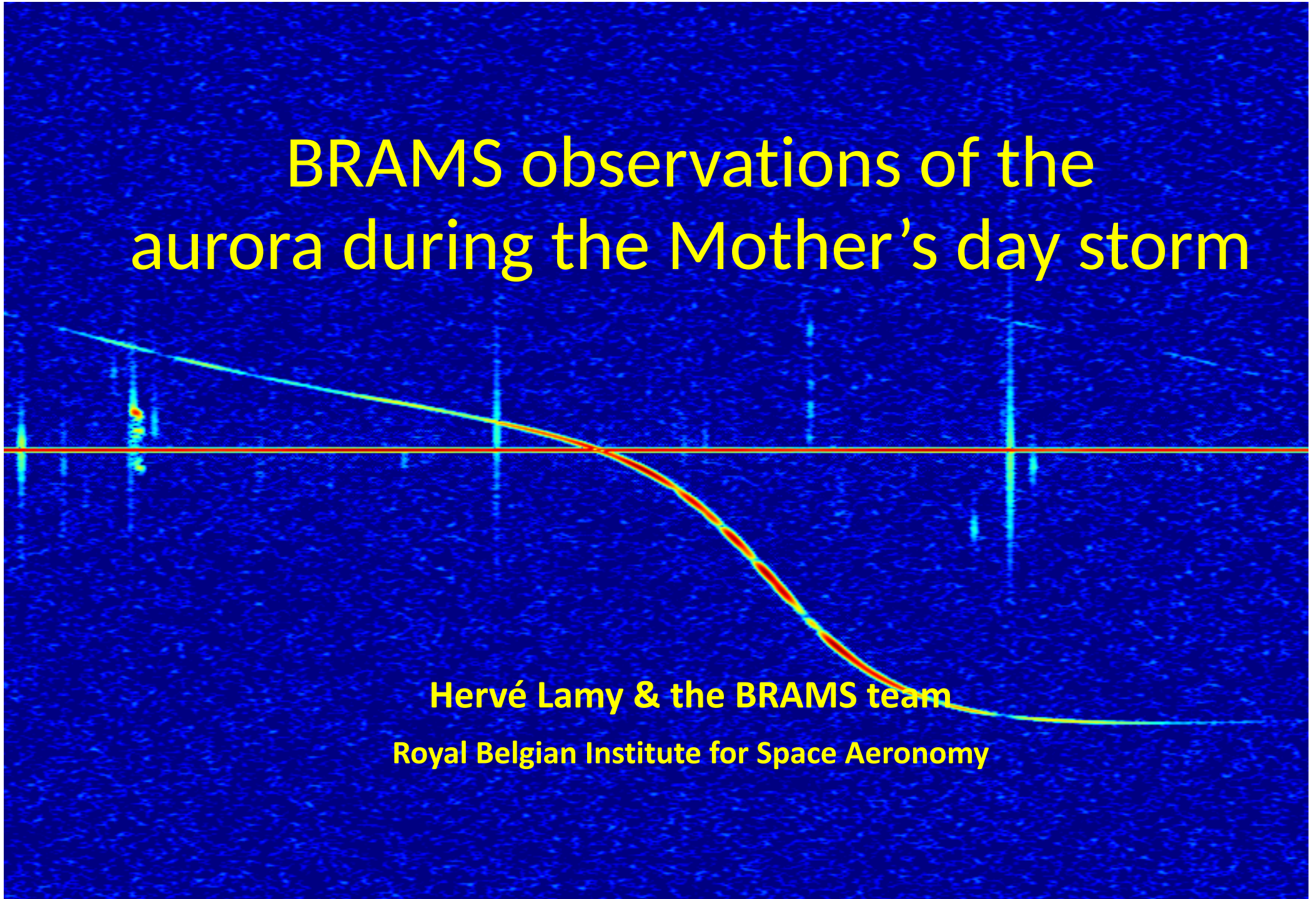
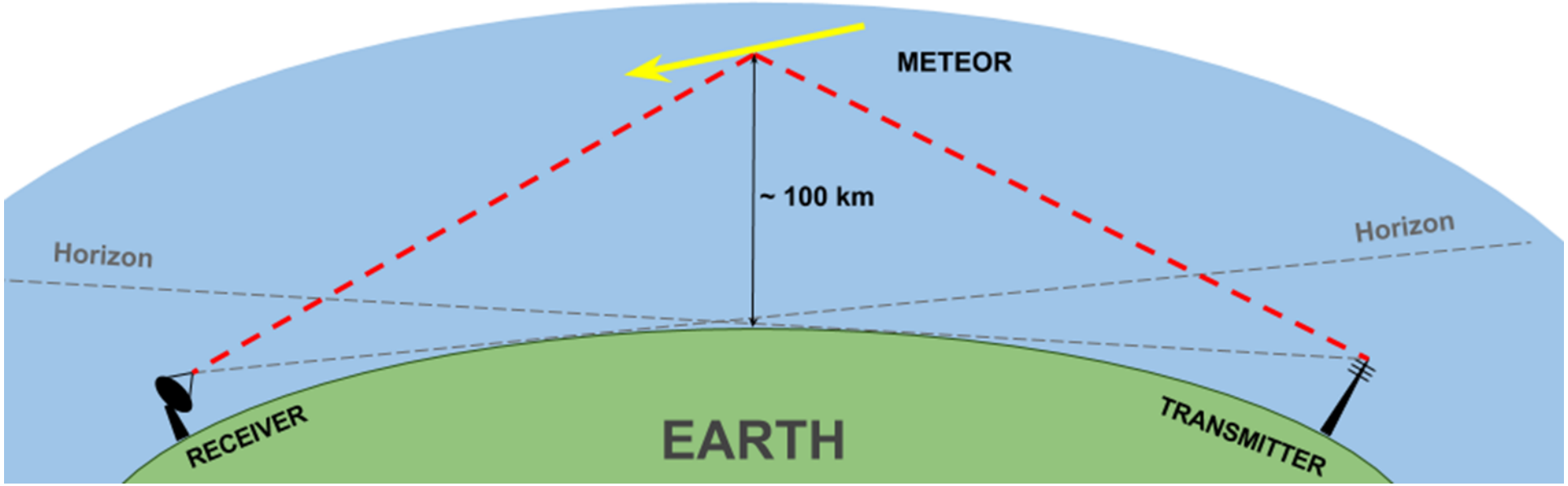
# BRAMS observations of the aurora during the Mother's day storm



**Hervé Lamy & the BRAMS team**

**Royal Belgian Institute for Space Aeronomy**

# Forward scatter radio observations of meteors

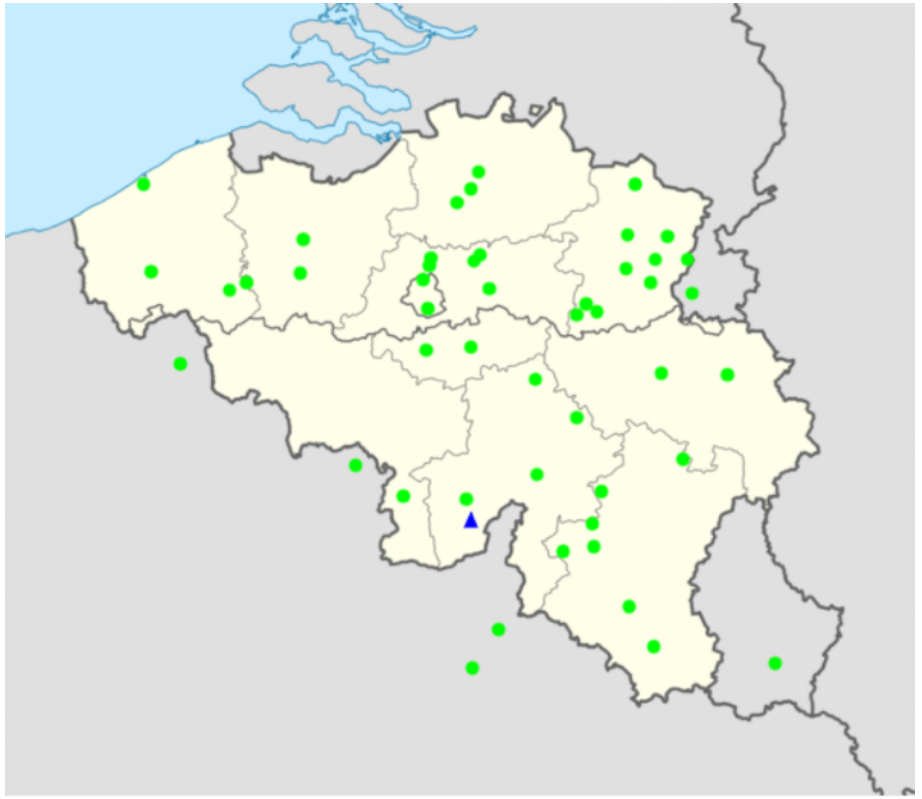


# The BRAMS network

**A dedicated Transmitter**

- ✓ Located in Dourbes (blue triangle) :
- ✓ ***f*=49.97 MHz**
- ✓ CW with no modulation
- ✓ Radiated power: 340 Watts
- ✓ circular polarization towards zenith



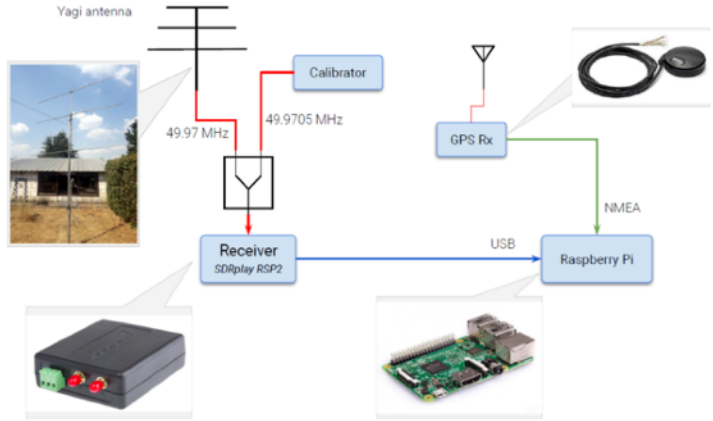




**50 Receiving stations**

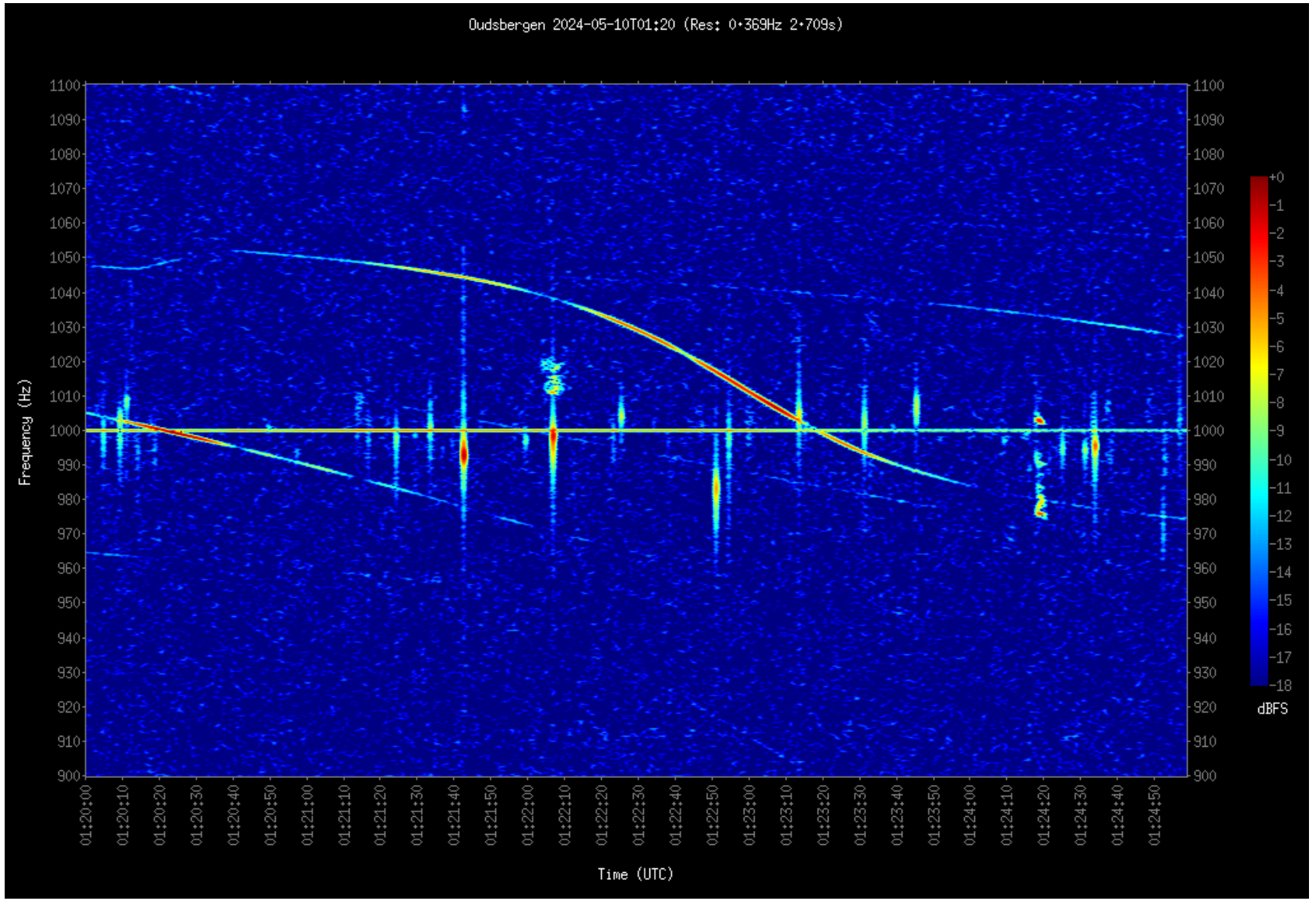
- ✓ Green dots
- ✓ 3-elements Yagi antennas
- ✓ Synchronized using GPS clocks



# BRAMS data at BEOUDS at 01H20 UT on 10/05/24

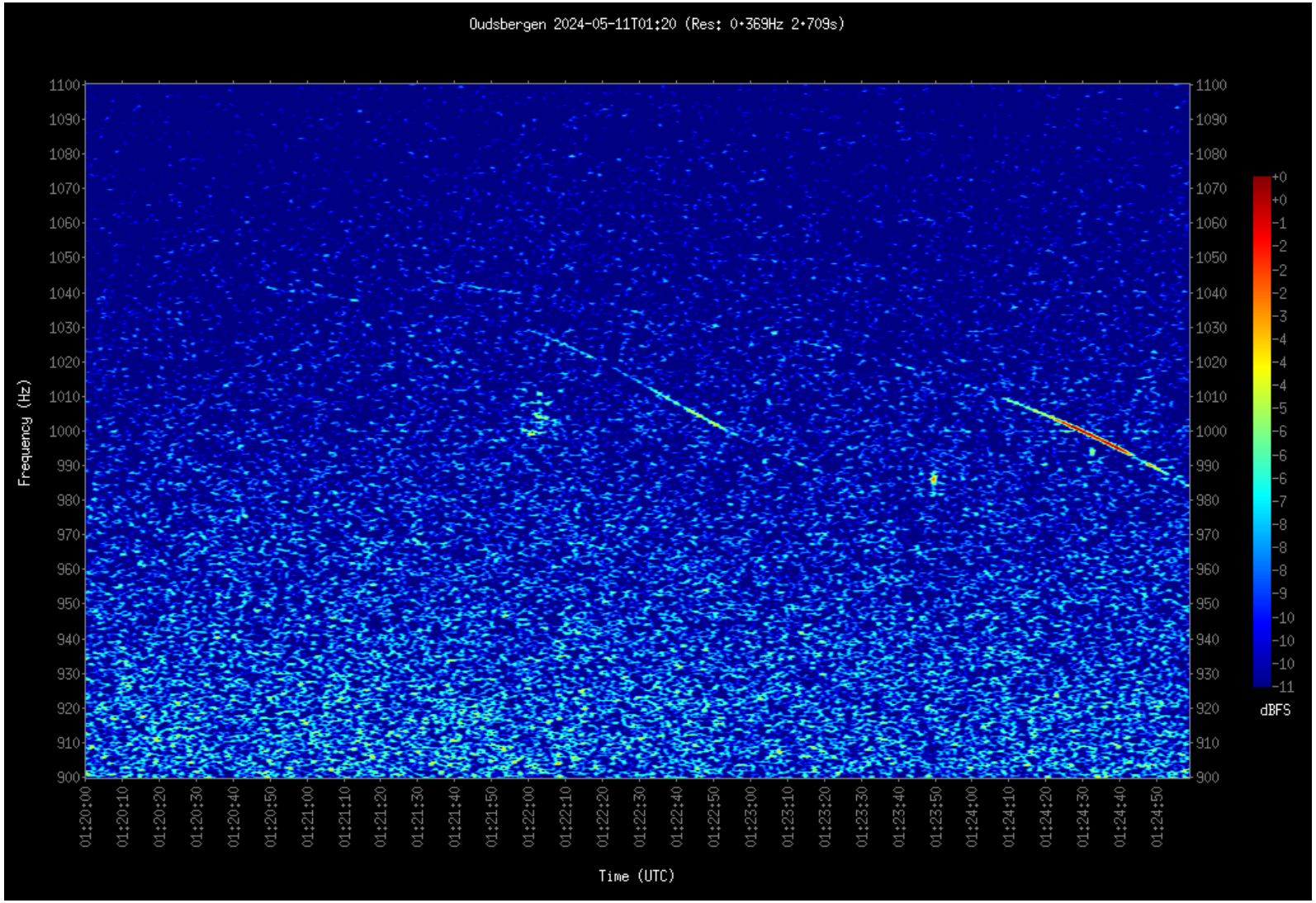
900-110
0 Hz




Typical spectrogram at BEOUDS with a really good SNR

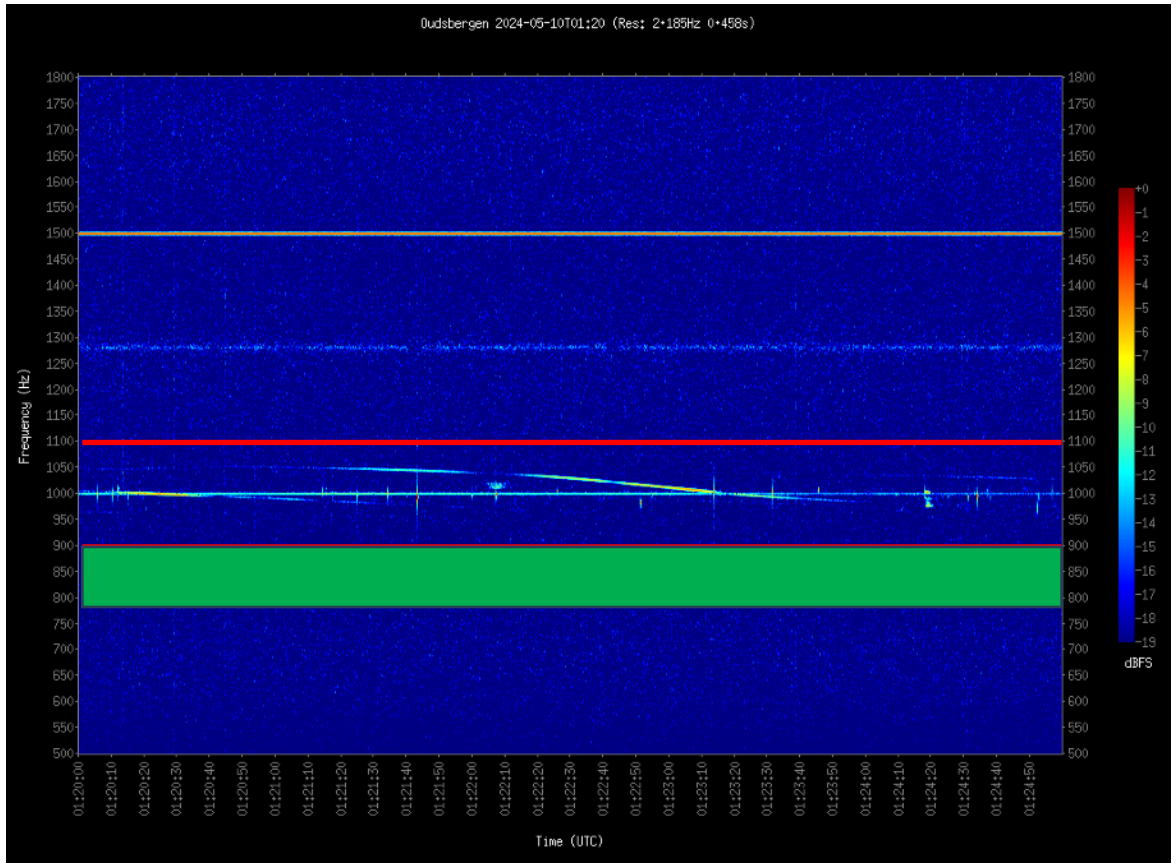
# BRAMS data at BEOUDS at 01H20 UT on 11/05/24

900-110
0 Hz



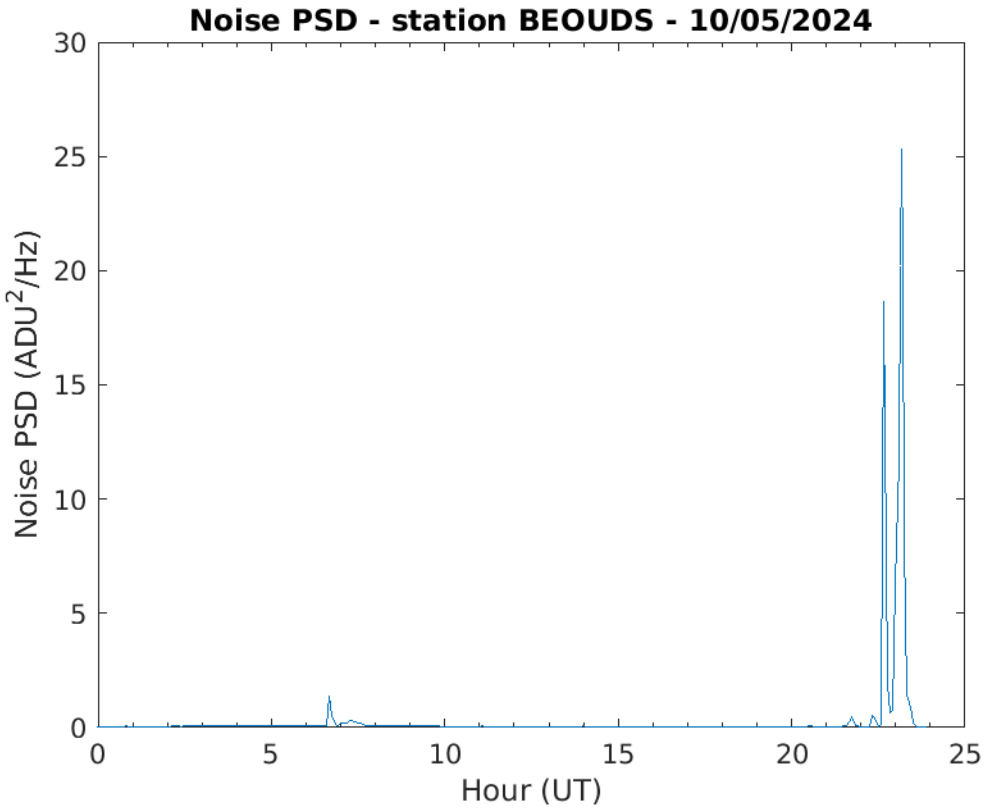

During the aurora, usual signals were drawn into “noise”

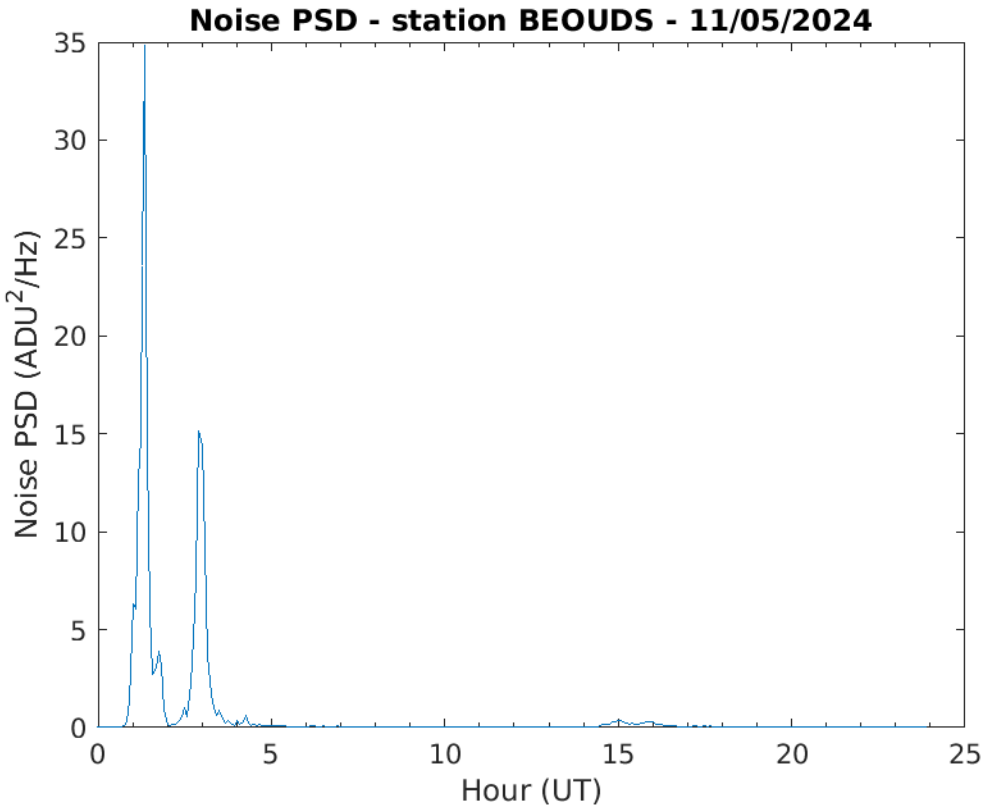
# Noise PSD integrated in [800-900] Hz




- All interesting signal appear in [900:1100] Hz (in between red lines)
- BRAMS calibrator signal at 1500 Hz
- Parasitic signal near 1300 Hz
- Noise is usually measured in [800:900] Hz (green band)

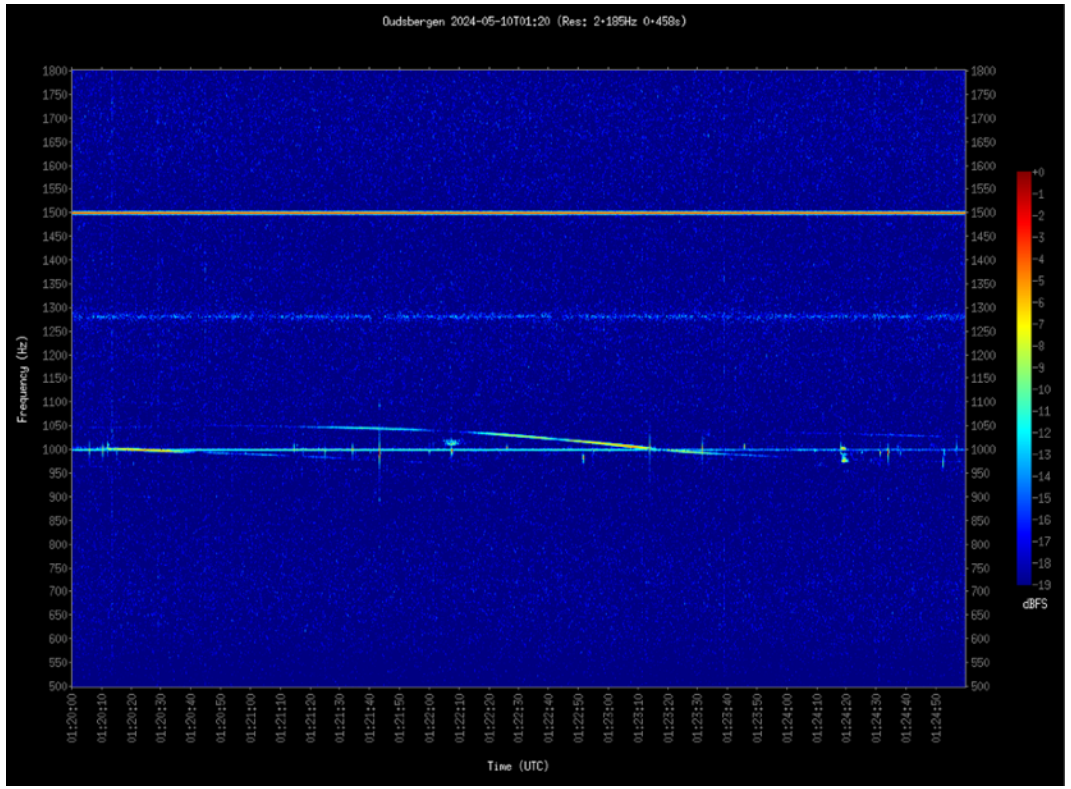
# Noise PSD integrated in [800-900] Hz

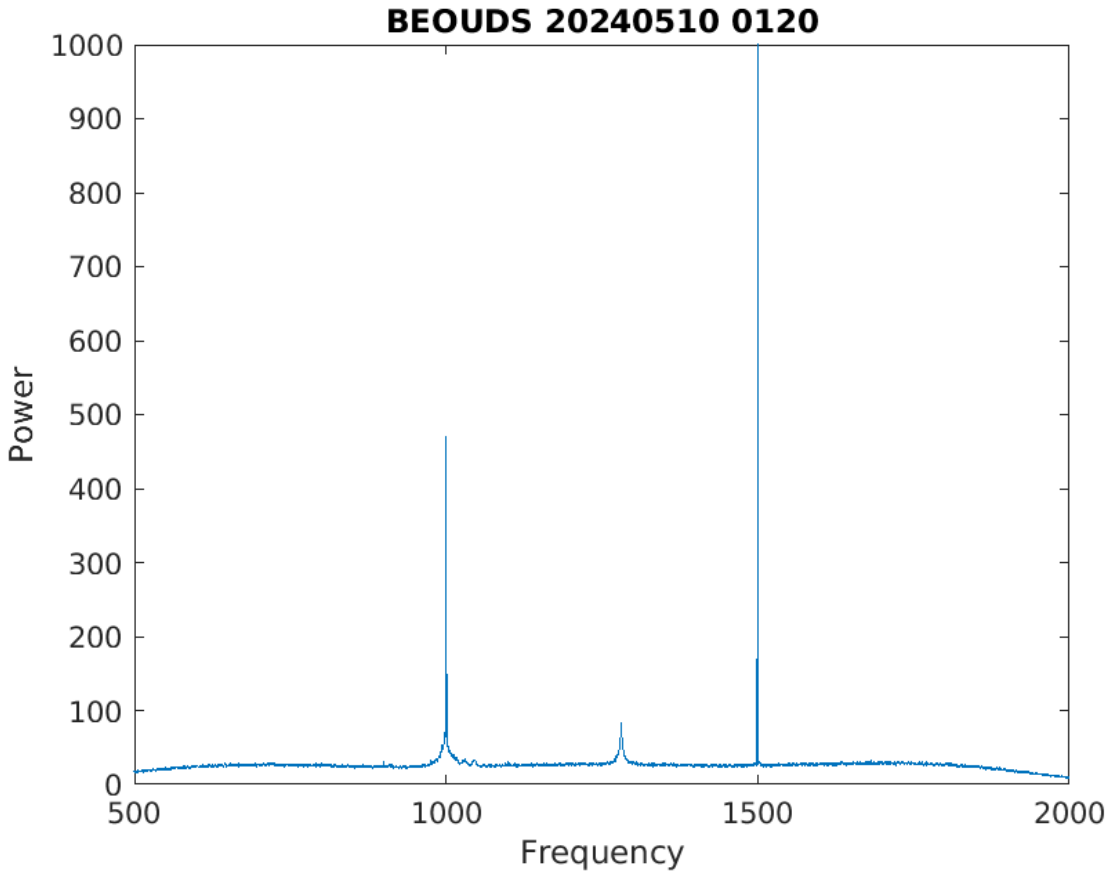


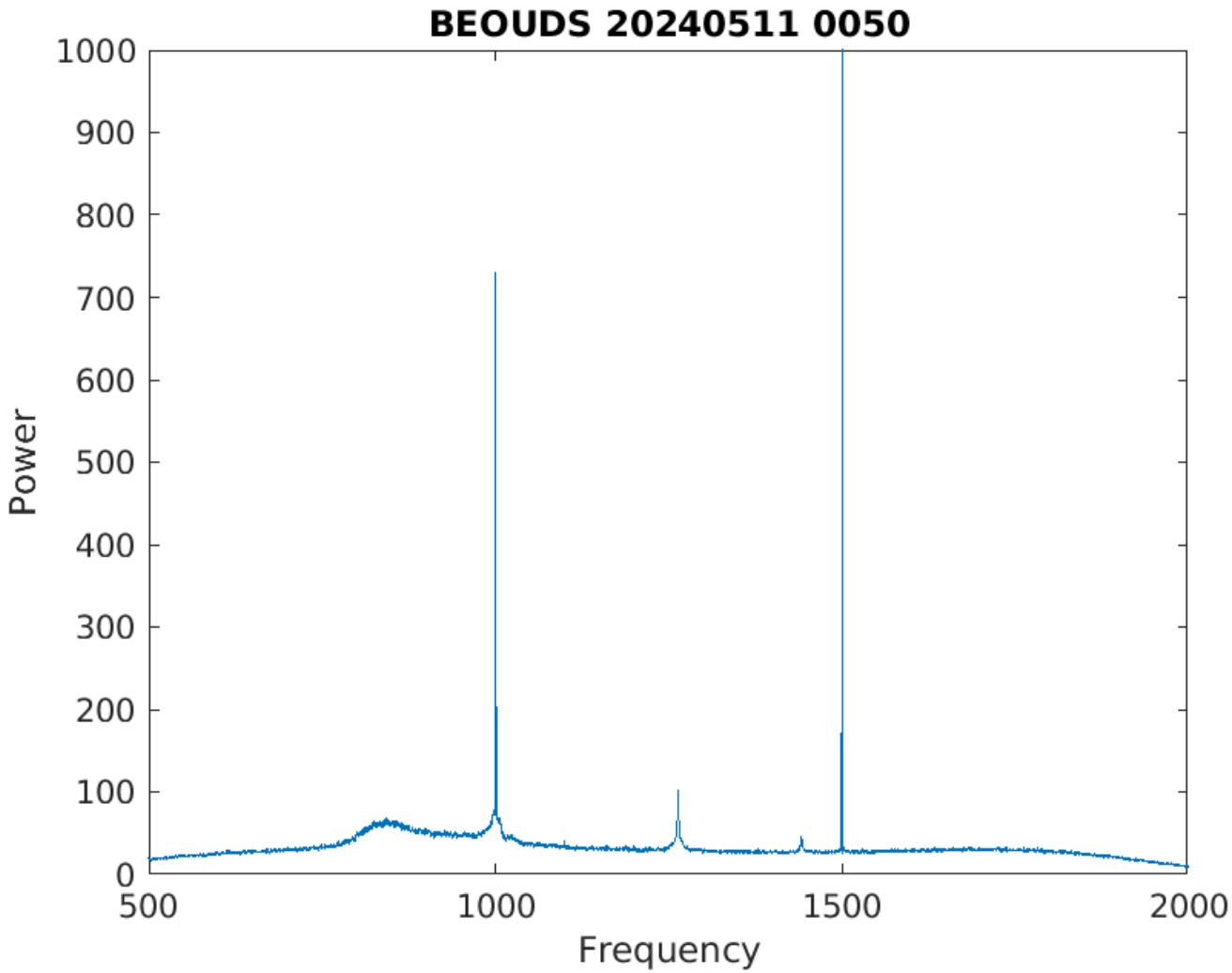

During the aurora, the “noise” level increased by a factor ~ 50-100

# Spectral distribution in normal conditions



# Spectral distribution during the aurora




- Very strong enhancement of the “noise”
- Width ≤ 1 Khz
- Very dynamic with sometimes multiple sub-peaks

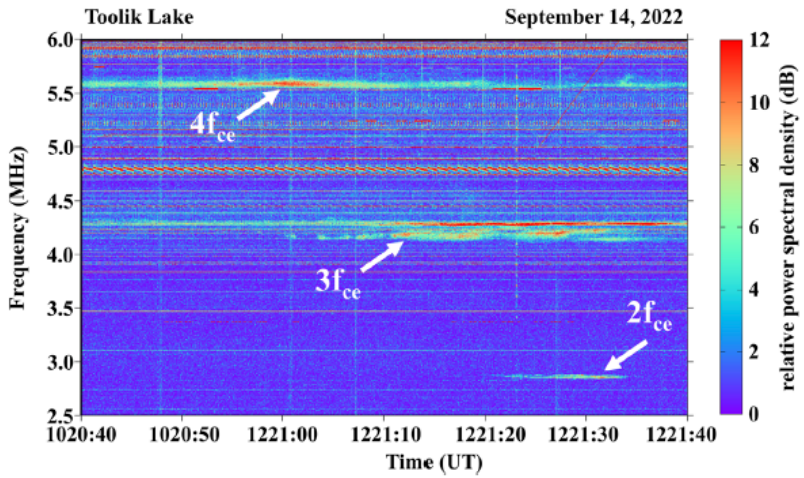
# So, what did we see?

- According to Labelle (2023)'s review paper, there are 4 types of radio auroral emissions observed from the ground before

LF/MF/HF auroral radio emissions observable at ground level

| type | frequency | polarization | outstanding problems |
|---|---|---|---|
| Auroral Hiss | <1.2 MHz (below $f_{ce}$) | Right (W-mode) | Mechanism of penetration to ground level<br>Sources of different types, source altitudes<br>Connection to substorms, current systems, use for substorm onset timing<br>Dayside hiss |
| Leaked AKR | 200-900 kHz (mostly 400-600 kHz at ground level) (below $f_{ce}$) | Right (W-mode) | Generation mechanism/connection to escaping AKR?<br>Wide range of fine structure<br>Ducted or nonducted propagation/area illuminated?<br>Interhemispheric asymmetry?<br>Remote sensing applications |
| Cyclotron harmonic emissions | ~2.8 MHz ($2f_{ce}$)<br>~4.1 MHz ($3f_{ce}$)<br>~5.4 MHz ($4f_{ce}$)<br>~6.5 MHz ($5f_{ce}$) | Left (subset of $4f_{ce}$ are Right) | Nonlinear generation mechanism of $4f_{ce}$?<br>Wide range of fine structure<br>Connection to flickering aurora<br>Remote sensing applications |
| Medium Frequency Burst | 1.4-5.5 MHz (above $f_{ce}$) | Left (L-mode) | Generation mechanism?<br>Connection to substorms, current systems, use for substorm onset timing?<br>Connected to Langmuir cavitation?<br>Wide range of fine structure, gap at $2f_{ce}$ |

None of them has been observed at ~ 50 MHz




- Fine structures, width and emissions in MHz may suggest cyclotron harmonic emissions

- At 50° latitude, |B| ~ 44000-42000 nT at 100-200 km altitude giving a cyclotron frequency of ~ 7.5-7.7 MHz. Is this possible that we have detected cyclotron harmonic emissions?

# Perspectives

- Looking at the structure of these emissions at several stations with the largest separation in latitude and longitude
- Looking at the structure of these emissions with a time resolution < 5 mins
- Looking at the polarization values at our station in Humain where we have a crossed Yagi antenna
- Looking at integrated total power of these emissions (using the values of the BRAMS calibrator). However, the gain of the antenna is unknown since we do not know where exactly the aurora was located
- Hence … looking at optical observations from several meteor cameras in Belgium

# Meteor cameras observations





Camera from the GMN network installed in Humain

# Timelapse movie from 10-11 May 2024

Credit:
Denis Vida
(GMN PI)

Thank you for your attention