IMC 2014
GIRON

FRIPON radio

Jean-L. RAULT

f6agr@orange.fr

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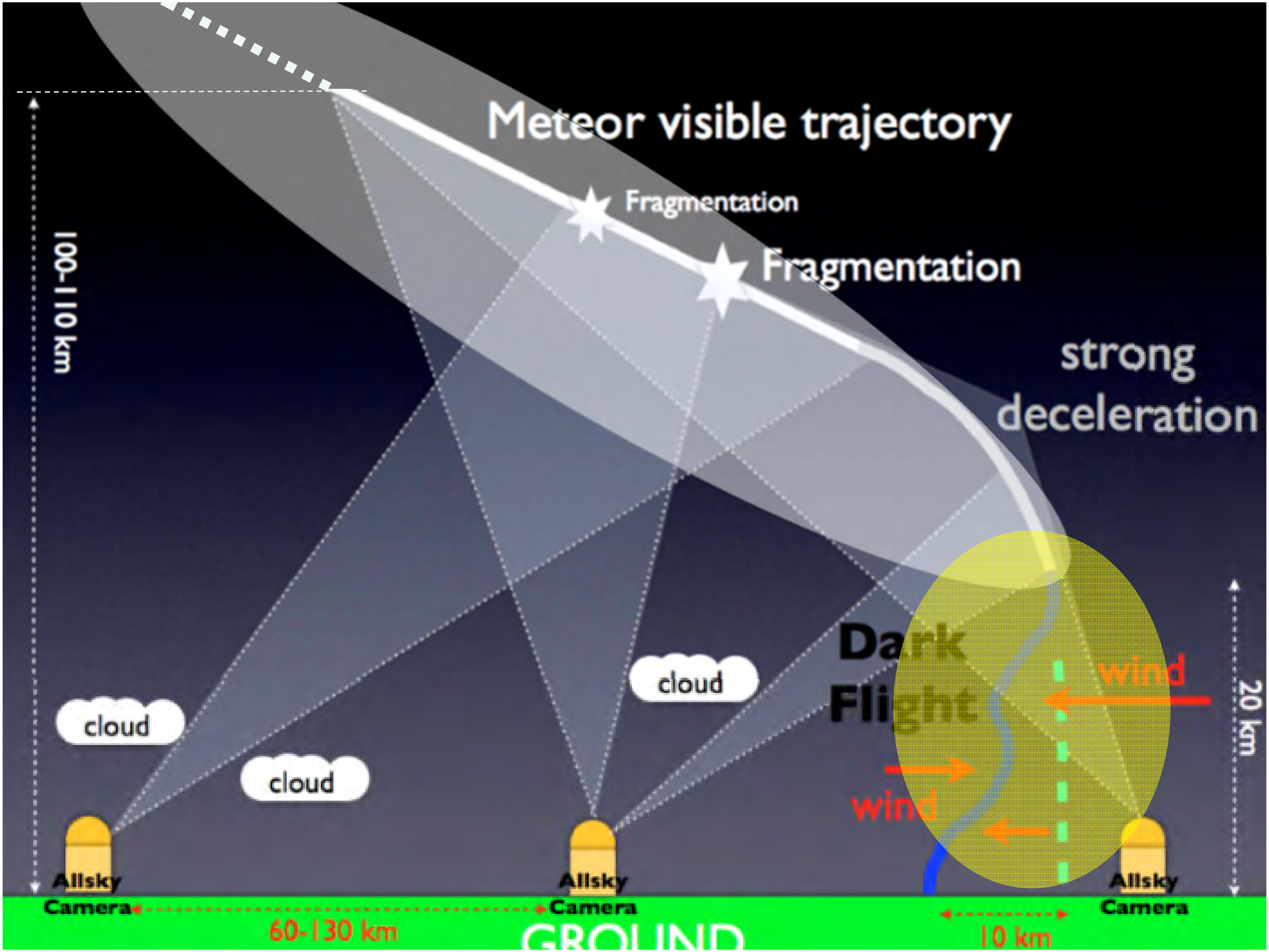
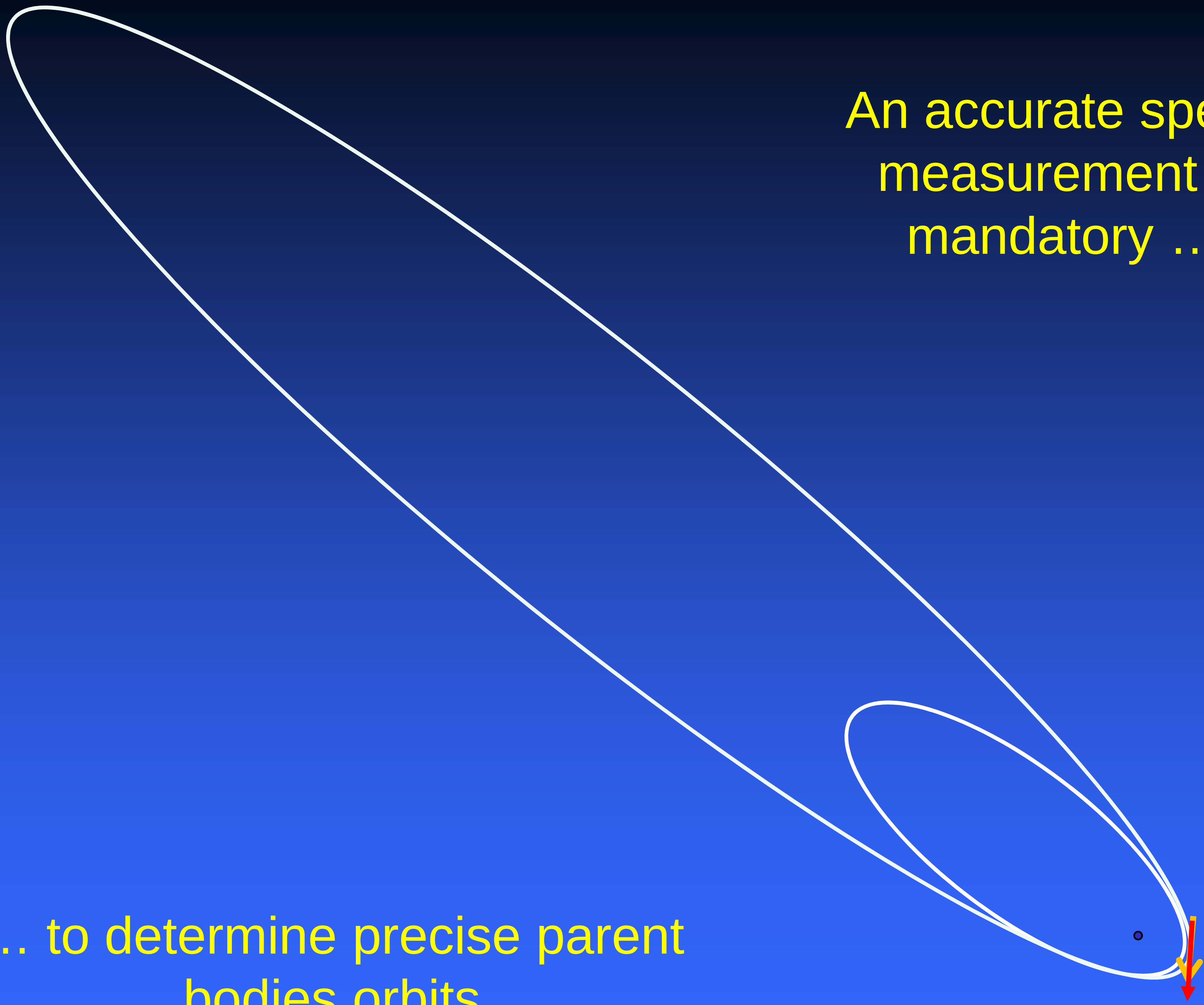
is going to install 100 CCD cameras and 10 digital radio receivers in France to detect large meteors and is aiming to find them if they become meteorites …


Meteor visible trajectory
Fragmentation
Fragmentation
strong
deceleration
100-110 km
Dark
Flight
wind
wind
20 km
cloud
cloud
cloud
Allsky
Camera
Allsky
Camera
Allsky
Camera
60-130 km
10 km
GROUND

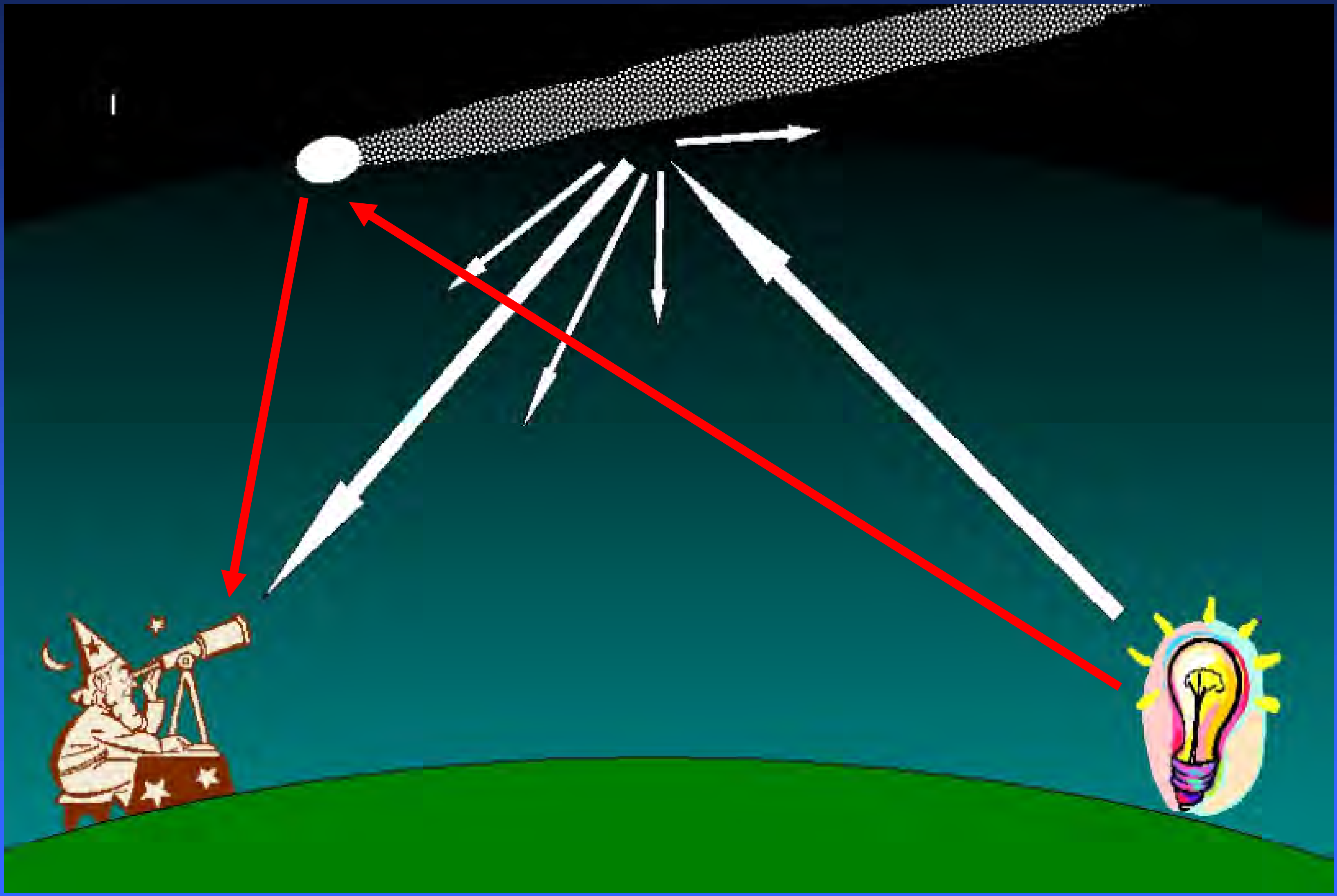
Thanks to the FRIPON radio sensors, it is hoped to improve the accuracy of the meteor speed measurements

An accurate speed measurement is mandatory …

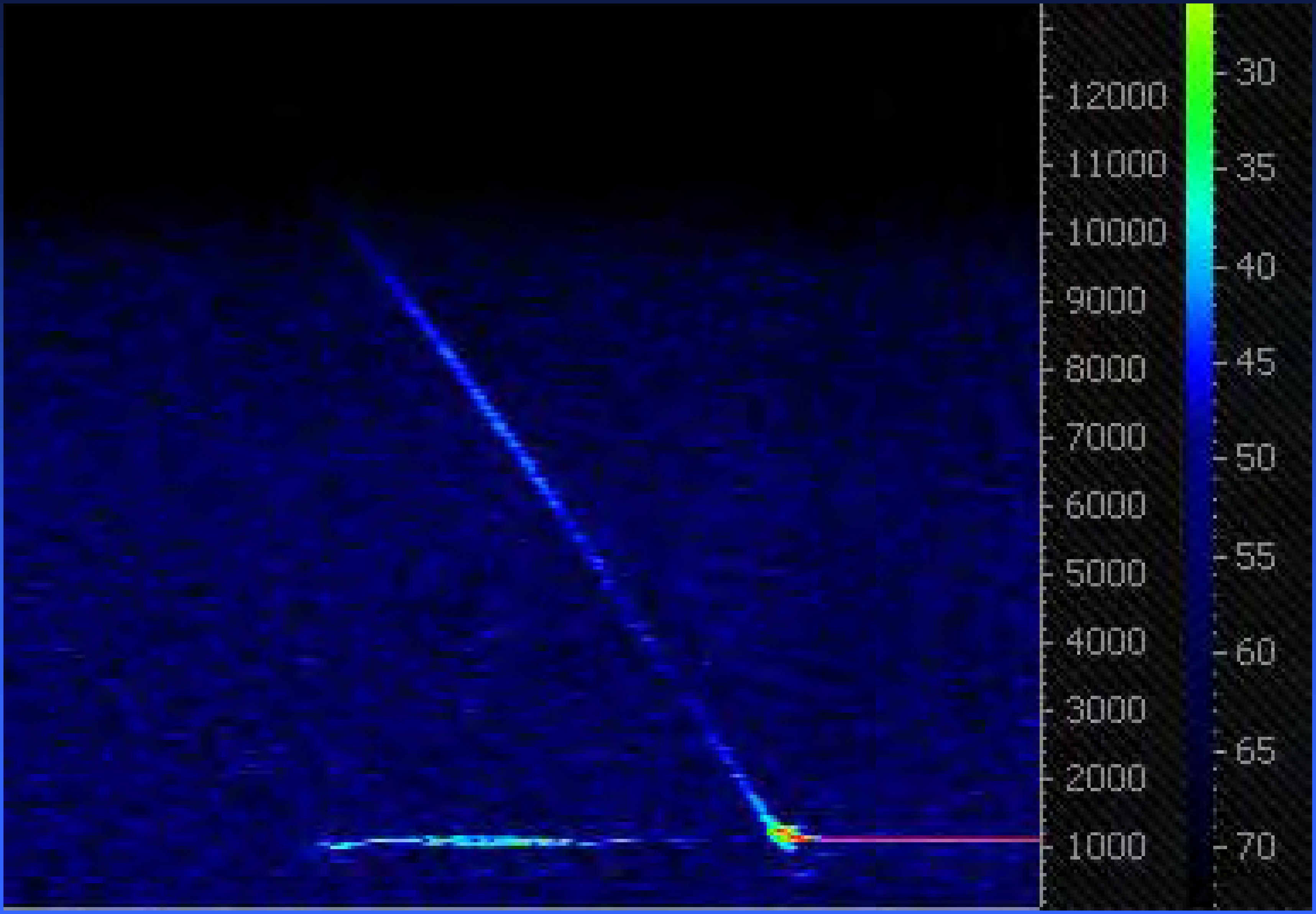


… to determine precise parent bodies orbits

Assessment of meteors radial speeds is performed thanks to head echoes Doppler shifts measurement



Example of meteor head echo detected with GRAVES radar at Pic du Midi Observatory



Maximum theoretical Doppler shift of a meteor head echo:

$$\Delta f = 2 * f_0 * (\Delta v / c)$$

i.e.:

- 67 kHz on 143 MHz (GRAVES)
- 23 kHz on 49 MHz (BRAMS)

for a target speed of 72 km/s

The FRIPON radio network will consist in:

-10 receiving equipment fitted with a 49 or 143 MHz Yagi beam antenna and a SDR (Software Defined Radio) connected to the video/data link computer

-at least 2 transmitters

The radio data will be acquired permanently but the data storage and transmission will be event-triggered to avoid too large data flows

Phased arrays antennas of the military GRAVES radar (Dijon, France)

Crossed dipoles of the BISA beacon (Dourbes, belgium)

Theoretical coverage of the BRAMS and GRAVES transmitters

Practical GRAVES coverage tests, using a simple low gain vertical monopole as receiving aerial

A few words about the FRIPON SDR

FUNcube Dongle Pro+ from AMSAT-UK

Testing a receiving 4 el. 144 MHz Yagi beam at Observatoire de Haute Provence

Some indoor dipole tests at Pic du Midi observatory

Testing the same dipole outdoors (using a ruggerized, professionnal, all-weather, waterproof, ice and lightning protected, scrubbing-brush)

Listening to the BRAMS low power beacon from Pic du Midi observatory

Testing FRIPON set-up prototype against Armagh-like monsters

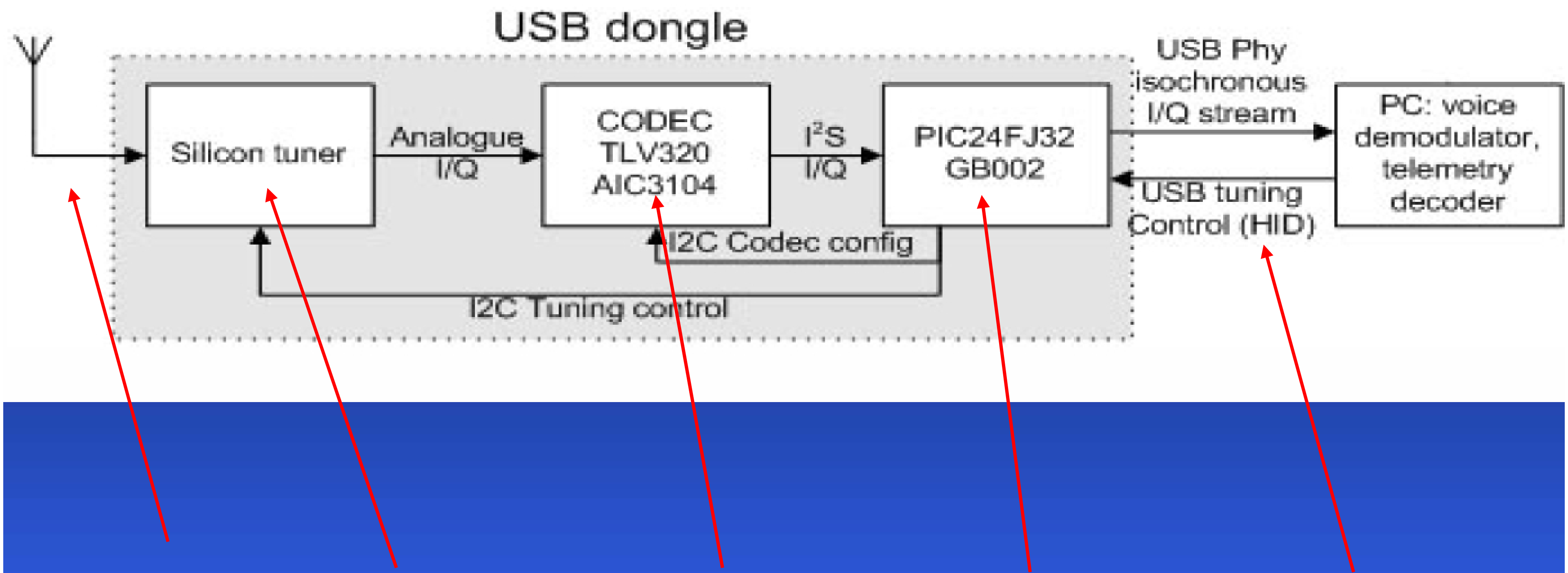
Choosing the FRIPON radio receiver

FRIPON choice is the simple, cheap but efficient AMSAT-UK FunCube Pro +2 dongle

< 150 €

Weight, size and interfaces

- 14 grammes
- 86 x 23 x 14 mm
- Antenna input: 50 Ω SMA connector
- Output: USB2 connector



Low Noise Amplifier + SAW filters + LC ? filters bank

E4000 Low power CMOS multiband tuner

TLV320 used as Analogue Digital Converter

PIC 24FJ32 Controller

USB 2 ways link to computer

Main performances

-150 kHz to 1900 MHz coverage (SAW filter on 143 MHz)

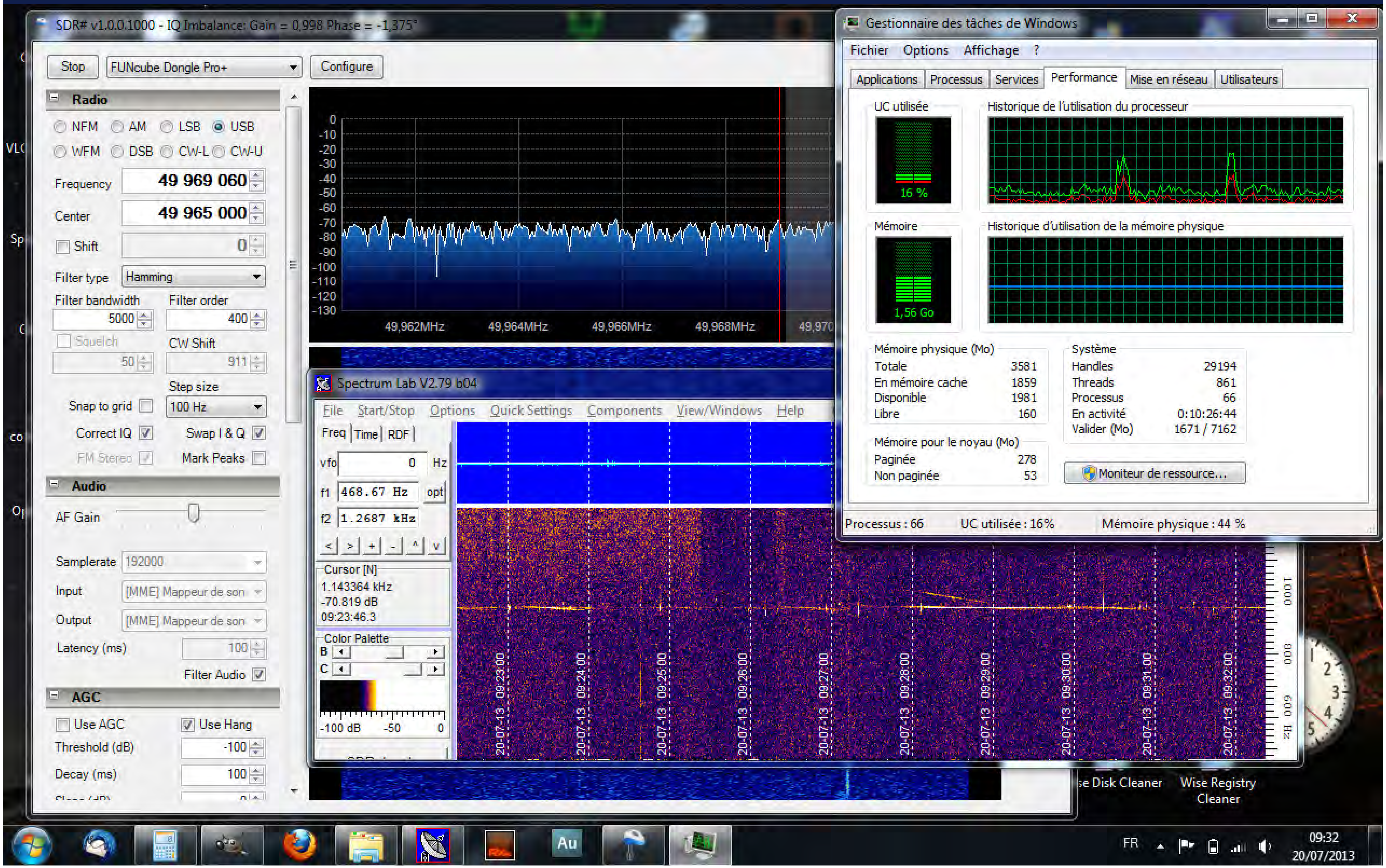
-Sample rate: 192 kHz (→ 192 kHz large band reception)

-IP_3 (third-order intercept point): 30 dBm

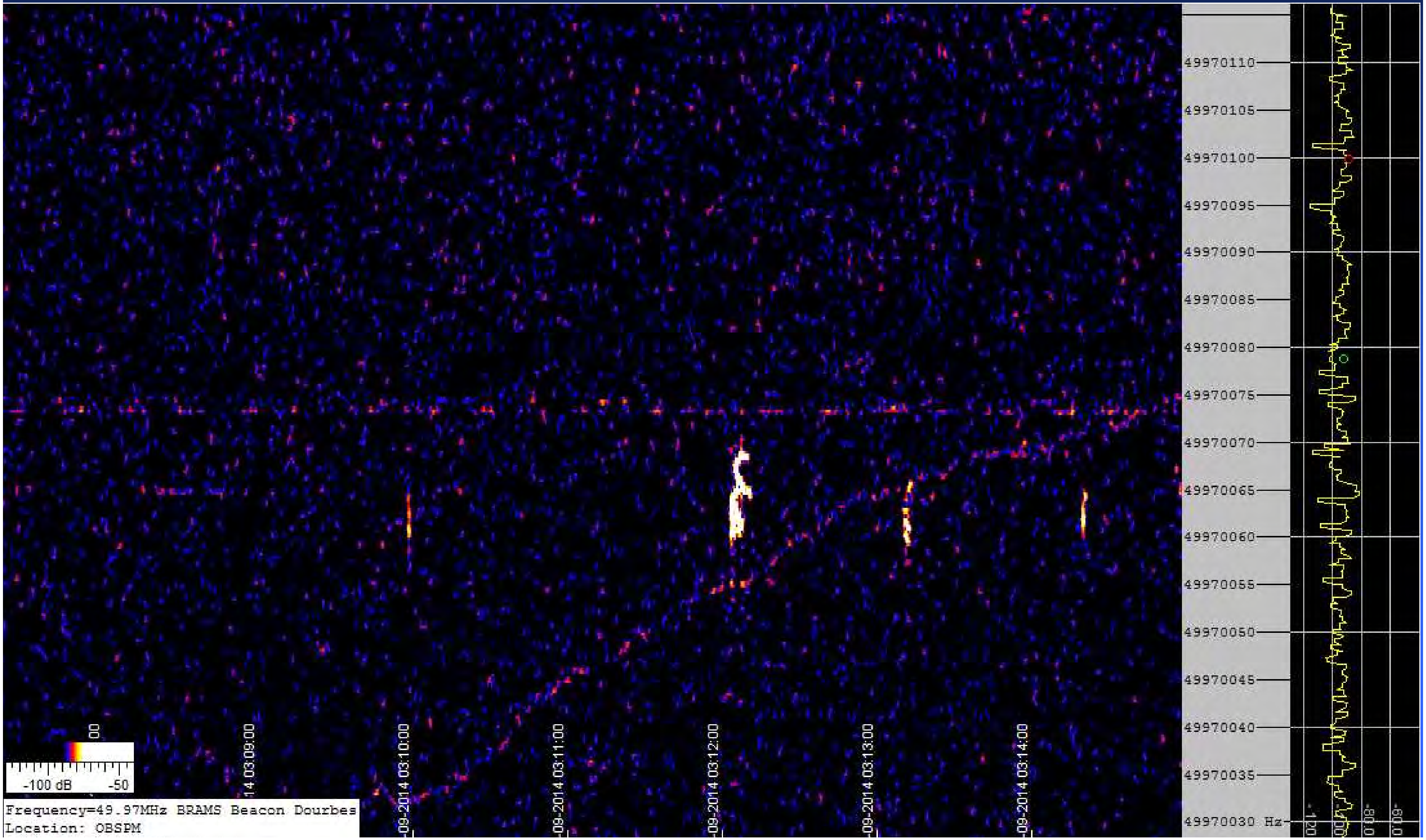
-TCXO: 0.5 10^{-6} (frequency offset adjustable by software)

-16 bits ADC resolution (→ 96 dB theoretical dynamic range)

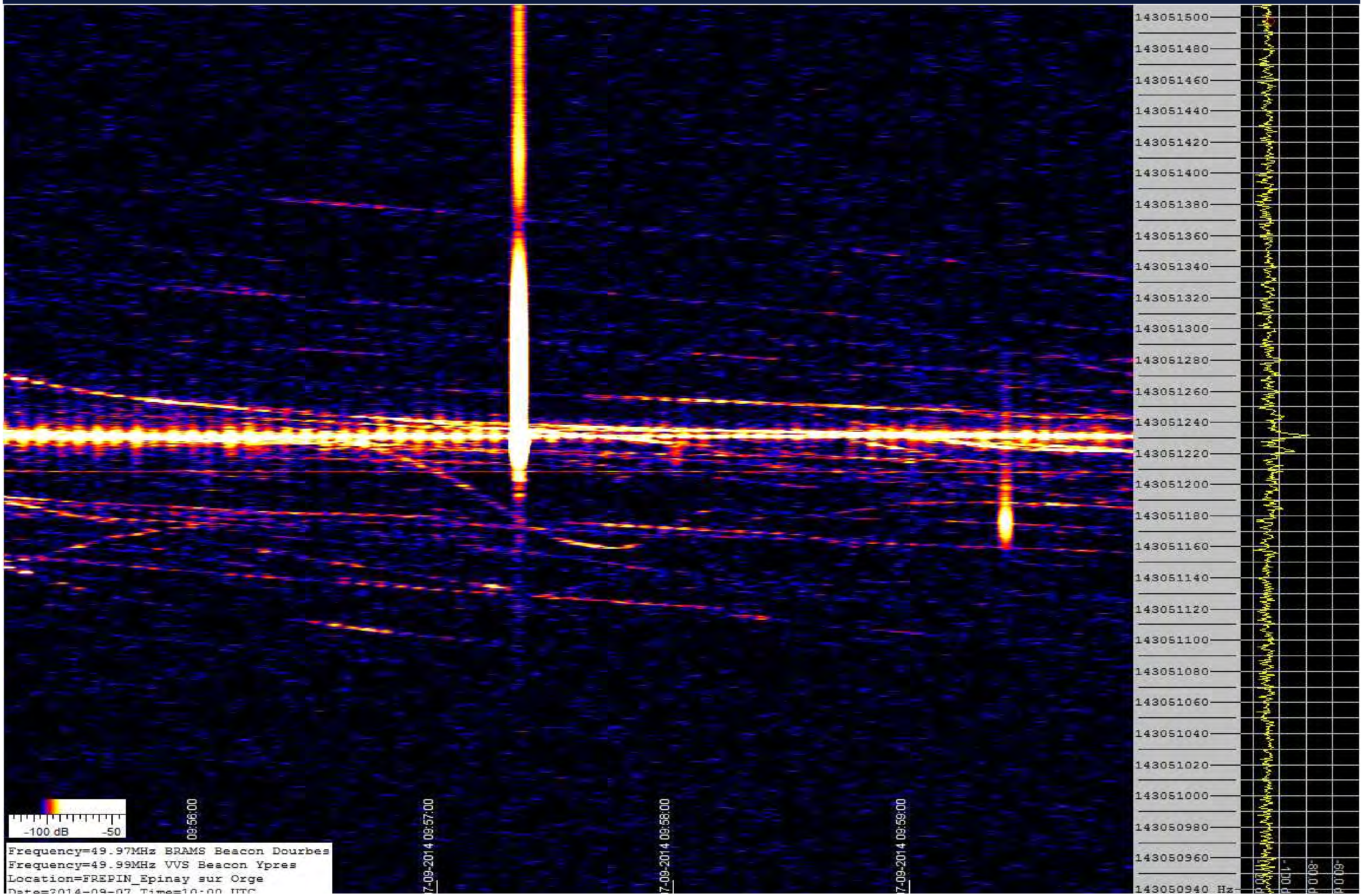
First tests of FUNcube on BRAMS beacon



Encouraging results on the FRIPON prototypes at Paris observatory: First light using BRAMS …



… and GRAVES


143051500
143051480
143051460
143051440
143051420
143051400
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143051280
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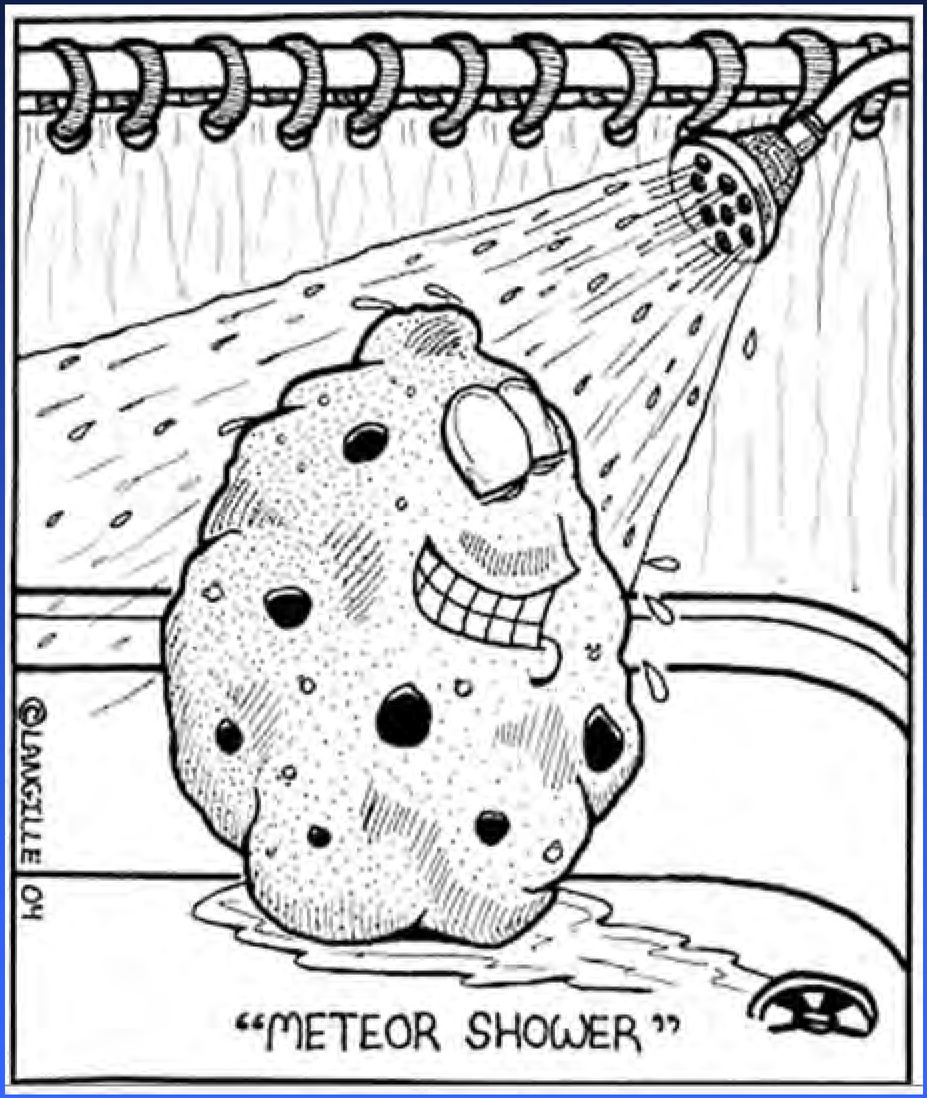
143051240
143051220
143051200
143051180
143051160
143051140
143051120
143051100
143051080
143051060
143051040
143051020
143051000
143050980
143050960
143050940 Hz
-100 dB
-50
09:56:00
7-09-2014 09:57:00
7-09-2014 09:58:00
7-09-2014 09:59:00
Frequency=49.97MHz BRAMS Beacon Dourbes
Frequency=49.99MHz VVS Beacon Ypres
Location=FREPIN_Epinay sur Orge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