

— ALMA Workshop 2018a —

ALMA-SOL-CDAW19

https://hinode.nao.ac.jp/user/shimojo/ALMA_WS_Solar_HP/Tokyo_2019.html

2019/01/14 - 17 @ SUBARU OPEN-USE ROOM
MITAKA CAMPUS, NAOJ

[Organizers]

Takenori "Joten" Okamoto (NAOJ)
Tomoko Kawate (JAXA/ISASA)
Masumi Shimojo (NAOJ)
Takaaki Yokoyama (U. Tokyo)

THE WORKSHOP IS SUPPORTED BY ALMA PROJECT, NAOJ.

SELF INTRODUCTION

GOALS OF THE WORKSHOP

1. Play with the ALMA data obtained in Cycle 4, and understand the properties of ALMA data.
2. Search scientific topics that can be obtained from ALMA data, and get a clue of scientific results.
3. Obtain the information for improving your proposals of ALMA-Cycle 7.
4. Look for candidates of the speaker in the ALMA session of the JpGU meeting (Shimojo's personal goal).

SCHEDULE: 1

THE SCHEDULE IS NOT RIGID.
TIME WILL BE CHANGED FLEXIBLY.

- Jan. 14 <Today>
 - 1300 - 1500: Introduction [This talk]
 - 1500 - 1515: Break
 - 1515 - 1700:
 - Check your analysis environment on MDAS
 - Group discussion of the data analysis, etc.
 - 1830 - : Banquet at “日本酒バル Tokutouseki” near Chofu station.

SCHEDULE: 2

THE SCHEDULE IS NOT RIGID.
TIME WILL BE CHANGED FLEXIBLY.

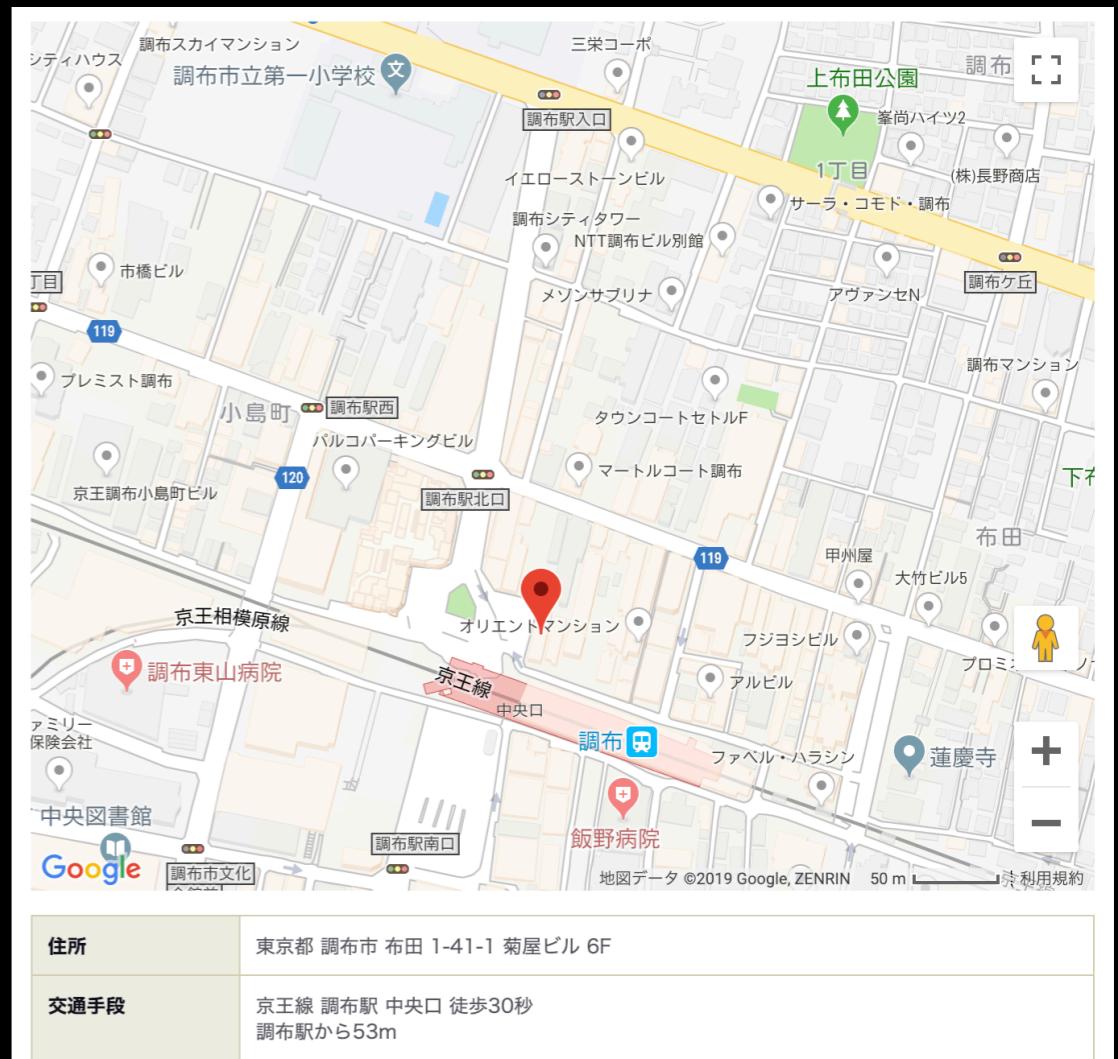
- Jan. 15
 - 1000 - 1200: Tutorial of solar image synthesis using CASA
 - 1200 - 1300: Lunch break
 - 1300 - : Analysis Time
- Jan. 16
 - All day: Analysis Time
- Jan. 17
 - AM: Analysis Time
 - 1300 - 1630: Summary meeting (Each group presents their results.)
 - Master Plan 2020 Sympo. Schedule: 1630 - 1700 Solar-C EUVST, 1700 - 1730 PhoENiX

LOCAL ISSUES: 1

- **Foods and drinks are not permitted in this open-use room except a drink in a bottle with "a lid".**
- The seminar room (the room next door) is kept for the workshop by the end of the workshop. You can use the room for discussions freely.
 - Coffee, tea, and teacakes are prepared in the seminar room. Please drink and eat them ***only in the room.***
 - ***We collect the fee of coffee, tea, and teacakes. The charge is 500 Yen/person.*** Of course, we welcome donations from you 😊.
- All entrances of the building are locked automatically. Please bring your "Access Card" when you leave the building.
- The room is never locked. Please do NOT leave your valuables.

LOCAL ISSUES: 2

- The banquet of the workshop is hold at "日本酒バル Tokutouseki ". The banquet start at 18:30.
- Charge: 4500 yen/Staff, 2000yen/Student
- Keio bus leaves "Tenmondai-mae" for Chofu Sta. at 17:55.
 - Arrive at Chofu Sta. 18:19



ATACAMA LARGE MILLIMETER/SUB-MILLIMETER ARRAY (ALMA)

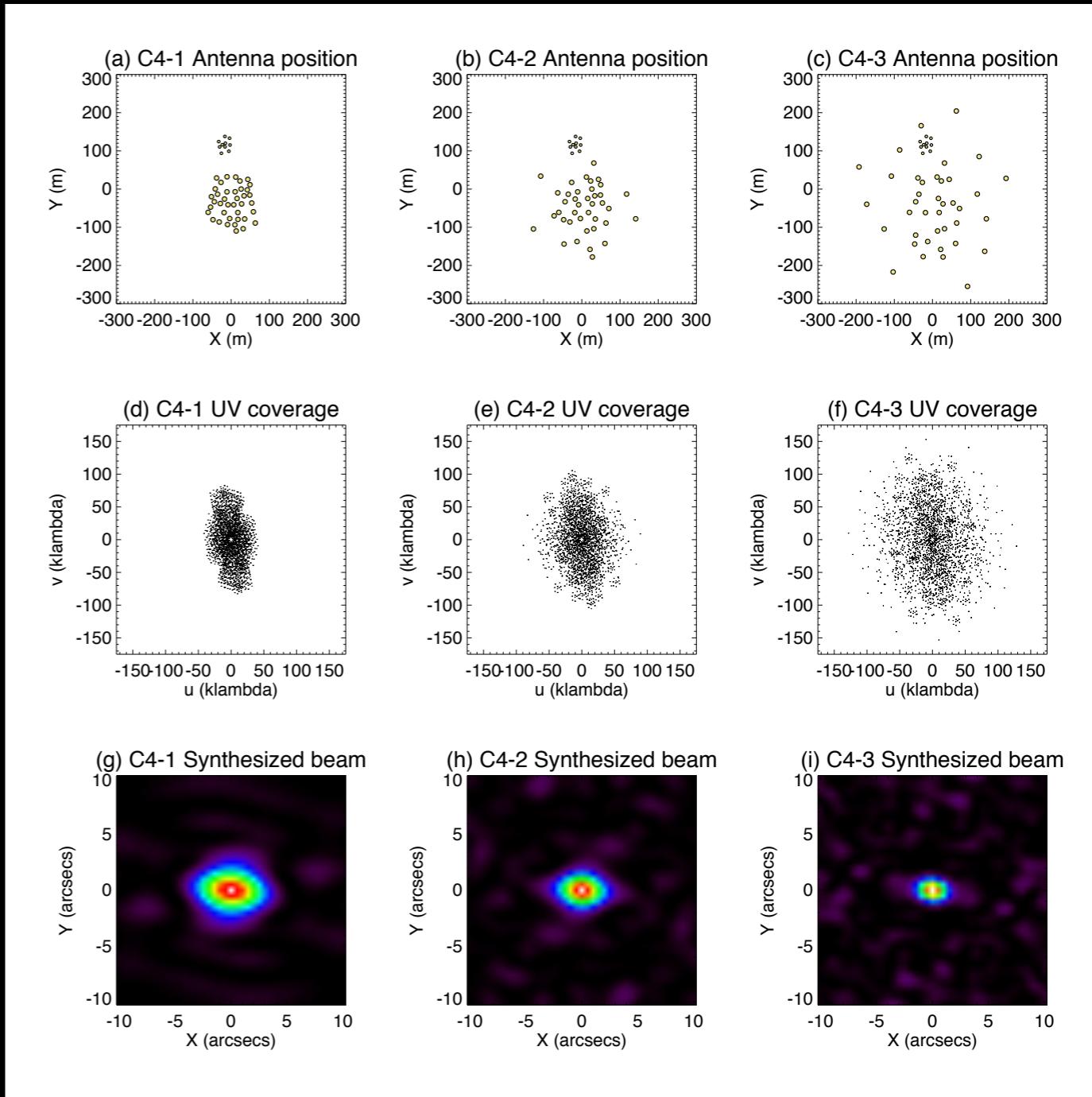


- ALMA is the largest millimeter/sub-millimeter array in the world, constructed from 54 12m-antennas and 12 7m-antennas.
- Observing Frequency: 84 GHz ~ 950 GHz (Wavelength: 0.3 ~ 3.6 mm)
- Longest Baseline: 150 m ~ 16 km (The array configuration is changing at all times.)

ARRAY CONFIGURATION FOR SOLAR OBSERVATION IN CYCLE 4

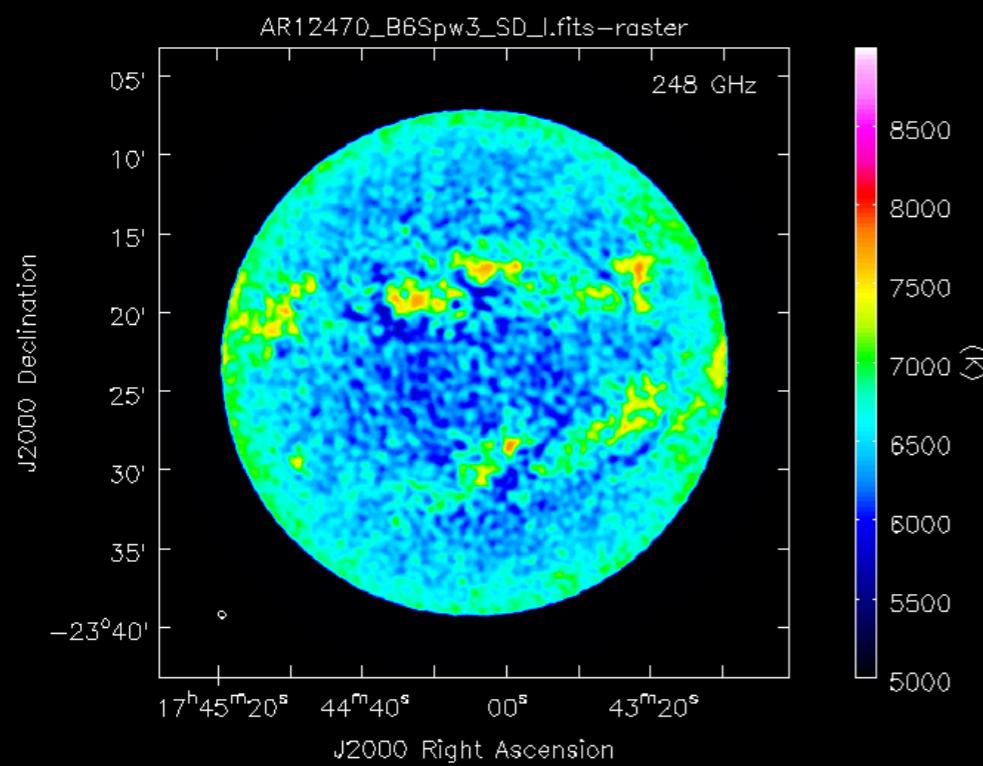
- The heterogeneous array is constructed from 40 12-m antennas and 10 7m-antennas only for solar observation.
- All antennas is connected to the 64-input correlator (BL correlator).
- The array configurations of 12m-array for solar observations are C40-1, C40-2, C40-3.

	Band3	Band6
C40-1+7m	3.4"	1.5"
C40-2+7m	1.8"	0.8"
C40-3+7m	1.2"	0.5"

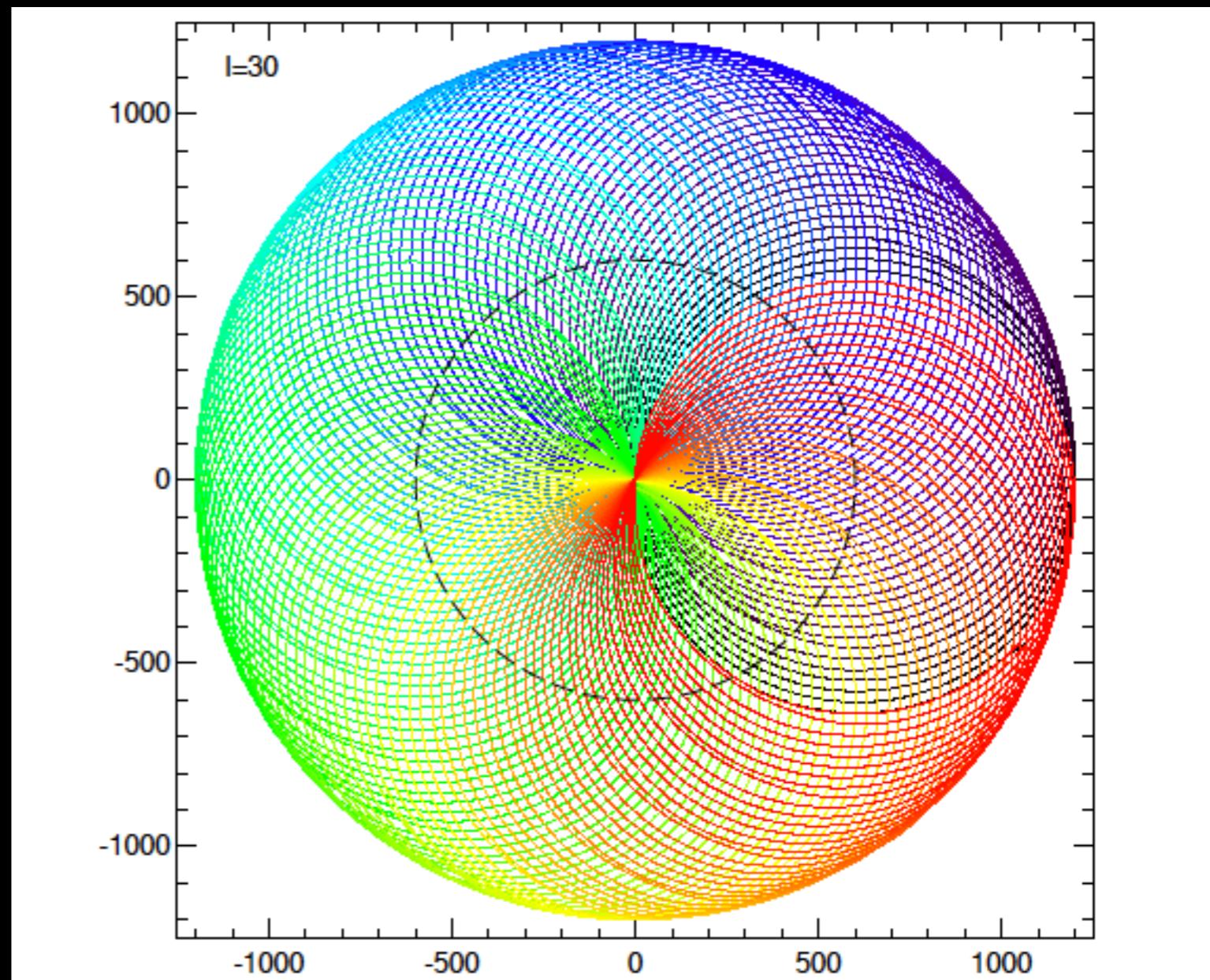


SINGLE-DISH SOLAR OBSERVATIONS WITH ALMA

- Fast-scan imaging
 - double-circle pattern
 - FoV: $2400''\Phi$
 - One map per ~ 7 mins

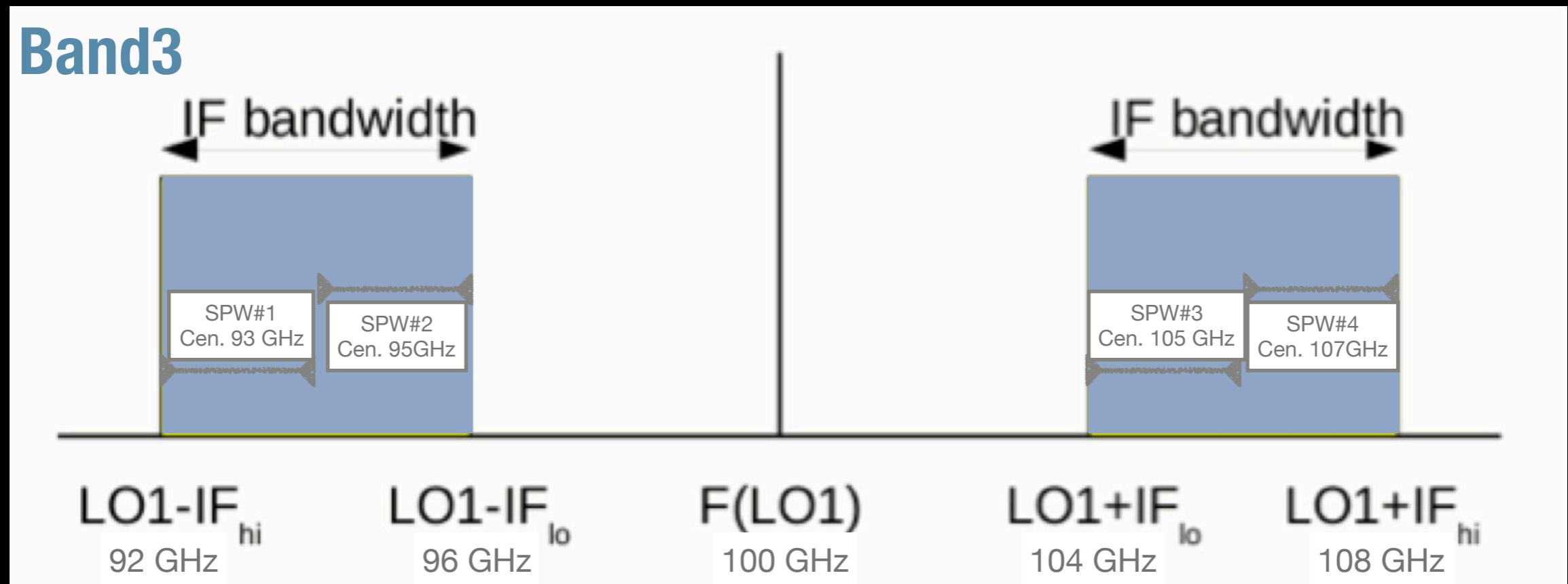


Double Circle Pattern



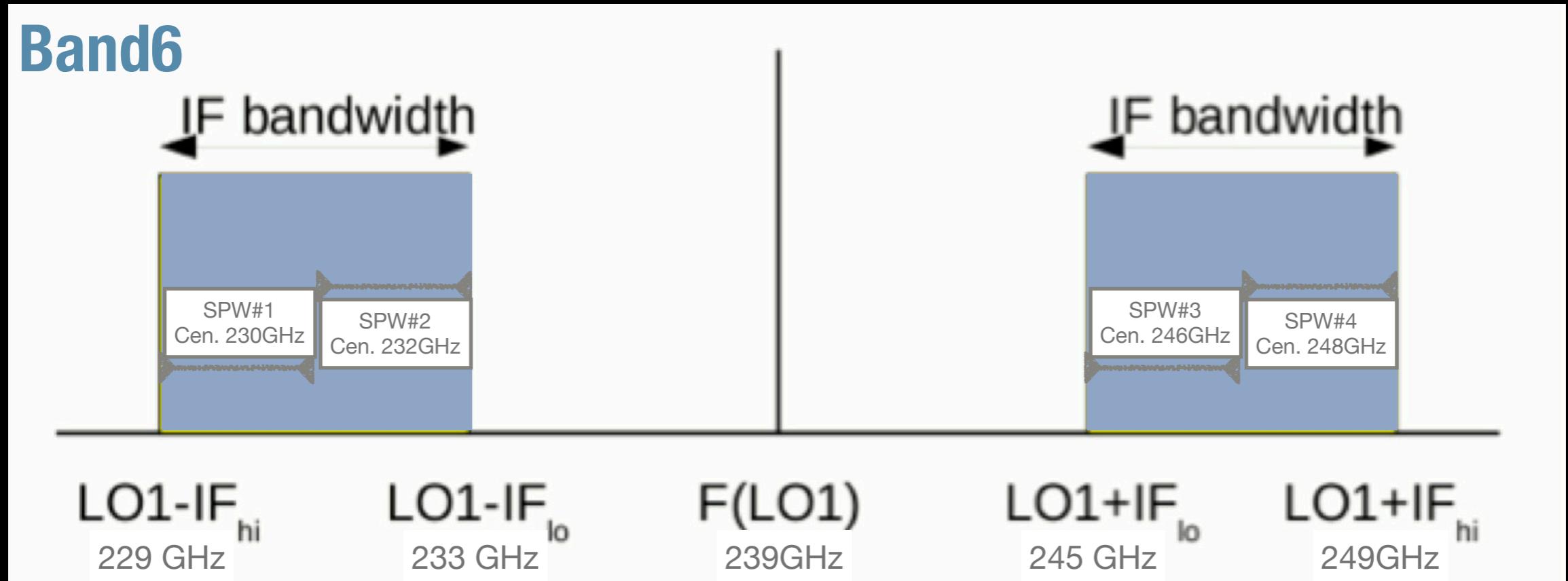
White et al. 2017

RECEIVER & CORRELATOR SETUP FOR SOLAR OBSERVATIONS IN CYCLE4



- For solar observations in Cycle4, observations with Band3 and Band6 receivers are offered.
- LO1 is fixed to 100 GHz for Band3, 239 GHz for Band6.
- Polarization is Stokes-I or XX only
- The correlator mode is TDM only.
 - # of ch is 128 ch/spw (Stokes-I), 256ch/spw (XX only)
 - Spectrum resolution: 15.6 MHz (Stokes-I) / 7.8 MHz (XX only)
- Integration time is 2 seconds. → Shortest time cadence of images is 2 seconds.

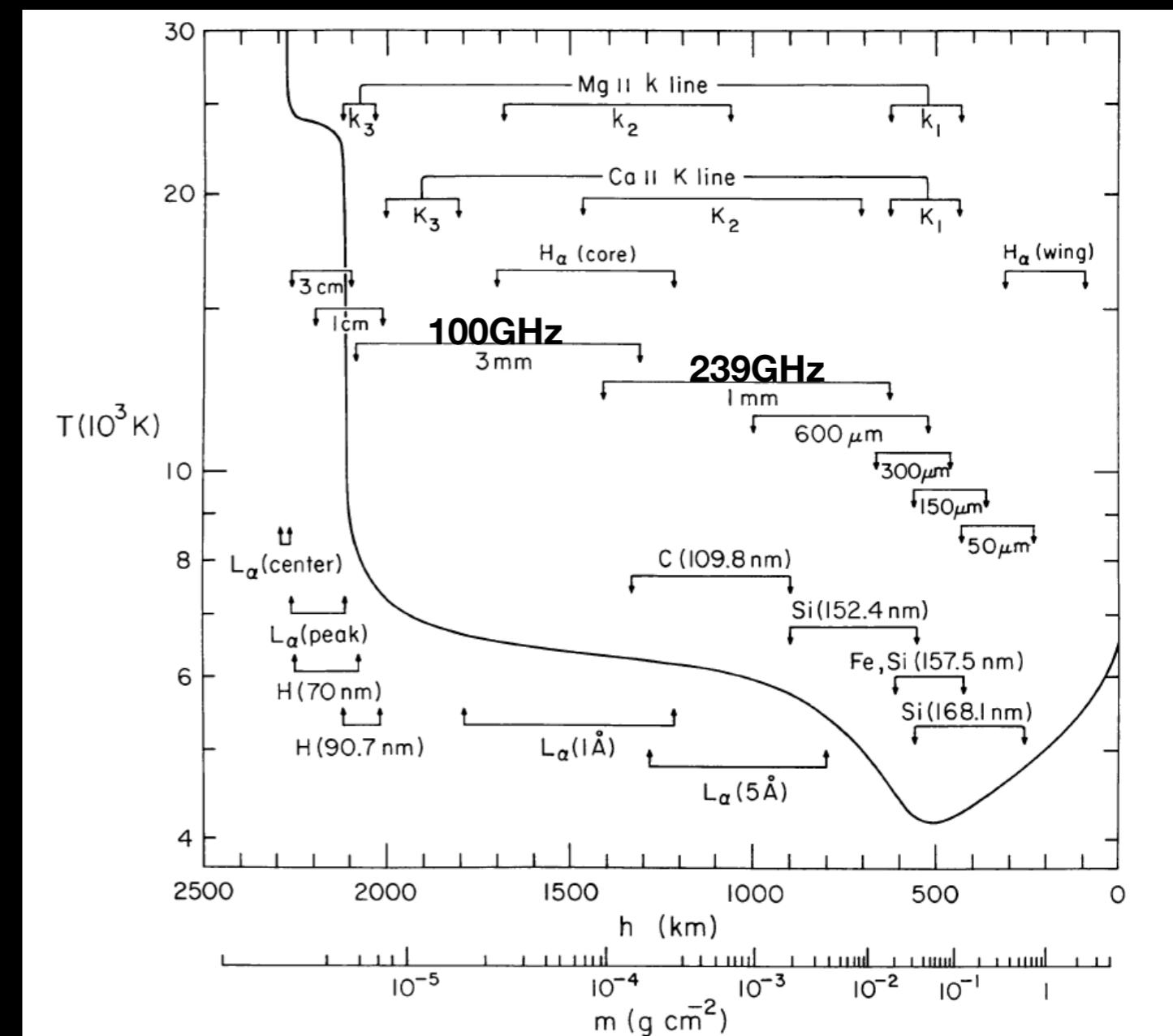
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WHAT WE CAN SEE IN ALMA IMAGES ?

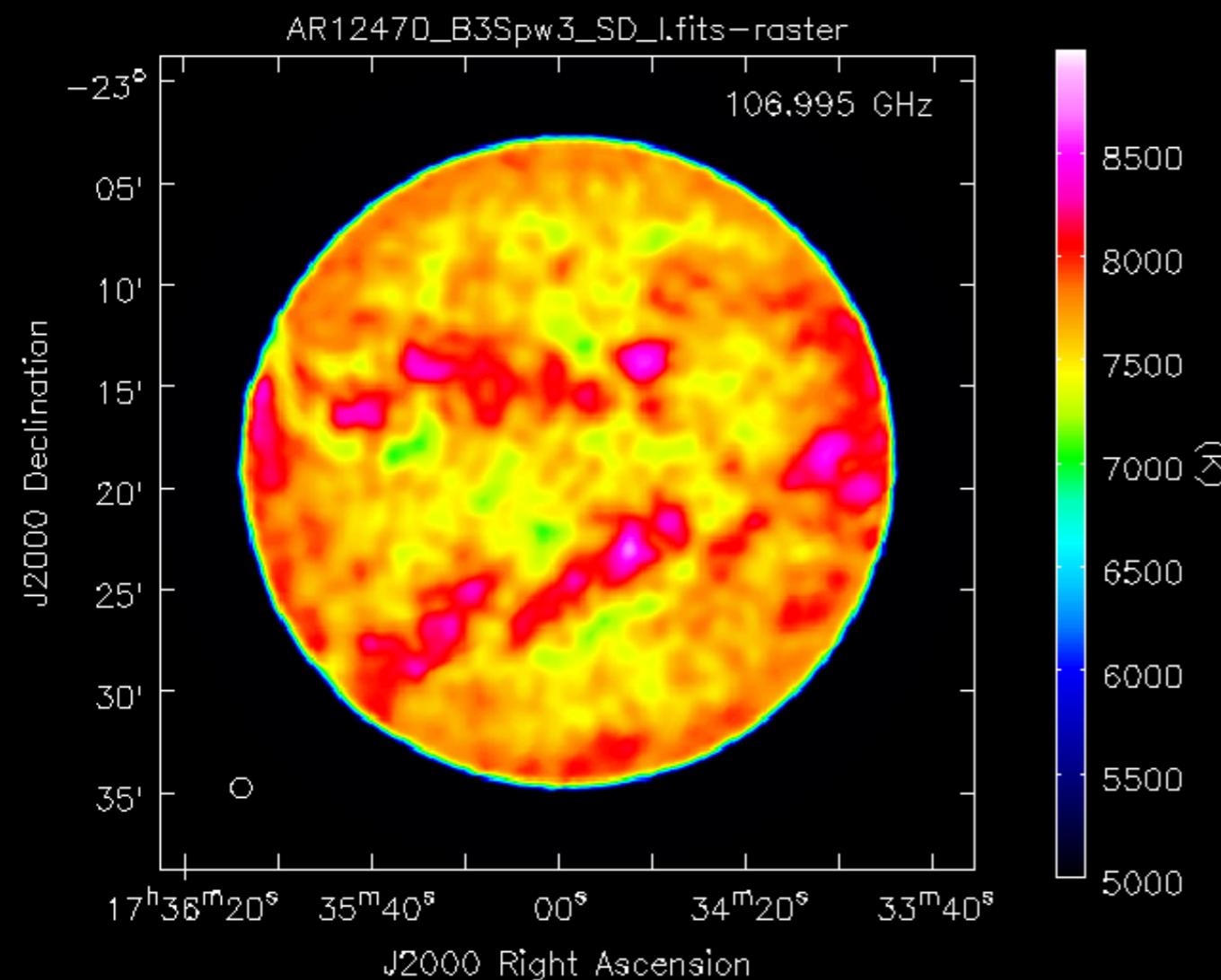
- When flares don't occur,
 - On Disk
 - Thermal emission from optically thick layer ($\tau=1$ layer:lower chromosphere)
 - $T_{\text{brightness}} = T_{\text{physical}}$
 - Off Limb
 - Thermal emission from the optically thin plasma.
- When a flare occurs,
 - Gyro-synchrotron emission from non-thermal electrons accelerated by the flare.



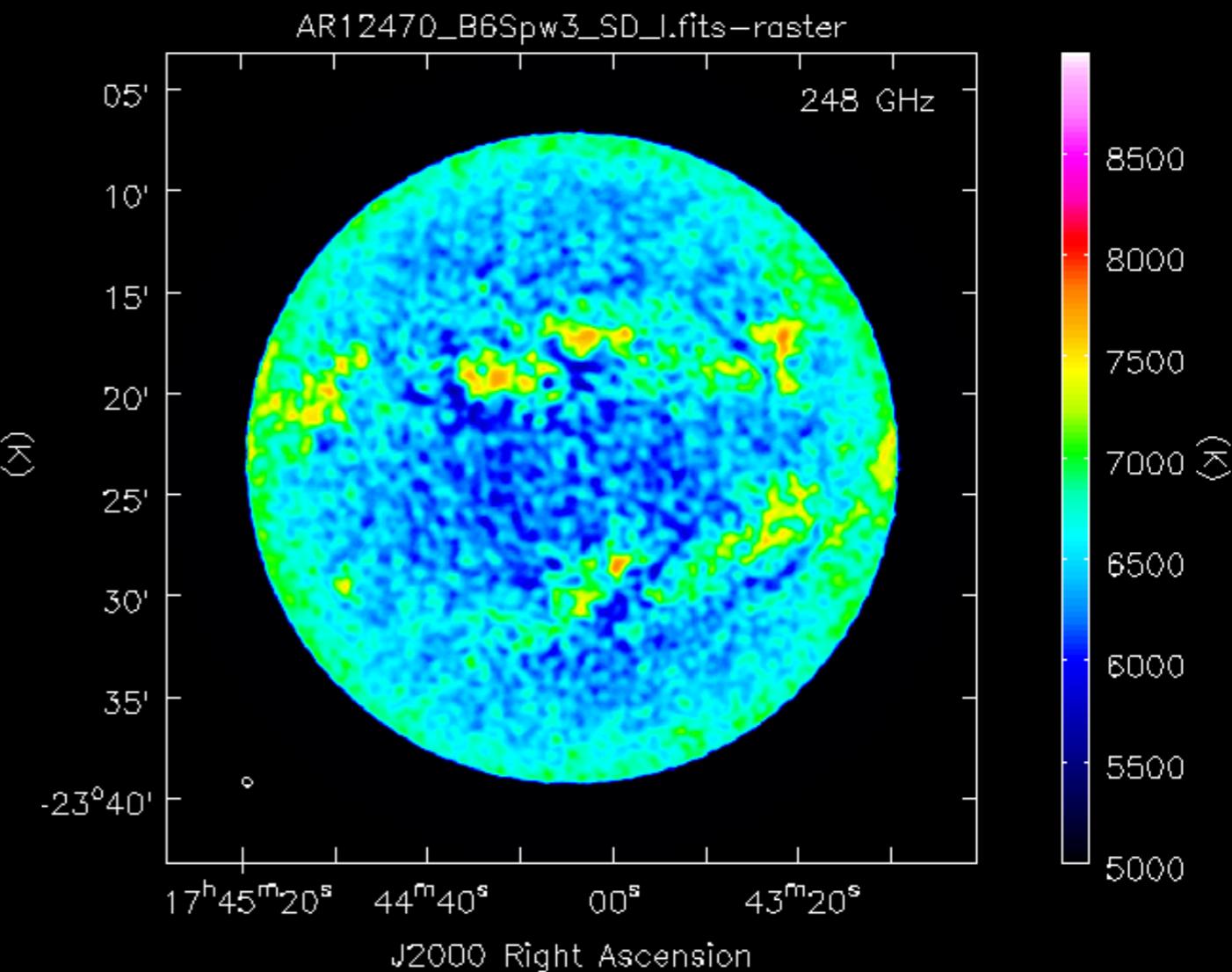
Vernazza, Avrett & Loeser, 1981

FULL-SUN IMAGES OBTAINED WITH THE SINGLE-DISH OBSERVATIONS

Band 3/107 GHz



Band 6/248 GHz



100GHz: 7300 K / 239 GHz: 5900 K @ Disk Center

DATASETS FOR THE WORKSHOP: 1

- All visibility data of the projects shown in the presentation are obtained in Cycle 4 and are released because the proprietary periods of them are already over.
- The image synthesis of the data analyzed in the workshop is already done, and you can start your analysis from the FITS files.
 - Except the tutorial on tomorrow morning, you do not need to use the CASA basically.
 - All spectrum windows are used for synthesizing one image (No Spectrum Inf.).
 - Except the polar-limb data, the multi-step self-calibration is applied to the visibility data.
 - Except limb data, the feathering process (combined TP data with INT data) is done. Hence, the values in the images are the absolute brightness temperature [unit: K].
- The details (project ID, Execution Block ID, reference time, heliocentric coordinates of the center of FoV, IRIS data [URL], Hinode data[URL], etc.) of the detests are written in the following google spreadsheet.
 - https://docs.google.com/spreadsheets/d/1PQaoCmdZYU291bk-xSrat2_E_cG8ND8hjkdL1MGnJQ/edit?usp=sharing

DATASETS FOR THE WORKSHOP: 2

- Quiet Sun: Project ID 2016.1.00202.S
 - Band3 w/2 sec-cad & Band6 w/40 sec-cad (Band6 is MOSAIC observation)
- Plage: Project ID 2016.1.00050.S
 - Band3 w/2 sec-cad & Band6 w/2 sec-cad
- Active Region: Project ID 2016.1.01532.S
 - Band3 w/2 sec-cad
- Polar Limb: Project ID 2016.1.00182.S
 - Band6 w/80 sec-cad (MOSAIC observation)
- Limb near Equator: Project ID 2016.1.00070.S
 - Band3 w/2 sec-cad

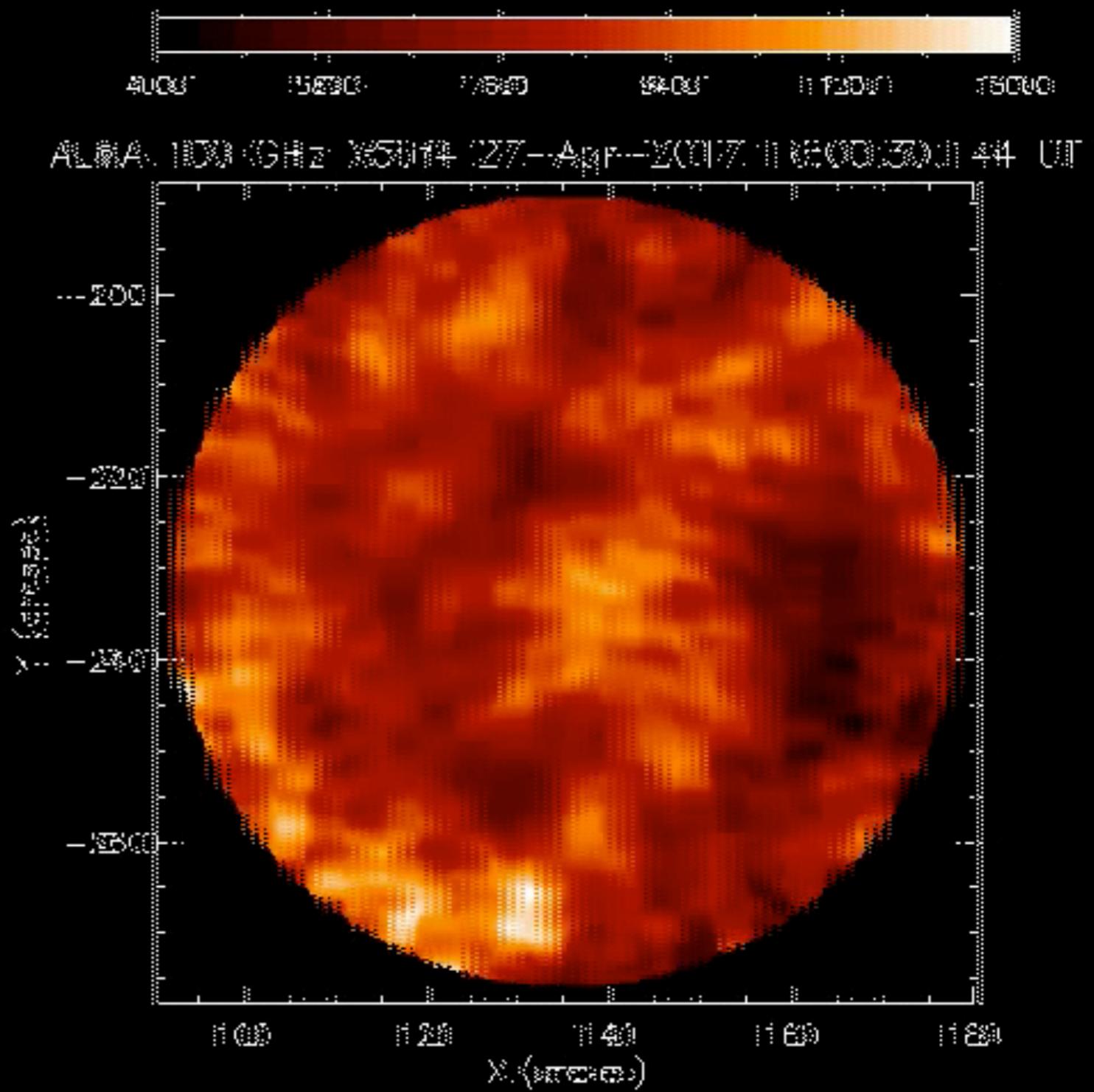
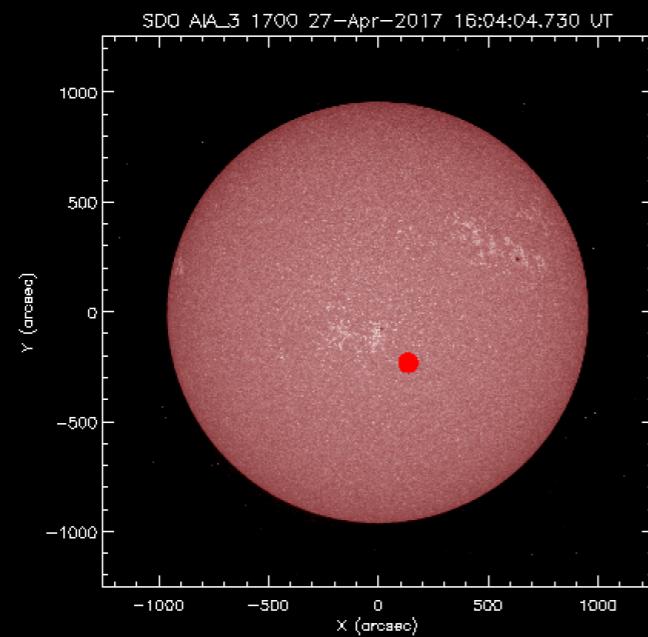
BAND3: 100 GHZ
FOV (SINGLE-POINTING): 60"
SYNTHESIZE BEAM SIZE: 1.8~2.8"
BAND6: 239 GHZ
FOV (SINGLE-POINTING): 25"
SYNTHESIZE BEAM SIZE: 0.7~1.3"

NOTE:
500M BASELINES (C41-3) ARE USED.

QUIET SUN WITH BAND3

- Project ID: 2016.1.00202.S
- PI: Stephen M. White
- Single-Pointing
- Observing Period:
2017-04-27 16:00:17 - 16:44:08
- Size of the synthesized beam
 - Major: 2.23 arcsec
 - Minor: 1.88 arcsec
- Time cadence: ~2 seconds

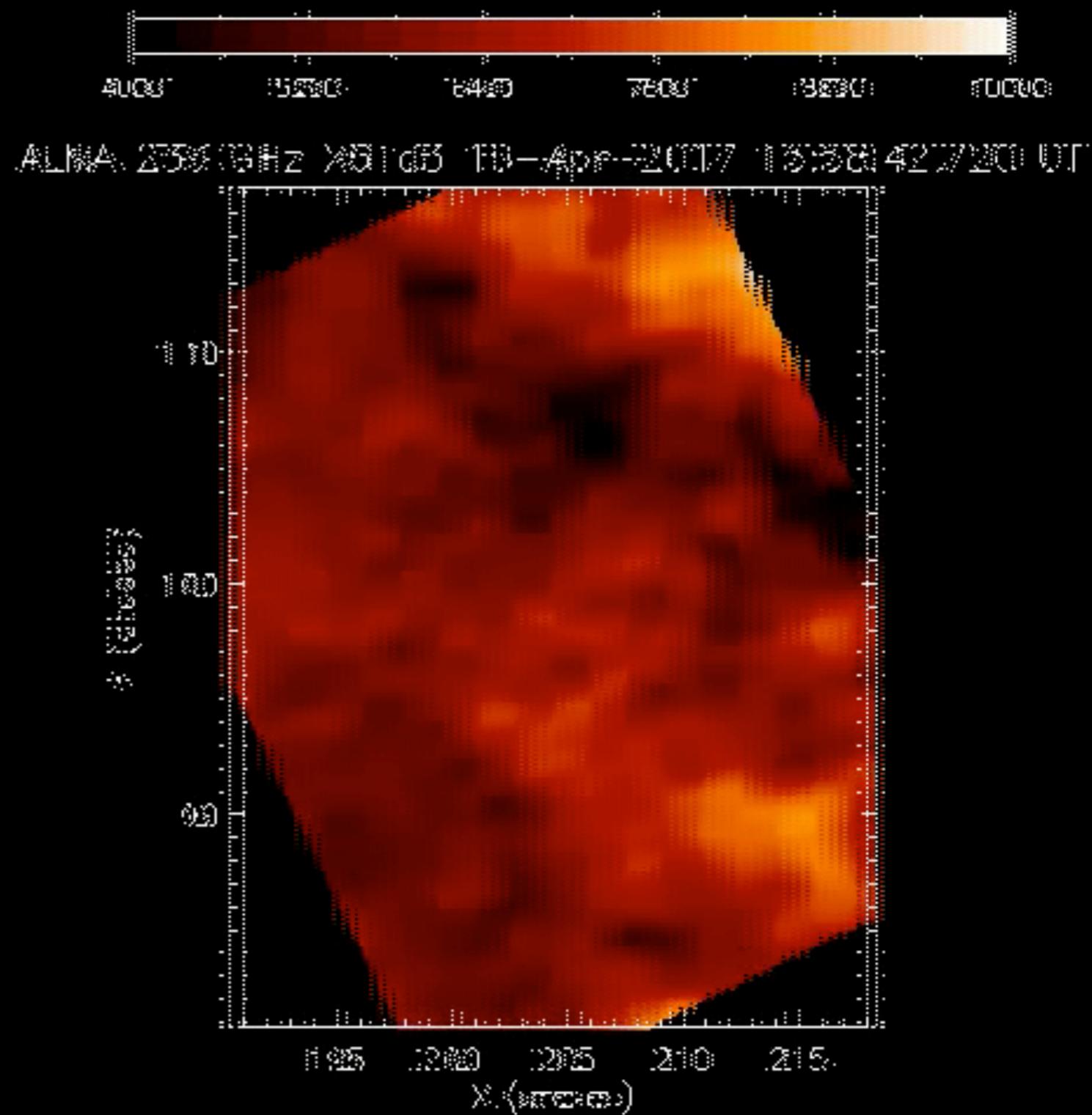
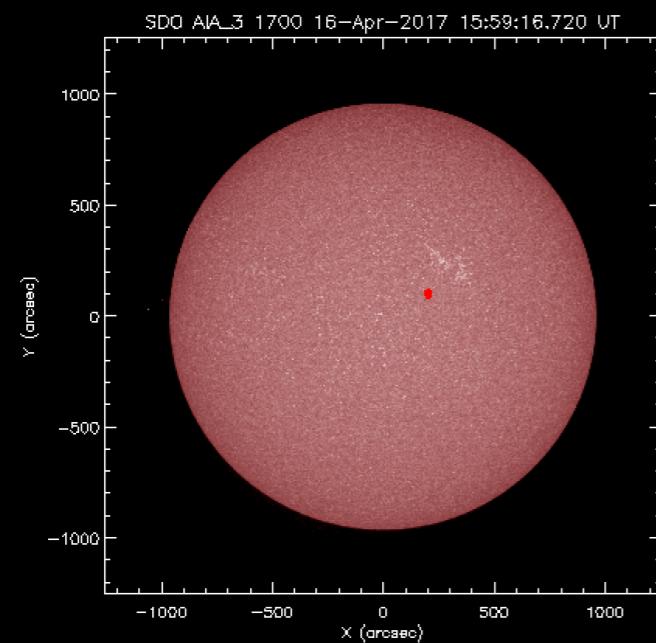
SDO AIA_3 1700 27-Apr-2017 16:04:04.730 UT



QUIET SUN WITH BAND6

- Project ID: 2016.1.00202.S
- PI: Stephen M. White
- MOSAIC (5 points)
- Observing Period:
2017-04-16 15:58:26 - 17:35:12
- Size of the synthesized beam
 - Major: 1.29 arcsec
 - Minor: 0.90 arcsec
- Time cadence: ~40 seconds

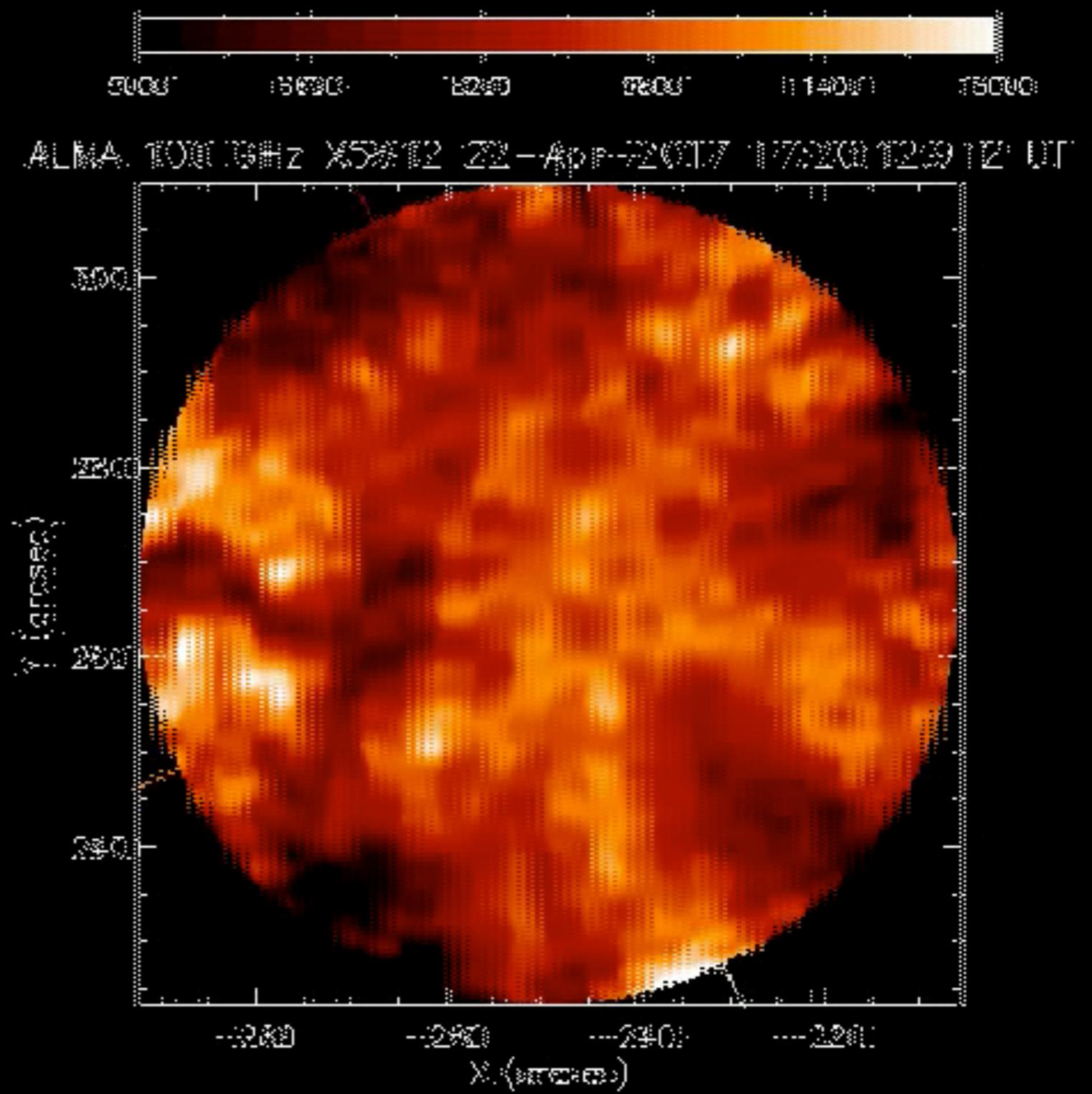
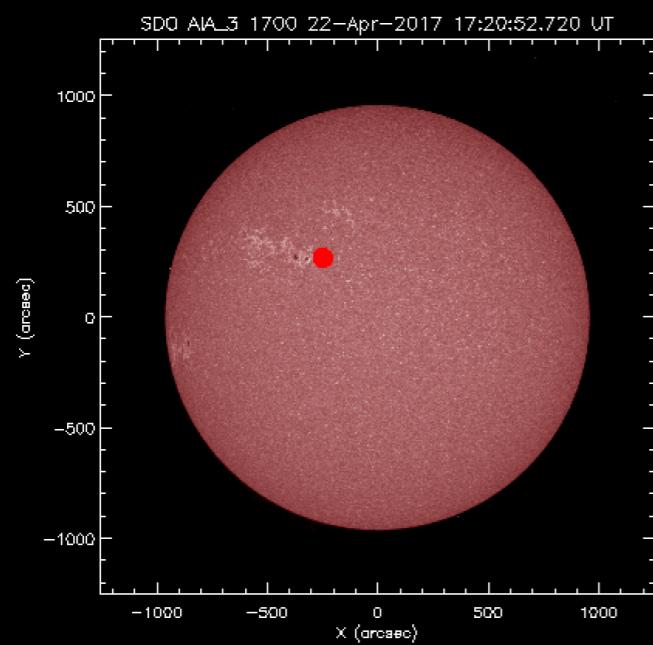
● ● ● IDL 0



PLAGE WITH BAND3

- Project ID: 2016.1.00050.S
- PI: Bart De Pontieu
- Single-Pointing
- Observing Period:
2017-04-22 17:20:04 - 17:55:04
- Size of the synthesized beam
 - Major: 2.72 arcsec
 - Minor: 1.85 arcsec
- Time cadence: ~2 seconds

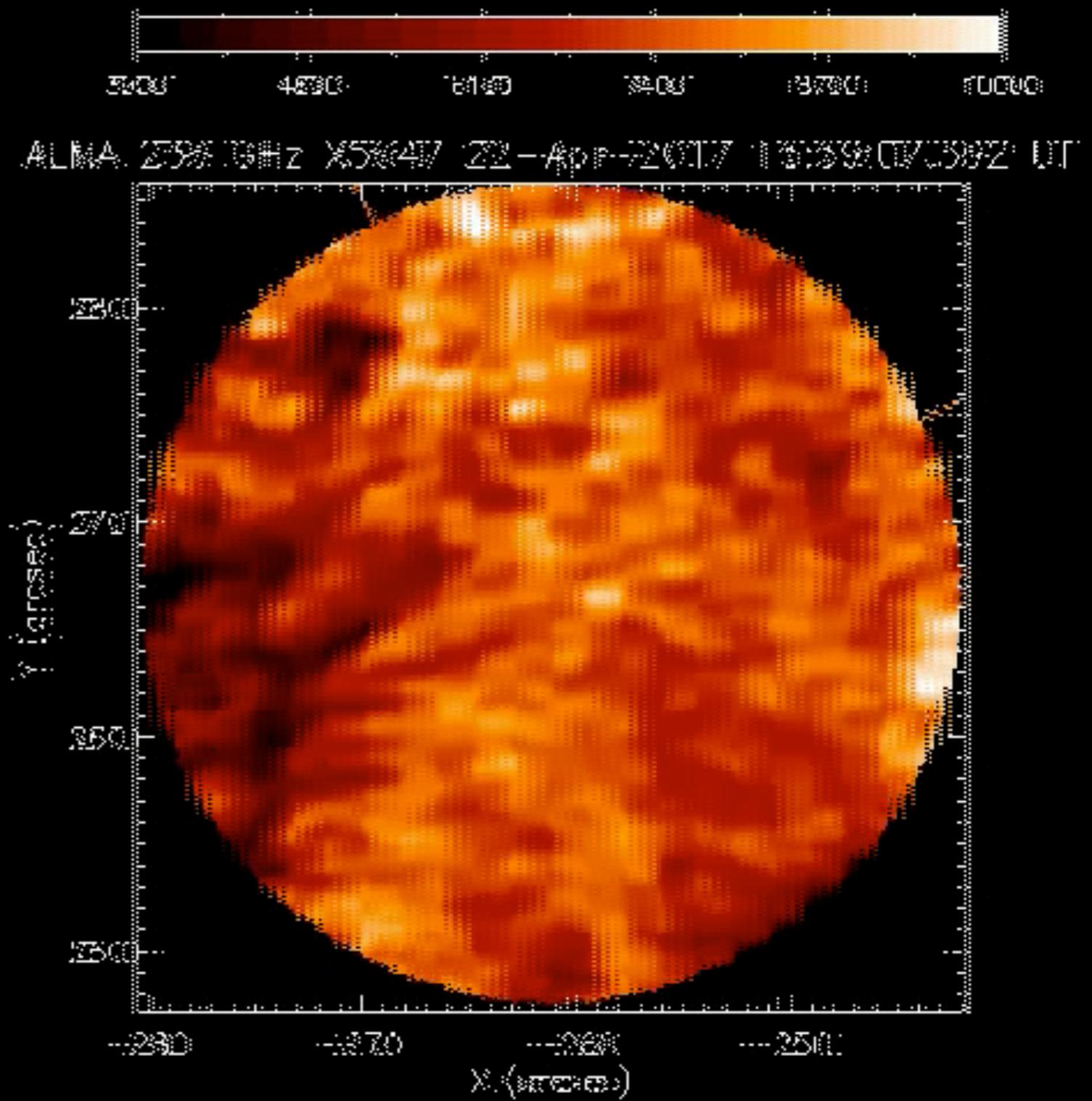
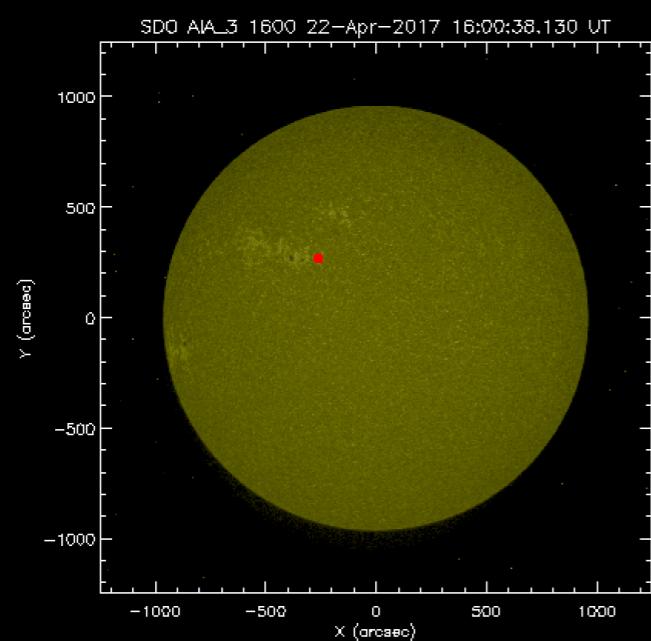
[●●●] IDL 0



PLAGE WITH BAND6

- Project ID: 2016.1.00050.S
- PI: Bart De Pontieu
- Single-Pointing
- Observing Period:
2017-04-22 15:58:58 - 16:43:34
- Size of the synthesized beam
 - Major: 0.91 arcsec
 - Minor: 0.72 arcsec
- Time cadence: ~2 seconds

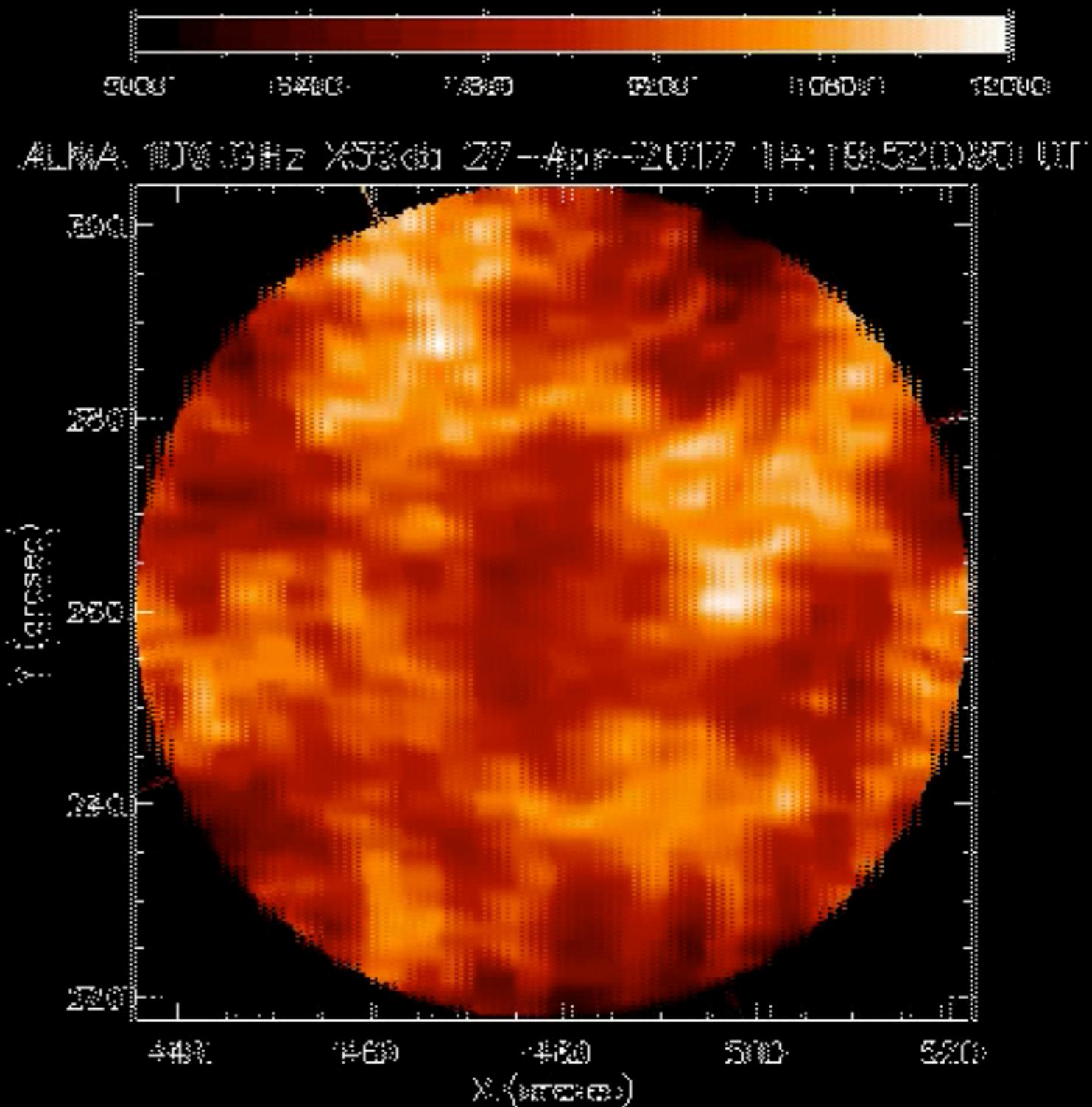
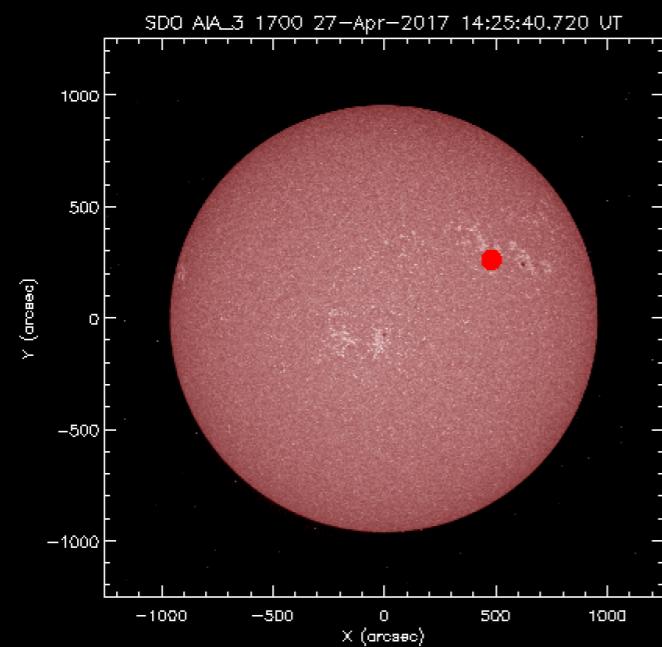
IDL 0



AR WITH BAND3

- Project ID: 2016.1.01532.S
- PI: Bin Chen
- Single-Pointing
- Observing Period:
2017-04-27 14:19:44 - 15:31:25
- Size of the synthesized beam
 - Major: 2.65 arcsec
 - Minor: 1.88 arcsec
- Time cadence: ~2 seconds

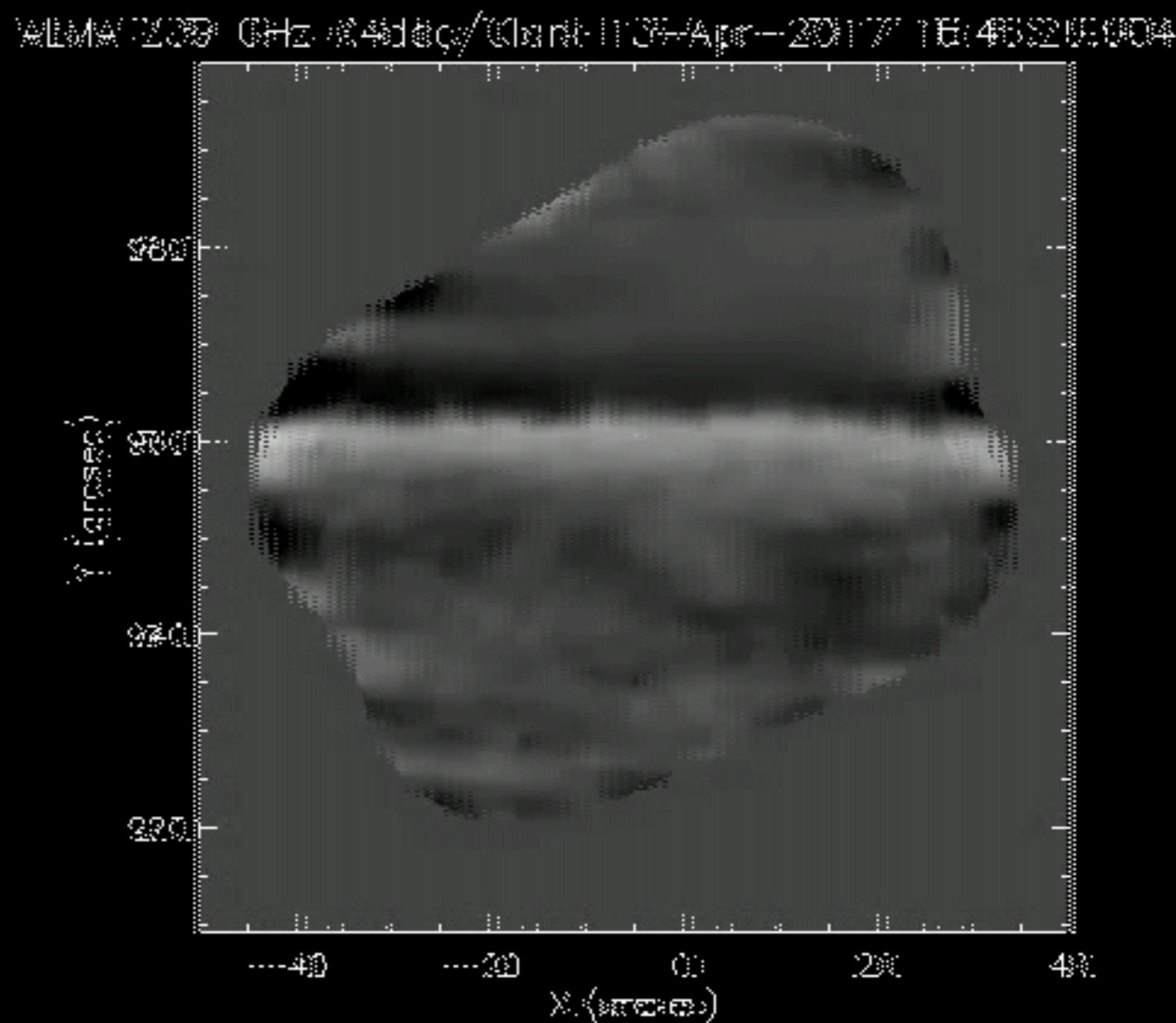
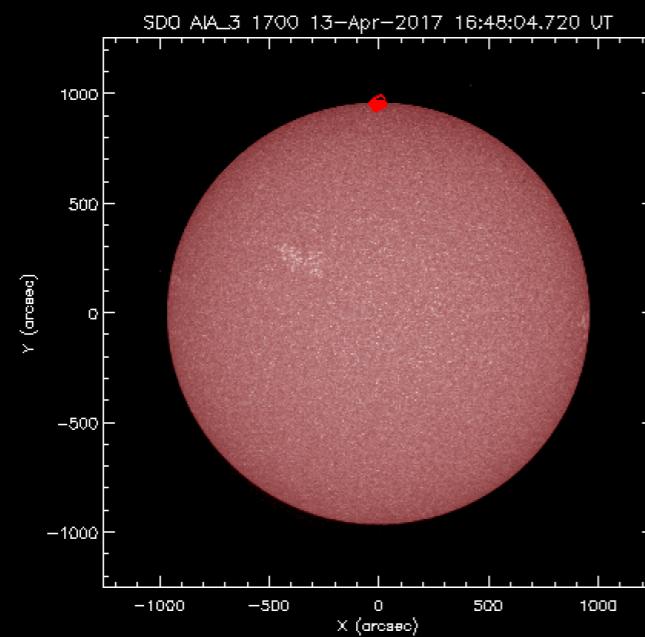
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POLAR LIMB WITH BAN6

- Project ID: 2016.1.00182.S
- PI: Tim Bastian
- MOSAIC (11 points)
- Observing Period:
2017-04-13 16:46:13 - 17:49:41
- Size of the synthesized beam
 - Major: 0.89 arcsec
 - Minor: 0.81 arcsec
- Time cadence: ~80 seconds

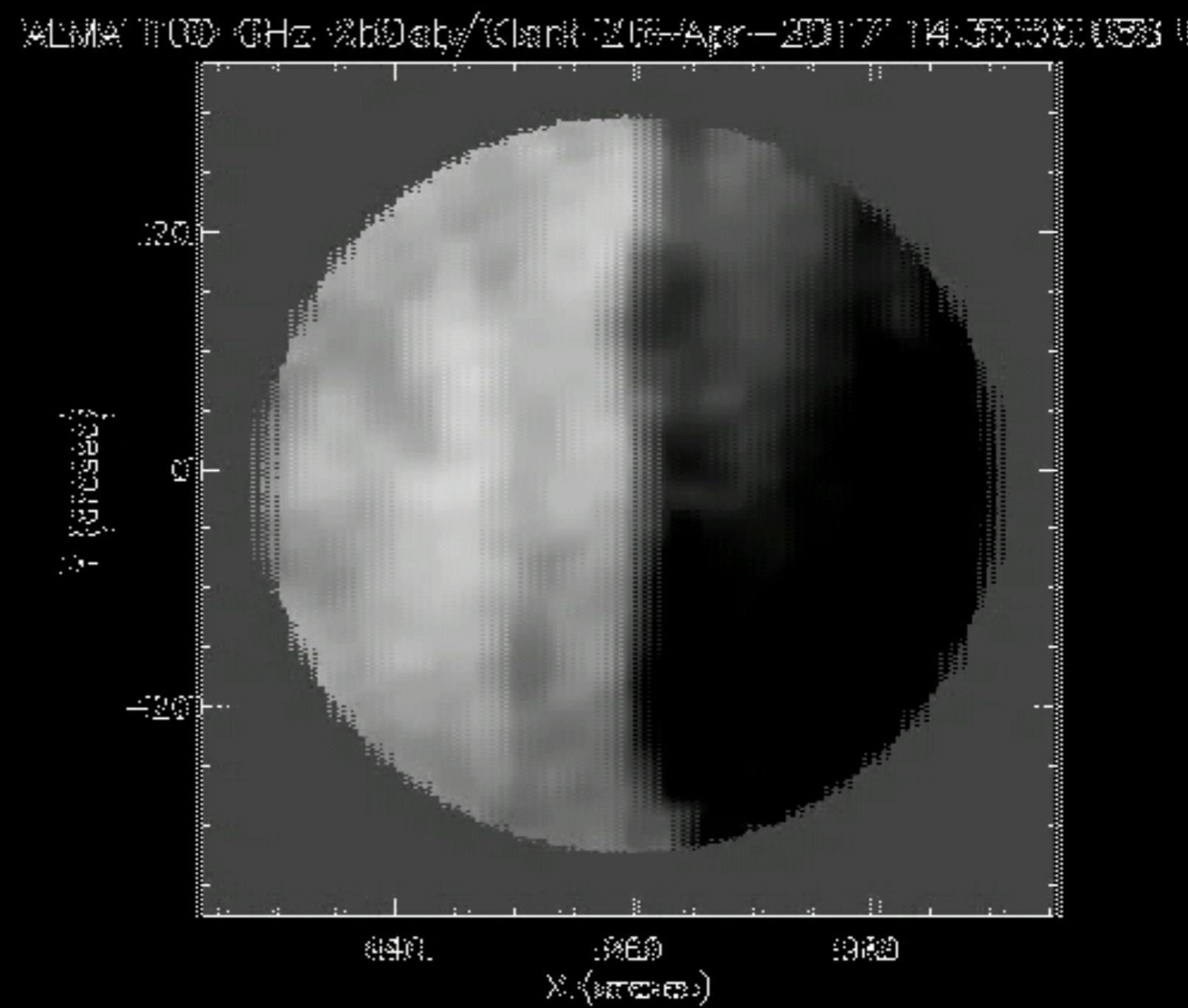
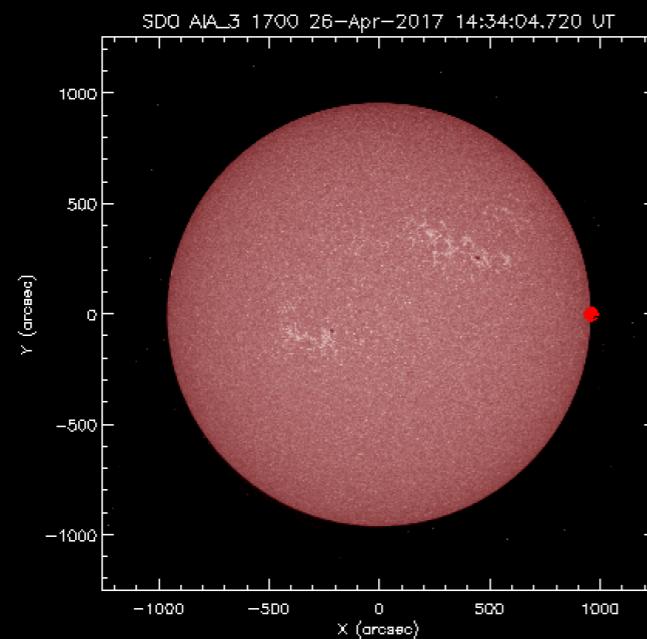
● ● ● IDL 0



EQUATORIAL LIMB WITH BAND3

- Project ID: 2016.1.00070.S
- PI: Masumi Shimojo
- Single-Pointing
- Observing Period:
2017-04-26 14:35:34 - 16:11:47
- Size of the synthesized beam
 - Major: 2.34 arcsec
 - Minor: 1.78 arcsec
- Time cadence: ~2 seconds

SDO AIA_3 1700 26-Apr-2017 14:34:04.720 UT



LOCATION OF THE FILES

- The root directory of the workshop on MDAS/ADC
 - /lfs01/almasolcdaw19/
 - The last part of the Project ID is the directory name of the project
 - The last part of the EB ID is the directory name of the dataset.
 - fits: FITS file / TP: data of single-dish / calMS: calibrated visibility data
 - Ex. : The directory name of the FITS file of Project ID: 2016.1.01532. S / EB ID: uid://A002/Xfb22d/X53da
 - /lfs01/almasolcdaw19/01532.S/X53da/fits

GROUPING

E N D