Study of the Quadrantids 2016 using BRAMS data

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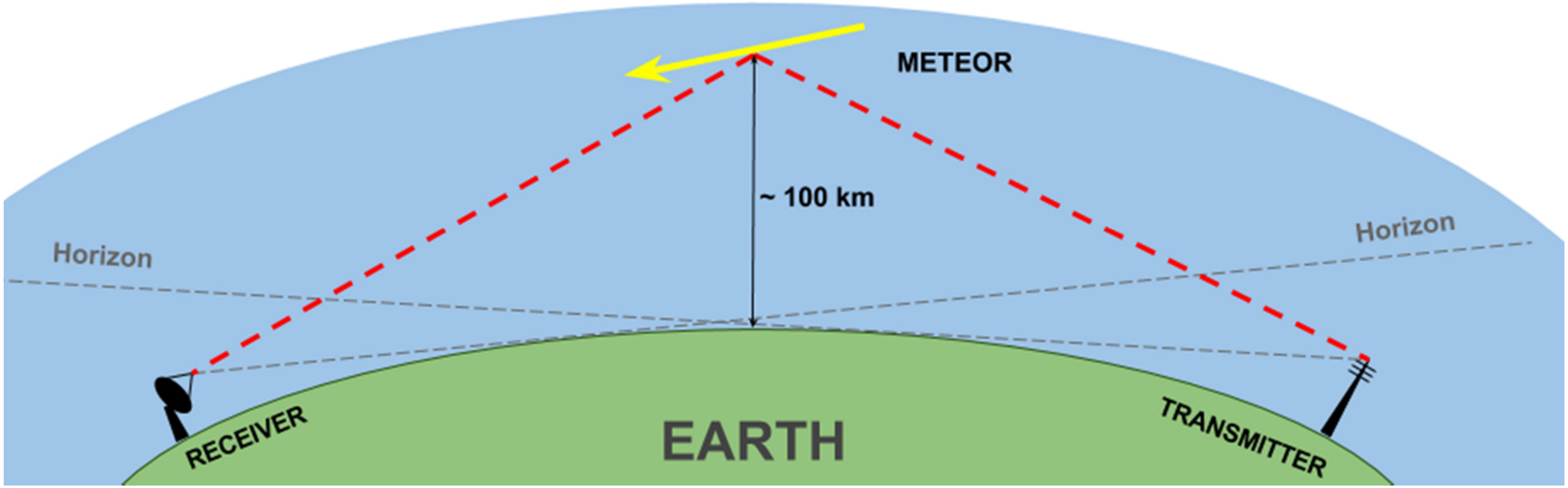
Outline

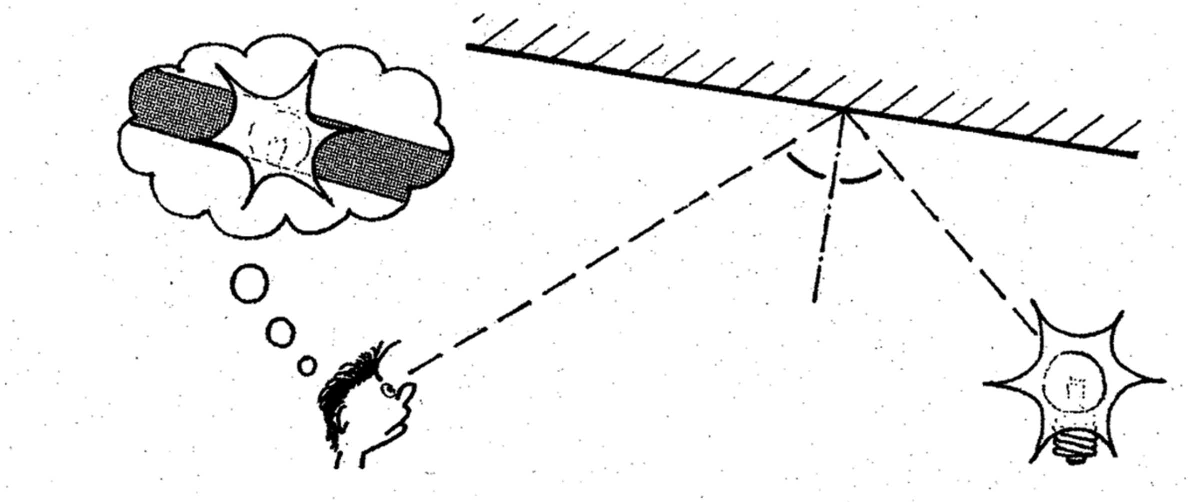
1. The BRAMS network and data

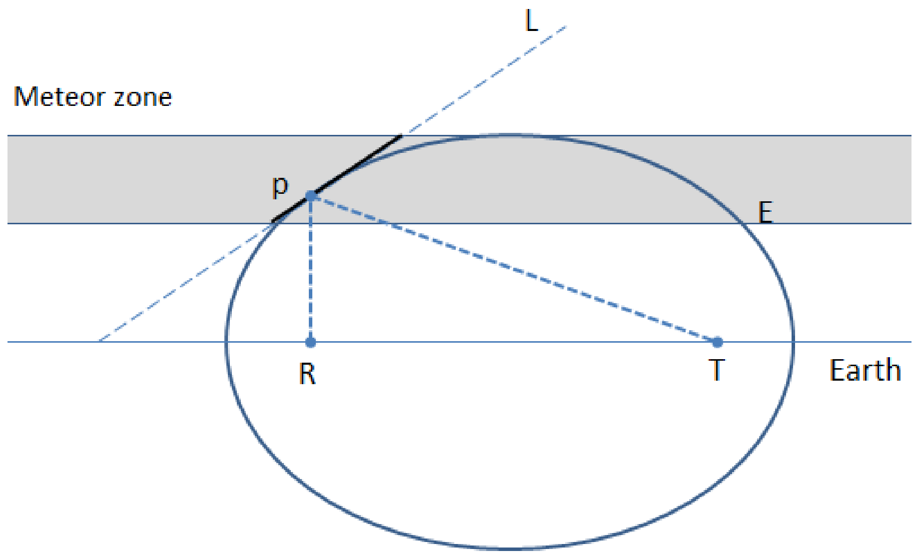
2. Mass index computation for Quadrantids 2016

Radio forward scatter observations

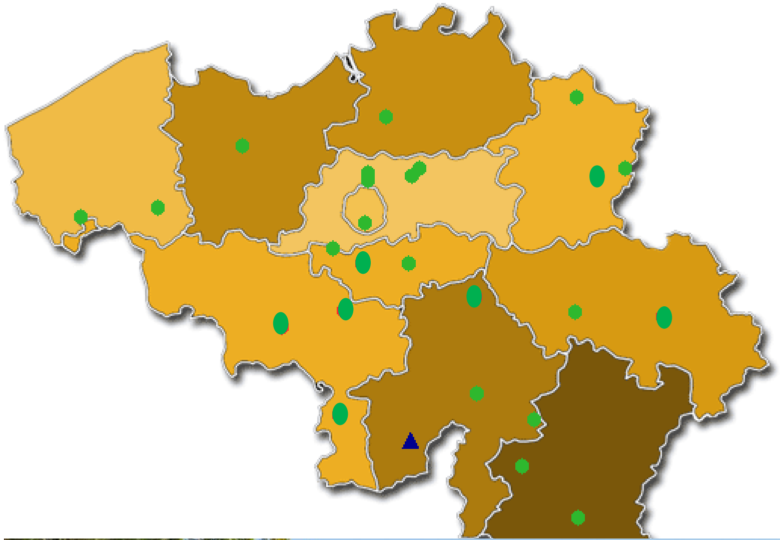


SPECULAR REFLECTION



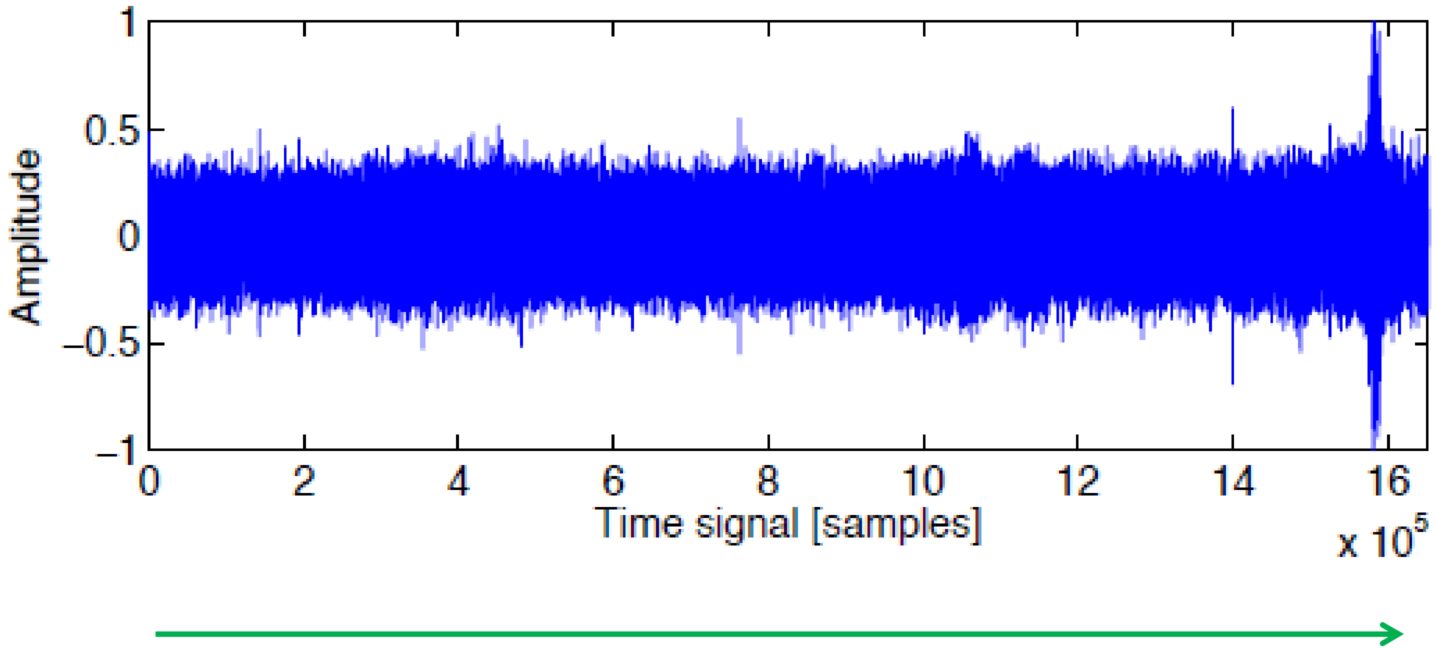


The BRAMS network



- ✓ 49.97 MHz
- ✓ 150 W
- ✓ pure sine wave

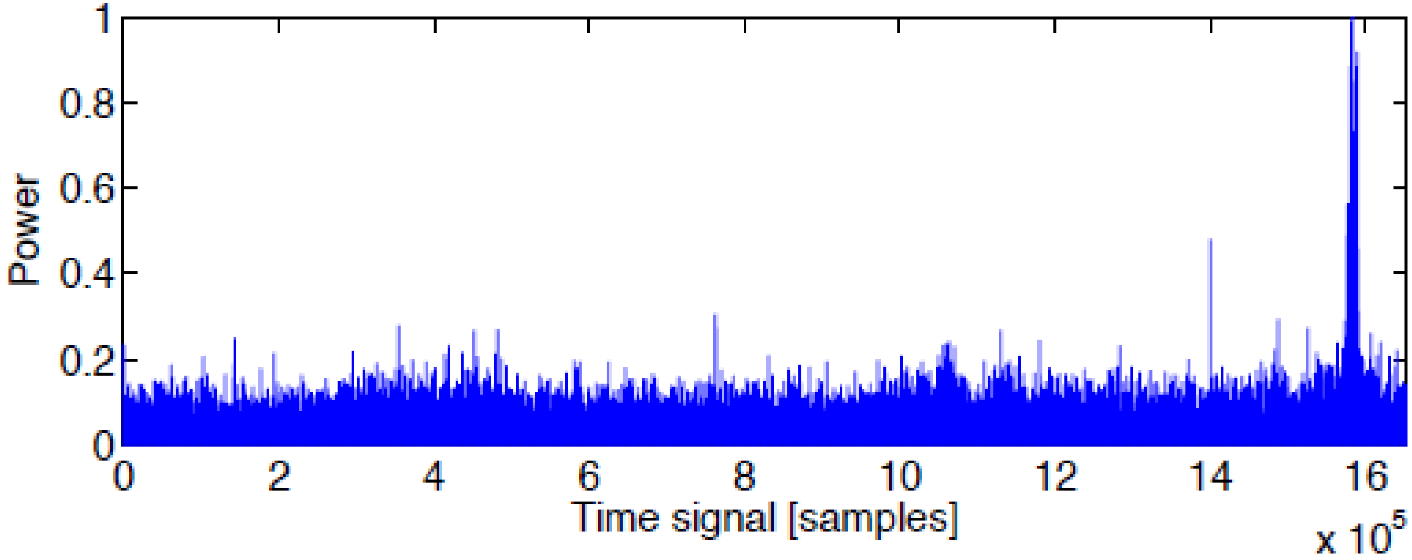
Example of BRAMS data



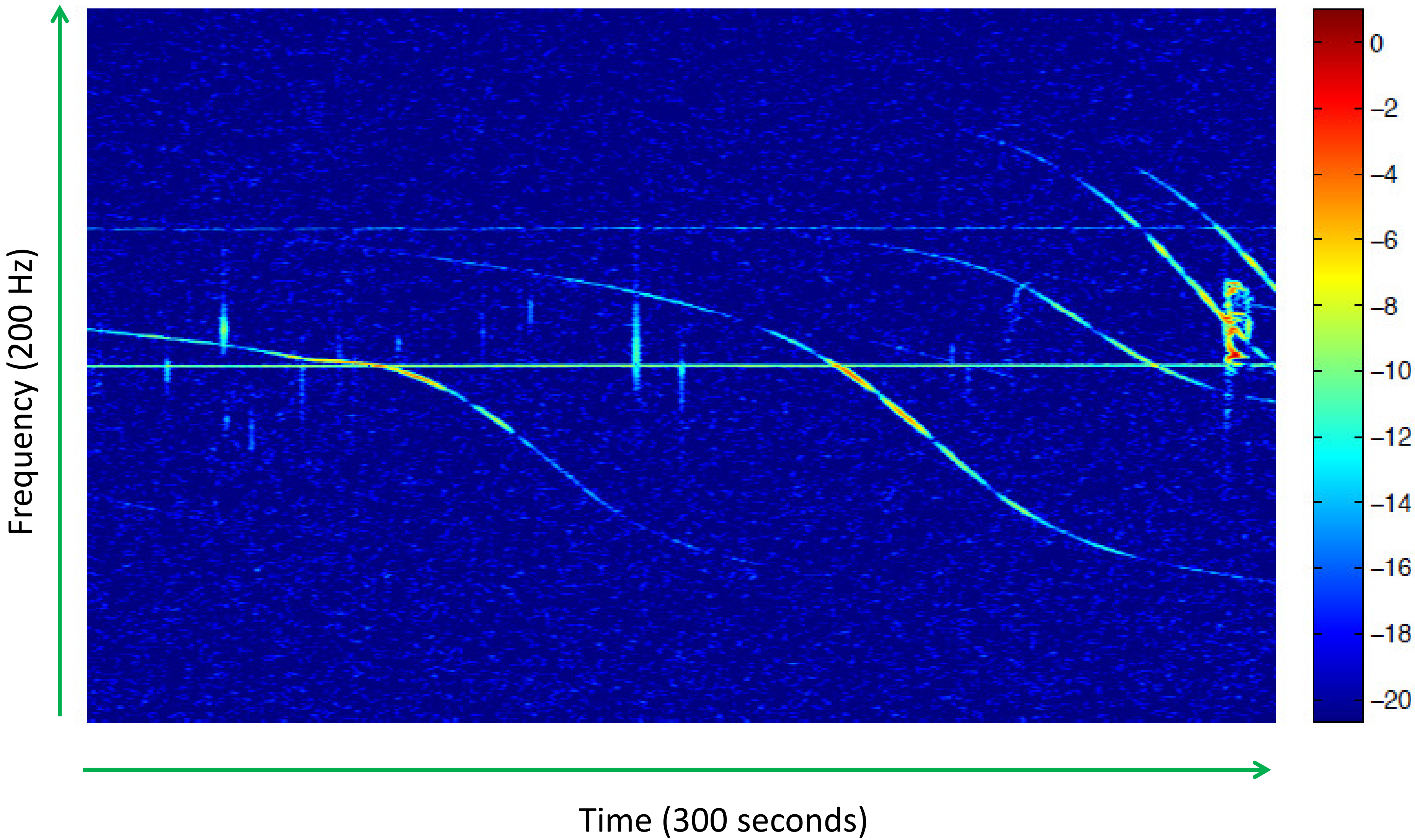
Time (300 seconds)

300×5512 = 1 653 600 samples

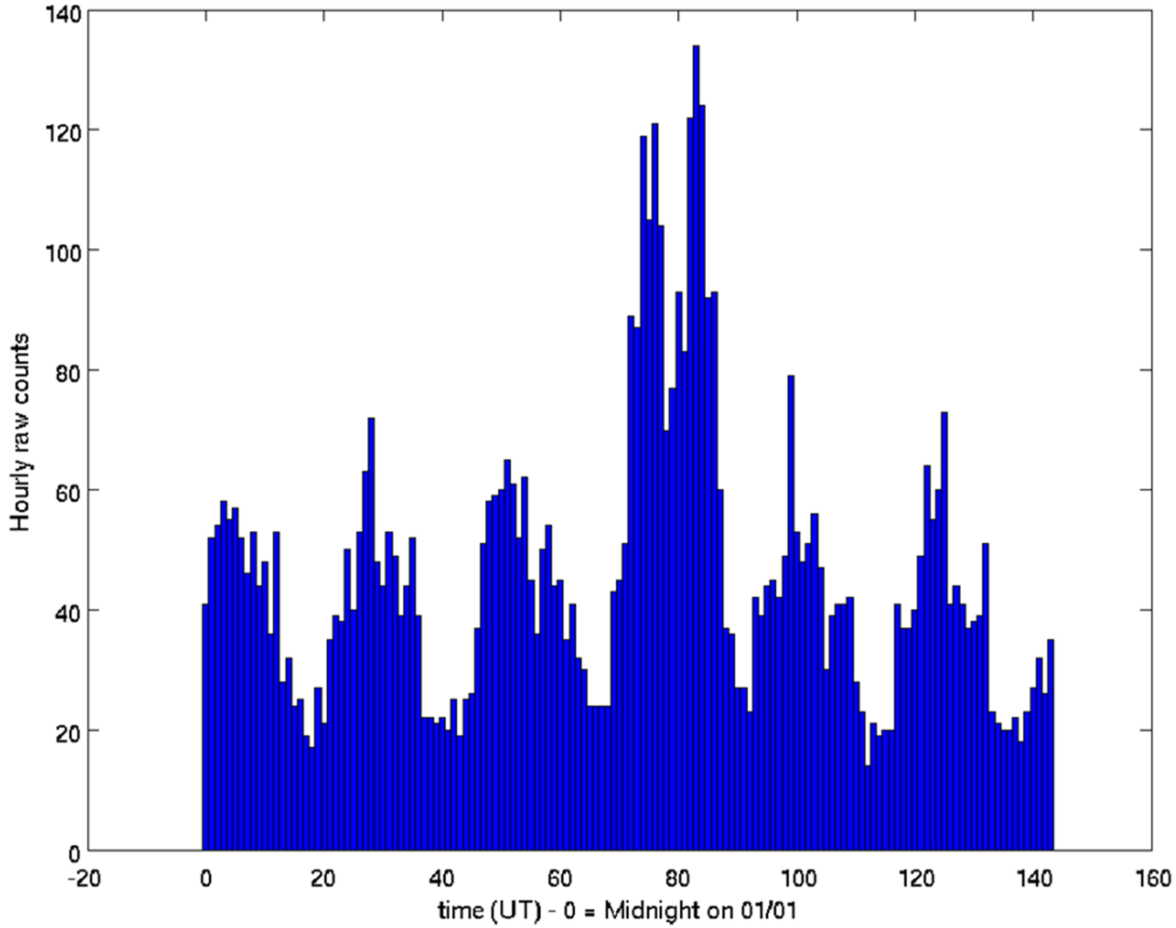
Example of BRAMS data



Example of BRAMS data



Quadrantids 2016



January 1-6, 2016

Mass index

$$dN_c = cM^{-s}dM \Rightarrow N_c \sim M^{-\alpha}$$

Cumulative mass distribution

α = s-1 = cumulative mass index exponent

- $\alpha > 2$: more mass in smaller particles
- $\alpha < 2$: more mass in larger particles

For radio observations : amplitude of the radio meteor echo is used as a proxy for mass

Mass index

Line electron density q

$< 10^{13}$ e-/m

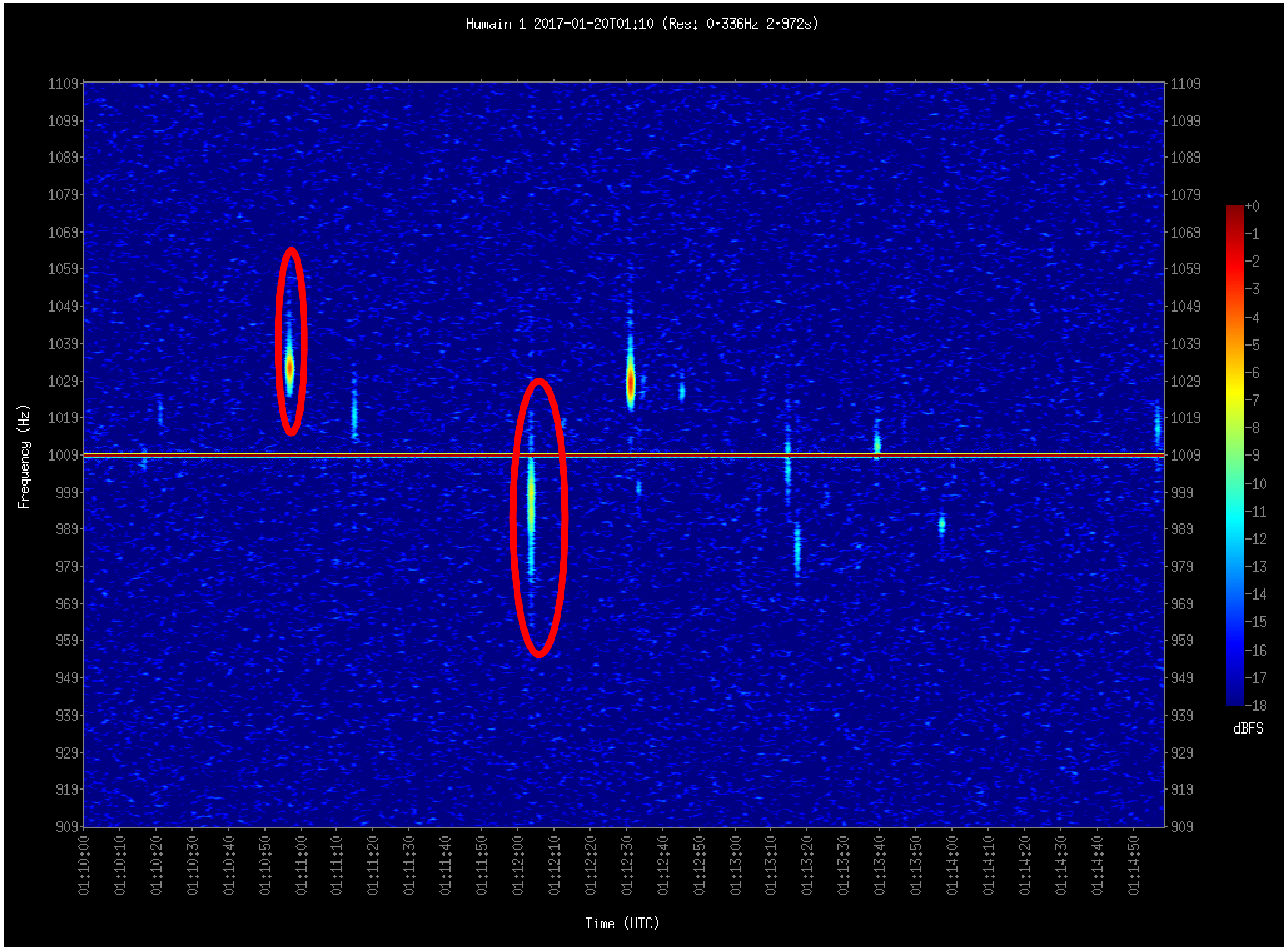
$> 10^{15}$ e-/m

Underdense meteor trail

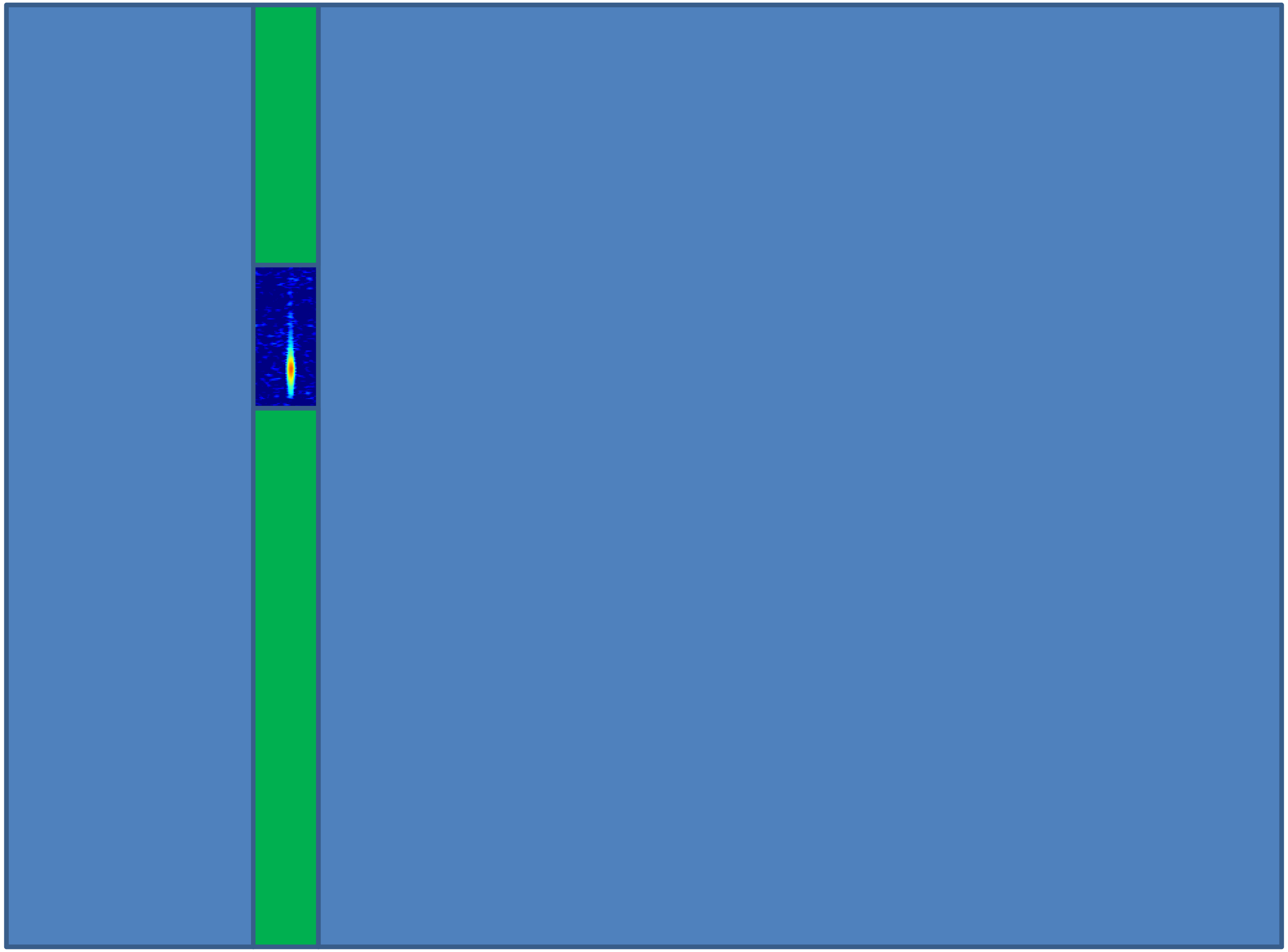
Overdense meteor trail

$$P_R = \frac{P_T G_T G_R \lambda^3 \sigma_e}{64\pi^3} \frac{q^2 \sin^2 \gamma}{(R_1 R_2)(R_1 + R_2)(1 - \sin^2 \phi \cos^2 \beta)}$$

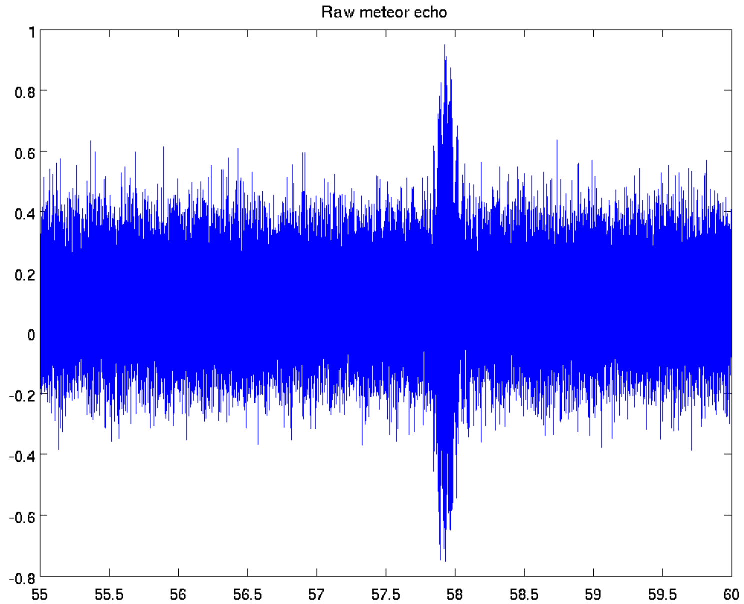
Measurements of amplitude of meteor echoes

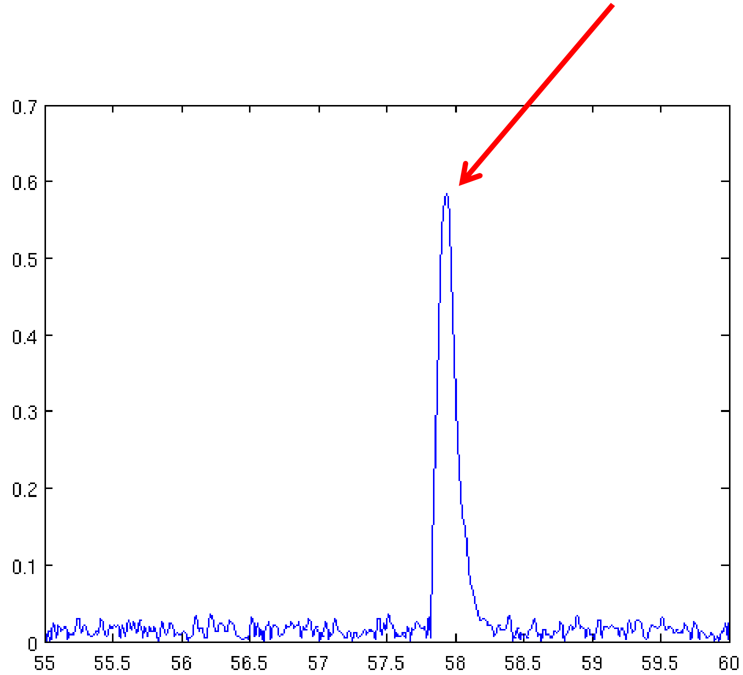


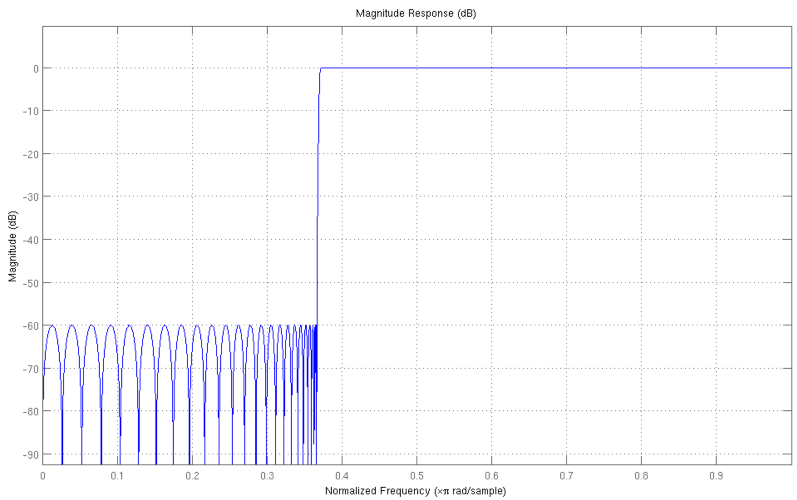
« Isolated » meteor echo



« Isolated » meteor echo

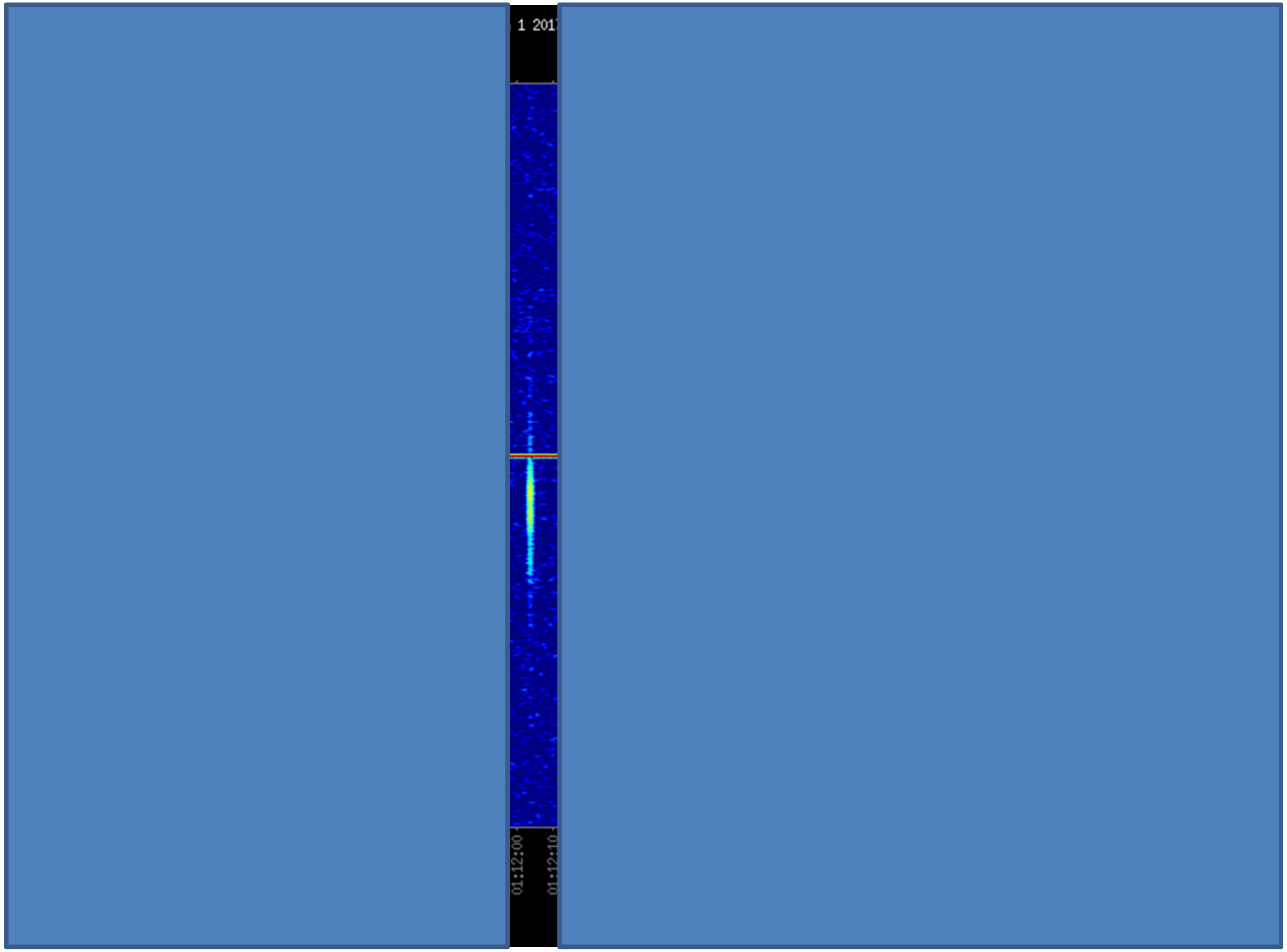






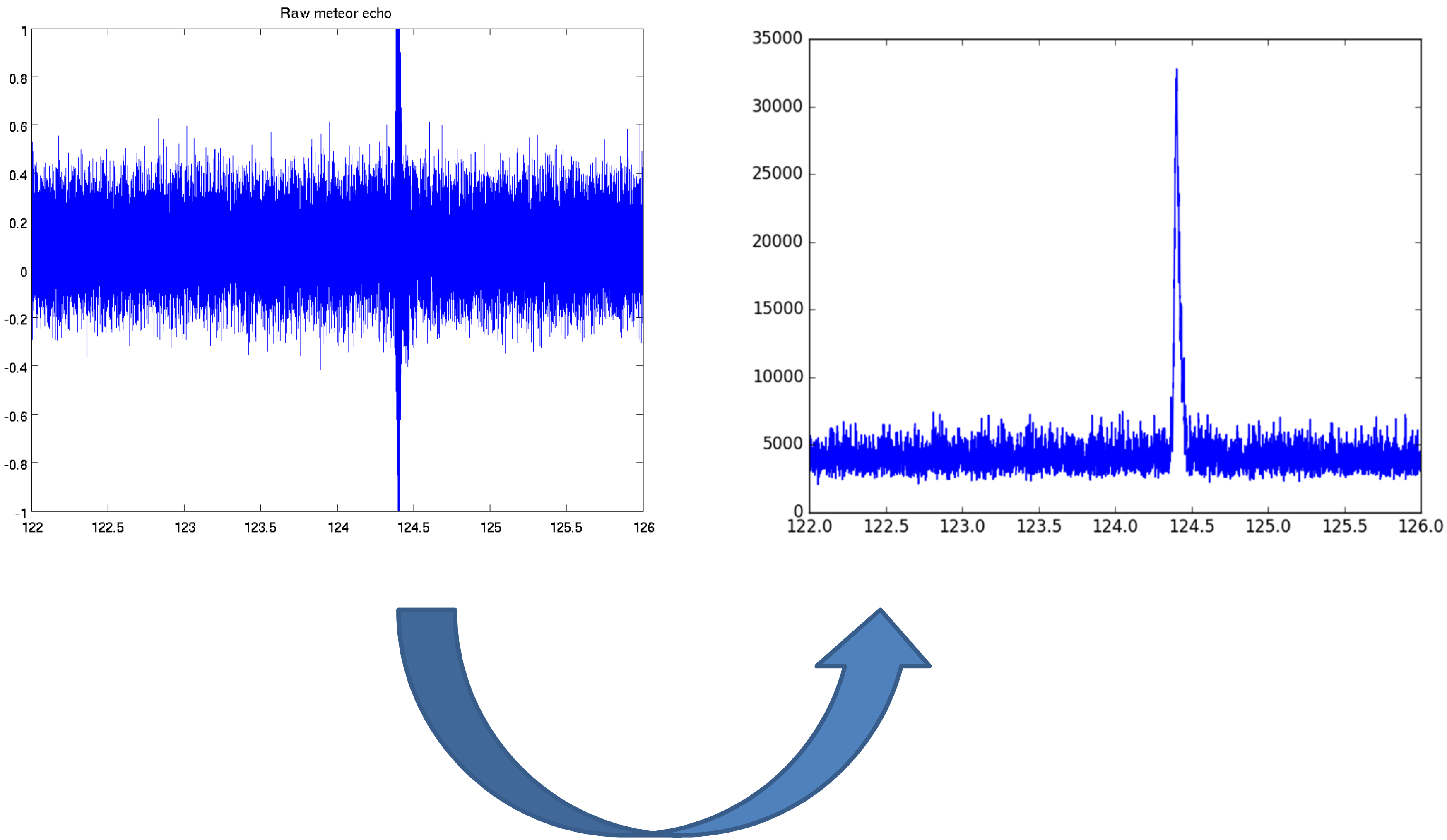
Cheby2

Meteor echo + direct signal from the beacon

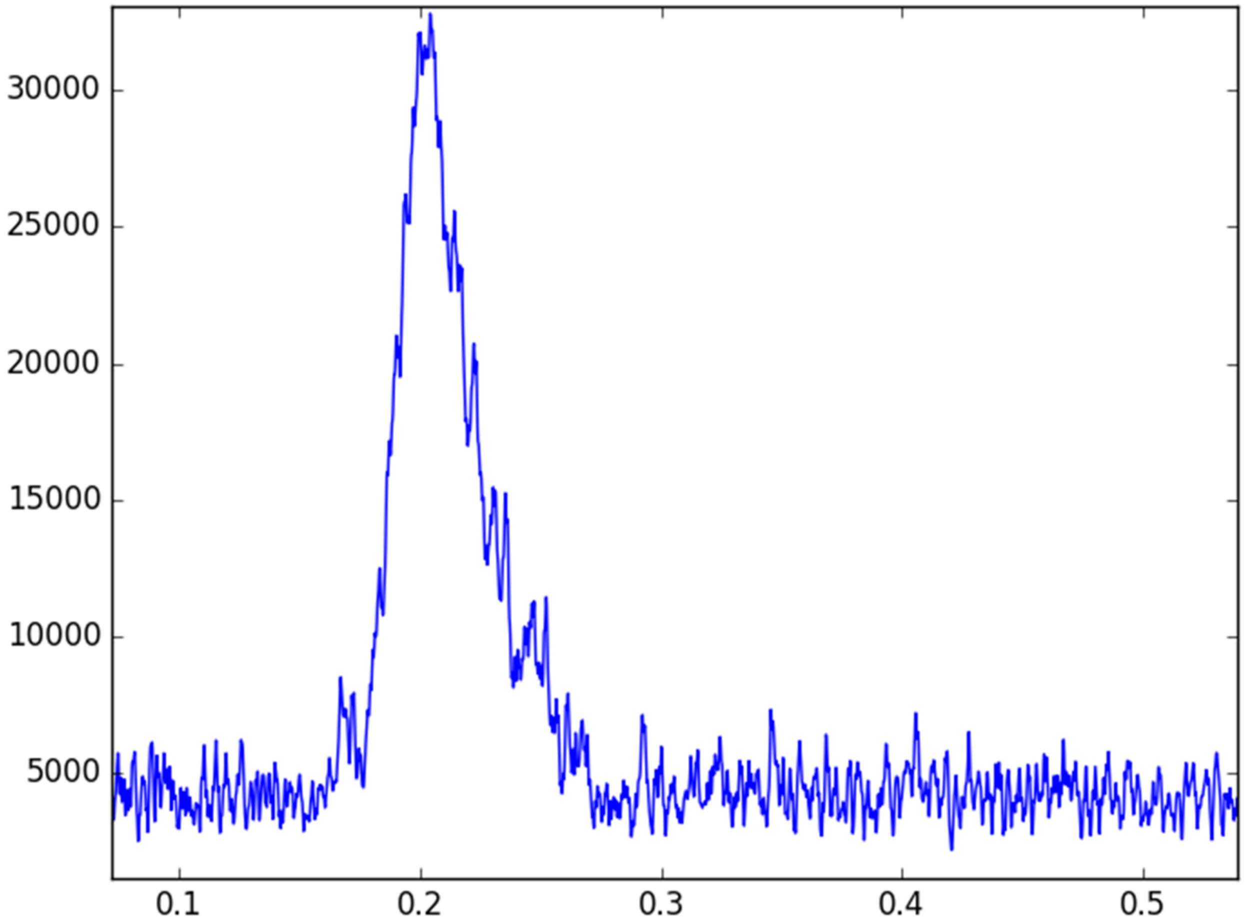


Reconstruction via FFT and subtraction of the beacon signal : A sin($\omega t + \phi$)

Meteor echo + direct signal from the beacon

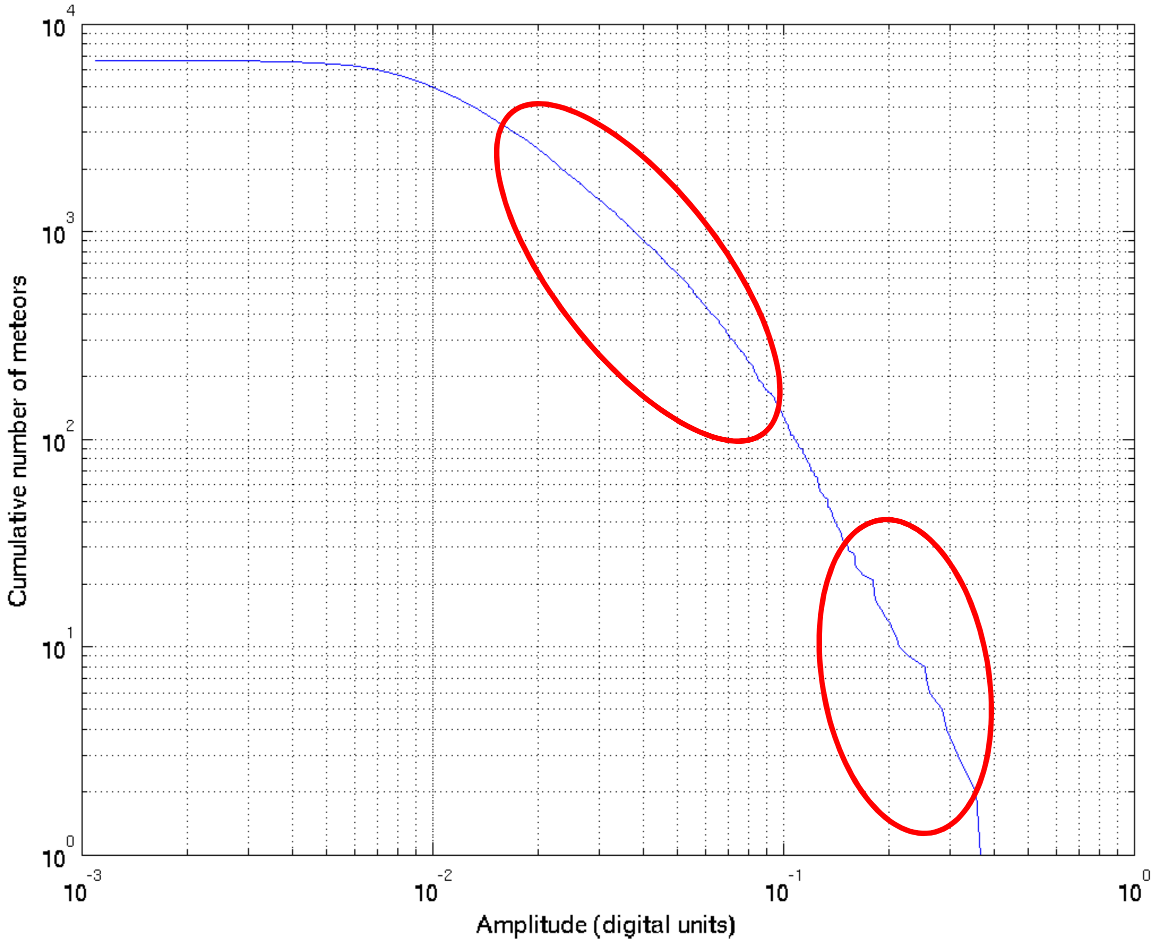


Zoom on the meteor echo



Cumulative amplitude distribution

Log N



Underdense meteor echoes

A ~ q

Slope = 1-s

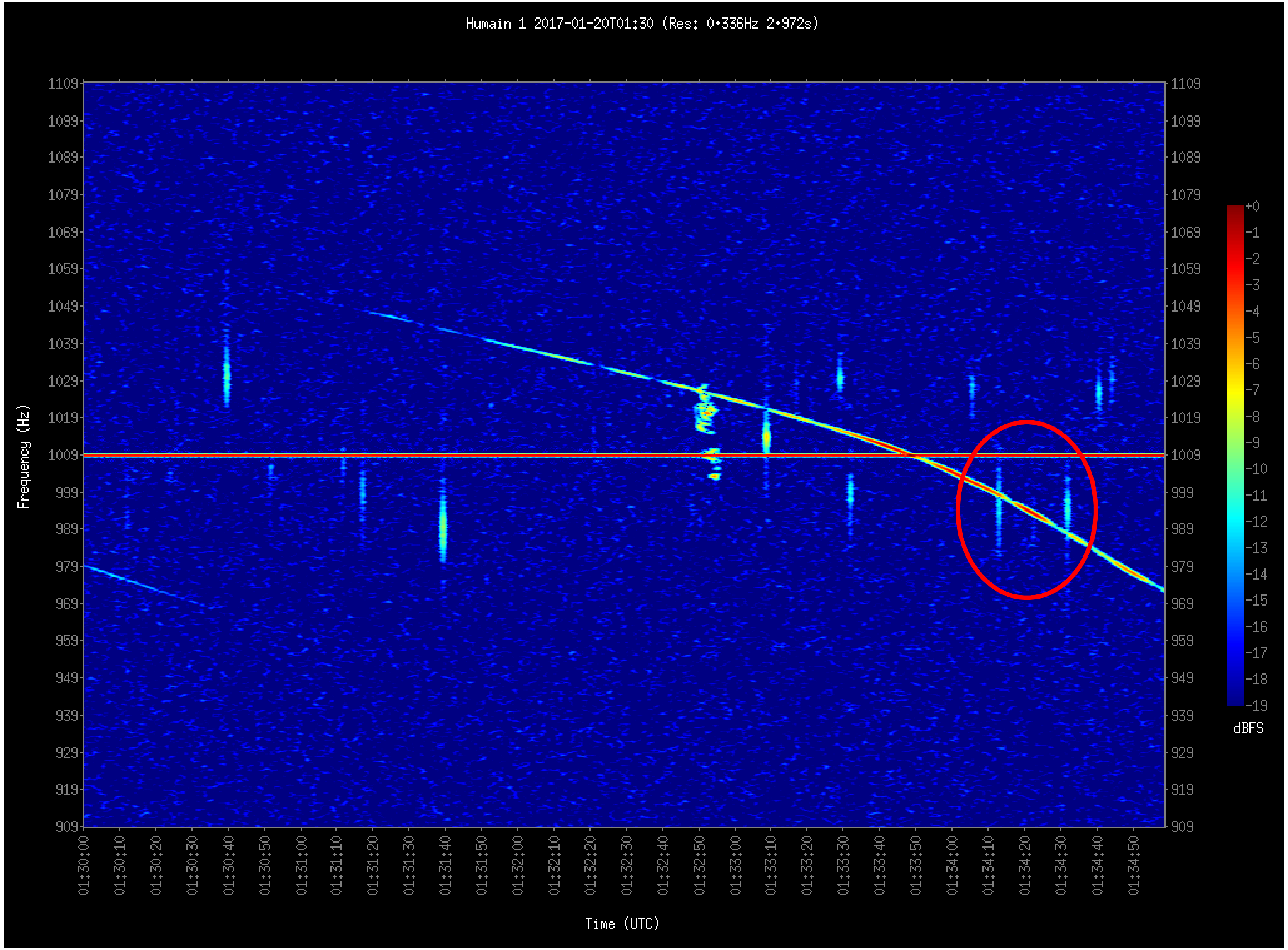
Overdense meteor echoes

A ~ $q^{1/2}$

Slope much harder to define

Log A

Still some problems to solve …



Moreover….

- Range is currently not known : a faint meteor echo can be intrinsically faint or distant
  - Solution : trajectories from multi-stations observations
- Sporadic contamination
  - Solution : compute CMD before and after the shower and see how it changes during the meteor shower
  - Solution 2 : trajectories

Conclusions

- BRAMS network is fully operational with 25 receiving stations
- A lot of data are available to study meteor showers
- Here we presented preliminary results with data from the Quadrantids 2016 to test the filtering of meteor echoes and try to compute the mass index.
- The computation of the mass index will be more accurate when individual trajectories will be available from BRAMS data.


Thank you