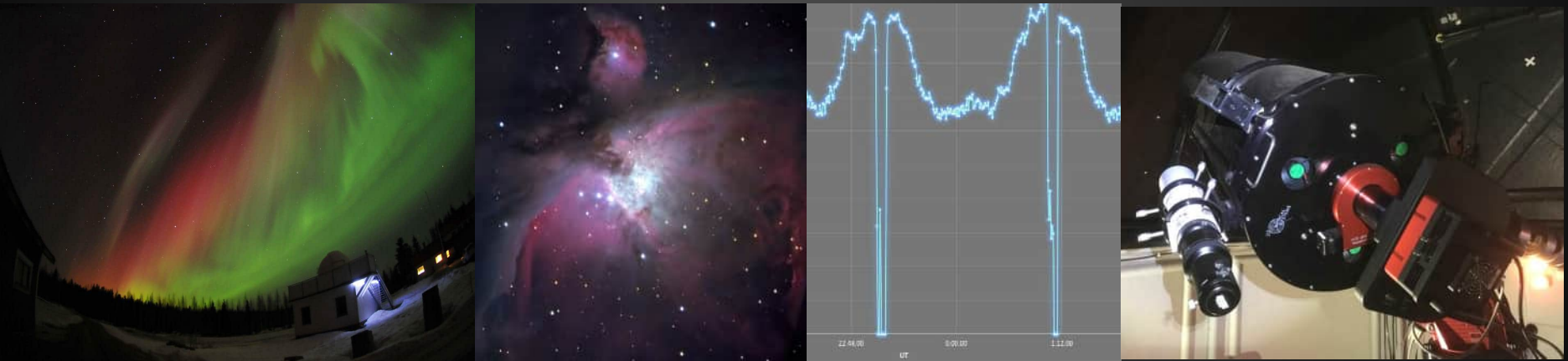


# Hankasalmen observatorio ja tieteelliset havainnot



5.4.2025

Revontulitapaaminen Artjärvi

Arto Oksanen & Harri Kiiskinen

Jyväskylän Sirius ry

# Jyväskylän Sirius ry



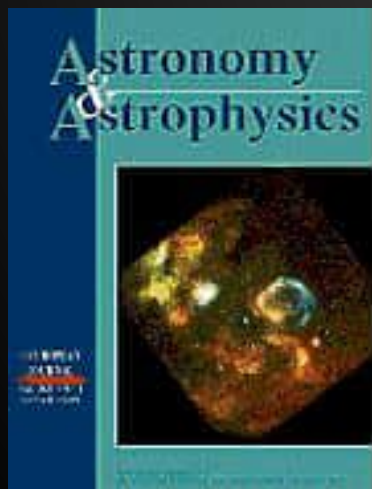
- tähtiharrastusyhdistys
  - perustettu 1959
  - n. 200 jäsentä
  - 3 observatoriota
  - toimii aktiivisesti
- toimintamuodot
  - tähtinäytännöt, jäsenillat, havaintotoiminta, jäsenlehti, retket, opetustoiminta



# Orionin suuri kaasusumu (M42)

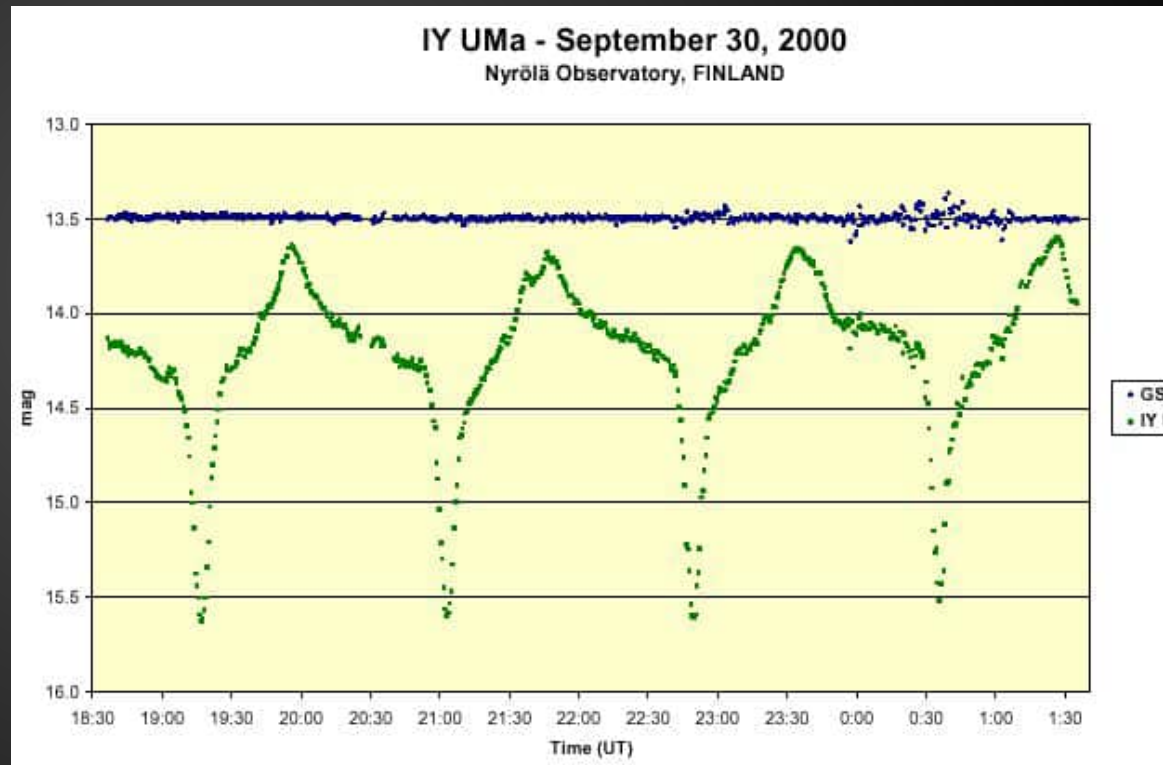
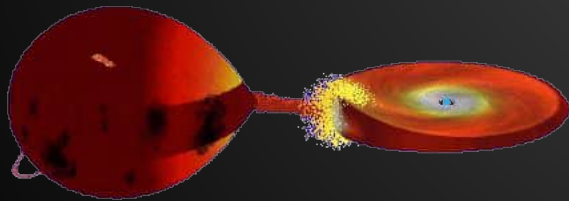


# Pro-am yhteistyö





# Kääpiönova IY Ursae Majoris



## Discovery of a New Deeply Eclipsing SU UMa-Type Dwarf Nova, IY UMa (= TmzV 85)

Makoto UEMURA, Taichi KATO, and Katsura MATSUMOTO

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*Edmonton, Alberta, Canada*

Jochen PIETZ

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Timo KINNUNEN

*Sinimäentie 10, SF-02000 Espoo, Finland*

Marko MOILANEN and Arto OKSANEN

*Nyrola Observatory, Jyväskylän Sirius ry, Kyllikinkatu 1, FIN-40100 Jyväskylä, Finland*

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Hiroyuki MAEHARA

*VSOLJ, Namiki 1-13-4, Kawaguchi, Saitama 332-0034*

and

Hiroshi ITOH

*VSOLJ, Nishiteragata-cho 1001-105, Hachioji, Tokyo 192-0153*

(Received 2000 February 23; accepted 2000 March 7)

### Abstract

We discovered a new deeply eclipsing SU UMa-type dwarf nova, IY UMa, which experienced a superoutburst in 2000 January. Our monitoring revealed two distinct outbursts, which suggest a superoutburst interval of  $\sim 800$  d, or its half, and an outburst amplitude of 5.4 mag. From time-series photometry during the superoutburst, we determined a superhump and orbital period of 0.07588 d and 0.0739132 d, respectively.

**Key words:** accretion disks — binaries: eclipsing — stars: cataclysmic variables — stars: individual (IY UMa)

QUICK FIELD: Author First Author Abstract Year Fulltext All Search Terms

← Start New Search

Arto Oksanen



Your search returned 226 results

Collection  
custom filter

Author  
Oksanen, A

Author  
Oksanen, Arto



Date

Export

Explore

## AUTHORS

- ☐ Oksanen, A 226
- ☐ Henden, A 36
- ☐ Dvorak, S 34
- ☐ Kato, T 33
- ☐ Matsumoto, K 27

more

## COLLECTIONS

- ☐ astronomy 226
- ☐ physics 10
- ☐ earthscience 6

## REFEREED

- ☐ non-refereed 145
- ☐ refereed 81

## INSTITUTIONS

## KEYWORDS

## PUBLICATIONS

## BIB GROUPS



Show highlights

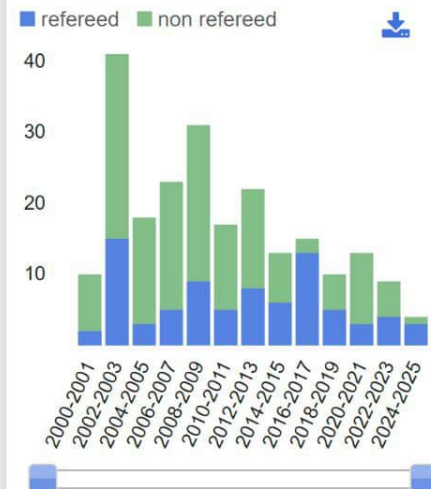
Show abstracts

Hide Sidebars

Go To Bottom

- ☐ 2025JGRA..13032793S 2025/02   
[Multi-Event Analysis of STEVE, SAR Arc, and Red/Green Arc at Subauroral Latitudes Using Data From Ground Optical and Radio Instruments and the Arase and Van Allen Probes Satellites](#)  
 Sugimura, Rei; Shiokawa, Kazuo; Otsuka, Yuichi *and 30 more*
- ☐ 2025arXiv250111524K 2025/01   
[GOTO065054+593624: a peculiar dwarf nova identified in real time via Kilonova Seekers](#)  
 Killestein, T. L.; Ramsay, G.; Kennedy, M. *and 62 more*
- ☐ 2024JGRA..12932077S 2024/04   
[Statistical Analysis of Low-Latitude Boundary of Polar-Type Medium-Scale Traveling Ionospheric Disturbances Observed by a 630-nm Airglow Imager at Nyrölä, Finland](#)  
 Sato, Masaki; Shiokawa, Kazuo; Oyama, Shin-ichiro *and 3 more*
- ☐ 2024A&A...682A.141T 2024/02 cited: 2   
[Ready for O4 II: GRANDMA observations of Swift GRBs over eight weeks in spring 2022](#)  
 Tosta e Melo, I.; Ducoin, J. -G.; Vidadi, Z. *and 106 more*
- ☐ 2023ApJ...955..150G 2023/10 cited: 1   
[A Surprising Periodicity Detected during a Super-outburst of V844 Herculis by TESS](#)

Years Citations Reads



Limit results to papers from

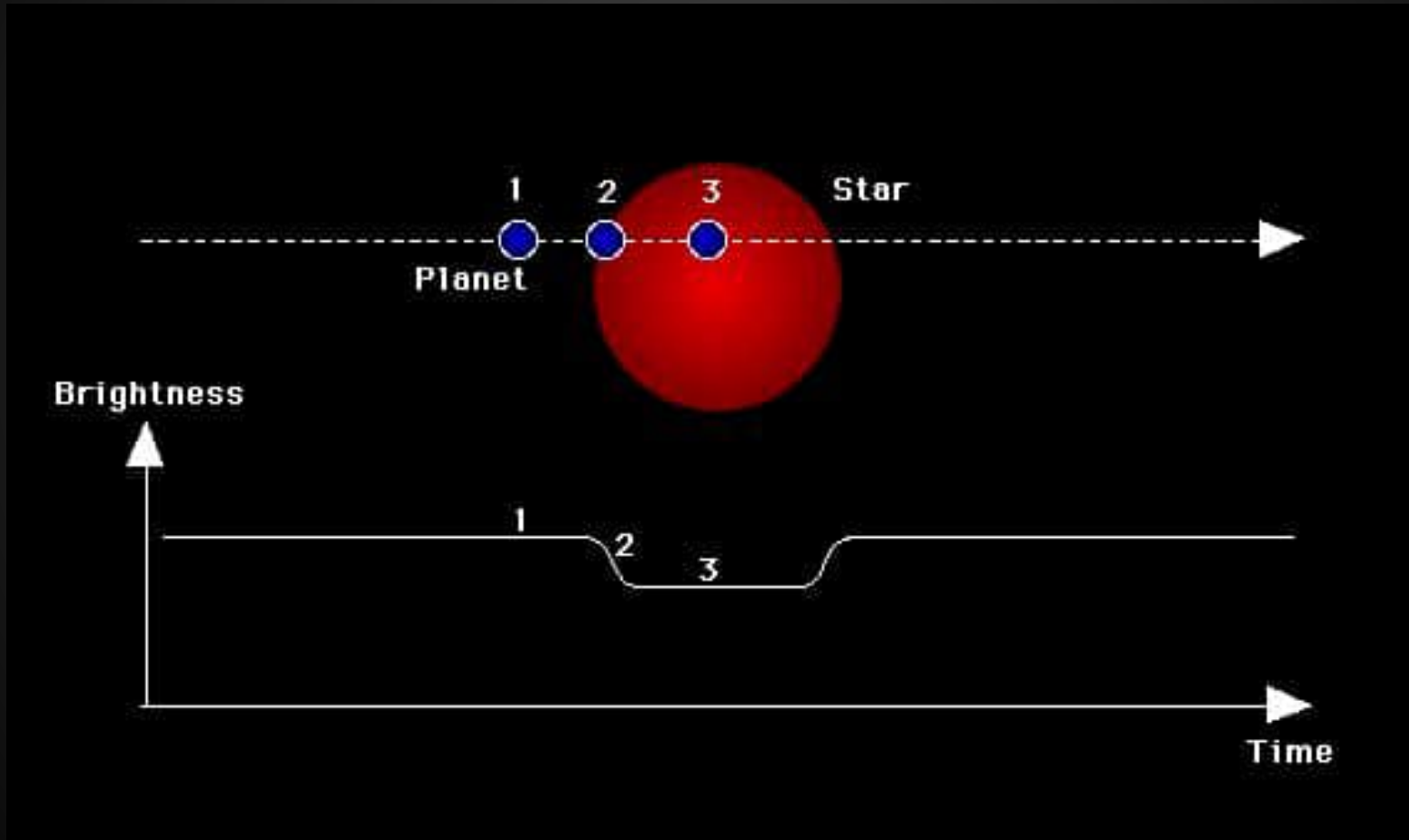
2000

to

2025

Apply

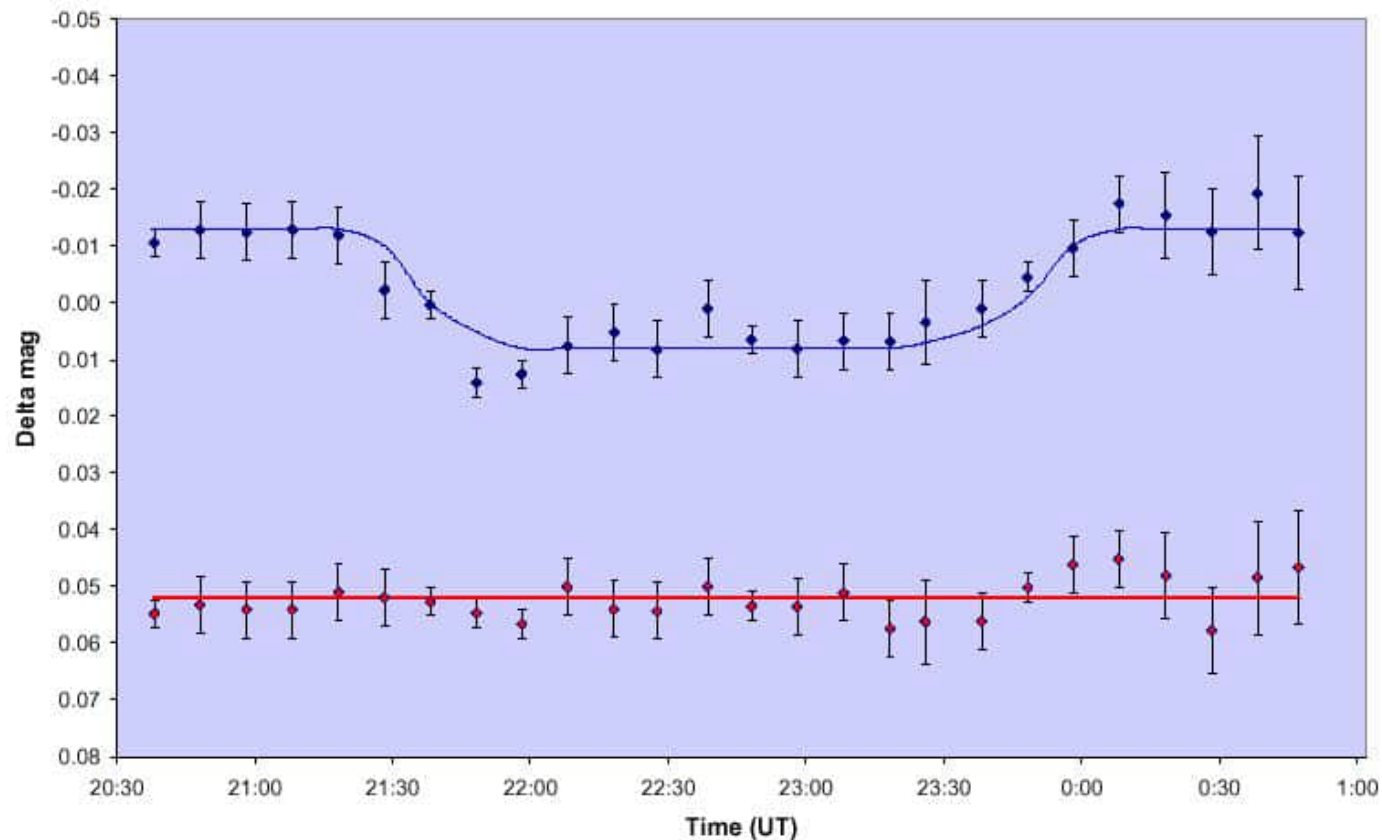
# Eksoplanetta HD 209458b





# HAVAINNOT 15.9.2000

**Exoplanet transit over HD209458**  
September 16, 2000 - Nyrölä Observatory, Finland

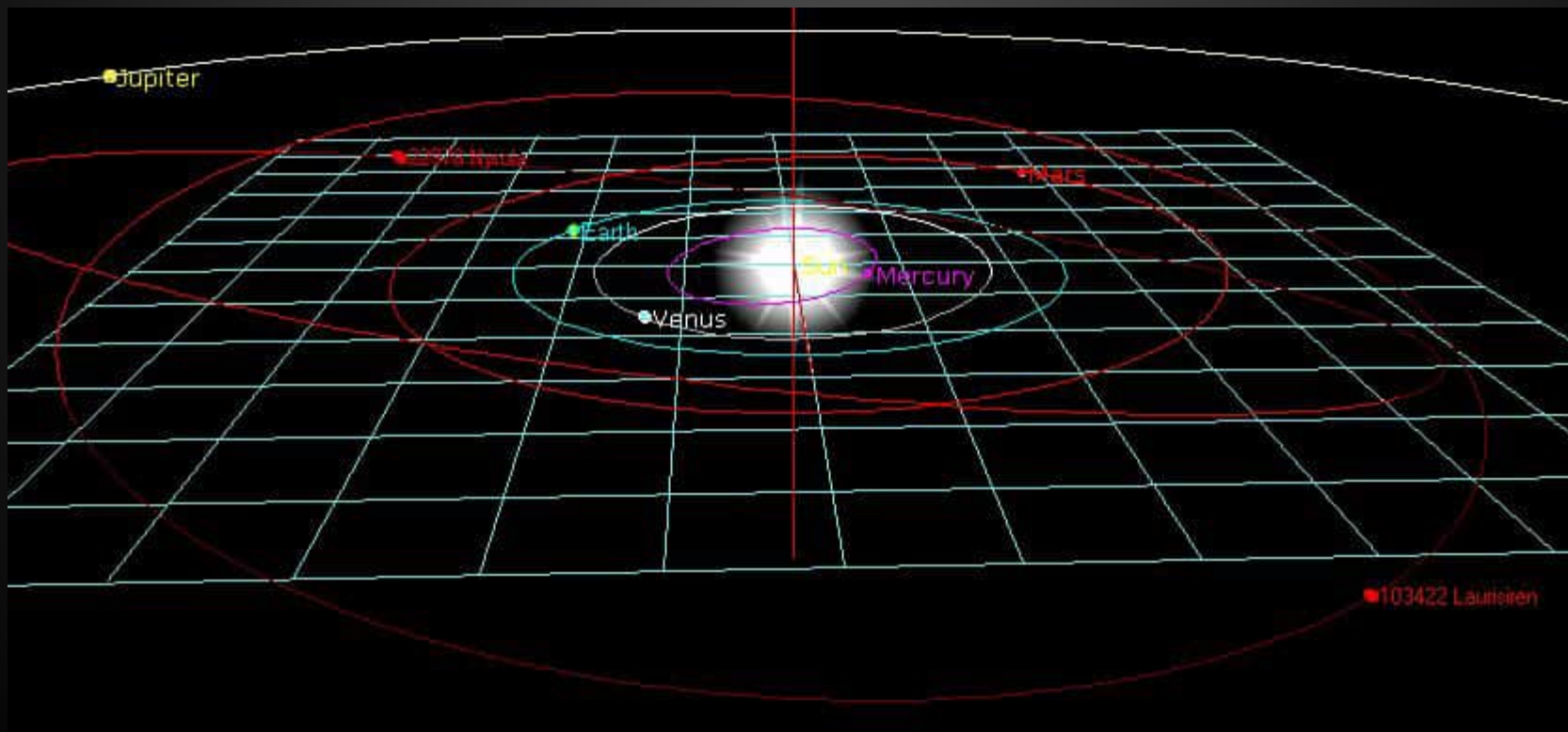


Maailman ensimmäinen harrastajan tekemä eksoplaneettahavainto!

# Siriuslaisten löytämät pikkuplaneetat

22978 Nyrölä = 1999 VO24

103422 Laurisiren = 2000 AG153



# Minor Planet Center

## **(22978) Nyrola = 1964 TK2 = 1999 VO24**

Discovered at Nyrola on 1999-11-14 by Nyrola.

(22978) Nyrola = 1999 VO24

Nyrola is a small rural village in central Finland and the site of the countryside observatory of the astronomical association Jyväskylän Sirius. This minor planet is the first to be found by Finnish amateur astronomers. [Ref: *Minor Planet Circ.* 42680]

## **(103422) Laurisiren = 2000 AG153 = 2002 UA35**

Discovered at Nyrola on 2000-01-09 by A. Oksanen and M. Moilanen.

(103422) Laurisiren = 2000 AG153

Finnish amateur astronomer Lauri Sirén (b. 1921) founded the astronomical association Jyväskylän Sirius in 1959 and served 25 years the club secretary. [Ref: *Minor Planet Circ.* 56616]







# Hankasalmen observatorio

- Siriuksen etäkäytettävä maaseutuobservatorio
- Murtoisten entinen kyläkoulu
- Rakennettiin vuonna 2005 EU-hankerahoituksella
- Kansainvälistä havaintotoimintaa



# Huippulaitteet

- Etäkäytettävä 40 cm RC teleskooppi
  - Robottijalusta
  - Suurikenttäinen CCD-kamera
  - Automatisoitu kupu
- Radioteleskooppi
- Magnetometri (FMI)
- AllSky-kamera
- Revontuliäänien kuuntelu
- Laajakaistayhteys (murtoinen.jklsirius.fi)









# Etäkäyttö

Hankasalmen observatorion kaukoputkea ja CCD-kameraa voidaan etäkäyttää internet-selaimella.

Helppo (englanninkielinen) käyttöliittymä.

Jäsenet voivat saada oman käyttäjätunnuksen ja salasanan.

Tietokone huolehtii myös observatorion automaattisesta sulkemisesta.

## Hankasalmi Observatory

Welcome Antti Oksanen

Live Observing

Single Object Imaging

Single Image

Color Series

Multiple Objects (Plan)

Cal Frames

Dark/Flat

Simulated Sky Flat

One-Time Sky Flat

Special Tests

System Status Diag

Setup Sky Flat

Release the Obs.

Deep Sky Imaging

Obs. Plan Checker

Scheduled

My Documents

Acquired Images

Observing Plans

Run Logs

Shared Files

Observatory Info

Help Resources

Settings

### System Status

Hover the mouse over the links to see what they do

| Observatory     | Telescope         | Imager            | Activity                                                                            | Plan   |
|-----------------|-------------------|-------------------|-------------------------------------------------------------------------------------|--------|
| Ready (Closed)  | Stopped           | Idle              | Idle                                                                                | Set    |
| Local: 14.18.25 | RA: 01:02.4       | Filter: Luminance | Filter                                                                              | Target |
| UTC: 12.18.23   | RA: 18:40:42.77   | Filtering: 1:1    |                                                                                     | Repeat |
| LST: 15:43:04   | Dec: -00°19'58.7" | Color: off        |  | Filter |
| Owner: Free     | PA: 180°          |                   |                                                                                     | Count  |
| Weather: Rain   | Ac: 113.60°       |                   |                                                                                     |        |
| Shutter: Closed | Alt: 23.32°       |                   |                                                                                     |        |
| Dome: Stopped   | GSN: West         |                   |                                                                                     |        |
|                 | Alt: 2.114        |                   |                                                                                     |        |

[Mainframe Run Log and Alert Control](#)

### Observing Plans

Select a file to be uploaded to the /plans/obsplan directory:

[Choose File](#) or [File chosen](#)

[Upload File](#)

[Create Folder](#) [Upload Observing Plan](#) [FTP](#) [Copy FTP in Explorer or Finder](#)

| Name                                 | Type         | Date Modified            | Size |
|--------------------------------------|--------------|--------------------------|------|
| <a href="#">KIC_9801001_01</a>       | TextDocument | 10 Oct 2018 07:21:38 UTC | 440B |
| <a href="#">testplan-obsplan.txt</a> | TextDocument | 10 Nov 2018 15:23:13 UTC | 255B |
| <a href="#">KIC1102028-11a.txt</a>   | TextDocument | 10 Nov 2018 15:20:20 UTC | 413B |

[Refresh](#)

### Multiple Objects (Plan)

Select the folder containing the observing plan to run (if needed)

[KIC1102028-11a](#)

Select the observing plan to run:

[KIC1102028-11a](#)

[Loadplan button](#)

### Welcome

[Get the Manual](#) [Contact a Technician](#)

Welcome to Hankasalmi Observatory. If you haven't been here before, click the [Get the Manual](#) button to access some useful information. Start by taking



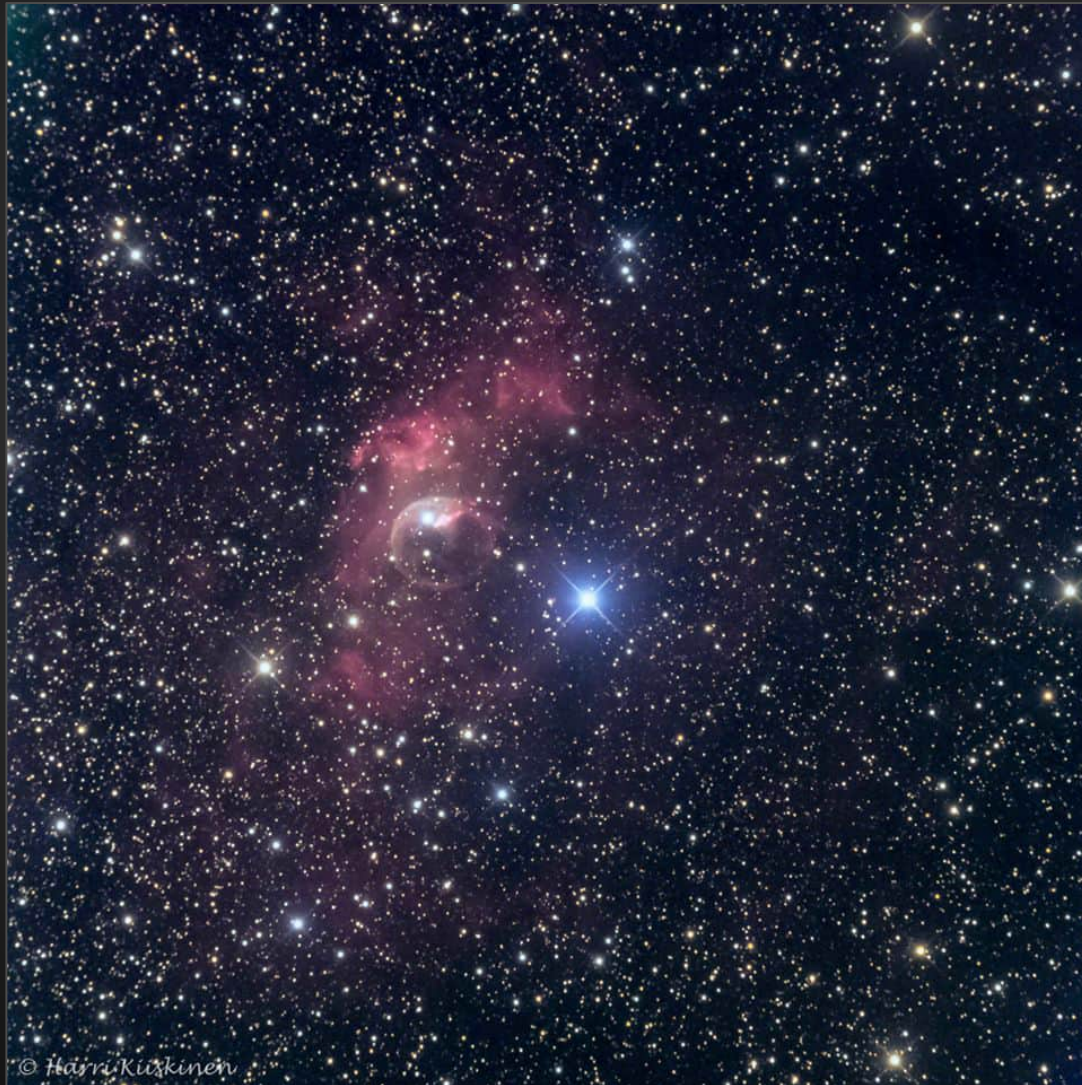
**C/2014 Q2**



Harri Kiiskinen



# Kuplasumu NGC 7645



# M42 h-alpha suotimella



# Toistuvat novat

- Novapurkaus toistuu alle 100 vuoden välein
- Valkoisen kääpiön massa  $> 1.2 M_{\text{sun}}$
- Massavirtaus suuri  $\sim 10^{-7} M_{\text{sun}}/\text{y}$
- Tunnetut RNe:t

- T Pyx
- IM Nor
- CI Aql
- V2487 Oph
- U Sco

- V394 CrA
- T CrB
- RS Oph
- V745 Sco
- V3890 Sgr



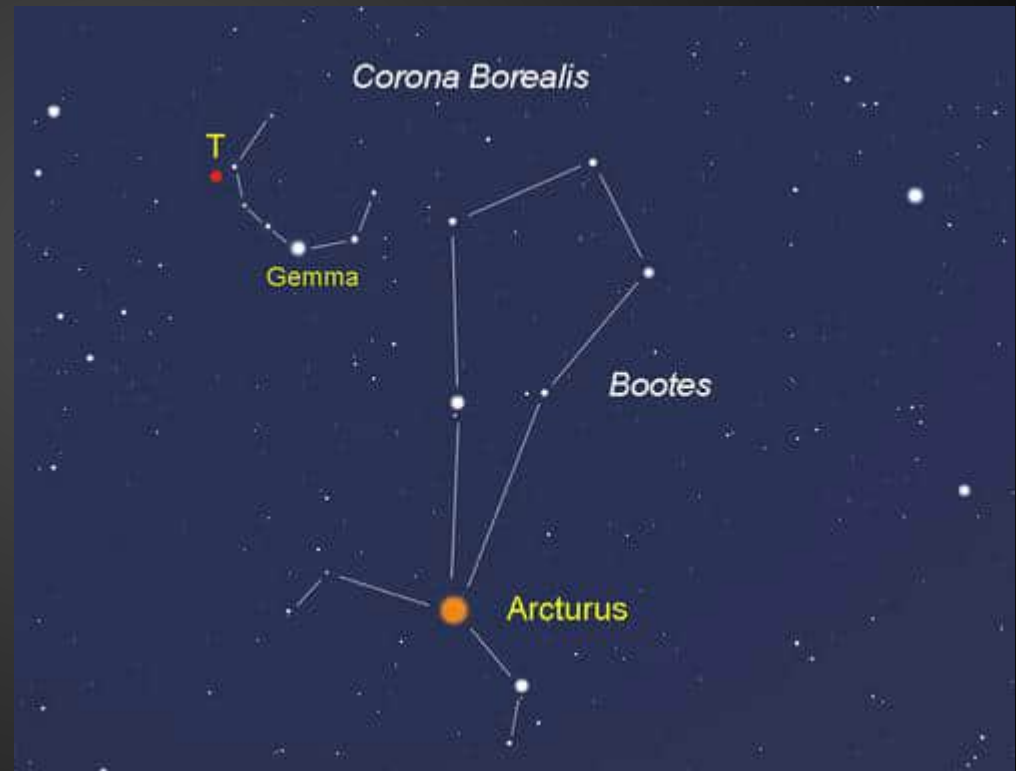


# T CrB - Seuraava purkaus?

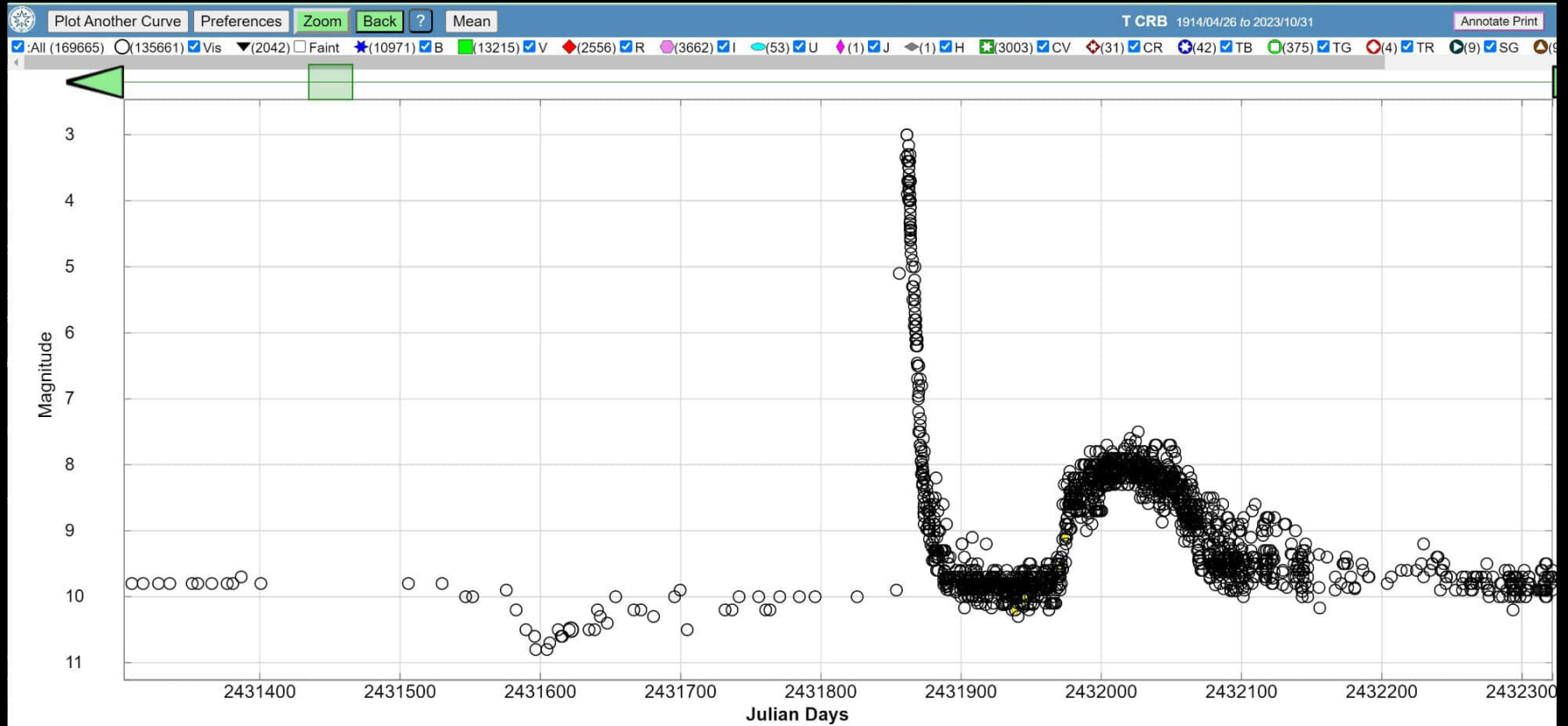
Edellinen purkaus  
1946

Ennustettu  
seuraava purkaus  
2024 (tai 2025 tai  
2026?)

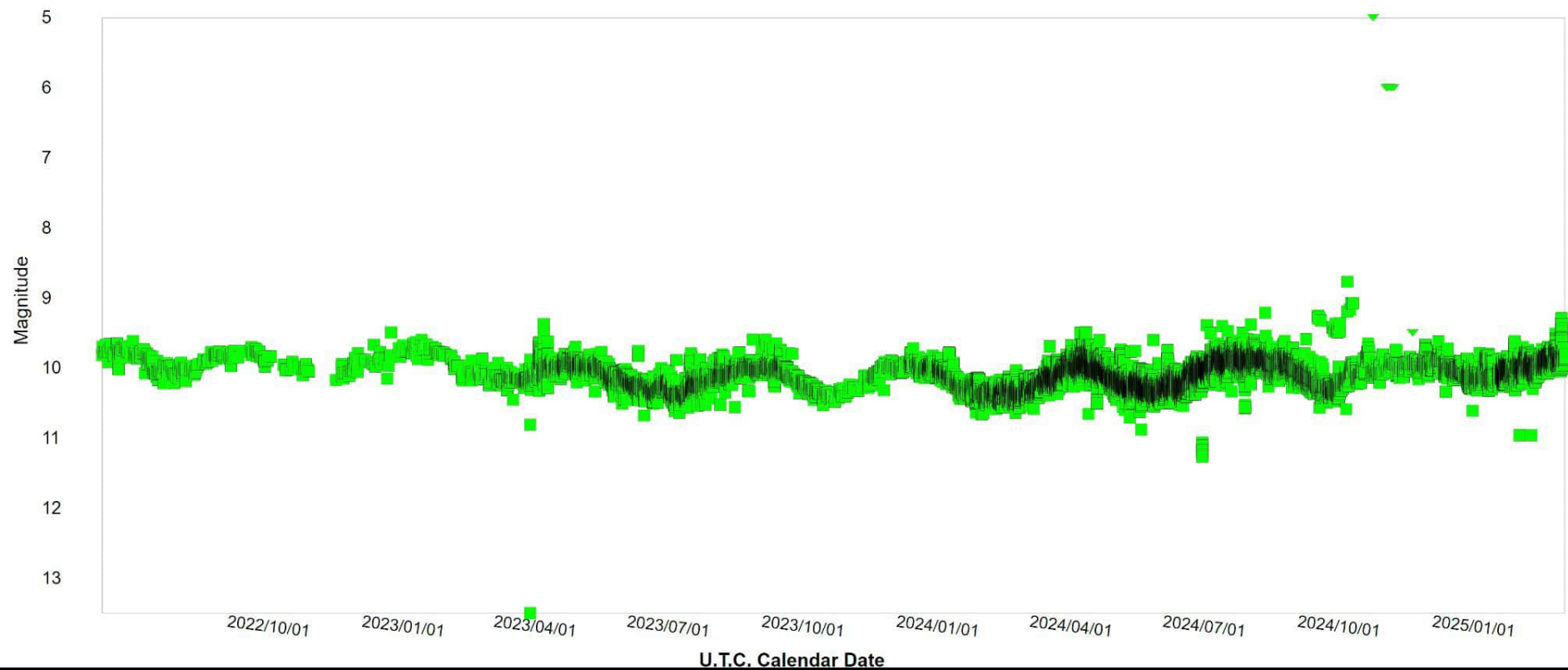
Maksimikirkkaus:  
2.5 mag



# Edellinen purkaus vuonna 1946



# Viimeiset 1000 vuorokautta (AAVSO V)





File TCrB-S044-R001-C001-V.fits

Object TCrB

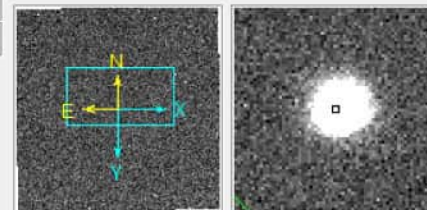
Value 5423

FK5  $\alpha$  15:59:30.2216  $\delta$  +25:55:12.733

Physical x 1693.24 y 1478.68

Image x 1693.24 y 1478.68

Frame 1 x 0.5 0 °



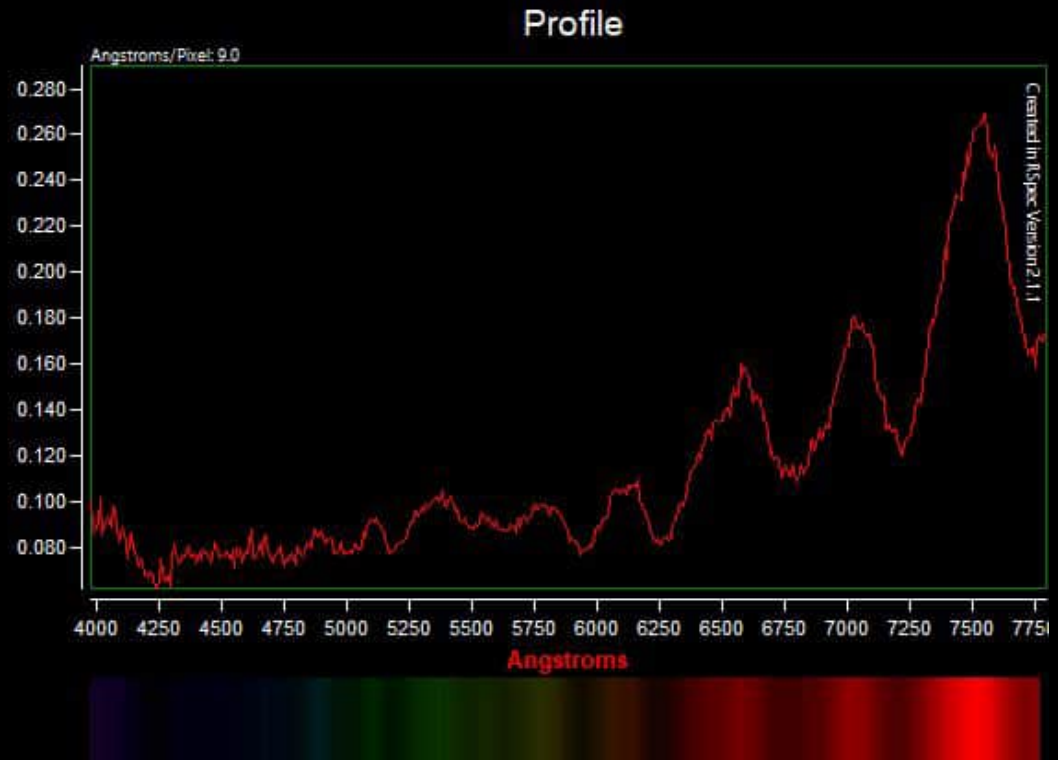
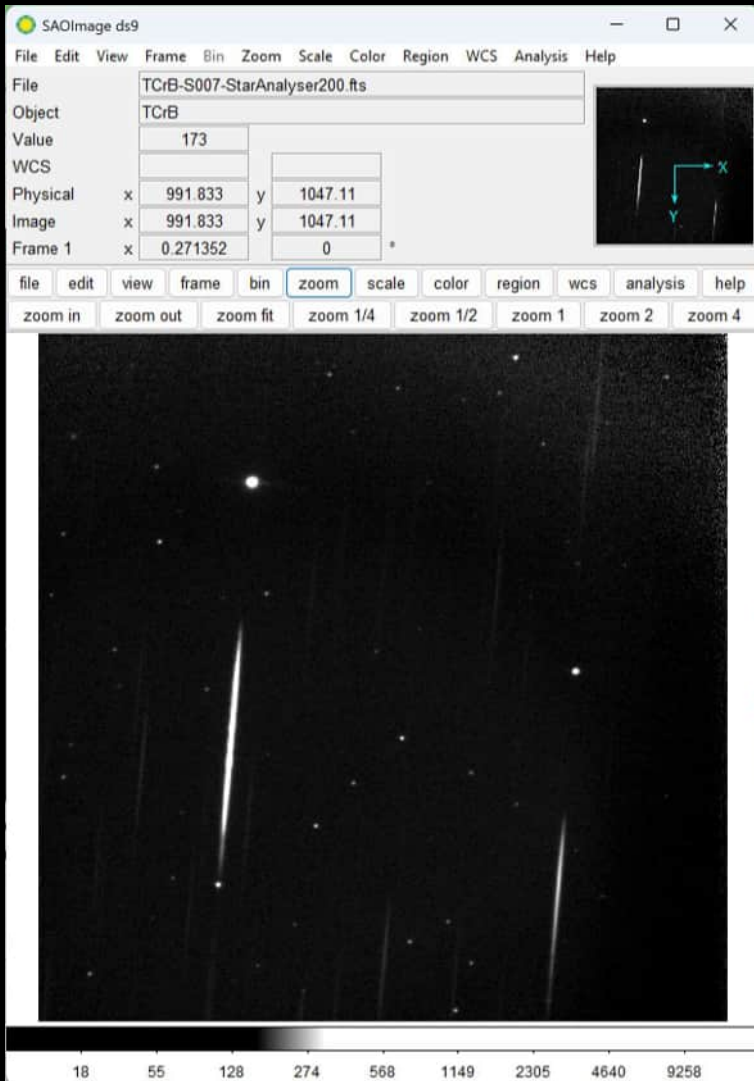
|      |      |      |       |     |      |       |       |        |     |          |      |
|------|------|------|-------|-----|------|-------|-------|--------|-----|----------|------|
| file | edit | view | frame | bin | zoom | scale | color | region | wcs | analysis | help |
|------|------|------|-------|-----|------|-------|-------|--------|-----|----------|------|

|         |          |          |          |          |        |        |        |
|---------|----------|----------|----------|----------|--------|--------|--------|
| zoom in | zoom out | zoom fit | zoom 1/4 | zoom 1/2 | zoom 1 | zoom 2 | zoom 4 |
|---------|----------|----------|----------|----------|--------|--------|--------|

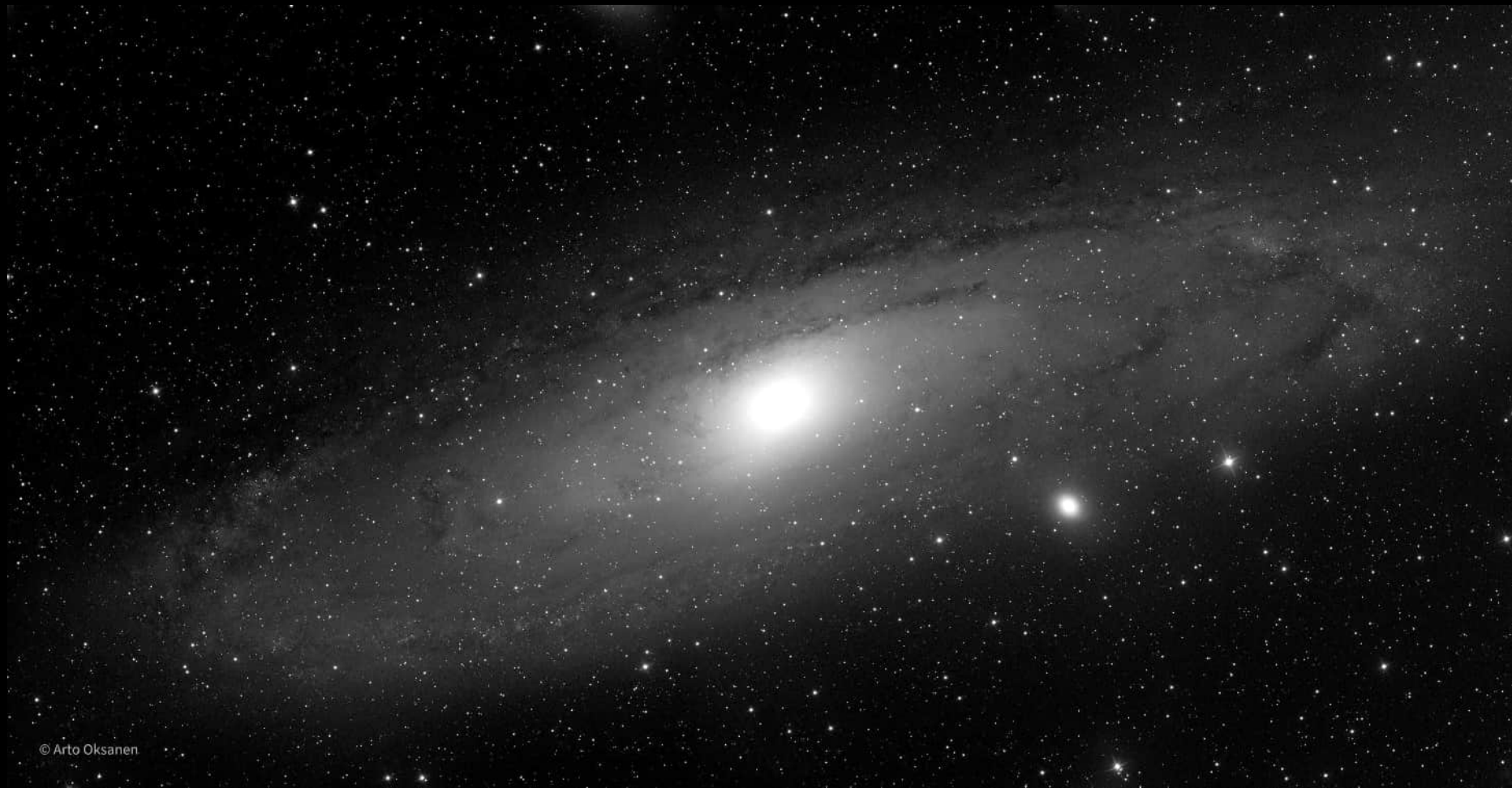


|         |         |         |         |         |       |         |         |         |
|---------|---------|---------|---------|---------|-------|---------|---------|---------|
| 1.4e+02 | 1.5e+02 | 1.6e+02 | 1.7e+02 | 1.9e+02 | 2e+02 | 2.1e+02 | 2.2e+02 | 2.3e+02 |
|---------|---------|---------|---------|---------|-------|---------|---------|---------|

# Spektroskopia T CrB

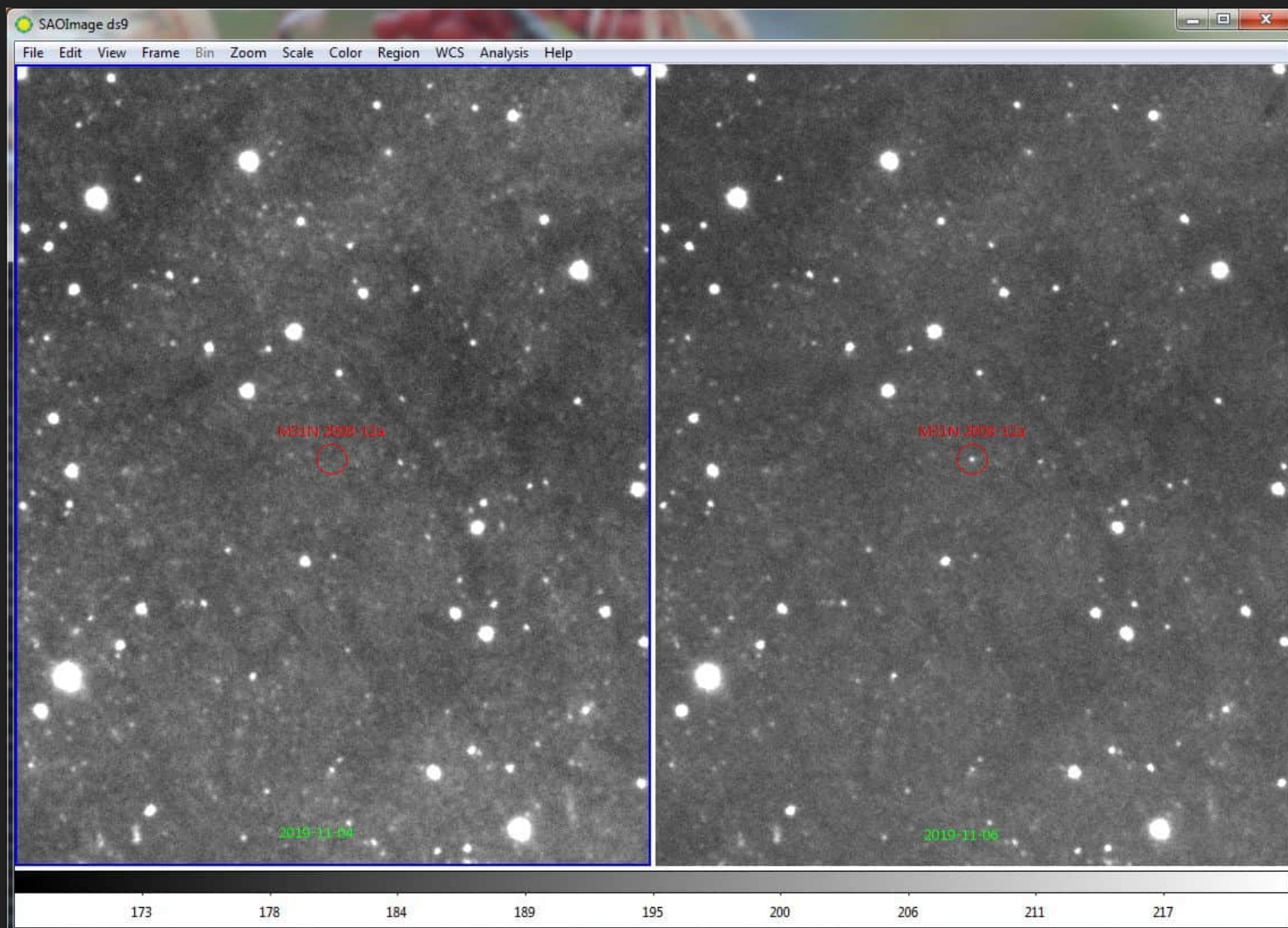


# Andromedan galaksi M31





# Andromedan galaksin toistuva nova M31N 2008-12a



# Löytöjulkaisu

## The Astronomer's Telegram

### Recurrent Nova M31N 2008-12a: discovery of the 2019 eruption

ATel #13269; *A. Oksanen (Hankasalmi Obs), M. J. Darnley (LJMU), A. W. Shafter (SDSU), S. Kafka (AAVSO), M. Kato (Keio University) and M. Henze (SDSU), on behalf of the 12a Collaboration*

*on 6 Nov 2019; 18:31 UT*

*Credential Certification: Allen W. Shafter (ashafter@sdsu.edu)*

Subjects: Optical, Nova, Transient

Referred to by ATel #: [13273](#), [13274](#), [13279](#), [13281](#)

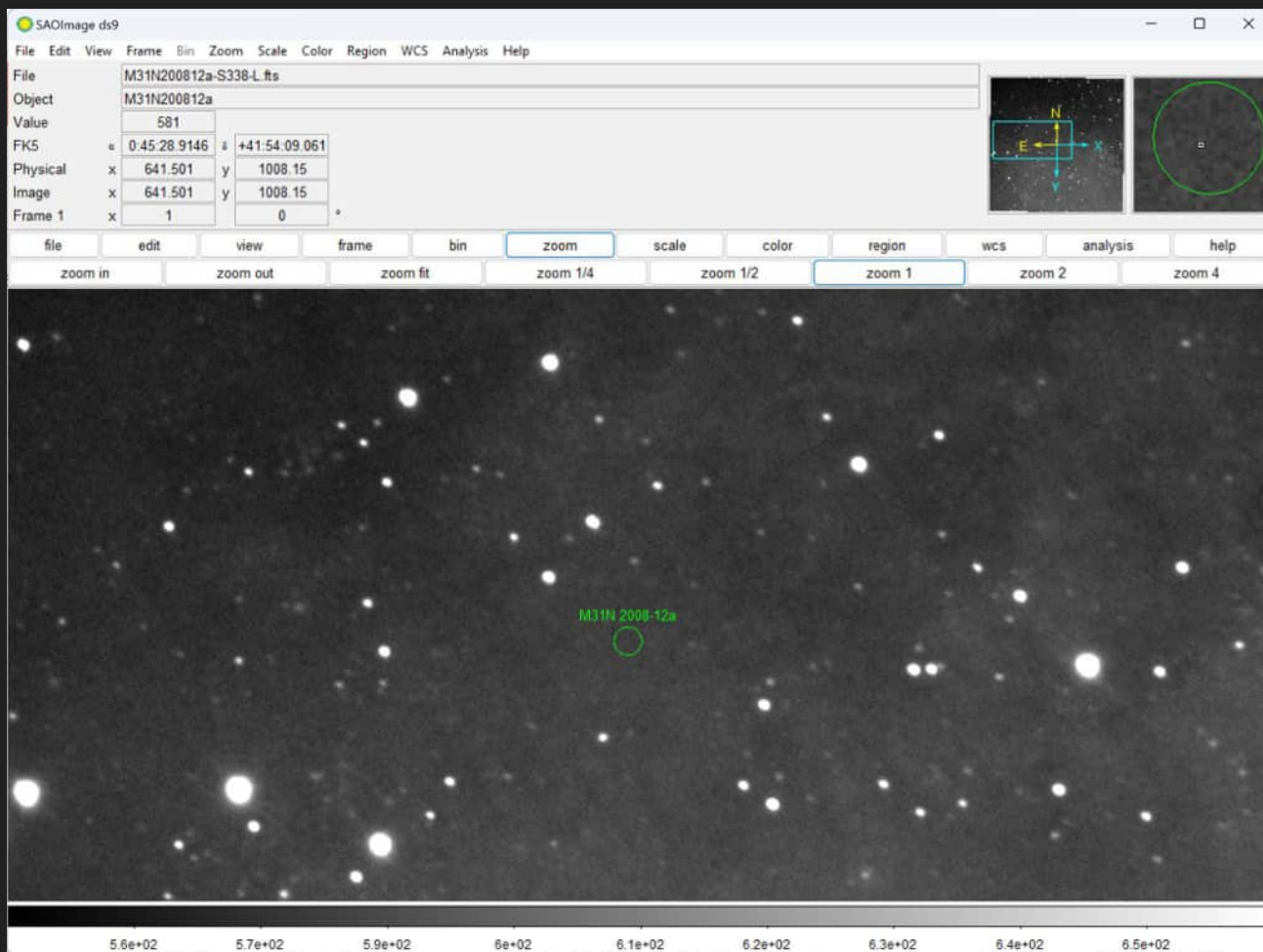
We report the discovery of the predicted 2019 eruption of the remarkable recurrent M31 nova M31N 2008-12a (see ATels #[5607](#), #[6527](#), #[7964](#), #[9848](#), #[11116](#), #[12177](#) for earlier detections as well as Darnley et al. [2014](#), [2015](#), [2016](#) and Henze et al. [2014](#), [2015a](#), [2015b](#), [2018](#), for comprehensive multi-wavelength studies of previous eruptions).

The nova was clearly detected on 2019 Nov 06 at 17.00 UTC on 25 1-minute exposures obtained at the Hankasalmi Observatory. The discovery magnitude was  $\sim 19.4$ . The nova is continuing to brighten with a latest measurement of  $m=18.99 \pm 0.05$  at 18:00 UT. We will continue to monitor the nova light curve and strongly encourage additional follow-up observations.

# Seuraavaa purkausta odotetaan syksyllä 2025

## Havaitut purkaukset:

- 2008 Dec 26
- 2009 Dec 3
- 2010 Nov 20
- 2011 Oct 23
- 2012 Oct 19
- 2013 Nov 28
- 2014 Oct 3
- 2015 Aug 28
- 2016 Dec 12
- 2017 Dec 31
- 2018 Nov 6
- 2019 Nov 6
- 2020 Oct 30
- 2021 Nov 14
- 2022 Dec 2
- 2023 Dec 5
- 2024 Dec 13



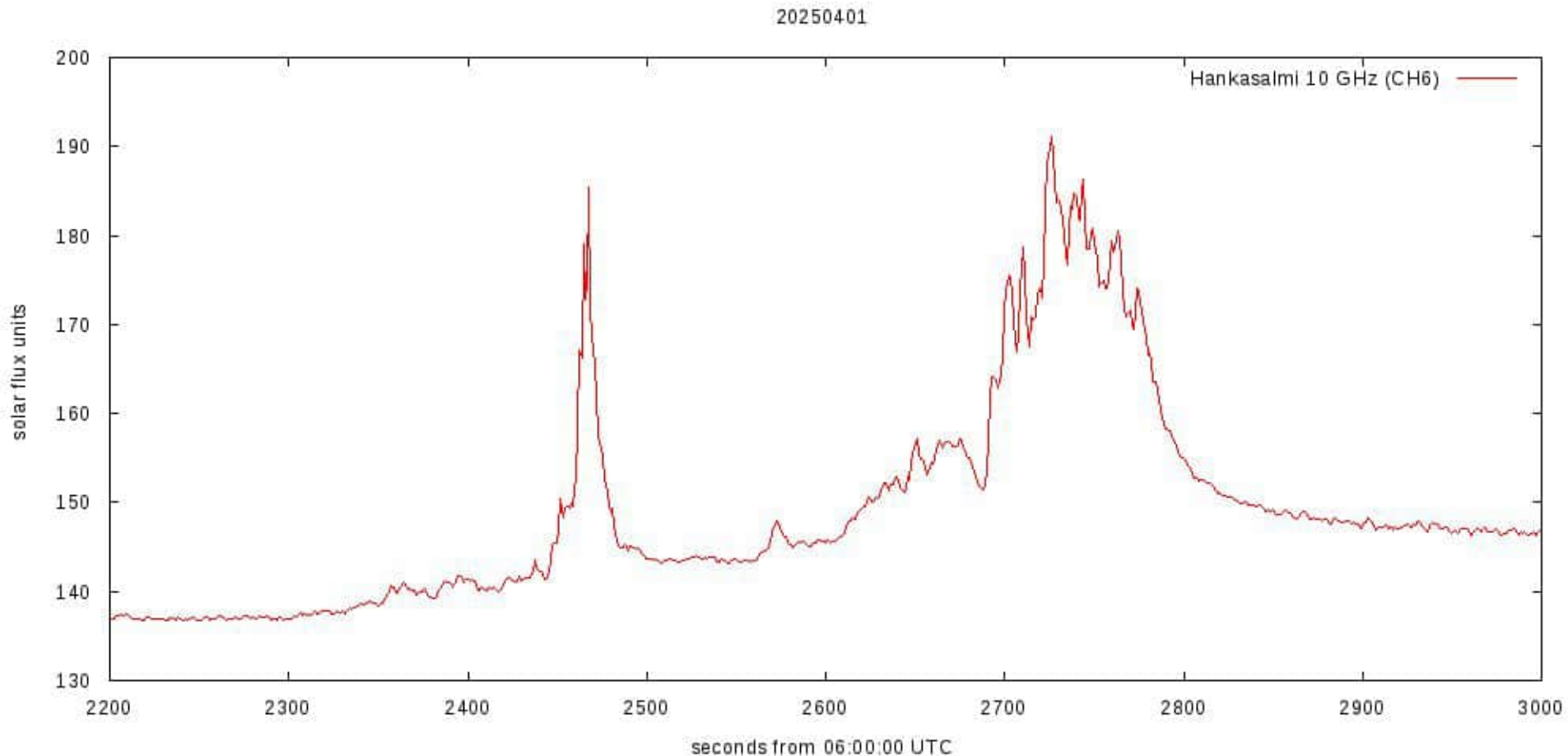


# Hankasalmen radioteleskooppi

- 3 m paraboloidi
- venäläinen säätutka
- siirrettiin Nyrölästä
- AOR AR5000A
- liikennevastaanotin
- diodivastaanotin
- 1.4/1.7/8.4/10 GHz
- tietokoneohjaus
- etäkäyttö



# M5.6 flarepurkaus 1.4.2025



# Alcor OMEA-1.3-HCA AllSky Camera



185 ° x 165 ° kalansilmä

1280x960 pixels

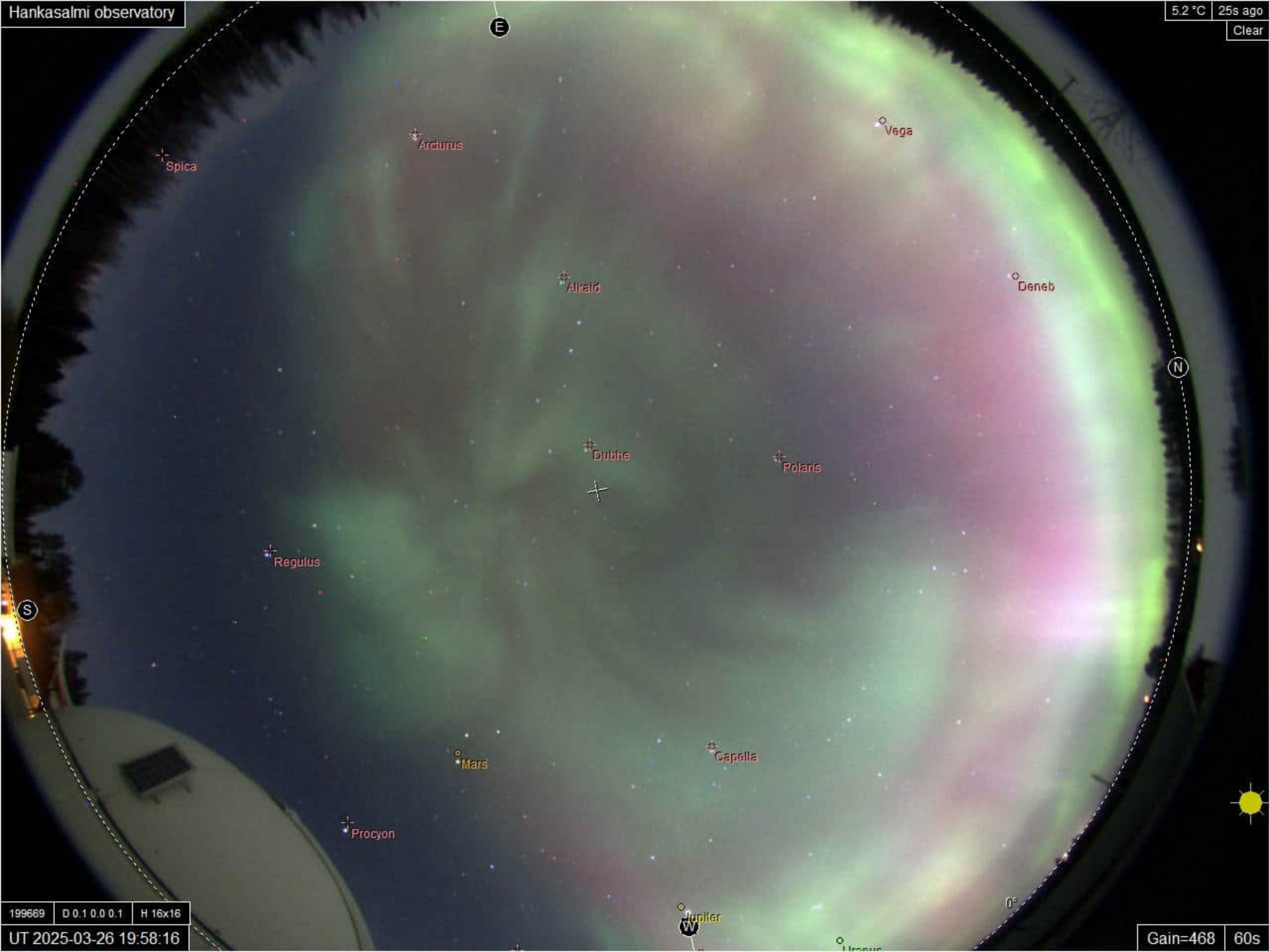
Iris-himmennin F/11 päivällä  
ja F/1.4 yöllä

Kirkkauden mukaan säätyvä  
valotusaika (1 ms - 60s)

Uusin kuva ja koko yön video  
näkyvissä observatorion  
kotisivulla ([murtoinen.jklsirius.fi](http://murtoinen.jklsirius.fi)).







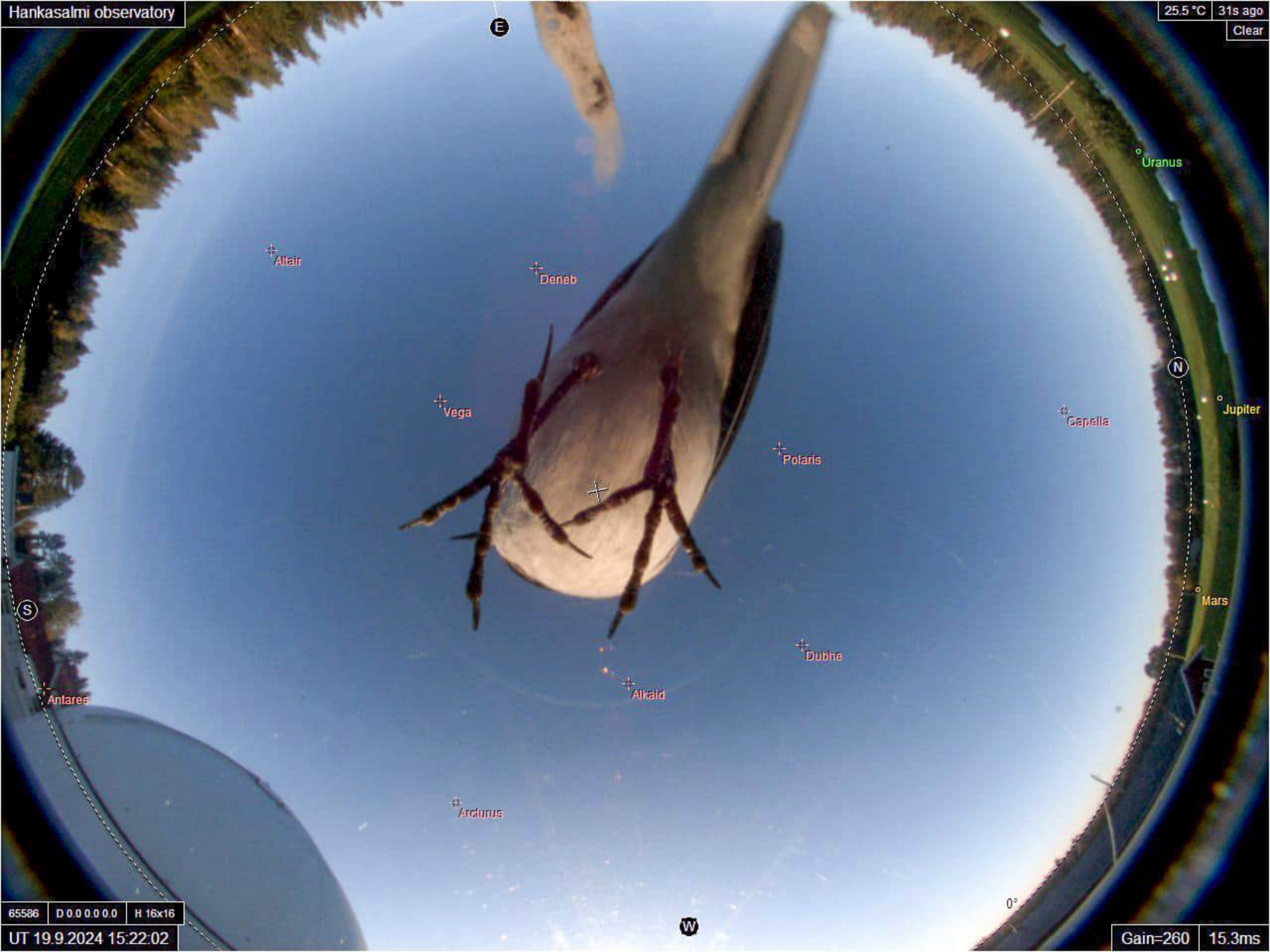














# Discovery of a new aurora form: dunes



**AGU Advances**  
**Volume 1, Issue 1**  
Mar 2020

## ARTICLE

Citizen Scientists Discover a New Auroral  
Form: Dunes Provide Insight Into the Upper  
Atmosphere

[View article page](#)

M. Palmroth, M. Grandin, M. Helin, P. Koski, A.  
Oksanen, M. A. Glad, R. Valonen, K. S. ... [See all authors](#)



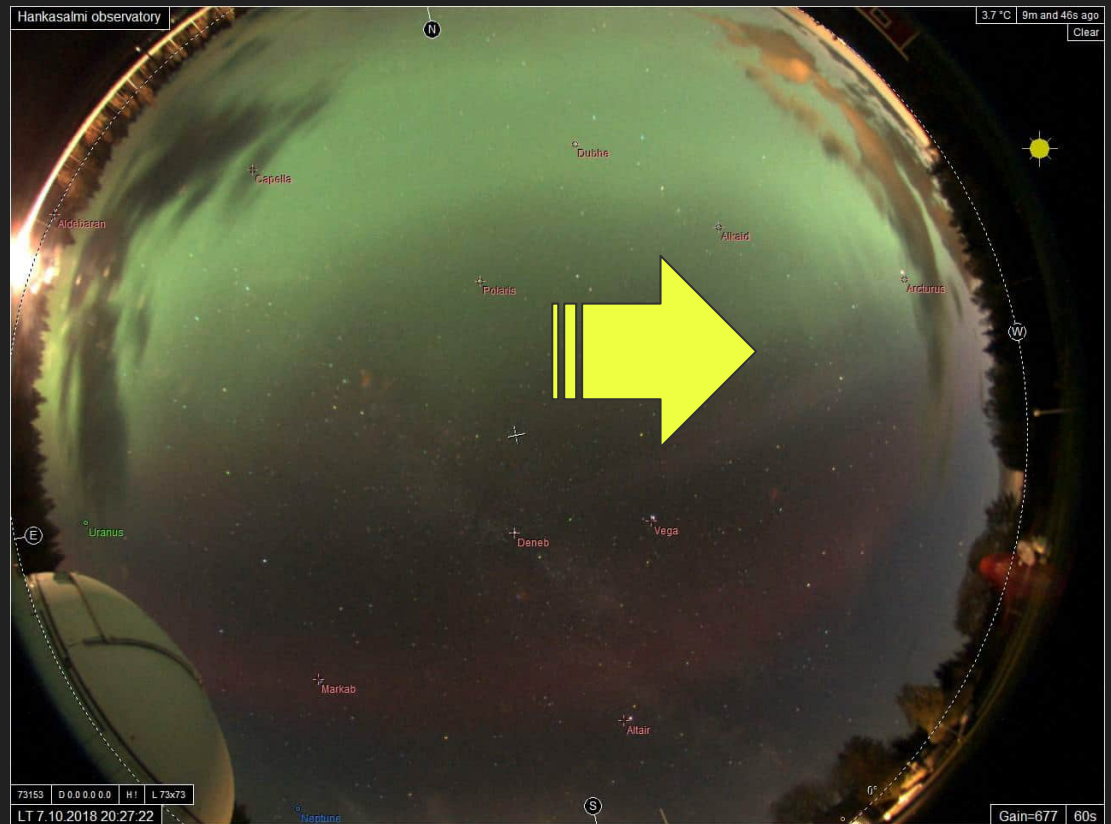
CITE



Check for updates

©2019. The Authors.

<https://doi.org/10.1029/2019AV000133>



# Youtube “Hankasalmi Observatory”

The screenshot shows the YouTube channel page for Hankasalmi Observatory. The browser address bar displays `youtube.com/@hankasalmiobservatory4625`. The channel banner features a wide-field astronomical image with labels for 'Casella', 'Fornax', and 'Antennae'. The channel name 'Hankasalmi Observatory' is prominently displayed, along with the handle '@hankasalmiobservatory4625', 342 subscribers, and 3.3k videos. A 'Tilattu' (Subscribed) button is visible. The left sidebar contains navigation icons for Home, Shorts, and Library. The main content area is divided into two sections: 'Sinulle' (For you) and 'Videot' (Videos). The 'Sinulle' section displays three video thumbnails, each labeled 'AllSky timelapse' with a date and view count. The 'Videot' section displays five video thumbnails, also labeled 'AllSky timelapse' with dates and view counts.

YouTube (753) Hankasalmi Observatory x +

youtube.com/@hankasalmiobservatory4625

For Observers | aavso testisali lehteri murtoinen.jksirius.fi HAN allsky Nyrölä All Sky All Bookmarks

Haku

Koti

Shorts

Tilaukset

Siv

**Hankasalmi Observatory**

@hankasalmiobservatory4625 · 342 tilaajaa · 3,3 t. videoita

Lisätietoja tästä kanavasta ...lisää

Tilattu

Etusivu Videot

**Sinulle**

AllSky timelapse 31-03-2025 15 katselukertaa · 1 päivä sitten

AllSky timelapse 09-11-2024 91 katselukertaa · 4 kuukautta sitten

AllSky timelapse 30-09-2024 76 katselukertaa · 6 kuukautta sitten

**Videot**

AllSky timelapse 01-04-2025 4 katselukertaa · 1 tunti sitten

AllSky timelapse 31-03-2025 15 katselukertaa · 1 päivä sitten

AllSky timelapse 30-03-2025 15 katselukertaa · 2 päivää sitten

AllSky timelapse 29-03-2025 24 katselukertaa · 3 päivää sitten

AllSky timelapse 28-03-2025 25 katselukertaa · 4 päivää sitten

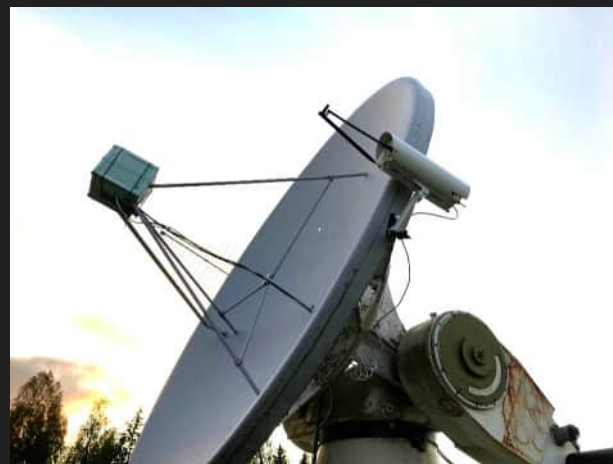
# HaloCAM

Kamerana toimii ZWO ASI 120MC-S, jonka resoluutio on 1280\*960 pikseliä. Optiikkana on 2,5 mm laajakulmalinssi.

Kamera on kiinnitetty radioteleskooppiin, joten se seuraa Aurinkoa automaattisesti.

Kameran suojakoteloon on Raspberry Pi 3+:n lisäksi asennettu lämpötilamittakset sisä- ja ulkopuolelle sekä releillä ohjattavat lämmitin ja tuuletin, joiden avulla kotelon lämpötilaa voidaan säätää ja näin estää kosteuden ja jään kertyminen kotelon lasiin. Alumiinikiskojen päähän 3D-tulostettuun pitimeen asennettiin hitsauslasi Auringon peittäjäksi.

Kameran kuva-alan leveys on noin 90 astetta, joten nykyisellä systeemillä systeemi soveltuu erityisesti aurinkokeskeisten 22 asteen renkaan sisä- ja ulkopuolella olevien halojen havainnointiin.





20250327 08:18:03 (UTC)  
Hankasalmi observatory  
Sensor: 23C  
Exposure: 0.06 ms  
TempOut 7.0 C, TempBox 15.8 C



# Tapo C325WB-kamera

- Tarkkuus korkeintaan: 2K QHD 4MP, 2688 x 1520, 15 fps
- Kuvasensori: 1/1.79" Progressive Scan CMOS
- Minimivalaistus: Väri: 0.0005 Lux, 0 Lux LED-valoilla
- Linssi: 4.58 mm polttoväli ( $\pm 5\%$ ), aukko F/1.0 ( $\pm 5\%$ )
- Näkökenttä: 127° (diagonaalinen)
- Yönäkö: ColorPro Night Vision
- H.264-videopakkaus
- Kaksisuuntainen ääni, kamerassa sisäänrakennettu mikrofoni ja kaiutin
- Älykäs liikkeentunnistus, ihmiset, ajoneuvot ja lemmikit
- Langaton standardi: Wi-Fi 802.11b/g/n (2.4GHz)
- Ethernet 10/100
- MicroSD-muistikorttipaikka (kortti ostettava erikseen, maks. 512 Gt)
- Viestit ja ilmoitukset suoraan puhelimeen
- Android- ja iOS-tuki, Tapo-sovellus
- Amazon Alexa, Google Assistant -tuki
- Käyttölämpötila:  $-20^{\circ}\text{C} \sim 45^{\circ}\text{C}$
- 9.0V/0.6A
- IP-luokka: IP66
- Mitat: 148.7 x 137.9 x 90.4 mm



2025-04-03 23:20:09



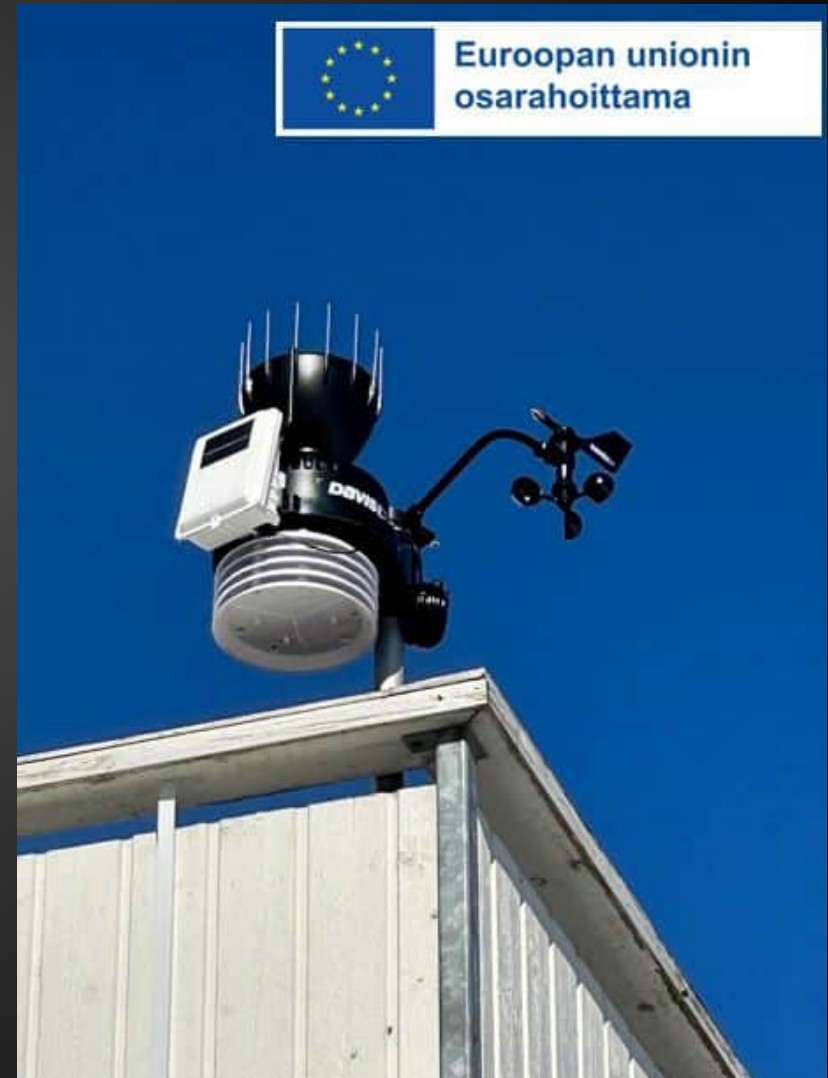


# Reaaliaikainen videokuva



# Davis Vantage Pro2 plus -sääasema

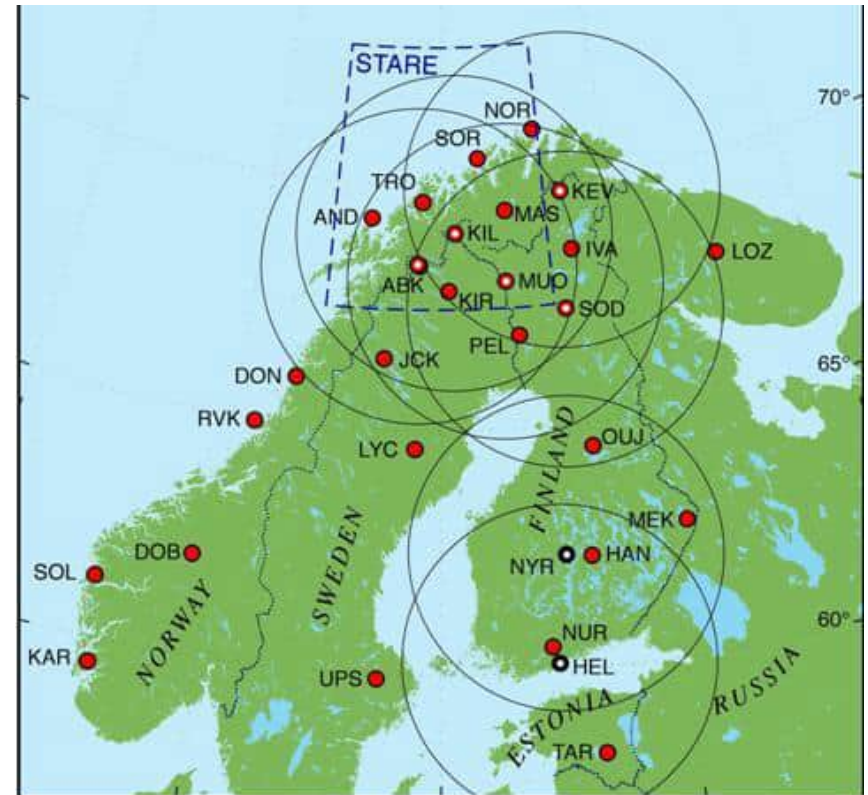
| Hankasalmi observatory                                                                                                                 |               |                    |        |                    |        |       |
|----------------------------------------------------------------------------------------------------------------------------------------|---------------|--------------------|--------|--------------------|--------|-------|
| Conditions as of: 10:22 Tuesday, Apr 01, 2025                                                                                          |               |                    |        |                    |        |       |
| Hankasalmi observatory, Murtoinen                                                                                                      |               |                    |        |                    |        |       |
| Station Summary                                                                                                                        |               |                    |        |                    |        |       |
|                                                                                                                                        | Current       | Daily Highs        |        | Daily Lows         |        |       |
| Temperature                                                                                                                            | 3,7 °C        | 4,6 °C   00:00     |        | 2,3 °C   07:49     |        |       |
| Humidity                                                                                                                               | 92,9 %        | 95,2 %   08:05     |        | 91,5 %   00:06     |        |       |
| Heat Index                                                                                                                             | 3,7 °C        | 4,6 °C   00:00     |        |                    |        |       |
| THW Index                                                                                                                              | 3,7 °C        |                    |        |                    |        |       |
| Wind Chill                                                                                                                             | 3,7 °C        |                    |        | 1,7 °C   08:29     |        |       |
| Dew Point                                                                                                                              | 2,6 °C        | 3,4 °C   00:23     |        | 1,6 °C   07:49     |        |       |
| Wet Bulb                                                                                                                               | 3,2 °C        |                    |        | 1,9 °C   07:49     |        |       |
| Barometer                                                                                                                              | 1024,1 hPa    | 1024,2 hPa   10:17 |        | 1020,0 hPa   00:04 |        |       |
| Bar Trend                                                                                                                              | Rising Slowly |                    |        |                    |        |       |
| Wind Speed                                                                                                                             | 0,5 m/s       | 3,5 m/s   09:33    |        |                    |        |       |
| Wind Direction                                                                                                                         | W 263 °       | WNW 294 °          |        |                    |        |       |
| Wind                                                                                                                                   | 2 Minute      | 10 Minute          |        |                    |        |       |
| Avg Wind Speed                                                                                                                         | 0,4 m/s       | 0,3 m/s            |        |                    |        |       |
| Wind Gust Speed                                                                                                                        | 1,4 m/s       | 1,4 m/s            |        |                    |        |       |
| Rain                                                                                                                                   | Rate          | Hour               | Day    | Month              | Year   | Storm |
| Rain                                                                                                                                   | 0,0 mm/h      | 0,0 mm             | 0,0 mm | 0,0 mm             | 0,2 mm | --    |
| DAVIS Weatherlink Network                                                                                                              |               |                    |        |                    |        |       |
| Vantage Pro2 Plus, Wireless via WLL<br>Shop Weather Stations at <a href="http://www.davisinstruments.com">www.davisinstruments.com</a> |               |                    |        |                    |        |       |





# MIRACLE-verkko

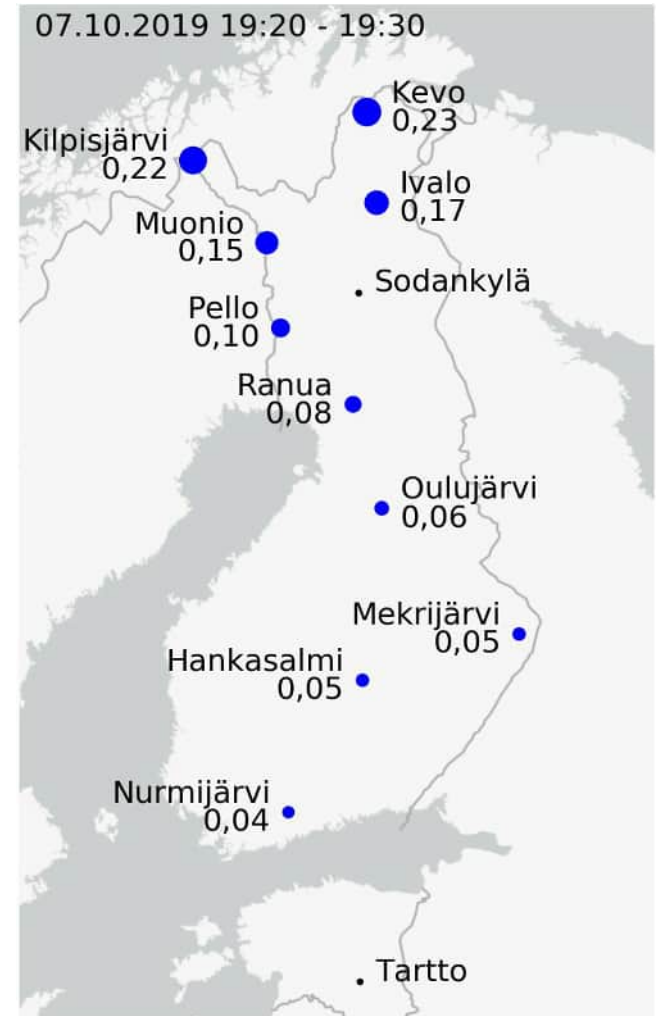
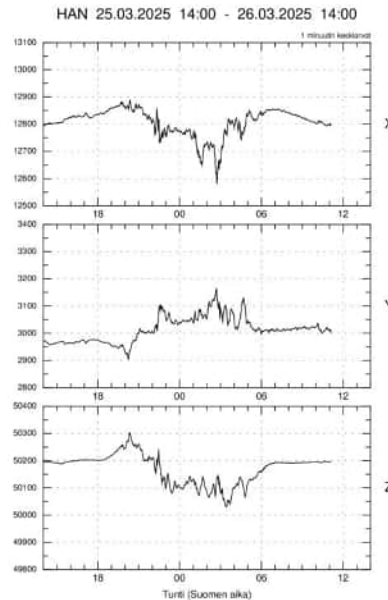
- Ilmatieteen laitoksella on useita mittausasemia eri puolella Suomea
- Sirkuksen observatoriot Jyväskylässä (revontulikamerat) ja Hankasalmella (magnetometri ja revontulikamera) kuuluvat verkkoon





# Magneettikentän mittaaminen

- Suomessa 11 mittauspistettä
  - Yksi mittauspiste Hankasalmen observatoriolla
  - Mittaus 10 s välein
- Auroras Now
- <https://ilmatieteenlaitos.fi/revontulet-ja-avaruussaa>
- <https://rwc-finland.fmi.fi/>

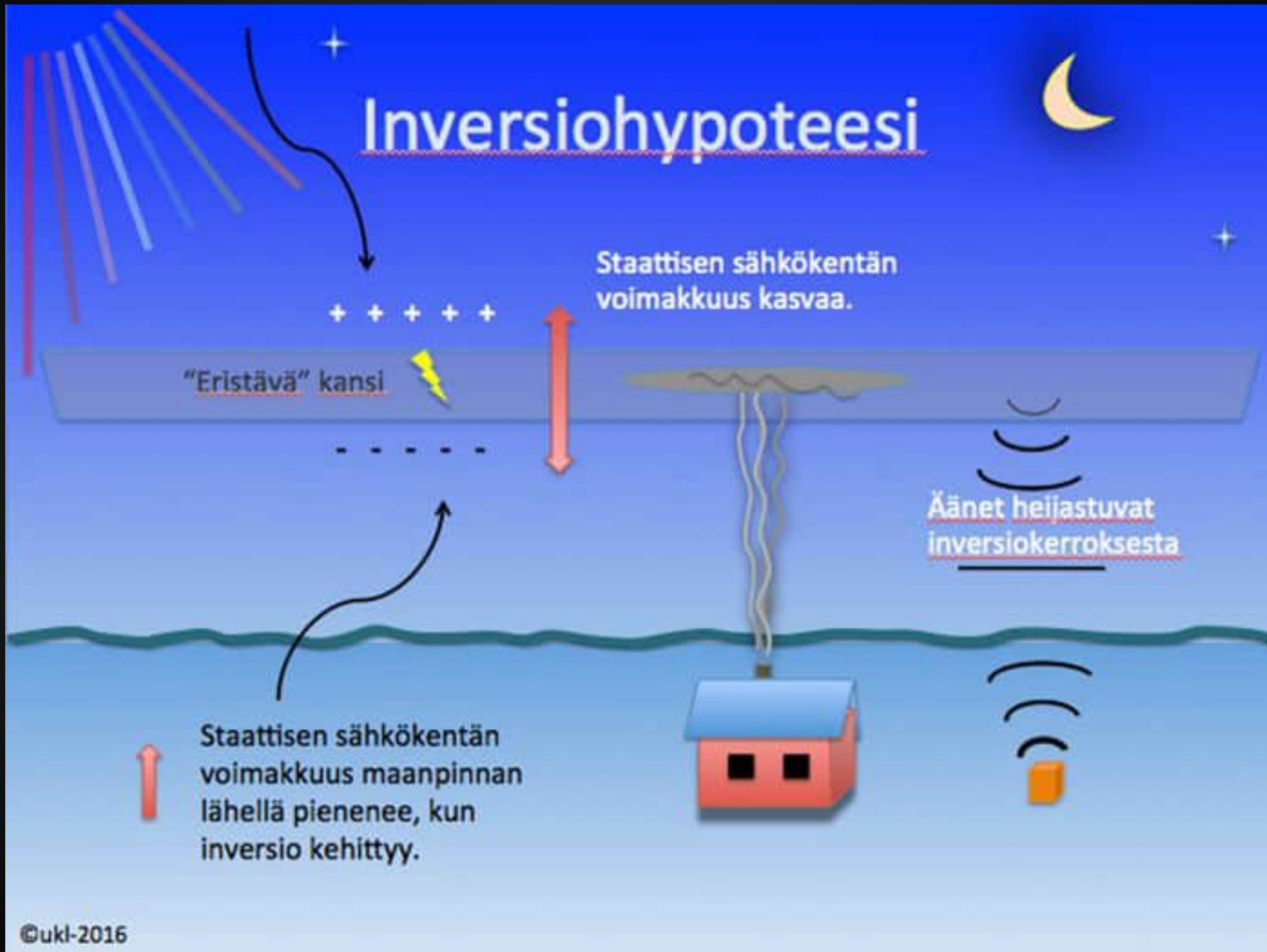


# Revontulien äänet?

- Revontulien äänet elävät vahvasti kansanperinteessä
- Luotettavia tallenteita erittäin vähän
- Äänet eivät voi syntyä samalla korkeudella kuin valoilmiö
- Synestesia?



# Inversiohypoteesi





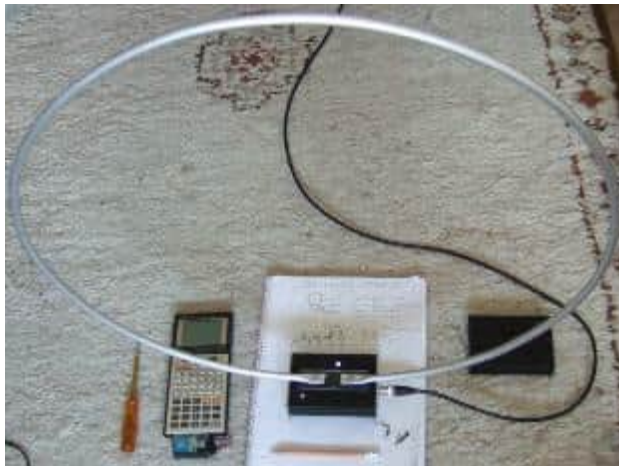
# Revontulien kuunteluasema

- Neljä mikrofonia (äänen suunta)
- VLF-antenni (äänen etäisyys)
- Äänilähde (inversiokerroksen korkeus)
- EU-hanke: Maaseutukehitys ry/Leader
- Etäkäytettävä - aina valmiina kuuntelemaan
- Ainutlaatuinen koko maailmassa

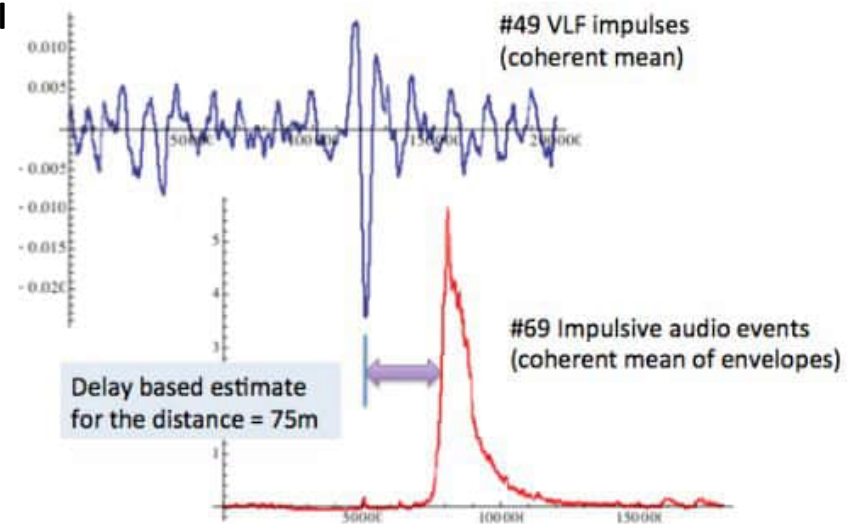


# Sähkömagneettinen pulssi

- Inversiokerroksen purkauksesta aiheutuva sähkömagneettinen pulssi
- VLF-antenni
  - Pulssi etenee valon nopeudella
    - 300 000 km/s
  - Yhdistettynä äänihavaintoon kertoo äänilähteen etäisyyden



[https://www.qsl.net/dl4yhf/vlf\\_rdf/vlf\\_single\\_turn\\_loop.htm](https://www.qsl.net/dl4yhf/vlf_rdf/vlf_single_turn_loop.htm)

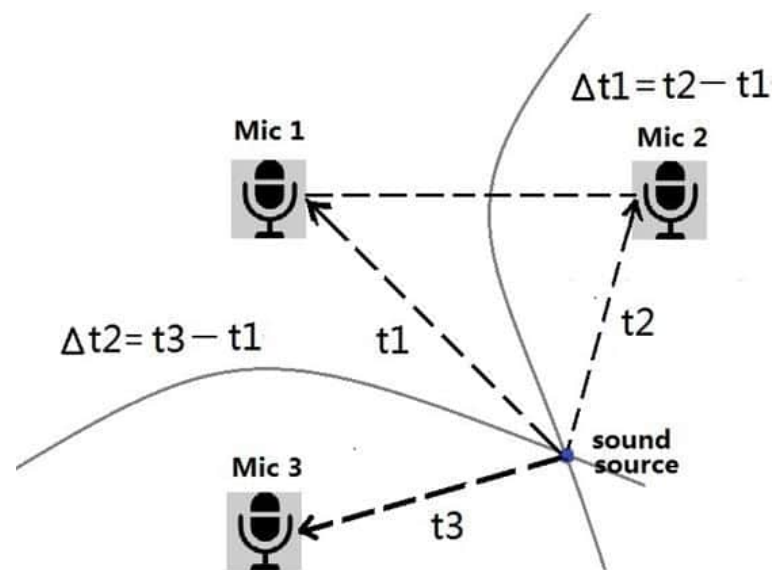


Laine, U.K. (2016) Auroral Acoustics project – a progress report with a new hypothesis.

[https://www.researchgate.net/publication/304252270\\_Auroral\\_Acoustics\\_project\\_-\\_a\\_progress\\_report\\_with\\_a\\_new\\_hypothesis](https://www.researchgate.net/publication/304252270_Auroral_Acoustics_project_-_a_progress_report_with_a_new_hypothesis)

# Äänilähteen suunnan määrittäminen

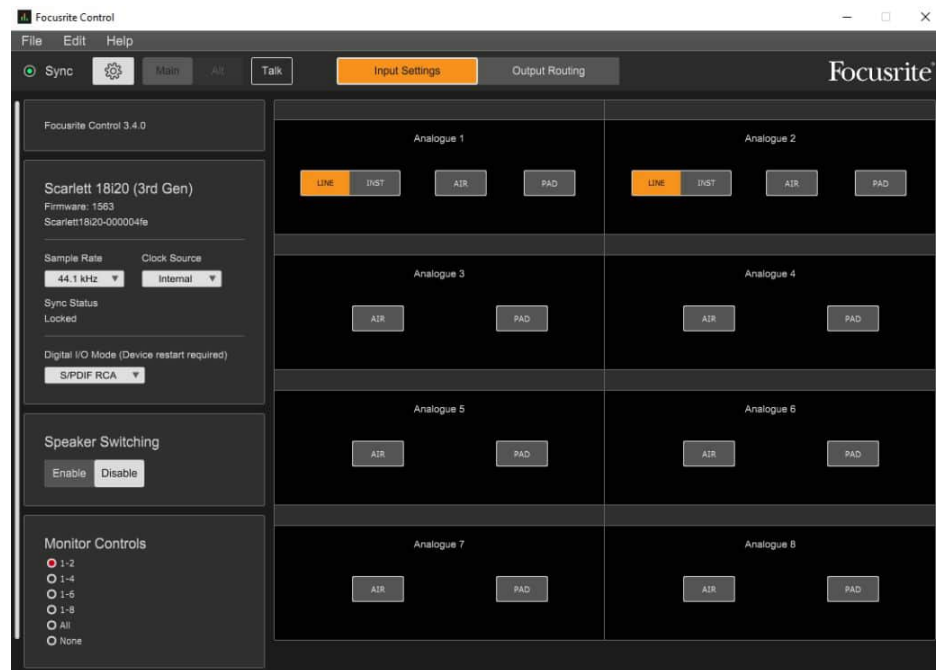
- Monimikrofonijärjestelmä – microphone array
- Äänen nopeus ilmassa 343 m/s
- Mikrofonien väli 6 m  $\approx 0.017$  s
- Viiveistä voidaan laskea äänilähteen suunta



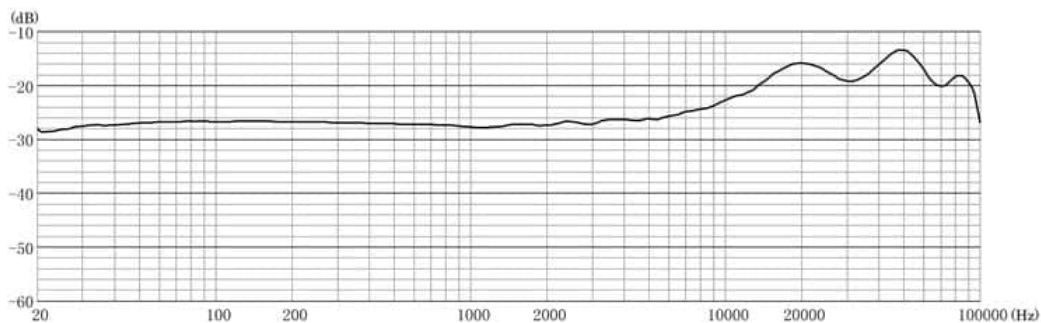


# Äänten tallennus

- 4 x mikrofoni
- Focusrite-äänikortti
- Sennheiser-mikrofonit 4 kpl
  - 10 – 60 kHz
- Näytteenottotaajuus valittavissa
  - Toistaiseksi 44.1 kHz

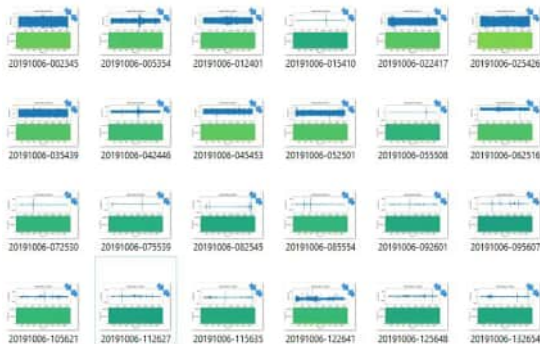
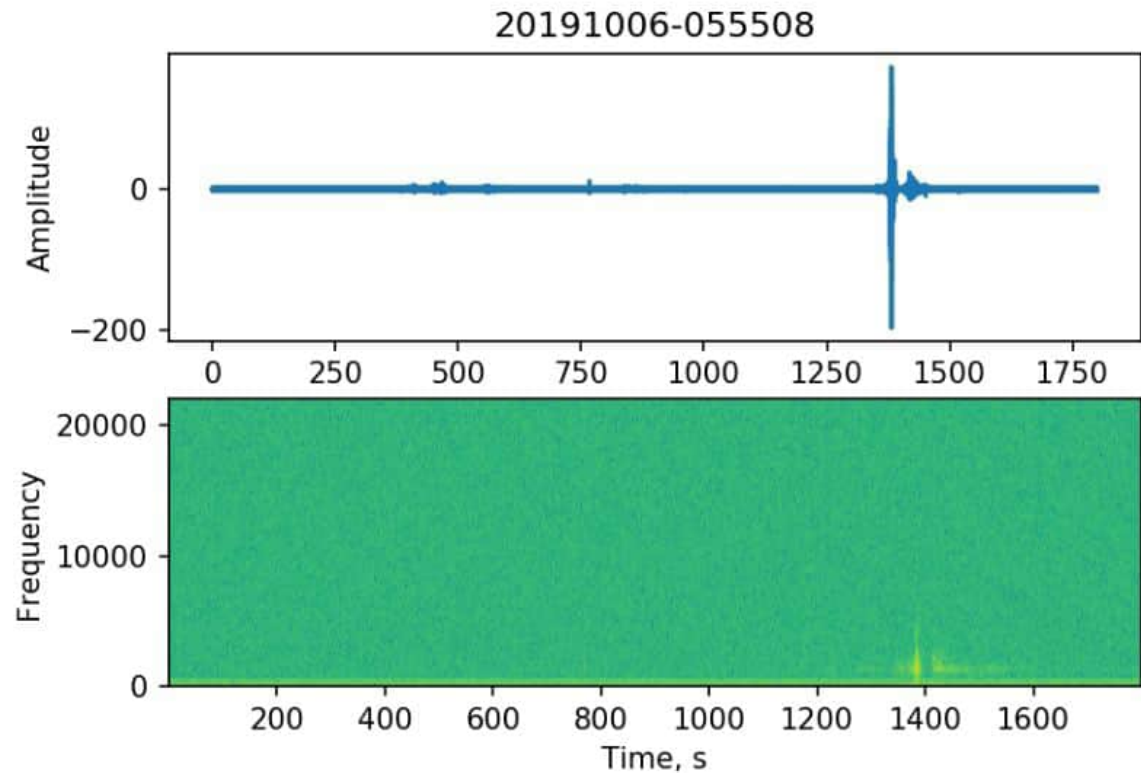


CO-100K



# Äänien analysointi

- Äänien automaattinen tunnistus ja luokittelu
- Revontuliäänien tunnistaminen?
- Tornirakennuksen äänet ja muut häiriöt





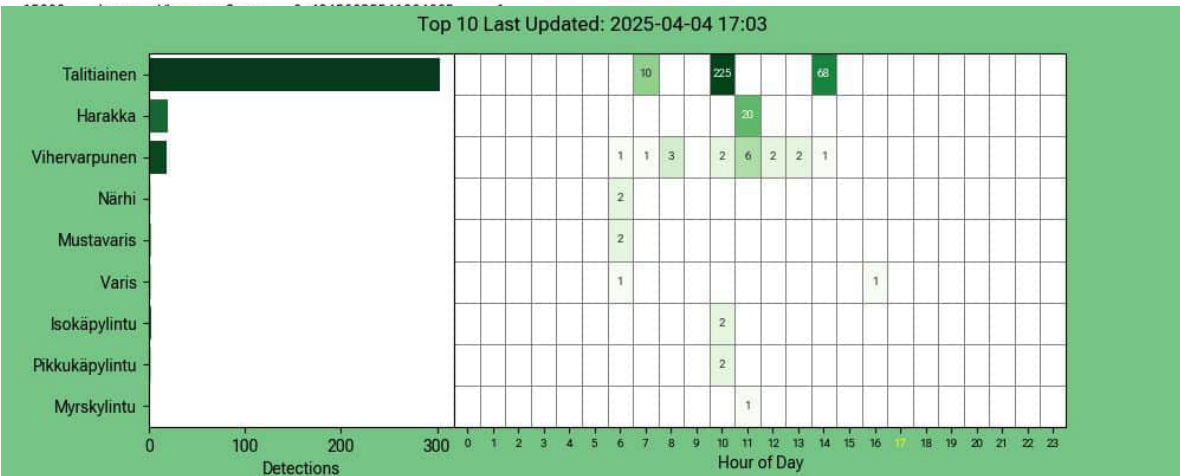
# Lintujen äänet

|                                          |             |         |                       |                |              |               |                |              |                     |   |
|------------------------------------------|-------------|---------|-----------------------|----------------|--------------|---------------|----------------|--------------|---------------------|---|
| 20210403-034000_1.BirdNET.selections.txt |             |         |                       |                |              |               |                |              |                     |   |
| Selection                                | View        | Channel | Begin File            | Begin Time (s) | End Time (s) | Low Freq (Hz) | High Freq (Hz) | Species Code | Common Name         |   |
| Confidence                               | Rank        |         |                       |                |              |               |                |              |                     |   |
| 1                                        | Spectrogram | 1       | 20210403-034000_1.wav | 6.0            | 9.0          | 1500          | gretit1        | Great Tit    | 0.16133324914258704 | 1 |
| 2                                        | Spectrogram | 1       | 20210403-034000_1.wav | 159.0          | 162.0        | 15000         | whoswa         | Whooper Swan | 0.9132949580551264  | 1 |
| 3                                        | Spectrogram | 1       | 20210403-034000_1.wav | 165.0          | 168.0        | 15000         | whoswa         | Whooper Swan | 0.10732118706958123 | 1 |
| 4                                        | Spectrogram | 1       | 20210403-034000_1.wav | 168.0          | 171.0        | 15000         | whoswa         | Whooper Swan | 0.22201747330122024 | 1 |
| 5                                        | Spectrogram | 1       | 20210403-034000_1.wav | 171.0          | 174.0        | 15000         | whoswa         | Whooper Swan | 0.8939521617485785  | 1 |
| 6                                        | Spectrogram | 1       | 20210403-034000_1.wav | 174.0          | 177.0        | 15000         | whoswa         | Whooper Swan | 0.19463129454853767 | 1 |
| 7                                        | Spectrogram | 1       | 20210403-034000_1.wav | 195.0          | 198.0        | 15000         | gretit1        | Great Tit    | 0.1135424764167048  | 1 |
| 8                                        | Spectrogram | 1       | 20210403-034000_1.wav | 237.0          | 240.0        | 15000         | gretit1        | Great Tit    | 0.10490387803361445 | 1 |
| 9                                        | Spectrogram | 1       | 20210403-034000_1.wav | 243.0          | 246.0        | 15000         | gretit1        | Great Tit    | 0.10115056259004296 | 1 |
| 10                                       | Spectrogram | 1       | 20210403-034000_1.wav | 246.0          | 249.0        | 15000         | gretit1        | Great Tit    | 0.1679172147484702  | 1 |
| 11                                       | Spectrogram | 1       | 20210403-034000_1.wav | 0.0            | 3.0          | 15000         | gretit1        | Great Tit    | 0.14780223124451392 | 1 |

|                                          |             |         |                       |                |              |               |                |                          |                     |   |
|------------------------------------------|-------------|---------|-----------------------|----------------|--------------|---------------|----------------|--------------------------|---------------------|---|
| 20210403-040000_1.BirdNET.selections.txt |             |         |                       |                |              |               |                |                          |                     |   |
| Selection                                | View        | Channel | Begin File            | Begin Time (s) | End Time (s) | Low Freq (Hz) | High Freq (Hz) | Species Code             | Common Name         |   |
| Confidence                               | Rank        |         |                       |                |              |               |                |                          |                     |   |
| 1                                        | Spectrogram | 1       | 20210403-040000_1.wav | 48.0           | 51.0         | 15000         | grswoo         | Great Spotted Woodpecker |                     |   |
| 0.11123623314340222                      |             | 1       |                       |                |              |               |                |                          |                     |   |
| 2                                        | Spectrogram | 1       | 20210403-040000_1.wav | 78.0           | 81.0         | 15000         | gretit1        | Great Tit                | 0.170420402133702   | 1 |
| 3                                        | Spectrogram | 1       | 20210403-040000_1.wav | 87.0           | 90.0         | 15000         | gretit1        | Great Tit                | 0.1269809287530529  | 1 |
| 4                                        | Spectrogram | 1       | 20210403-040000_1.wav | 93.0           | 96.0         | 15000         | gretit1        | Great Tit                | 0.10870069682379895 | 1 |
| 5                                        | Spectrogram | 1       | 20210403-040000_1.wav | 69.0           | 72.0         | 15000         | gretit1        | Great Tit                | 0.18308682973716423 | 1 |
| 6                                        | Spectrogram | 1       | 20210403-040000_1.wav | 120.0          | 123.0        | 15000         | gretit1        | Great Tit                | 0.14927837517136727 | 1 |
| 7                                        | Spectrogram | 1       | 20210403-040000_1.wav | 135.0          | 138.0        | 15000         | gretit1        | Great Tit                | 0.1241206119020044  | 1 |
| 8                                        | Spectrogram | 1       | 20210403-040000_1.wav | 177.0          | 180.0        | 15000         | grswoo         | Great Spotted Woodpecker |                     |   |
| 0.23993406493726754                      |             | 1       |                       |                |              |               |                |                          |                     |   |
| 9                                        | Spectrogram | 1       | 20210403-040000_1.wav | 189.0          | 192.0        | 15000         | hoocro1        | Hooded Crow              | 0.2088014557528909  | 1 |
| 10                                       | Spectrogram | 1       | 20210403-040000_1.wav | 333.0          | 336.0        | 15000         | hoocro1        | Hooded Crow              | 0.1618532170665618  | 1 |

|                                          |             |         |                       |                |              |               |                |              |                     |   |
|------------------------------------------|-------------|---------|-----------------------|----------------|--------------|---------------|----------------|--------------|---------------------|---|
| 20210403-041000_1.BirdNET.selections.txt |             |         |                       |                |              |               |                |              |                     |   |
| Selection                                | View        | Channel | Begin File            | Begin Time (s) | End Time (s) | Low Freq (Hz) | High Freq (Hz) | Species Code | Common Name         |   |
| Confidence                               | Rank        |         |                       |                |              |               |                |              |                     |   |
| 1                                        | Spectrogram | 1       | 20210403-041000_1.wav | 153.0          | 156.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |
| 2                                        | Spectrogram | 1       | 20210403-041000_1.wav | 171.0          | 174.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |
| 3                                        | Spectrogram | 1       | 20210403-041000_1.wav | 207.0          | 210.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |
| 4                                        | Spectrogram | 1       | 20210403-041000_1.wav | 183.0          | 186.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |
| 5                                        | Spectrogram | 1       | 20210403-041000_1.wav | 255.0          | 258.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |
| 6                                        | Spectrogram | 1       | 20210403-041000_1.wav | 258.0          | 261.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |
| 7                                        | Spectrogram | 1       | 20210403-041000_1.wav | 387.0          | 390.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |
| 8                                        | Spectrogram | 1       | 20210403-041000_1.wav | 387.0          | 390.0        | 15000         | talitia        | Talitiainen  | 0.16133324914258704 | 1 |

## Nyrölä observatory

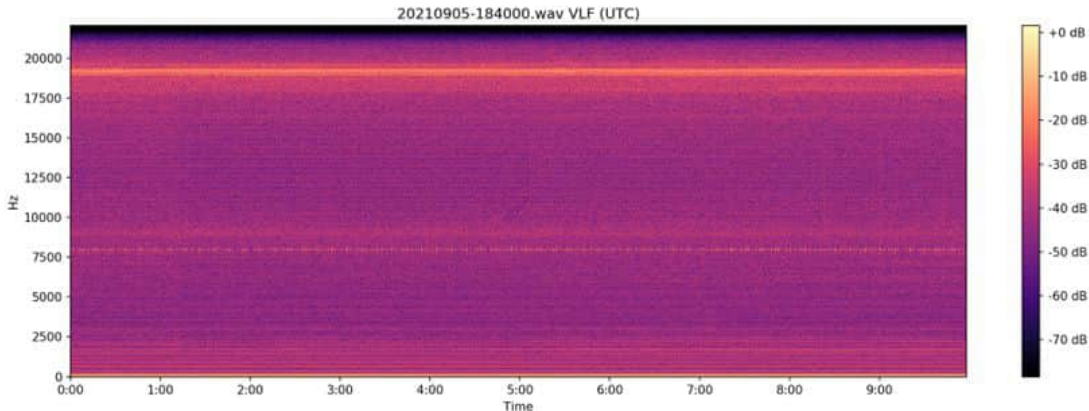
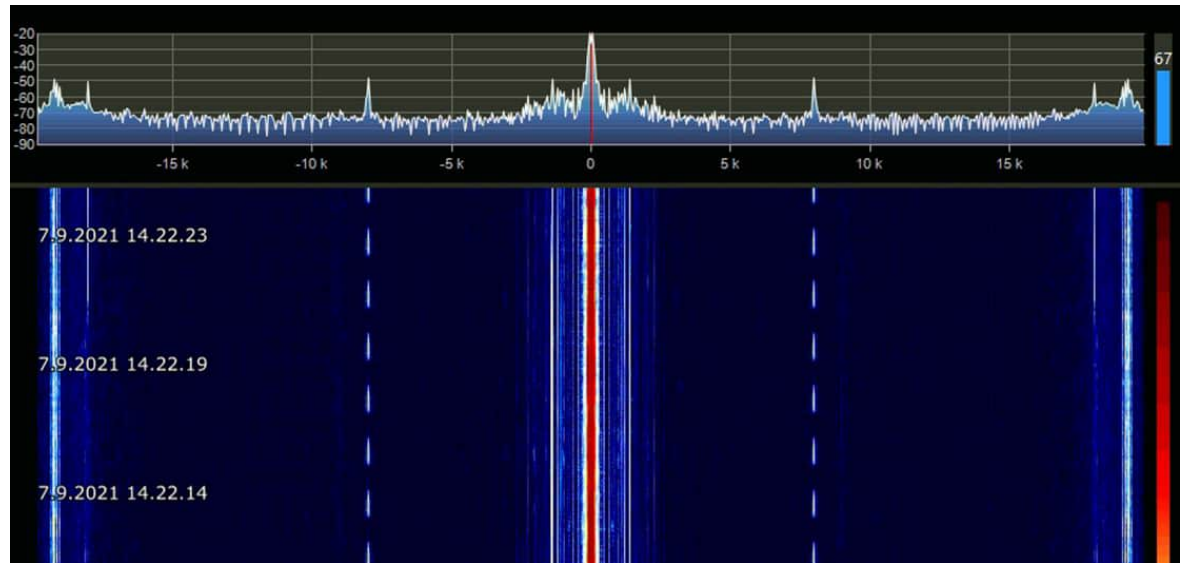


# 8 kHz mysteerisignaali

- Piippaus 2 s välein 8 kHz taajuudella
- Kuuluu 24/7

Ei enää mysteeri

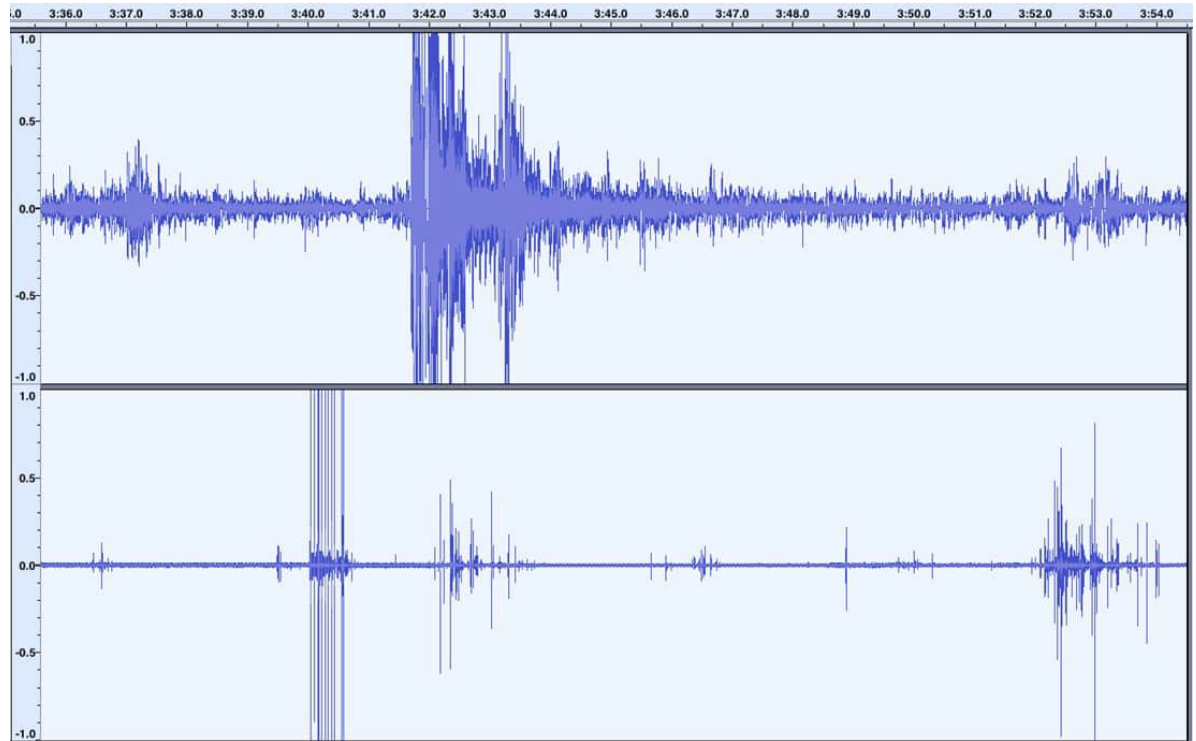
= Kaukoputken kuvun  
kommunikaatio





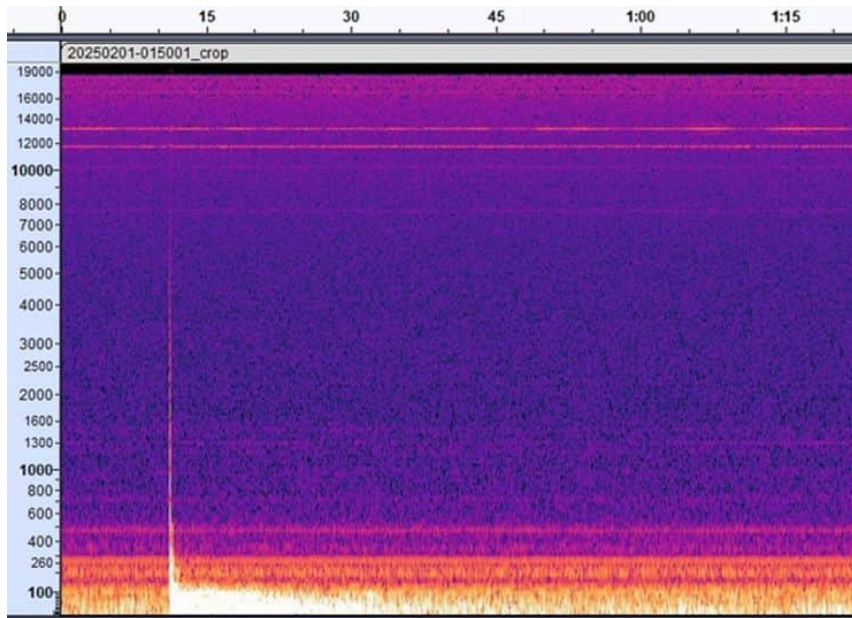
# Ukonilma 28.6.2020

- Salamanisku 590 m päähän tornista
- VLF-signaalin ja äänen ero 1,7 s





# Tulipallo yöllä, täysikuuta kirkkaampi - 1.2.2025 Klo 03.47 Hankasalmi, Murtoinen

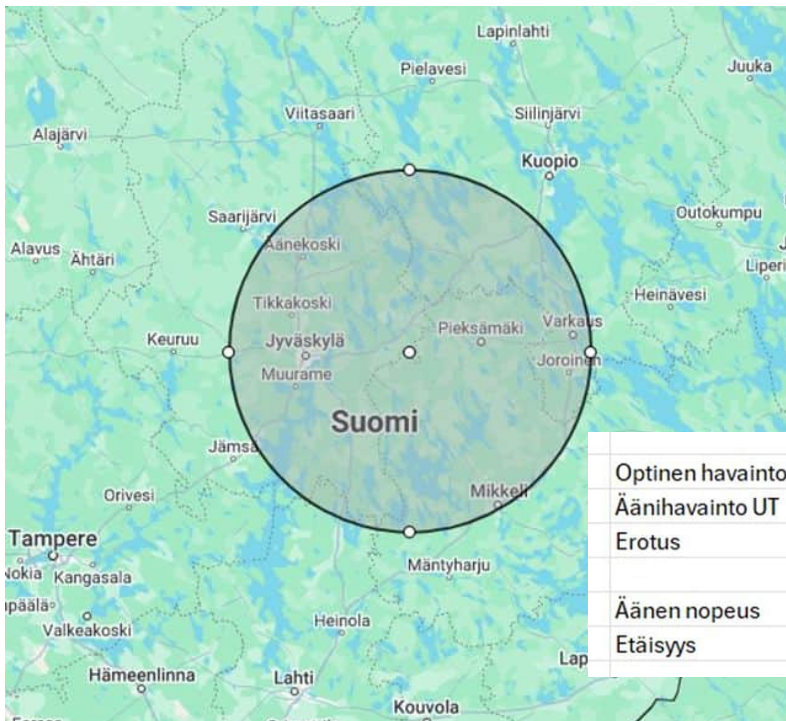


Euroopan maaseudun  
kehittämisen maatalousrahasto:  
Eurooppa investoi maaseutualueisiin



# Tulipallo yöllä, täysikuuta kirkkaampi - 1.2.2025 Klo 03.47 Hankasalmi, Murtoinen

- [http://nyrola.jklsirius.fi/allsky/20250201-015001\\_crop.mp3](http://nyrola.jklsirius.fi/allsky/20250201-015001_crop.mp3)
- <https://www.ksml.fi/paikalliset/8256970>
- <https://www.is.fi/kotimaa/art-2000011008028.html>



|                     |          |
|---------------------|----------|
| Optinen havainto UT | 01:47:39 |
| Äänihavainto UT     | 01:51:32 |
| Erotus              | 00:03:53 |
|                     | 233 s    |
| Äänen nopeus        | 319 m/s  |
| Etäisyys            | 74.3 km  |



Euroopan maaseudun  
kehittämisen maatalousrahasto:  
Eurooppa investoi maaseutualueisiin

# KYSYMYKSIÄ?



Arto Oksanen

puh: 040-5659438

[arto.oksanen@jklsirius.fi](mailto:arto.oksanen@jklsirius.fi)

[www.jklsirius.fi](http://www.jklsirius.fi)