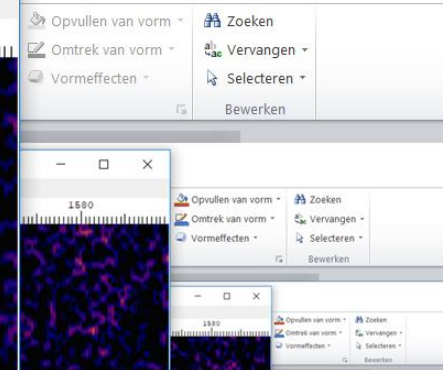


Some interesting observations



Doppler:
20 Hz @ 50 MHz
→ $V = 120 \text{ m/s}$
 $= 432 \text{ km/h}$

How is this possible?





Some interesting observations - 2



Is turbulence rotating fast enough?
Effect of high wind speeds?

Can Meteorites cause
A turbulent trail?



Some interesting observations - 2



Chelyabinsk, 2013

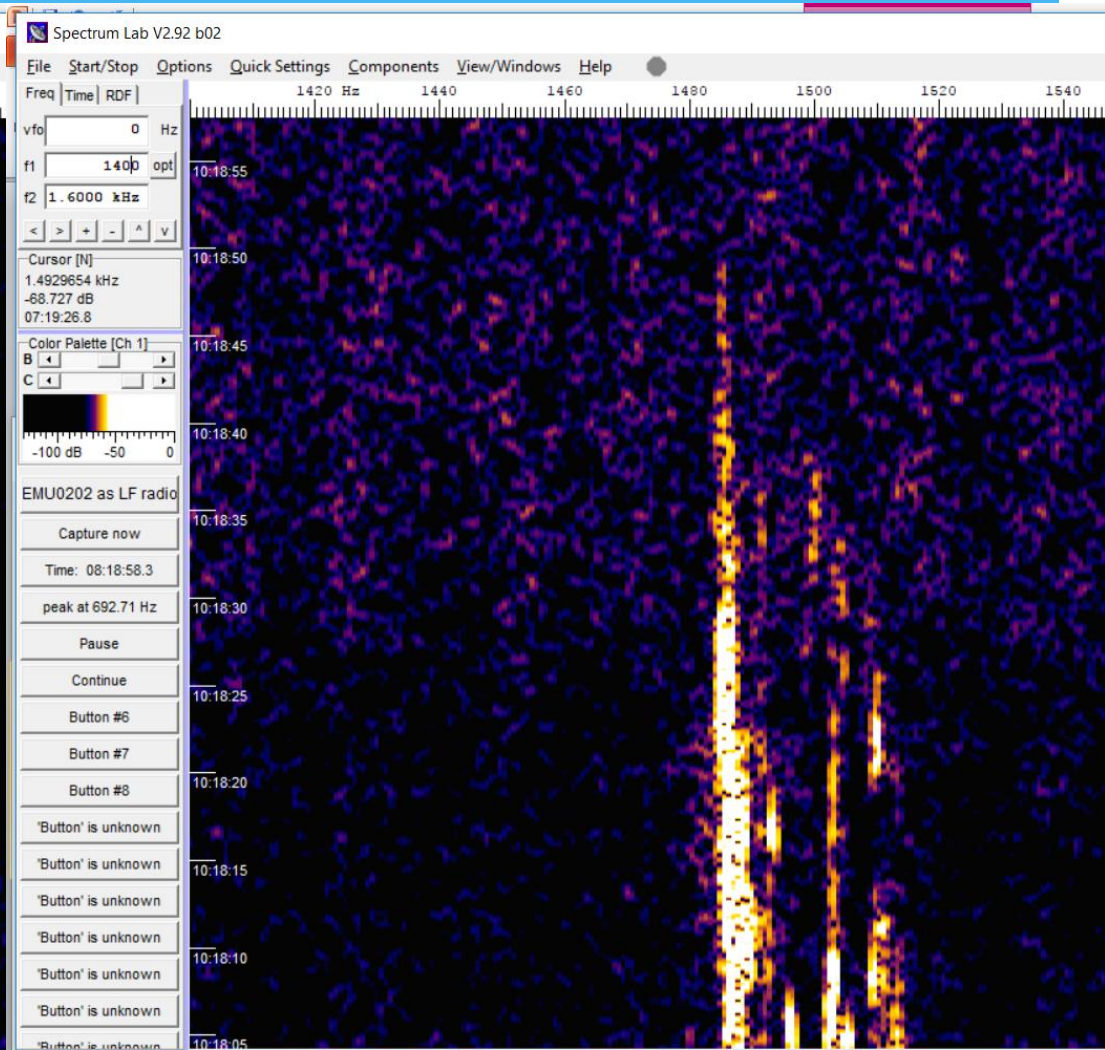
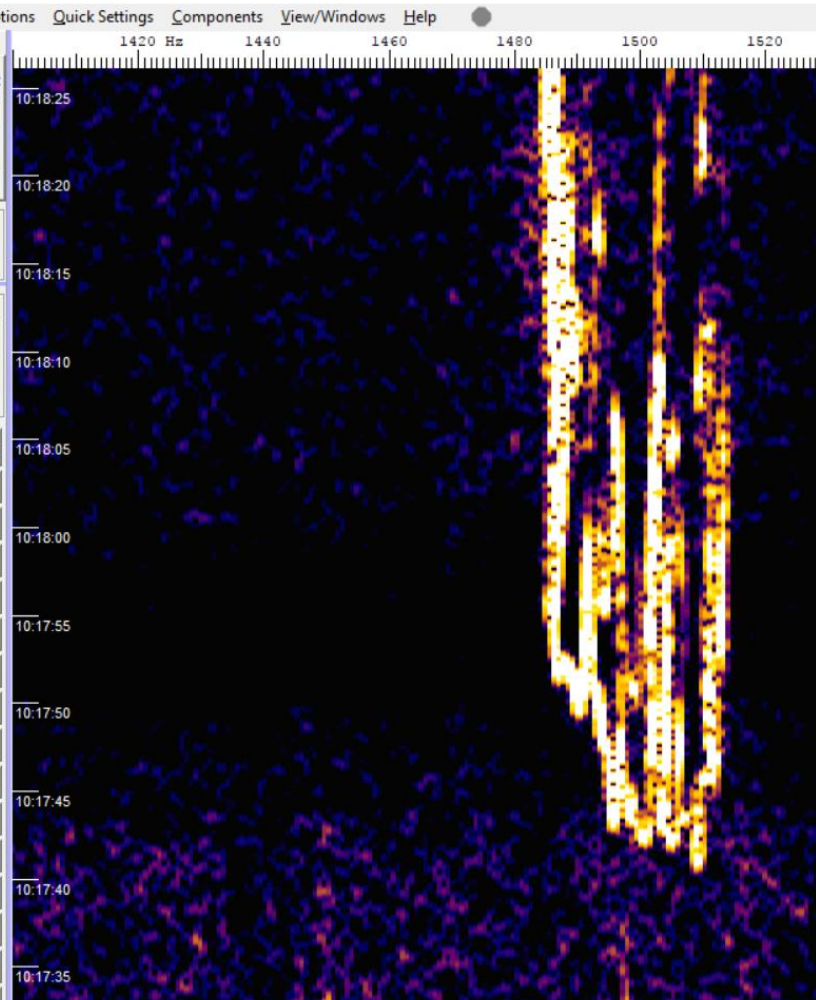
6:07

YouTube.com/Tuvix72



MORE interesting observations

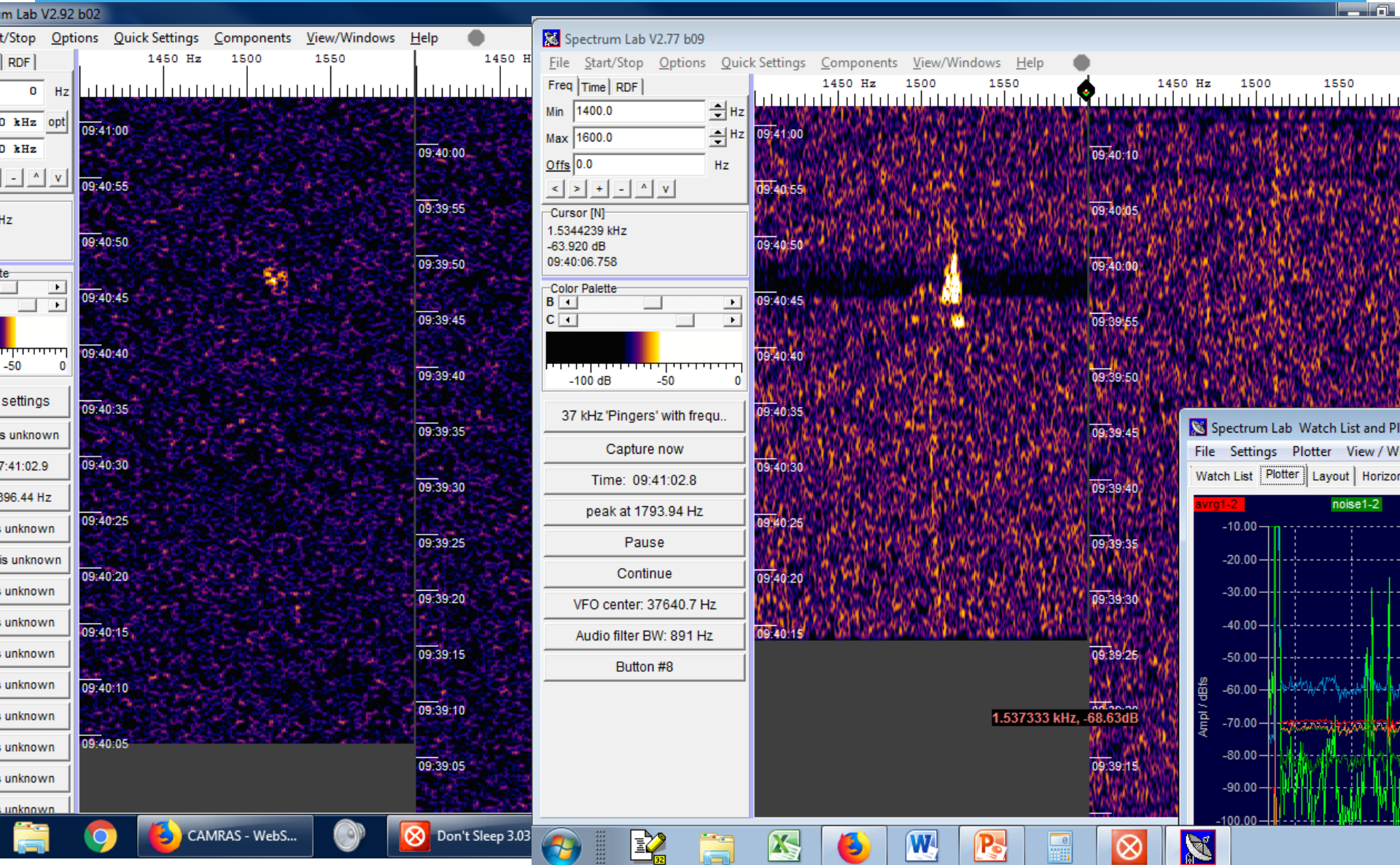
02 b02





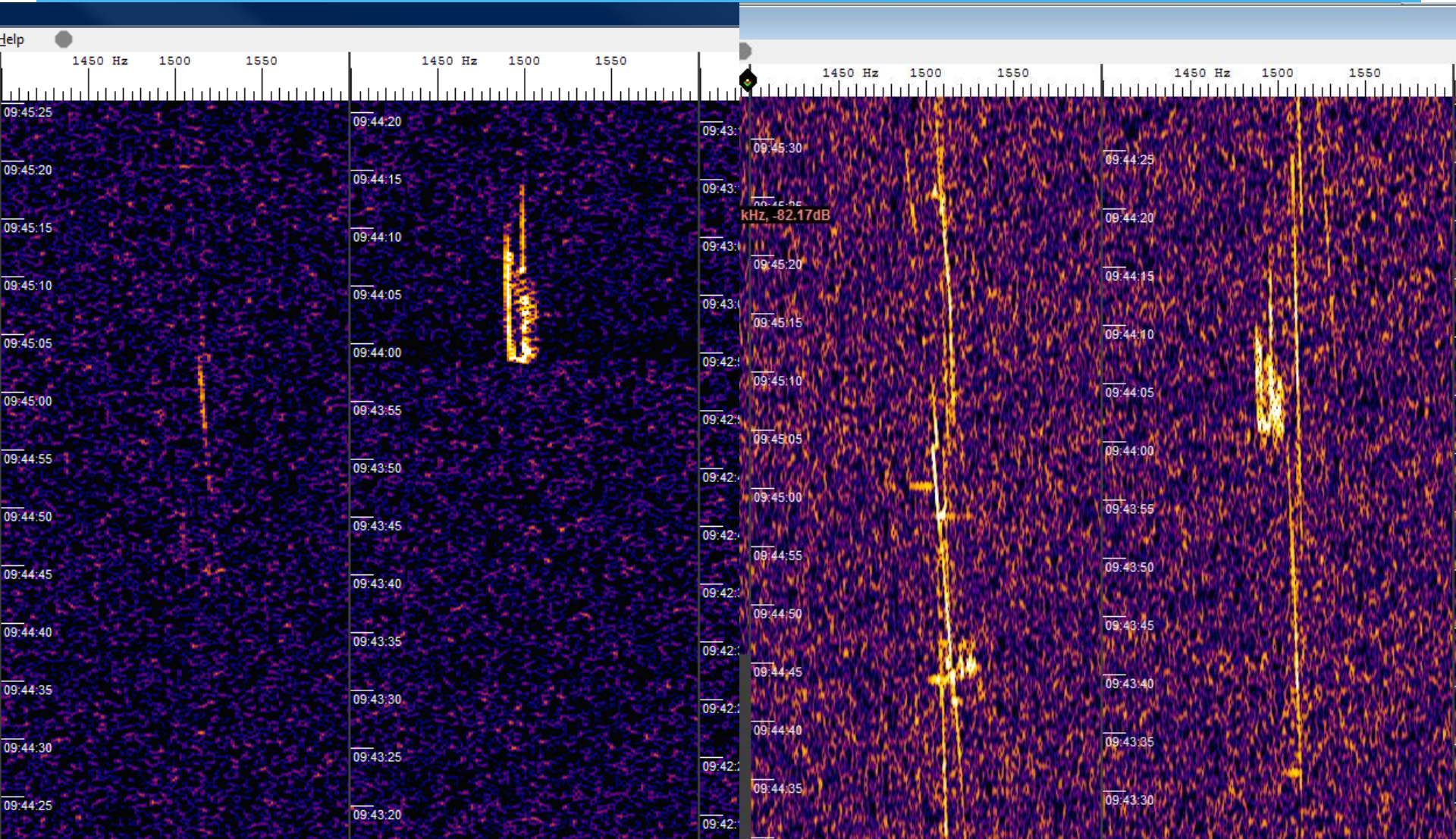


Simultaneous observations !



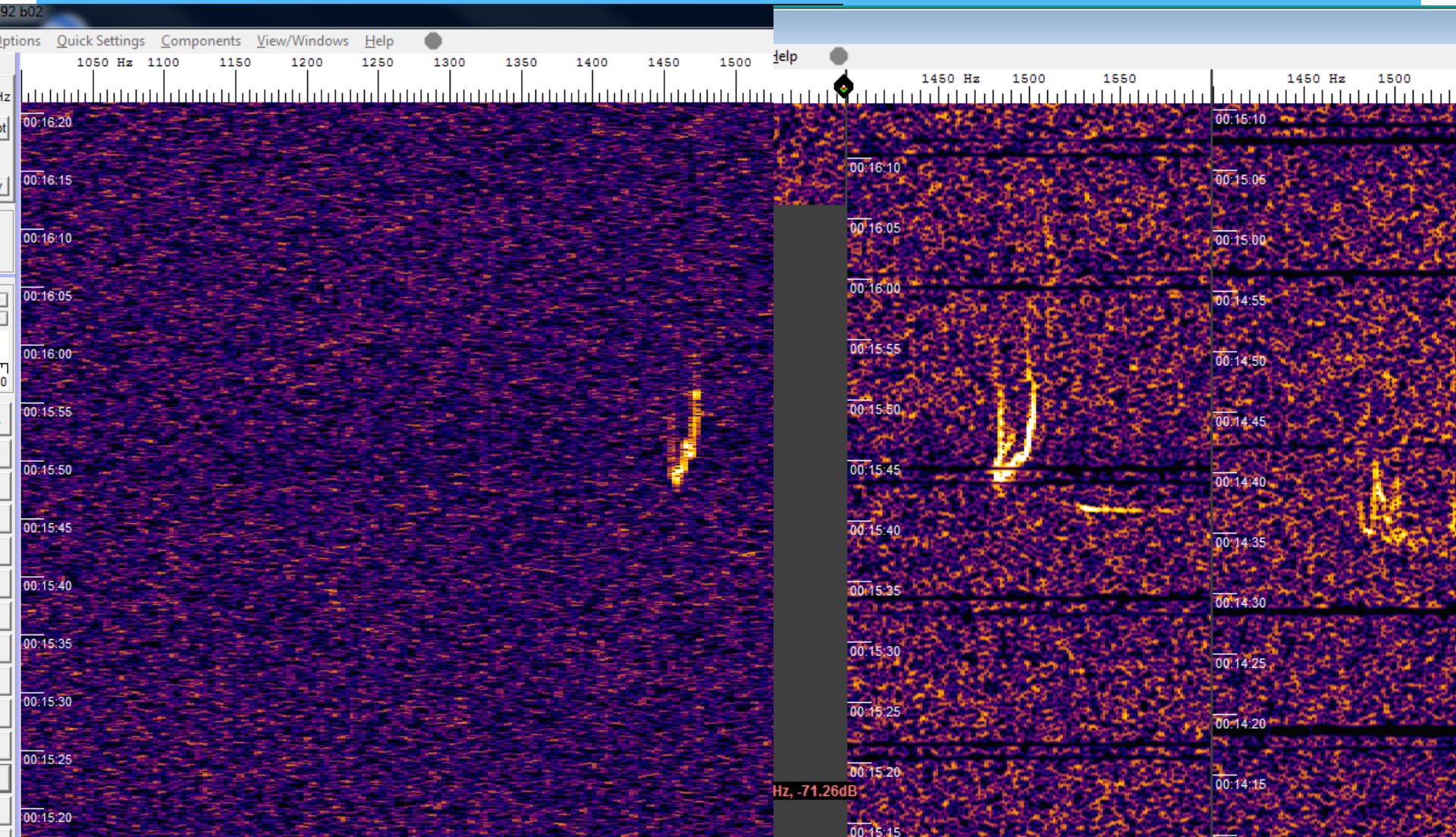


Simultaneous observations !



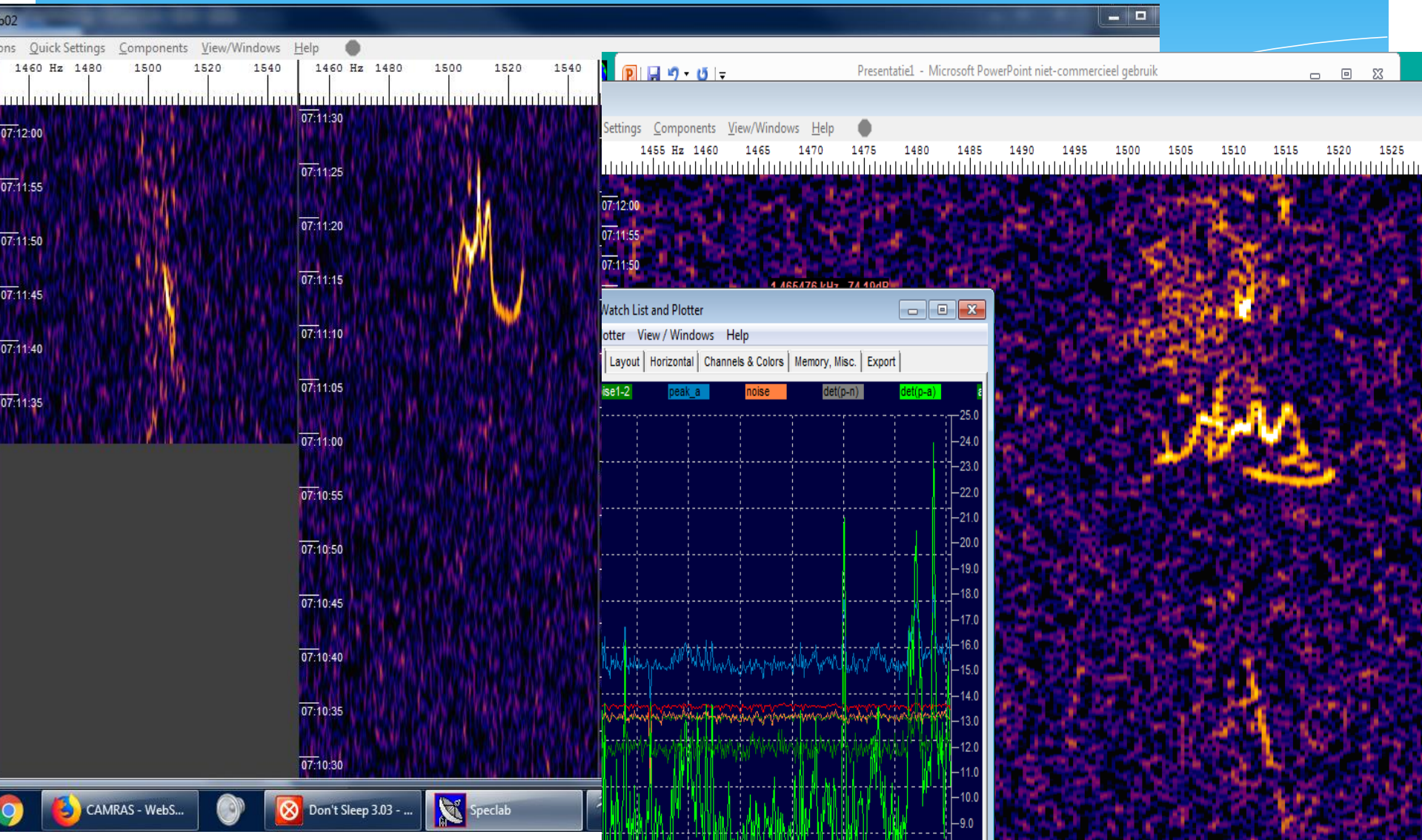


Simultaneous observations !





Simultaneous observations !

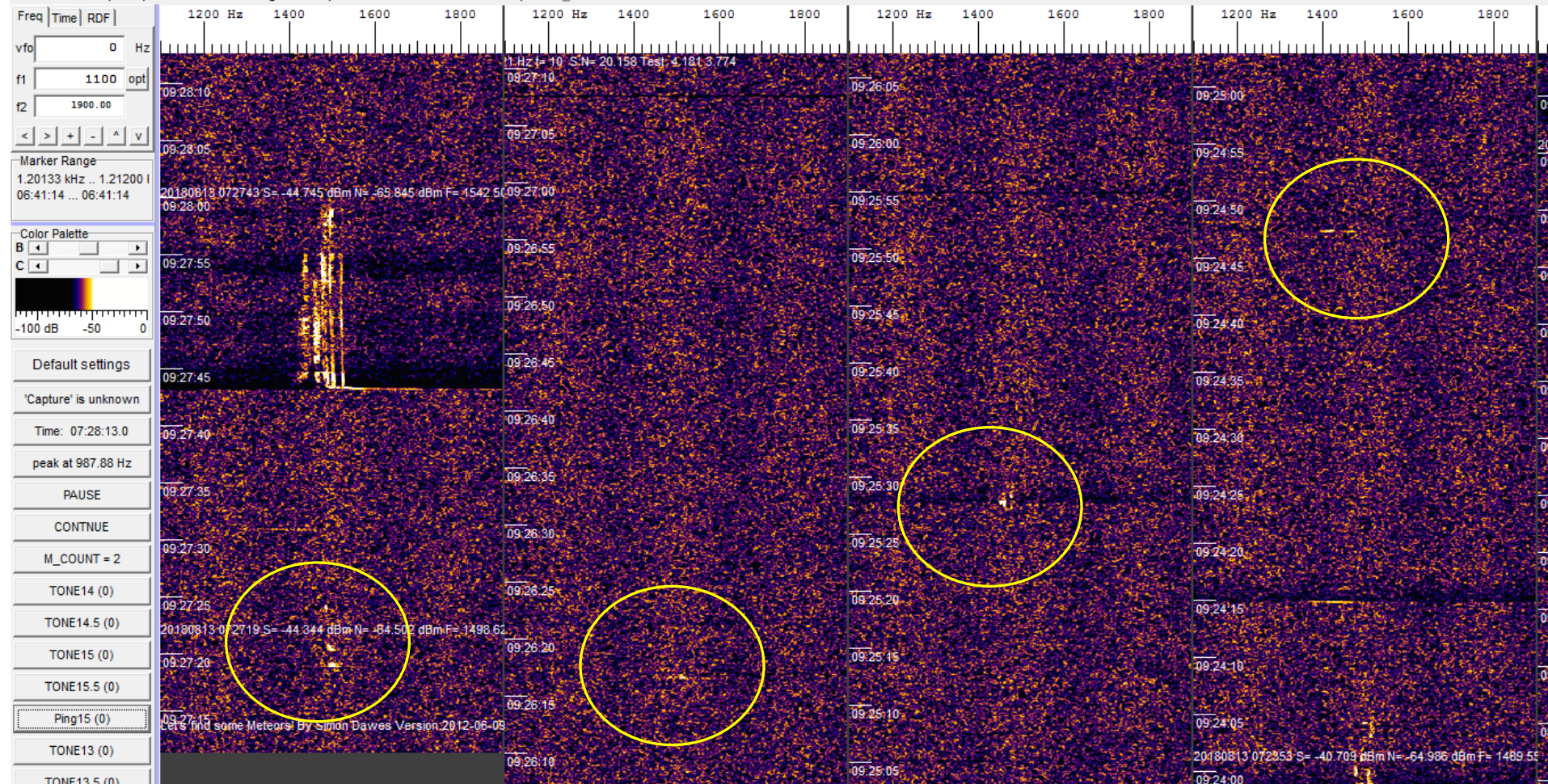




'Manual' counting

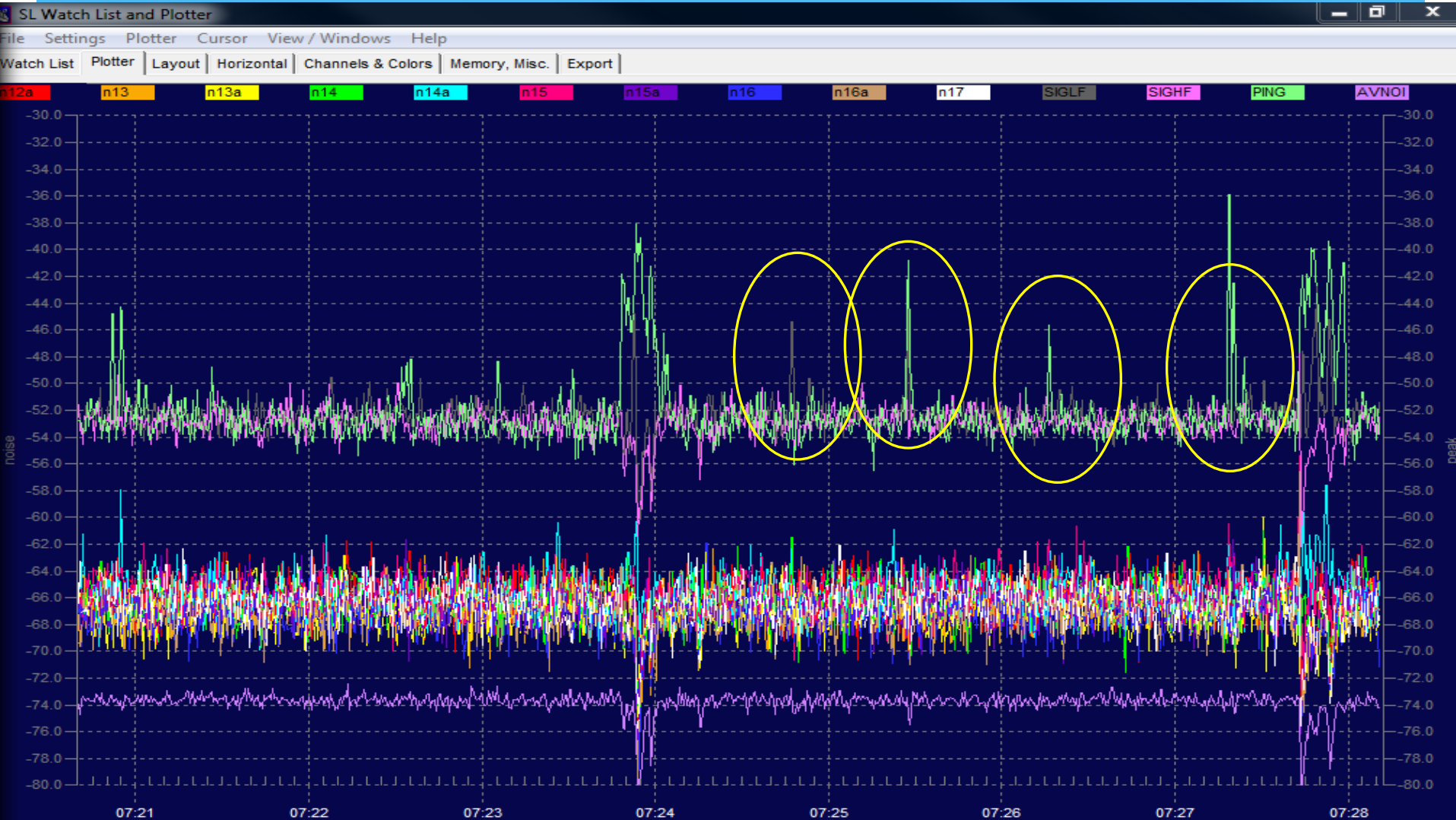
Spectrum Lab V2.92 b02

File Start/Stop Options Quick Settings Components View/Windows Help





'Manual' counting





Automatic counting

purpose: Diurnal effect and maxima determination

Info, including Conditional script found via :

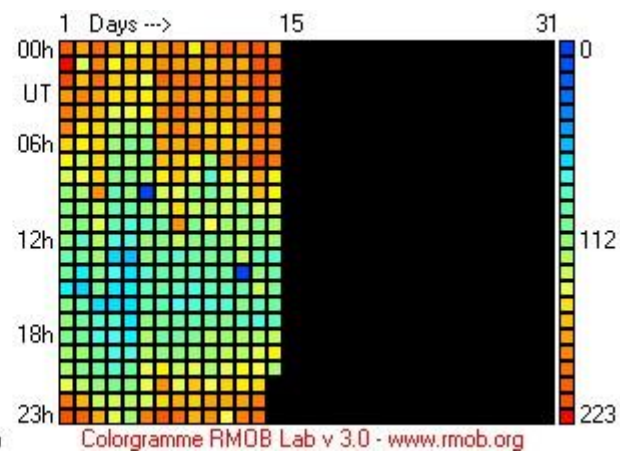
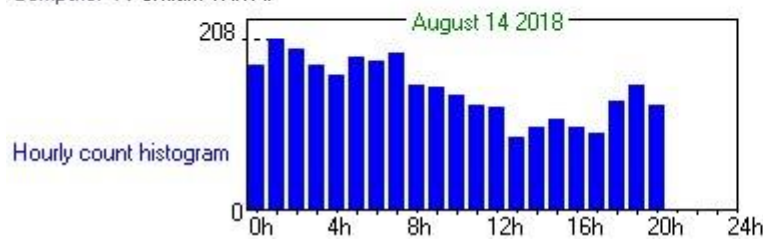
<http://cmhas.wikispaces.com/RadioMeteor>

<http://cmhas.wikispaces.com/SLMeteor>

<http://radio.meteor.free.fr/fr/en/logiciels.html#4>

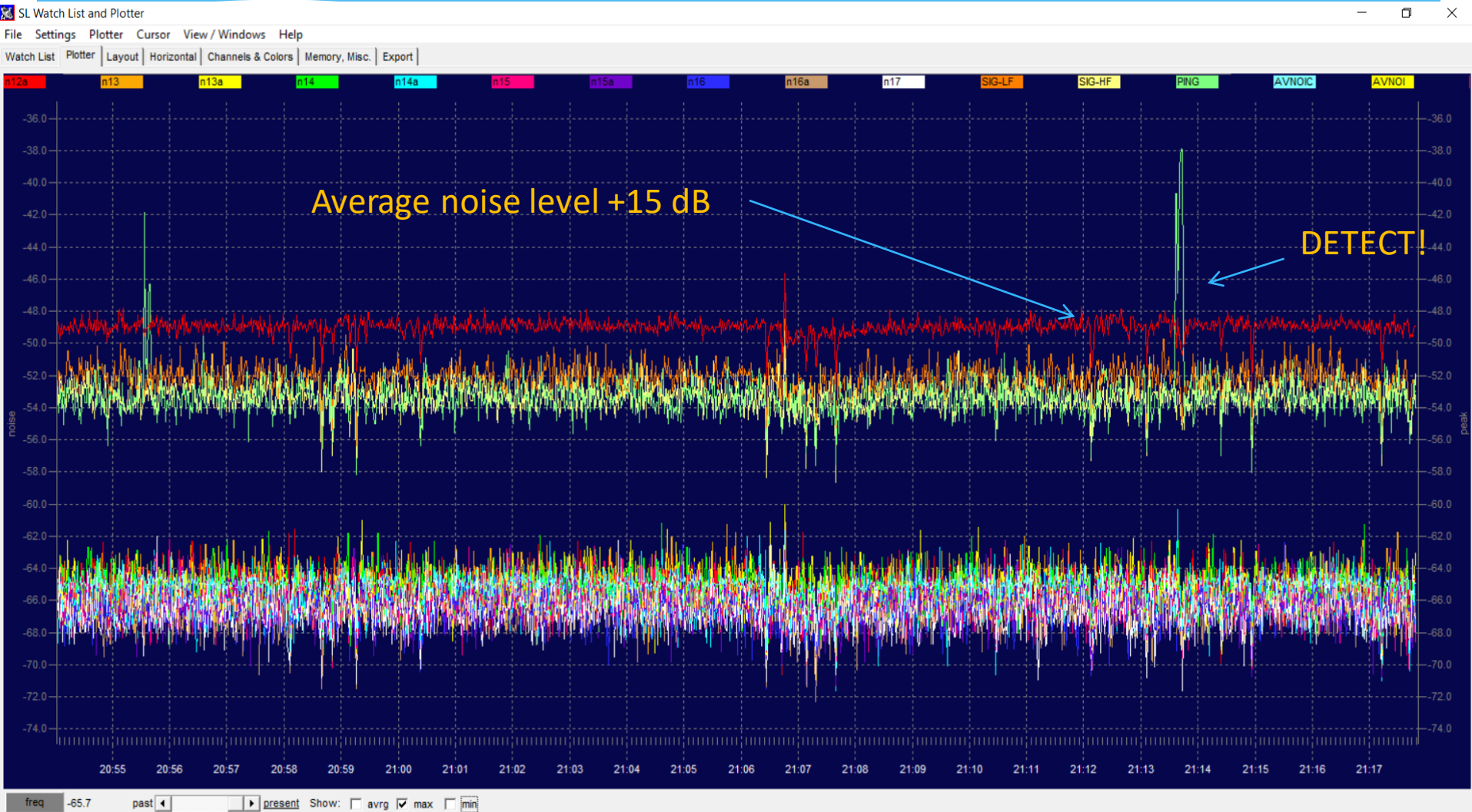
<http://www.rmob.org/livedata/main.php>

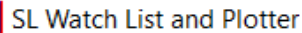
Observer : AAV Planetario_di_Venezia Location : 012°22'35 East
Country : Italy 045°25'00 North
City : Venezia Frequency : 143.050 MHz
Antenna : Yagi 6 elements Az : 294° El : 20°
RF preamp. / Receiver : Yaesu FT-817
Obs.Method : Spectrum Lab
Computer : Pentium Win XP





Automatic counting Detection level needed





Watch List	Plotter	Layout	Horizontal	Channels & Colors	Memory, Misc.	Export
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Just for creating
the graphs



Automatic counting

Courtesy Simon Dawes,

Crayford Manor House Astronomical Society (CMHAS)

Screen Capture, Periodic and Scheduled Actions

Periodic Actions | Scheduled Actions | Conditional Actions | Screen Capture | Capture Macros

The conditions in this table are periodically checked, and commands executed if TRUE.

☒ cyclic,	Nr	IF.. (event, condition)	THEN.. (reaction, interpreter commands)
50 ms	1	(initialising)	ON=1: OFF=0: VERSION="2018-08-14"
☐ on FFT	2	(never)	REM Threshold = difference that triggers meteor check
	3	(initialising)	THRESHOLD=16:LOW=1000:HIGH=2000
	4	(never)	REM DIR = folder to store logs; M_NAM = prefix name for meteor files
	5	(initialising)	DIR="d:\\meteorlog\\" : M_NAM="Meteor"
	6	(never)	REM log_WAV = turns .wav file logging on & off; log_PLOTpic turns save of the plotter on & off
	7	(initialising)	log_WAV=OFF:log_PLOTpic=OFF
	8	(never)	REM NOI=noise, SIG=Signal
	9	(initialising)	NOI=0:SIG=0:TOTAL_DUR=0:COUNT_HR=0:FLAG_TIME=0:MAX_DUR=0:T1=0:
	10	(never)	REM RUN = switch, starts turned off and prevents meteors from being measured until timer 4 exp
	11	(never)	REM CHK = switch, if SIG>NOI+THRESHOLD then turn on and check for meteor
	12	(initialising)	RUN=OFF:CHK=OFF:TST=OFF
	13	(never)	REM M_ = possible Meteor ; M_TIM=time ; M_SIG=Signal; M_FRQ=Frequency; M_NOI=noise; M_DUR=dura
	14	(never)	REM M_YMD= date in YYYYMMDD format; M_HR=hour; M_MS= minutes seconds in MMSS format
	15	(initialising)	M_TIM=0:M_SIG=0:M_FRQ=0:M_NOI=0:M_DUR=0:M_YMD="":M_HR="":M_MS=""
	16	(never)	REM A# = temp noise values used to provide a rolling average for the noise
	17	(initialising)	A0=0:A1=0:A2=0:A3=0:A4=0:A5=0
	18	(initialising)	timer4.start(10)
	19	(initialising)	FLAG_A=0: FLAG_B=0 :TEST_A=10:TEST_B=0
	20	(timer4.expired(1))	RUN=ON:sp.print("METEOR CONTER -- Version:"+VERSION):NOI=noise(LOW,HIGH):
	21	(always)	A5=A4:A4=A3:A3=A2:A2=A1:A1=A0:A0=noise(LOW,HIGH)
	22	(always)	NOI=(A0+A1+A2+A3+A4+A5)/6:SIG=peak_a(1200,1800)
	23	(always)	M_YMD=str("YYYYMMDD",now):M_HR=str("hh",now):M_MS=str("mmss",now)
	24	((M_DUR==0)&&(SIG>(NOI+THRESHOLD))&&(RUN==ON))	CHK=ON
	25	(else)	CHK=OFF
	26	((CHK==ON)&&(SIG>(NOI+THRESHOLD)))	M_TIM=M_YMD+" "+M_HR+M_MS:M_NAM="Meteor"+M_YMD+M_HR+M_MS:M_SIG=SIG: M_FRQ=peak_f(1200,1800):M
	27	(CHK==ON)	TEST_B=sigma(M_FRQ-10,M_FRQ+10):TEST_A=sqrt((peak_a(M_FRQ-10,M_FRQ-5)-M_SIG)^2)
	28	(never)	REM ----- Next line is for test only -----
	29	((CHK==ON)&(TST==ON))	sp.print("A"+str(TEST_A)+" B"+str(TEST_B)): TST=TST+1
	30	(else)	TST=OFF

Watch (expr): SIG >> -54.85

Test line 2 ->



Automatic counting Details in script

Screen Capture, Periodic and Scheduled Actions

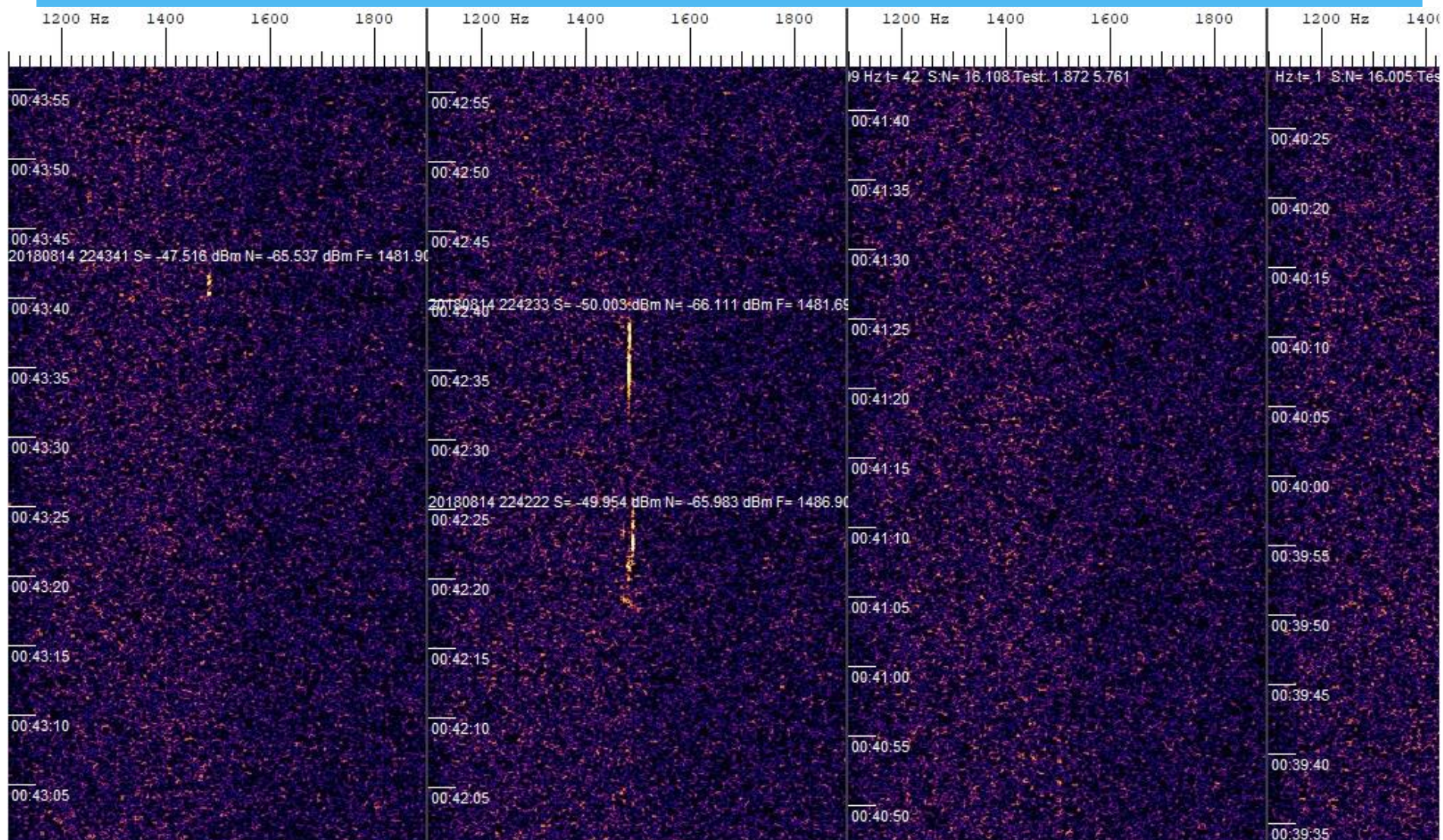
Periodic Actions | Scheduled Actions | Conditional Actions | Screen Capture | Capture Macros

The conditions in this table are periodically checked, and commands executed if TRUE.

☒ cyclic, 50 ms	Nr	IF.. (event, condition)	THEN.. (reaction, interpreter commands)
☐ on FFT	1	(initialising)	ON=1: OFF=0: VERSION="2018-08-14"
	2	(never)	REM Threshold = difference that triggers meteor check
	3	(initialising)	THRESHOLD=15:LOW=1000:HIGH=2000
	4	(never)	REM DIR = folder to store logs; M_NAM = prefix name for meteor files
	5	(initialising)	Dir="c:\spectrum\meteorlog\" : M_NAM="Meteor"
	6	(never)	REM log_WAV = turns .wav file logging on & off; log_PLOTpic turns save of the plotter
	7	(initialising)	log_WAV=OFF:log_PLOTpic=OFF
	8	(never)	REM NOI=noise, SIG=Signal
	9	(initialising)	NOI=0:SIG=0:TOTAL_DUR=0:COUNT_HR=0:FLAG_TIME=0:MAX_DUR=0:Tl=0:
	10	(never)	REM RUN = switch, starts turned off and prevents meteors from being measured until tim
	11	(never)	REM CHK = switch, if SIG>NOI+THRESHOLD then turn on and check for meteor
	12	(initialising)	RUN=OFF:CHK=OFF:TST=OFF
	13	(never)	REM M_ = possible Meteor ; M_TIM=time ; M_SIG=Signal; M_FRQ=Frequency; M_NOI=noise; M_
	14	(never)	REM M_YMD= date in YYYYMMDD format; M_HR=hour; M_MS= minutes seconds in MMSS format
	15	(initialising)	M_TIM=0:M_SIG=0:M_FRQ=0:M_NOI=0:M_DUR=0:M_YMD="":M_HR="":M_MS=""
	16	(never)	REM A# = temp noise values used to provide a rolling average for the noise
	17	(initialising)	A0=0:A1=0:A2=0:A3=0:A4=0:A5=0
	18	(initialising)	timer4.start(10)
	19	(initialising)	FLAG_A=0: FLAG_B=0 :TEST A=10:TEST_B=0
	20	(timer4.expired(1))	RUN=ON:sp.print("METEOR CONTER -- Version:"&VERSION):NOI=noise(LOW,HIGH):
	21	(always)	A5=A4:A4=A3:A3=A2:A2=A1:A1=A0:A0=noise(LOW,HIGH)
	22	(always)	NOI=(A0+A1+A2+A3+A4+A5)/6:SIG=peak_a(1200,1800)
	23	(always)	M_YMD=str("YYYYMMDD",now):M_HR=str("hh",now):M_MS=str("mmss",now)
	24	((M_DUR==0)&&(SIG>(NOI+THRESHOLD))&&(RUN==ON))	CHK=ON
	25	(else)	CHK=OFF
	26	((CHK==ON)&&(SIG>(NOI+THRESHOLD)))	M_TIM=M_YMD+" "+M_HR+M_MS:M_NAM="Meteor"+M_YMD+M_HR+M_MS:M_SIG=SIG: M_FRQ=peak_f(1200,
	27	(CHK==ON)	TEST_B=sigma(M_FRQ-10,M_FRQ+10):TEST_A=sqrt((peak_a(M_FRQ-10,M_FRQ-5)-M_SIG)^2)
	28	(never)	REM ----- Next line is for test only -----
	29	((CHK==ON)&(TST==ON))	sp.print("A"+str(TEST_A)+" B"+str(TEST_B)): TST=TST+1
	30	(else)	TST=OFF
	31	(never)	REM ----- previous line is for test only -----
	32	((CHK==ON)&&(TEST_A<6))	FLAG_A=1



Automatic counting every detection visible in waterfall





Automatic counting

Also storing pictures and logfiles

Windows File Explorer window titled "Meteorlog" showing the contents of the "Data (D:) > Meteorlog" folder. The left sidebar shows the folder structure, including "Documents", "Downloads", "Frans (aquarius)", "Loes (gemini)", "Muziek", "Video's", "Boot (C:)", "Data (D:)", and "Meteorlog". The main pane displays a grid of 124 items, all named "Meteor20180814" followed by a date and time stamp. The items are arranged in a grid, with some items showing a small thumbnail image of a meteor trail. The bottom status bar indicates "124 items".

The file names visible in the grid are:

- Meteor20180814 220745
- Meteor20180814 220930
- Meteor20180814 221120
- Meteor20180814 221301
- Meteor20180814 222143
- Meteor20180814 223756
- Meteor20180814 224039
- Meteor20180814 224233
- Meteor20180814 224348
- Meteor20180814 224508
- Meteor20180814 224942
- Meteor20180814 225030
- Meteor20180814 225128
- Meteor20180814 225147
- Meteor20180815 083401
- Meteor20180815 083526
- Meteor20180815 083616
- Meteor20180815 083633
- Meteor20180815 083745
- Meteor20180815 083917
- Meteor20180815 083951
- Meteor20180815 084047
- Meteor20180815 084106
- Meteor20180815 084222
- Meteor20180815 084329
- Meteor20180815 084355
- Meteor20180815 084432
- Meteor20180815 084530
- Meteor20180815 084554
- Meteor20180815 084618
- Meteor20180815 084659
- Meteor20180815 084750
- Meteor20180815 084810
- Meteor20180815 084841
- Meteor20180815 084904
- Meteor20180815 084954
- Meteor20180815 085010
- Meteor20180815 085040
- Meteor20180815 085056
- Meteor20180815 085116
- Meteor20180815 085152
- Meteor20180815 085347
- Meteor20180815 085449
- Meteor20180815 085604
- Meteor20180815 085623
- Meteor20180815 085711
- Meteor20180815 085742
- Meteor20180815 090812
- Meteor20180815 090853
- MeteorLog-2018 08
- RMOB_Dur-2018 08
- RMOB-201808



Automatic counting example log file



MeteorLog-201808 - Kladblok

Bestand Bewerken Opmaak Beeld Help

```
20180814 182223,-49,-65.8,1494.5,96
20180814 182250,-49.9,-66.2,1489,602
20180814 182445,-50.5,-67.6,1489.2,45
20180814 182455,-48.6,-66.6,1490.4,259
20180814 182538,-47.8,-66.4,1492.2,64
20180814 182554,-46.7,-66.4,1490.9,150
20180814 182627,-49.5,-66.3,1478.1,38
20180814 182646,-46.6,-65.8,1490.4,15
20180814 182700,-49.6,-65.8,1495.8,3
20180814 182706,-49.6,-66.3,1493,5
20180814 182710,-48.7,-66,1494.7,6
20180814 182715,-47.5,-65.8,1492.5,3
20180814 182719,-47.6,-66.1,1492.9,16
20180814 182725,-47.8,-66.9,1492.5,10
20180814 182729,-49.9,-66,1489.2,48
20180814 182743,-49.8,-66.2,1493.3,297
20180814 182904,-49.6,-66,1483.1,2
20180814 182909,-48.5,-66.5,1481.2,2
20180814 182926,-50,-66,1494.8,43
20180814 182940,-48.5,-66.6,1491.8,12
20180814 182948,-46.9,-66.2,1491.4,69
20180814 183002,-45.3,-66.2,1487.5,21
20180814 183007,-48.4,-65.9,1487.6,4
20180814 183056,-49.7,-65.8,1480,1
```

Date time power(dB) noise(dB) freq.(Hz) duration

17-9-2018



What next

- * Improve filtering in CA file to suppress carrier (Graves)
 - * Add **Frequency based** detection
 - * Optionally Automate the colorgram
- * Create material for school projects
- * Options:
 - * Study more on meteor trail turbulence
 - * Triangulation

Thank you



References

- * <http://websdr.camras.nl:8901/>
- * <http://cmhas.wikispaces.com/RadioMeteor>
- * <http://cmhas.wikispaces.com/SLMeteor>
- * <http://radio.meteor.free.fr/fr/en/logiciels.html#4>
- * <http://www.rmob.org/livedata/main.php>
- * <http://brams.aeronomie.be/theory>
- * <https://www.imo.net/>