Using the Sun as a (Beam) Calibrator in the Far East

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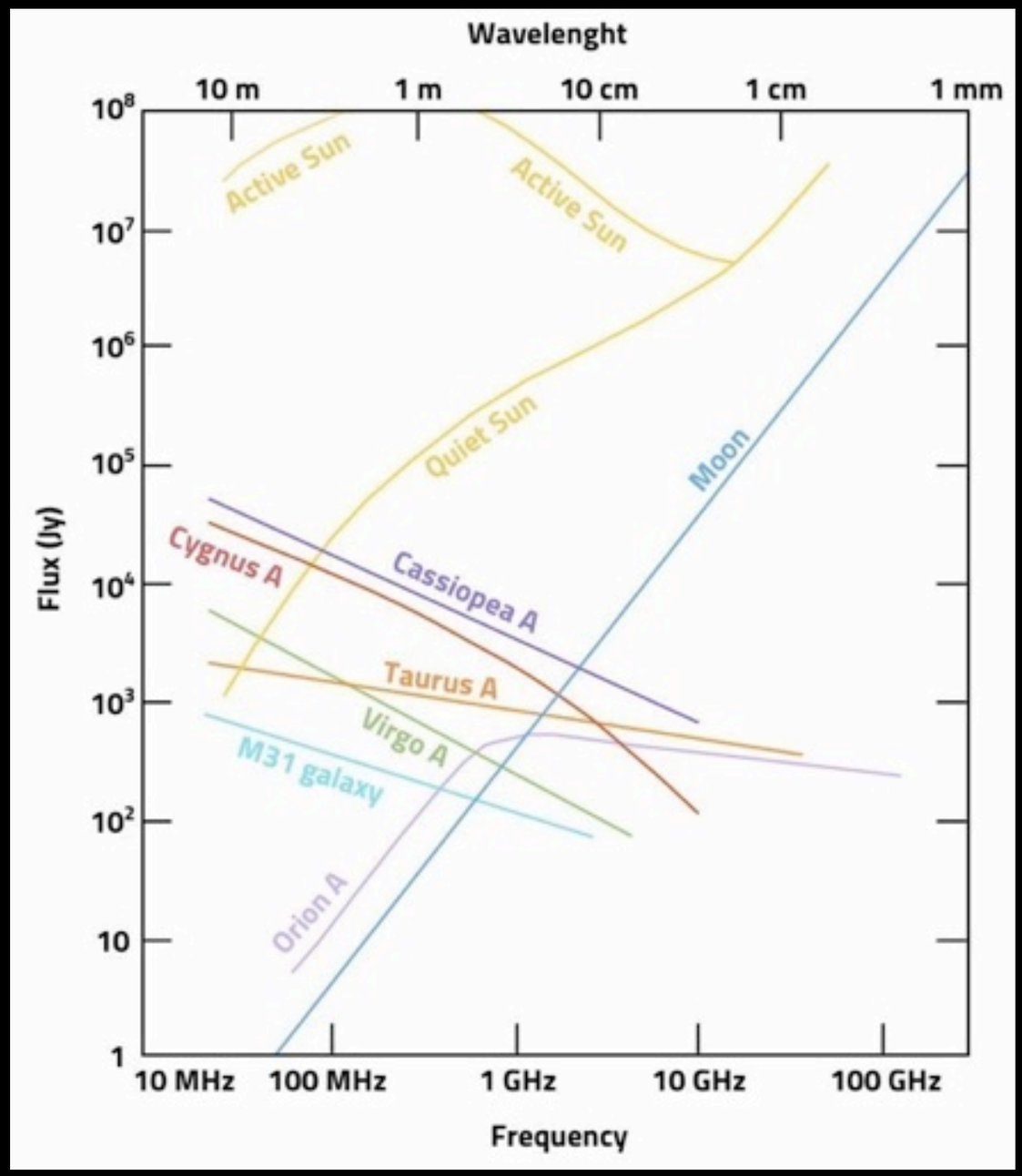
2017 05 11

A Good Beam Calibrator

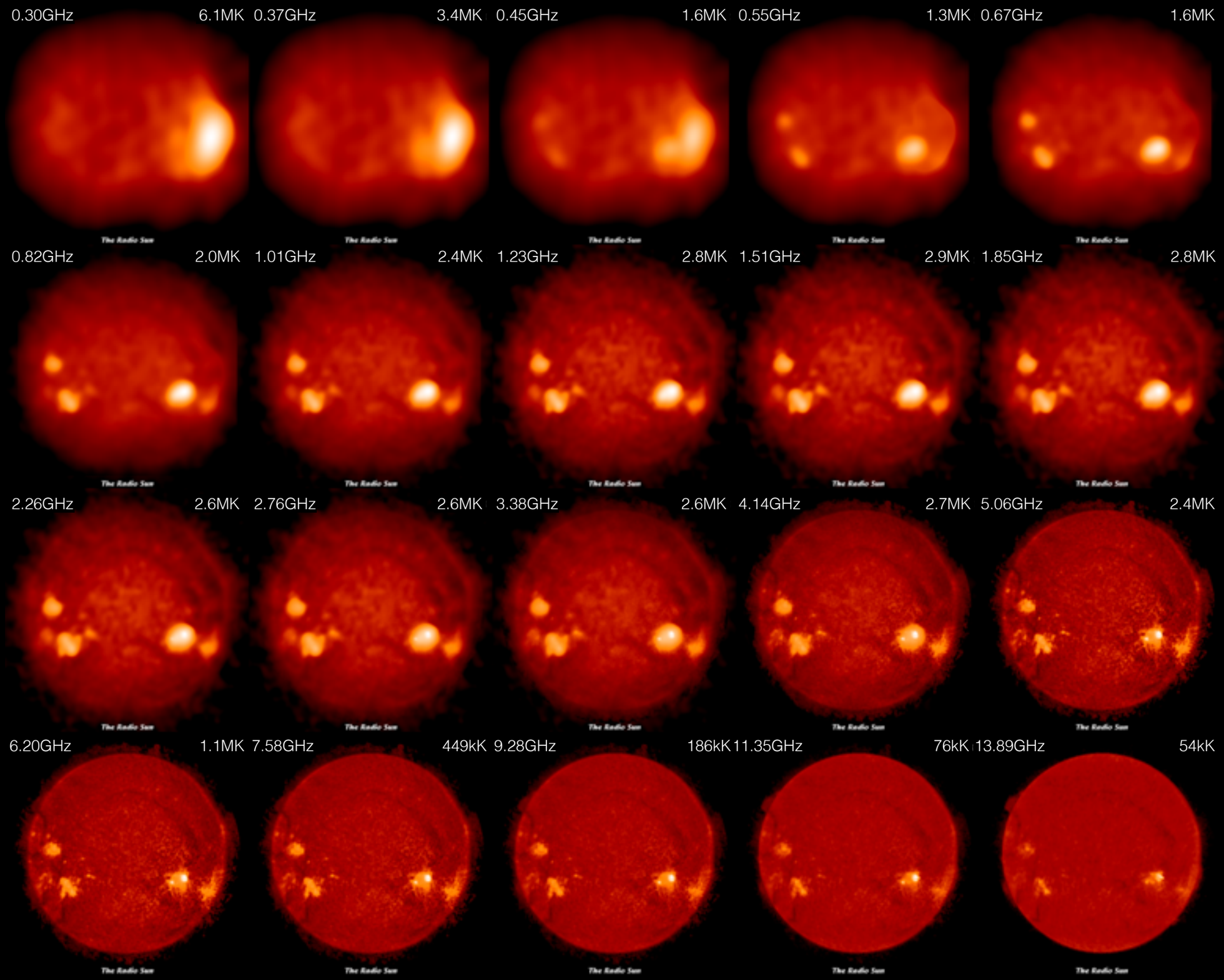
	Sun	radio source	drone	“noise source”
bright	✅	✔️	✅	✔️
above telescope in far field	✅	✅	✅	❌
samples the beam	✔️	❌	✅	❌
can be modulated independently of sky	❌	❌	✅	✅
always there	❌	❌	❌	✅
known emission pattern	✔️	✅	✅	✅

Sun: brightest source available



- bright sources allow rapid accurate calibration

Solar emission pattern depends on frequency, especially when active



The Sun becomes fuzzy below 1 GHz as upper atmosphere (chromosphere) becomes optically thick.

Radio telescopes take continuous (≲1sec) images of Sun:

imaging (radioheliographs):

CSRH: Chinese Spectral RadioHeliograph (0.4-15GHz)

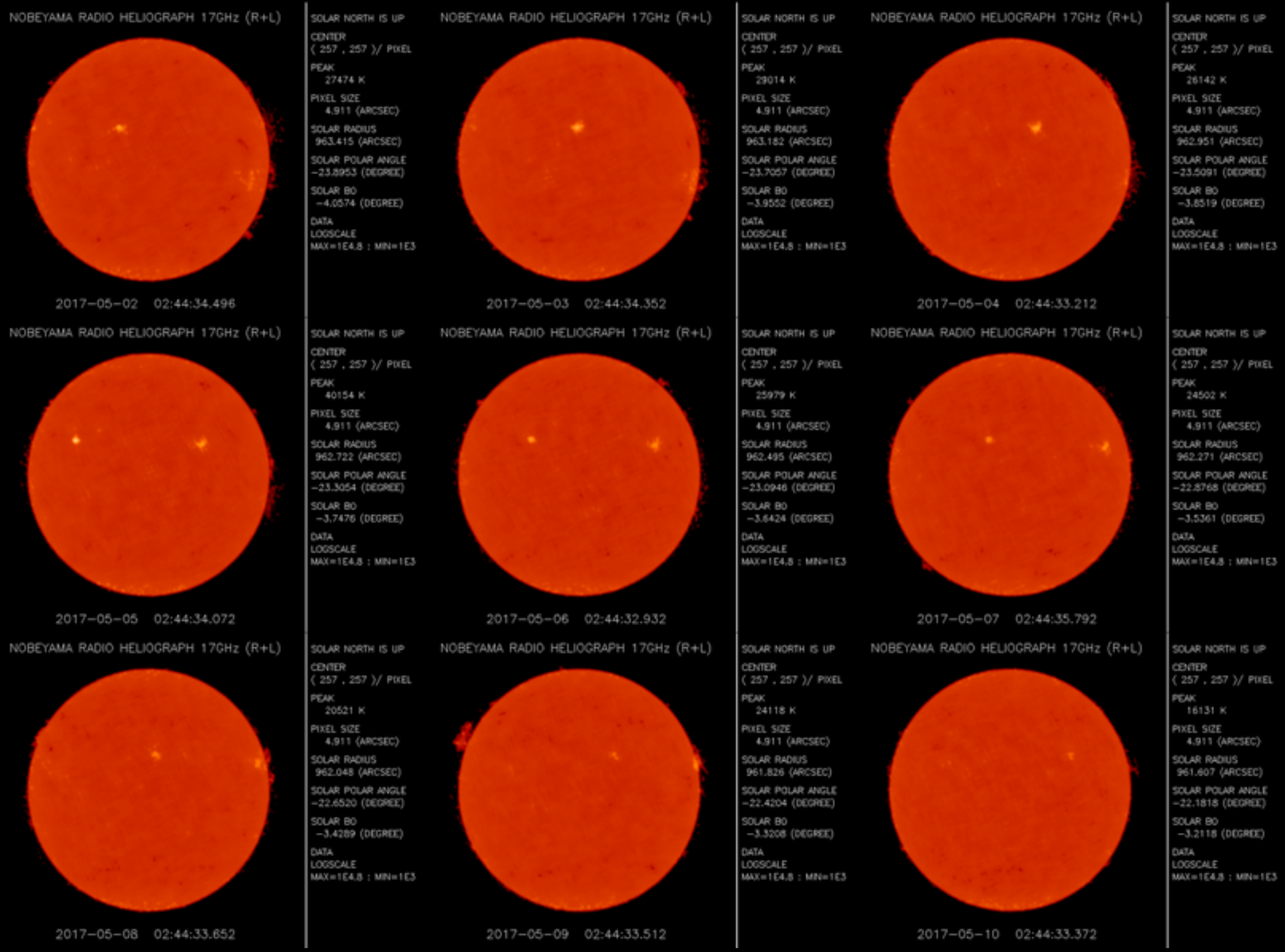
NoRH: Nobeyama RadioHeliograph (17,34 GHz)

non-imaging:

NoRP: Nobeyama RadioPolarimeter (1, 2, 3.75, 9.4 GHz)

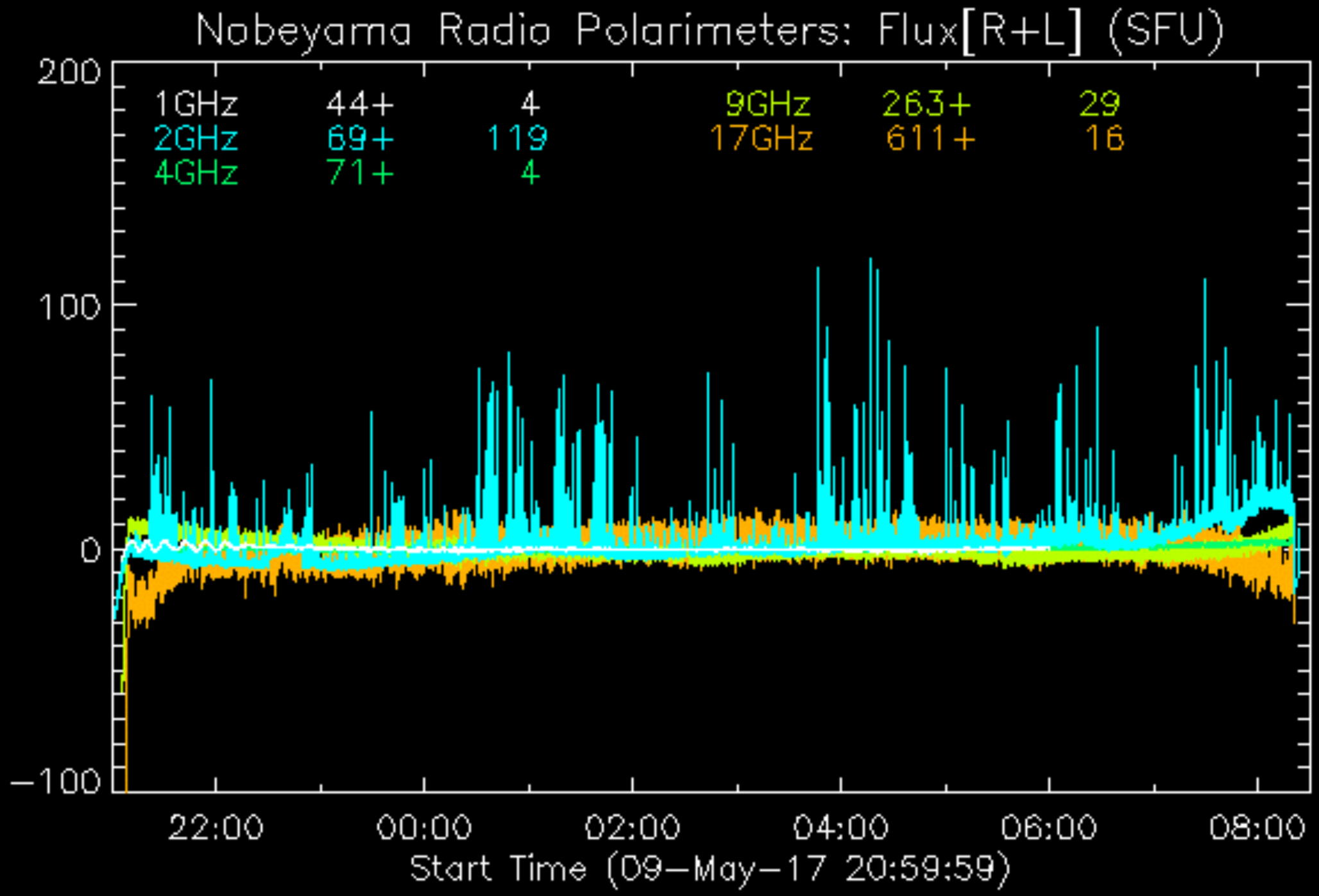
F10.7 data (10.7cm=2.8GHz) data (since 1947-02-14) @ DRAO

NoRH



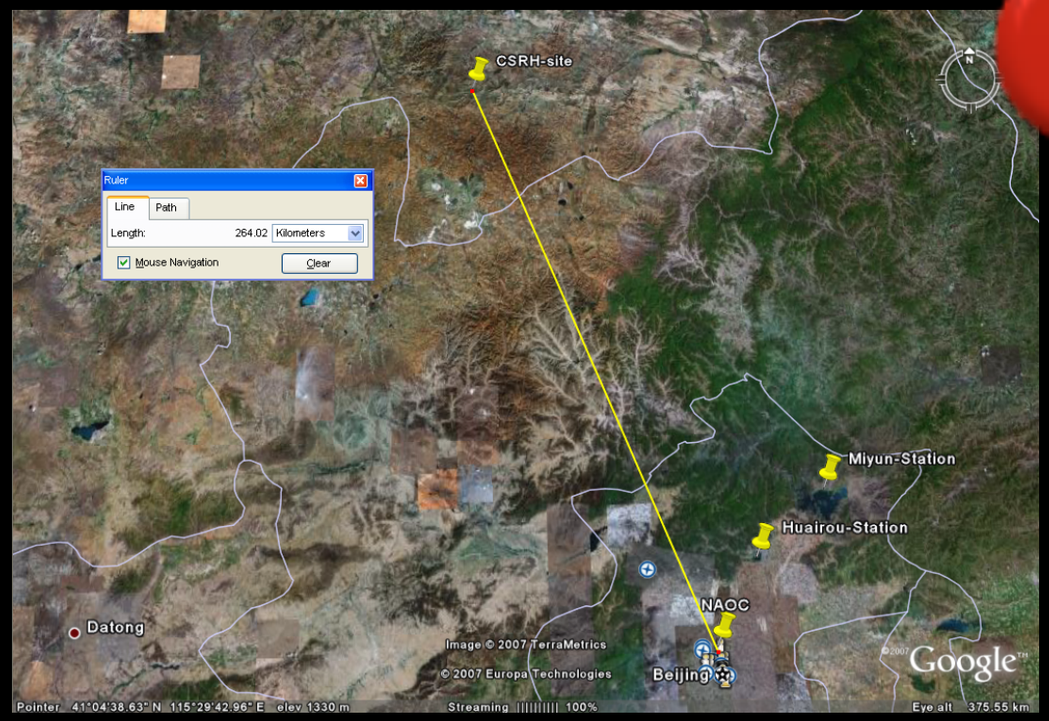
One can access FITS images of NoRH data

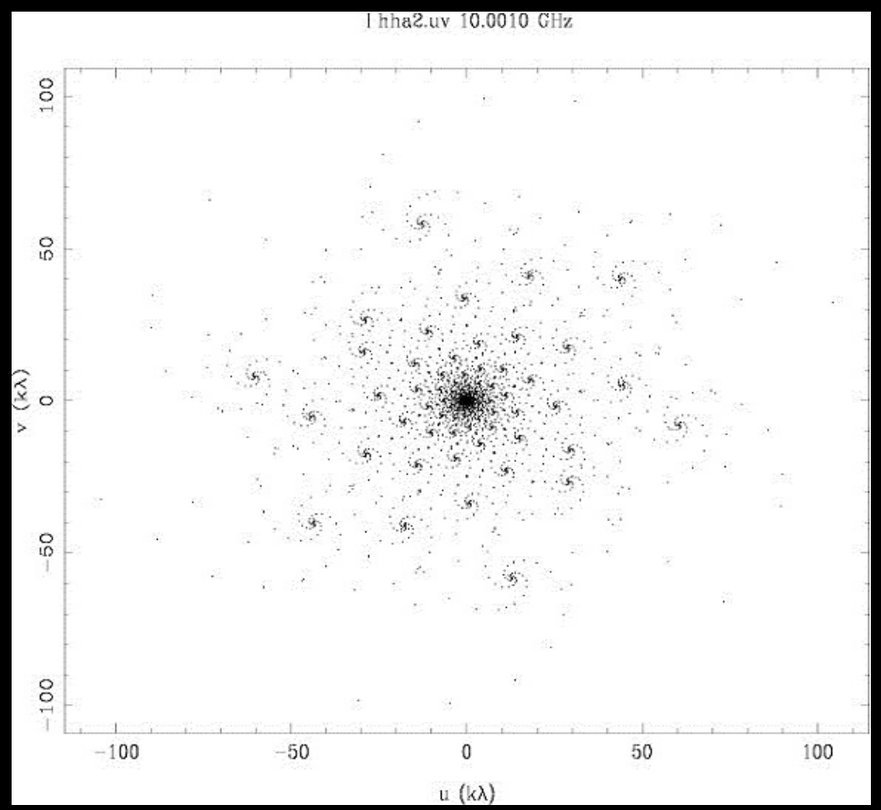
NoRP



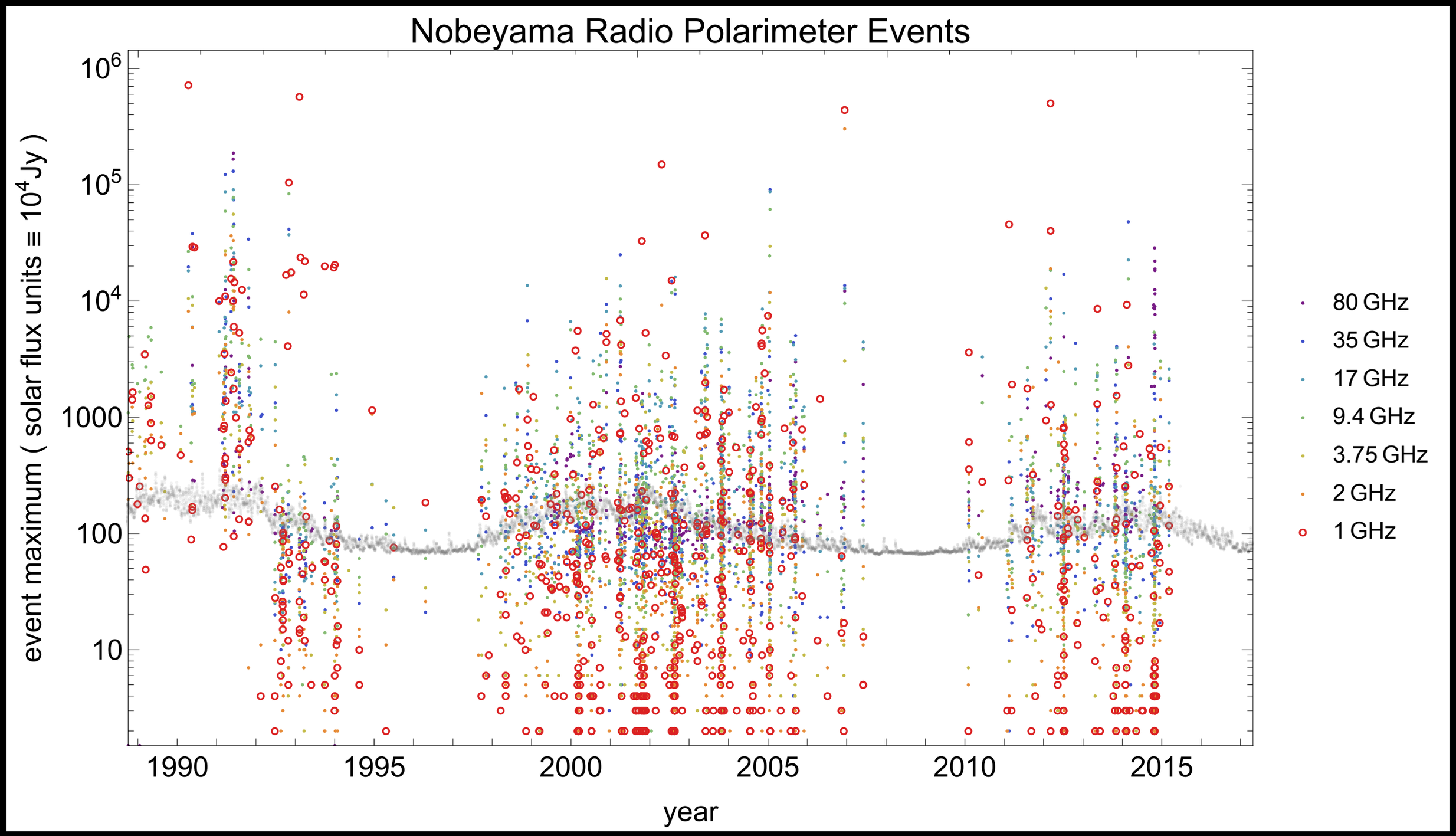
One can access tabular NoRP data

CSRH


CSRH-site
Ruler
Line
Path
Length:
264.02
Kilometers
Mouse Navigation
Clear
Miyun-Station
Huairou-Station
NAOC
Datong
Beijing
Image © 2007 TerraMetrics
© 2007 Europa Technologies
Google
Pointer 41°04'38.63" N 115°29'42.96" E elev 1330 m
Streaming 100%
Eye alt 375.55 km


I hha2.uv 10.0010 GHz
v (kλ)
u (kλ)
100
50
0
−50
−100
−100
−50
0
50
100

The Sun very occasionally has very larger outbursts especially during Solar maximum currently heading toward Solar minimum



- Japanese -

Nobeyama, Minamimaki, Minamisaku,
Nagano, 384-1305, Japan

31 March 2015

Dear Sir or Madam,

We regrettably inform you that the Nobeyama Solar Radio Observatory, National Astronomical Observatory of Japan (NAOJ) was closed at the end of Japanese FY2014, on March 31st, 2015. We deeply appreciate your support to our observatory for over 45 years.

Our two solar radio-telescopes are operated by the other institutes from April 1st, 2015. The Nobeyama Radioheliograph (NoRH) is operated by the Solar-Terrestrial Environment Laboratory, Nagoya University with the International Consortium for Continued Operation of Nobeyama Radioheliograph. The Nobeyama Radio Polarimeters (NoRP) are operated by the Nobeyama Radio Observatory, NAOJ. When you have a request, question or comment about the instruments, please visit the following web sites of these institutes.

NAOJ continues to provide the Solar Data Analysis System (SDAS) as the data archive and analysis system of NoRH/NoRP. When you need a data analysis of the instruments, please visit the SDAS web site.

Thank you very much for your support.

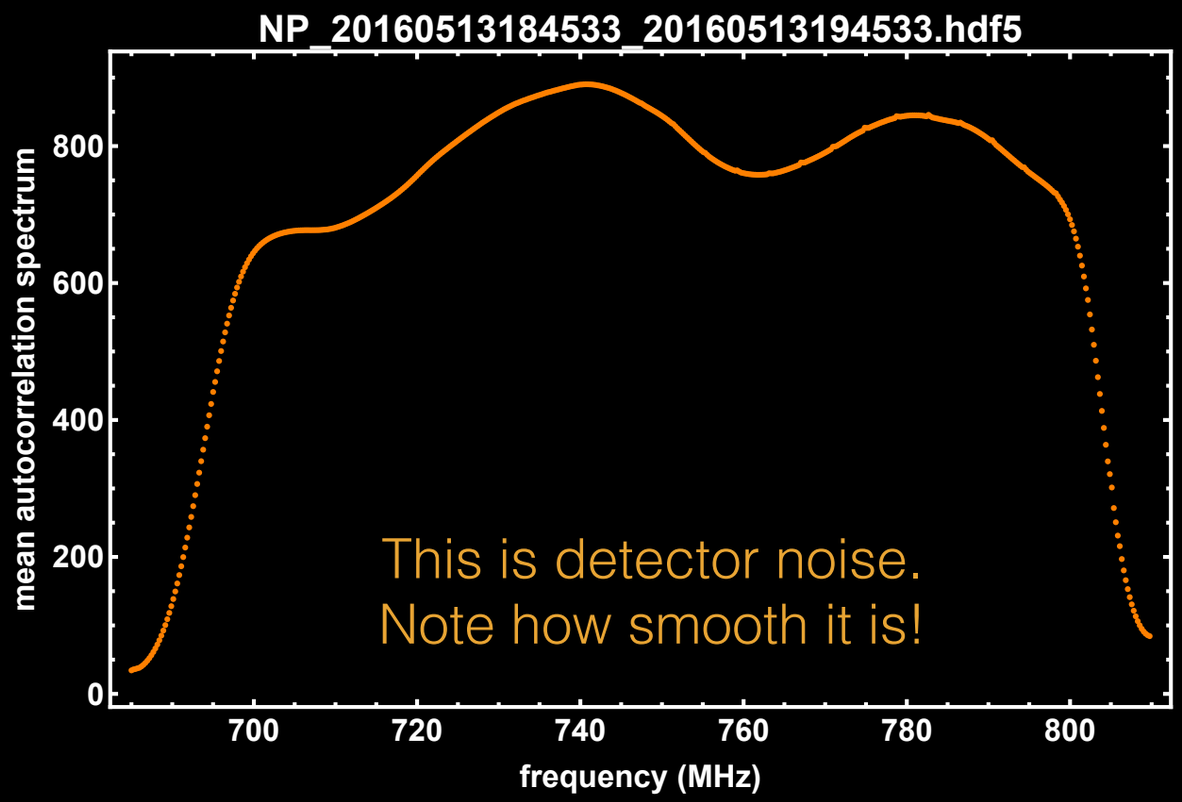
Respectfully yours,

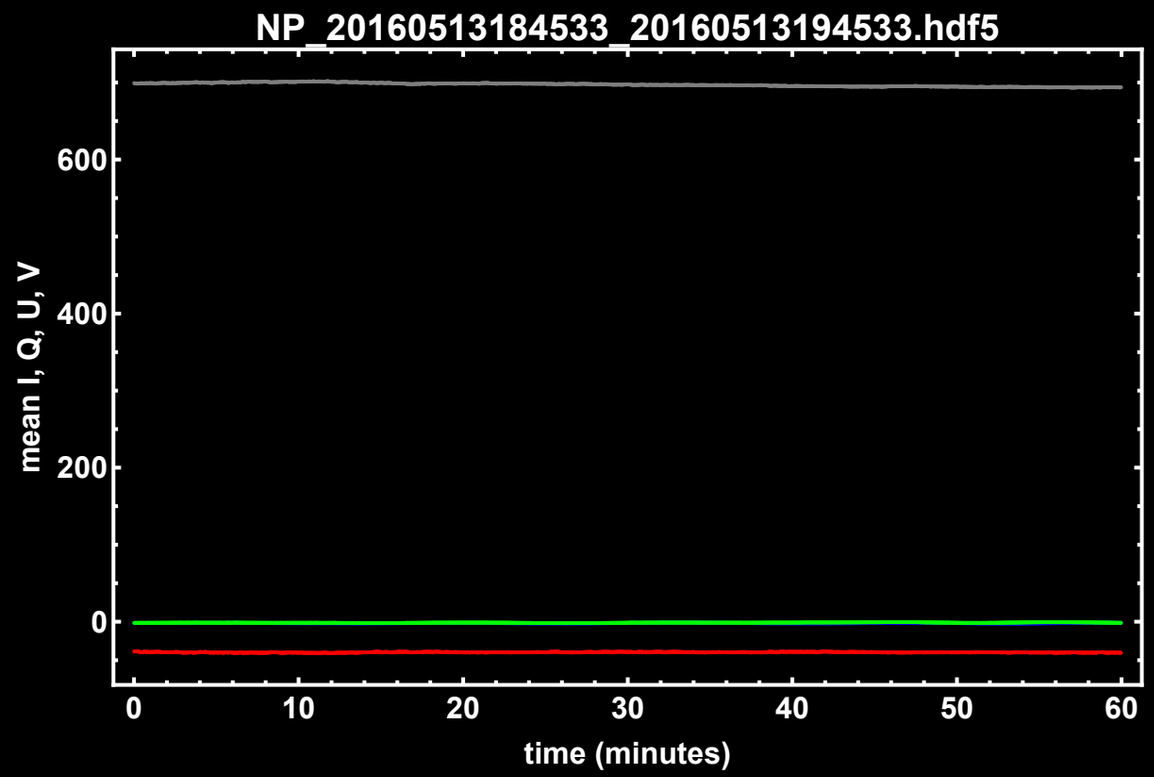
Nobeyama Solar Radio Observatory,
National Astronomical Observatory of Japan

Solar Constant?

- Sun has many transient events each day
- Typically these give a small fractional brightness increase for a short time especially below a GHz.
- We know when they occur.
- We can work around transients!
- Transients usually not bright enough to calibrate on

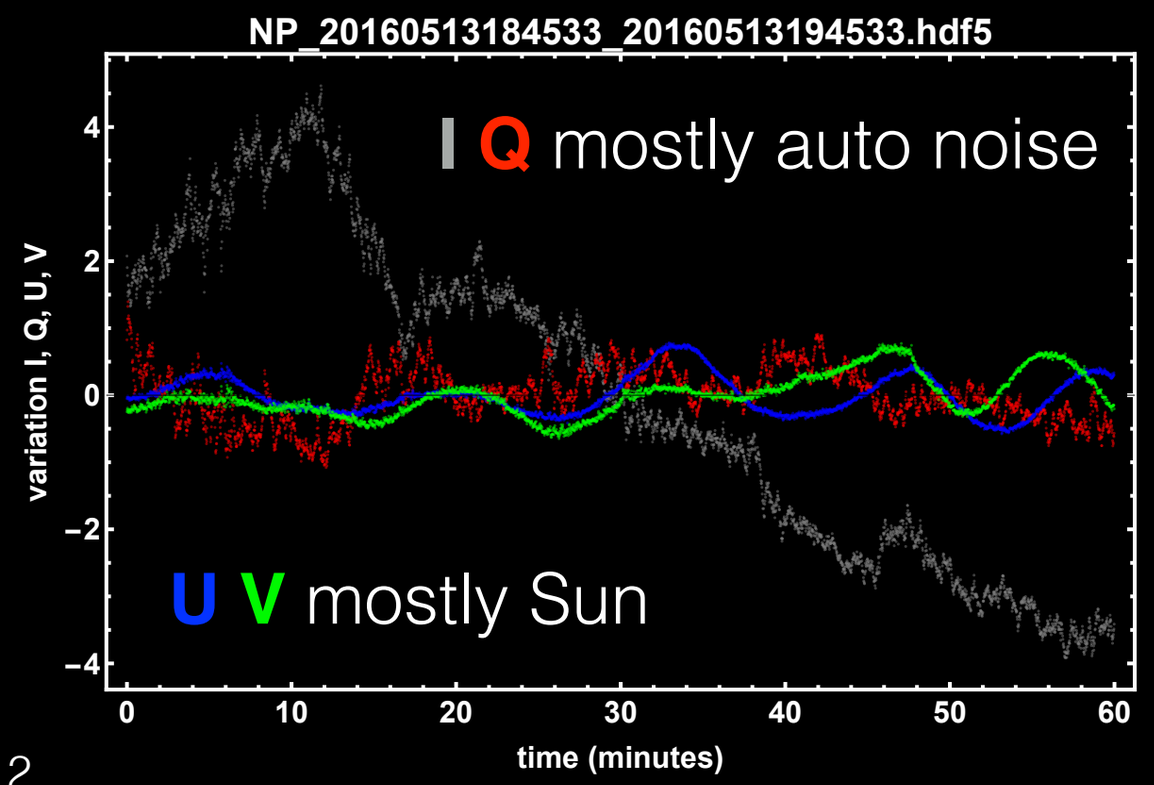
Tianlai Dish Array



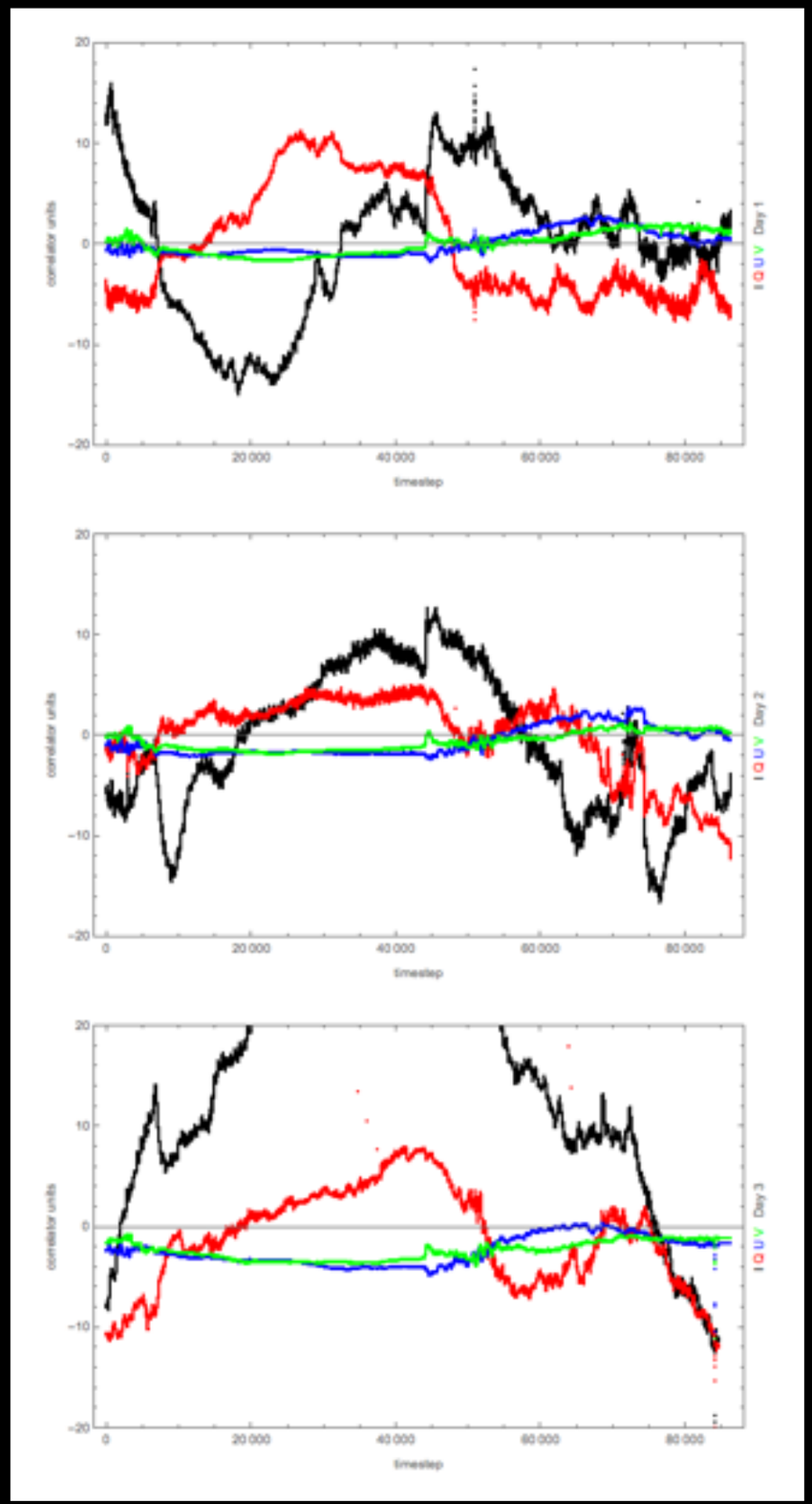


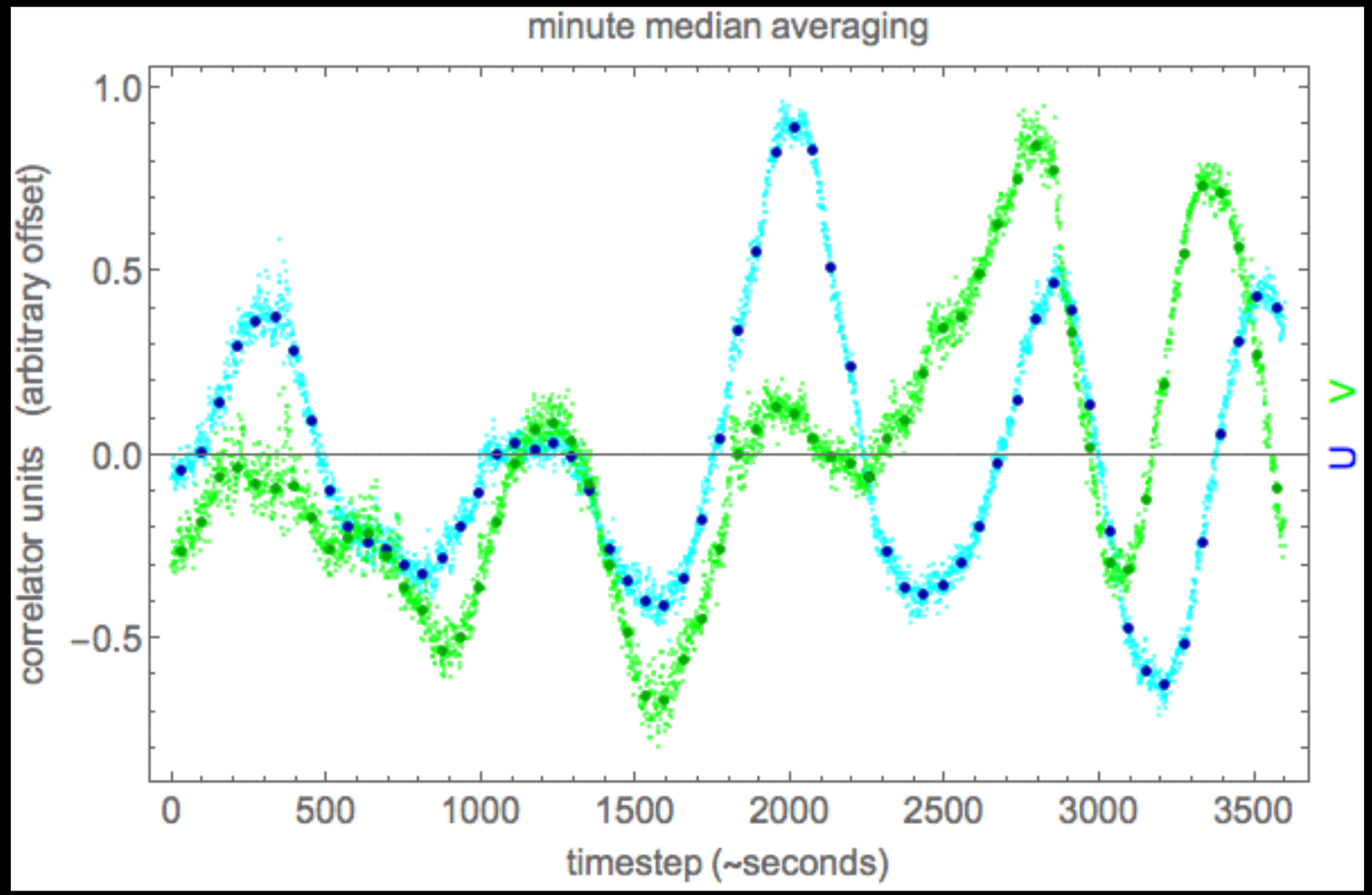
“Stokes like” intra-feed correlations

$I \equiv \langle XX^* \rangle + \langle YY^* \rangle$	**auto**
$Q \equiv \langle XX^* \rangle - \langle YY^* \rangle$	**auto**
$U \equiv 2\mathrm{Re}[\langle XY^* \rangle]$	**no-auto**
$V \equiv 2\mathrm{Im}[\langle XY^* \rangle]$	**no-auto**



TRHP: Tianlai RadioHelioPolarimeter





U, V seem to be smooth with noise ~0.05
variation timescale ~10 minutes

this data at sunset

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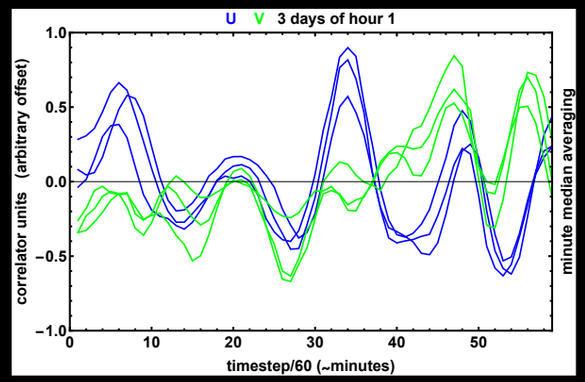

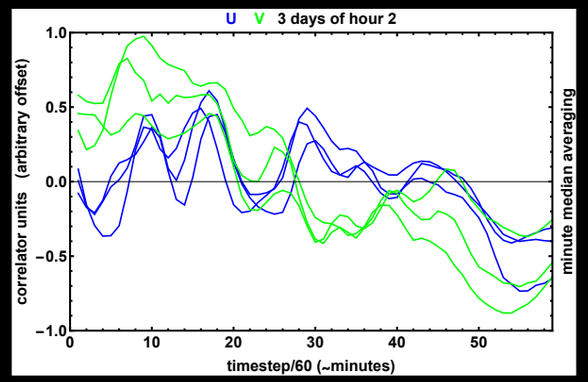

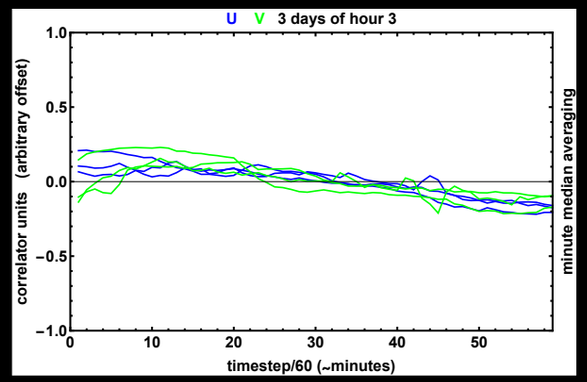

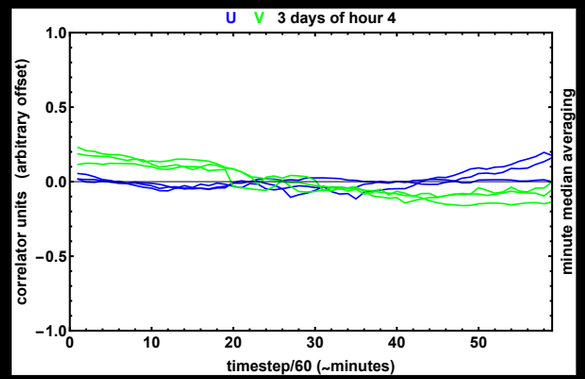

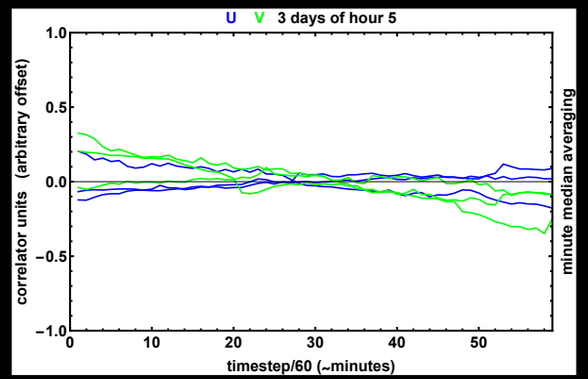

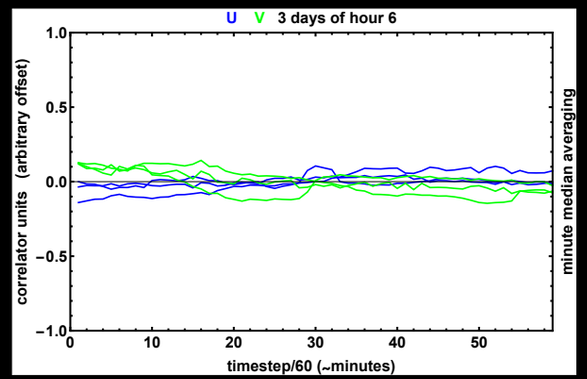

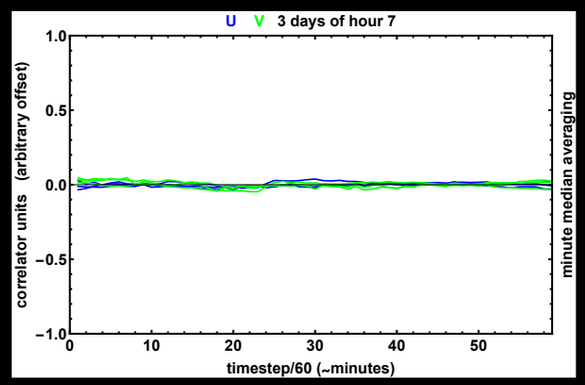

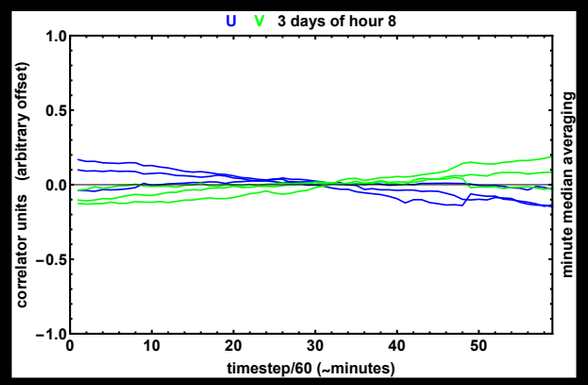

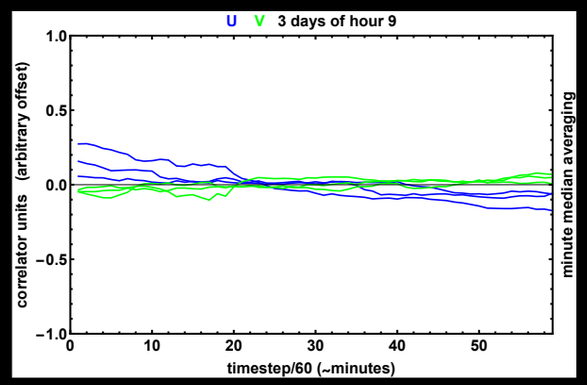

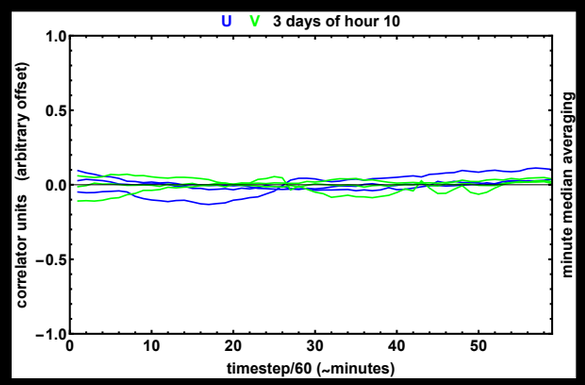

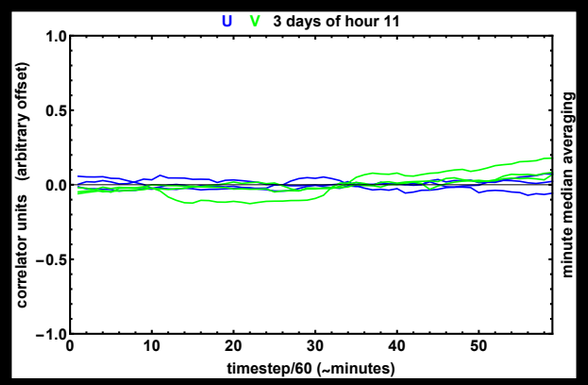

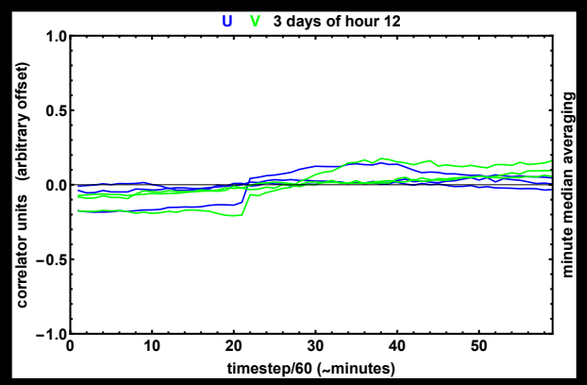

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