ALMA/NRO45m/ASTE Users Meeting 2021

ASTE Project Report

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on behalf of the ASTE Team

(ASTE Project http://aste.nao.ac.jp/index_e.html)

Atacama Submillimeter Telescope Experiment

- 10-m sub-mm telescope located
  at Pampa La Bola within the ALMA site
  - Surface accuracy: 19μm (→ ~40μm?)
  - Pointing accuracy: ~2″ (rms)
  - Receivers: DASH345 (321-376GHz), Band8 → **wide-IF-bandwidth Band8** (387-498GHz), Band10 (790-940GHz)
  - Backend: WHSF → **XFFTS**
  - Control and data reduction software:
    - COSMOS3, NEWSTAR/NOSTAR → CASA
- Site infrastructure
  - Diesel generator (150kW-220V ×2)
  - Fuel tank (15kL ×2, consumption 300L/d)
  - Satellite network (1Mbps)
  - Monitor (weather station, web cameras, etc.)

Atacama Submillimeter Telescope Experiment

- The prime objectives of ASTE
  - **Promote science** with the submm single-dish telescope
    - Strengthen EA ALMA proposals
  - **Promote development** of instruments and techniques for astronomical observations

For these purposes, the following activities were planned in 2021, but some of them were cancelled due to COVID-19 and a sub-reflector problem of the telescope.

- **Open-use program** → cancelled
- **DESHIMA** (Deep Spectroscopic High-redshift Mapper) → cancelled
- **Deployment of XFFTS (new spectrometer), IFDC (IF downconverter for XFFTS), CAT8W (wide IF bandwidth Band8 receiver)**
  → Installed, but no CSV due to the sub-reflector problem


CAT8W + IFDC + XFFTS

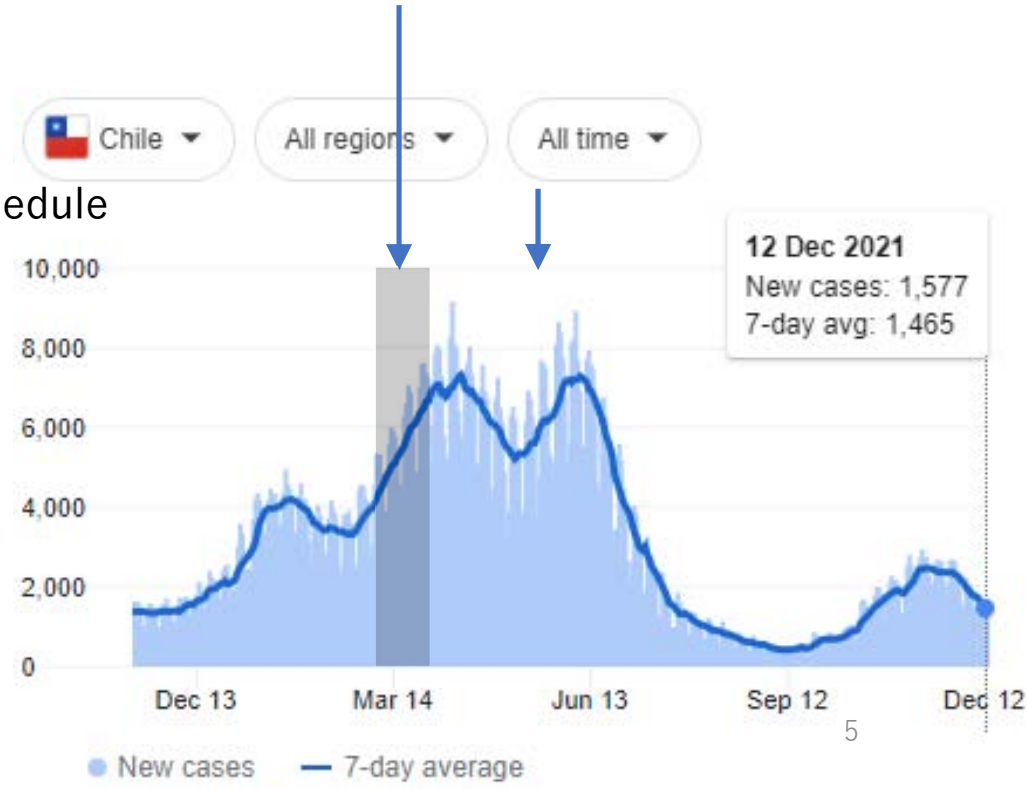
ASTE Operation in 2021

- Site activities and current status -

Operation in 2021 (Mar~May)

- 2021-March
  - Antenna mechanical and electrical maintenance was done by Chile-based staffs as planned.

- 2021-late May
  - Site restarted ~1 month behind the original schedule by vaccinated Chile-based staffs.



Operation in 2021 (Jun~Oct)

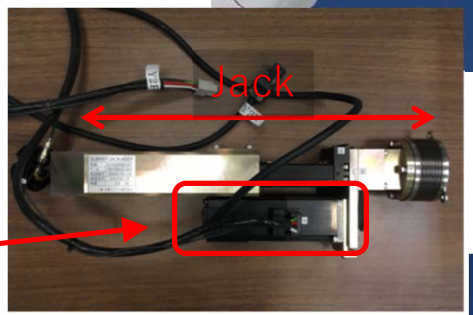
- 2021-June ~ early August
  - After heavy snowfall in June, the sub-reflector was inclined …
  - On-site staffs could not access the sub-reflector for close inspection with a manlift.
    (snowfall every week, strong wind, manlift malfunction)
  - We gave up to recover the sub-reflector in early August.
    - Most of observations were available by August.
  - **ASTE cancelled all observations carried from 2020.**
  - The site was closed.

- 2021-late October
  - The site restarted to investigate and recover the sub-reflector.

Sub-reflector malfunction

- Inclined sub-reflector, and servo amplifier alarm
  → Cannot control the sub-reflector

- Close inspection using a manlift in October
  - One of a jack supporting the sub-reflector has **a malfunction motor brake.**
    → The motor cannot keep the jack length.



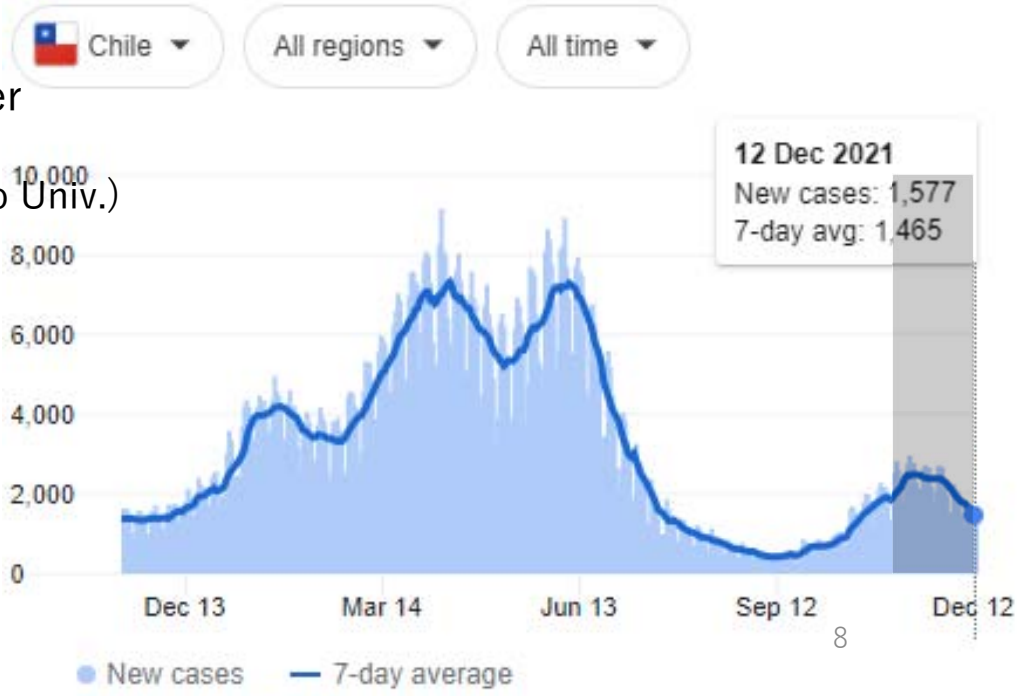
- No spare motor at the ASTE site
  - Two measures for the very old motor is on-going.
    - Procurement
    - Repair of the motor
  - The replacement is planned for next March.

Operation in 2021 (Oct~Dec)

- 2021-November
  - Integration of new spectrometer (XFFTS) and IF downconverter (IFDC)
    (Supported by the KAKENHI Kiban-A (P.I. Tosaki, JUEN)

- 2021-December
  - Installation of wide-IF-bandwidth Band8 receiver (CAT8W) upgraded from the Band8 receiver
    (Supported by the KAKENHI Kiban-A (P.I. Oka, Keio Univ.)

  Hardware and software tests of the new instruments are running until this week.
  - Signal connection and level check
  - Control tests

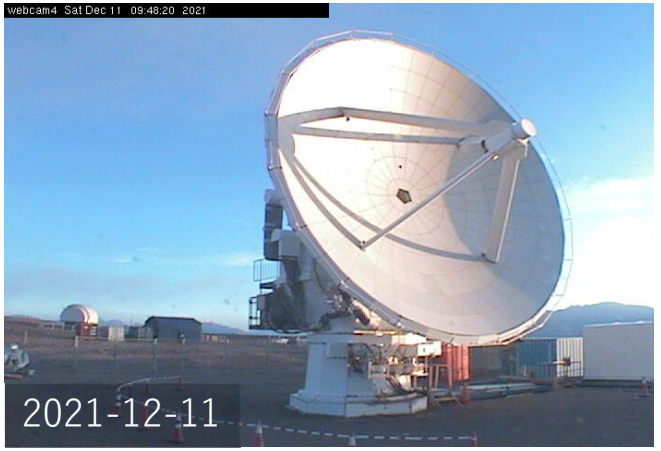


Current status and return to operation

- Hardware and software tests for CAT8W + IFDC + XFFTS continue until this week, and then, the ASTE site will be closed.
  - No CSV activity cannot be done due to the sub-reflector problem.

- The sub-reflector has still malfunction to be repaired.
  - This is a blocker against normal operation.
  - Its recovery work is planned between late February and March in 2022.

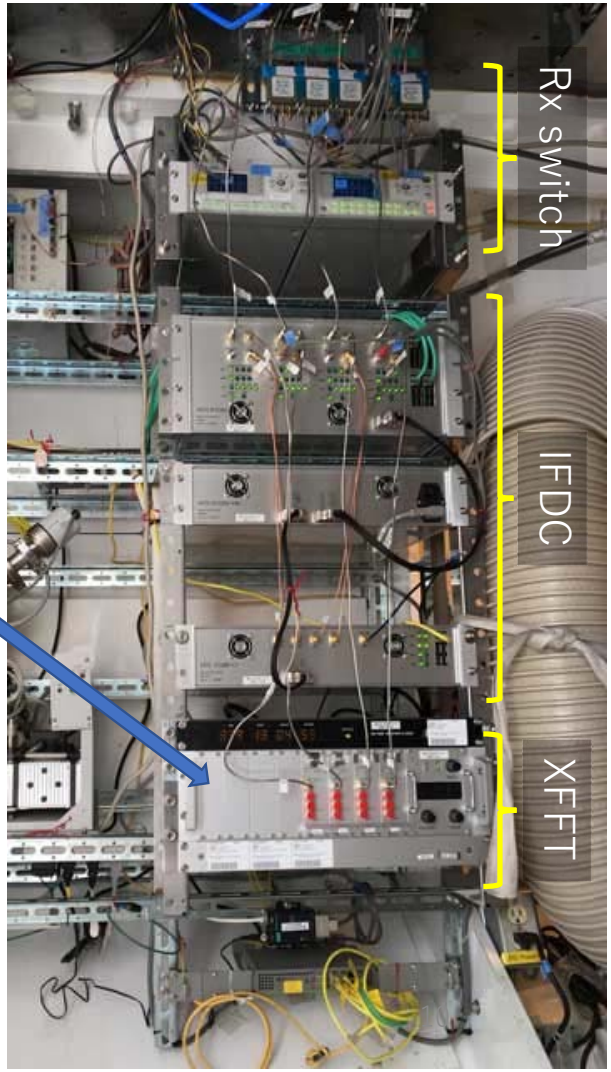
- After the sub-reflector is recovered,
  - Regular antenna maintenance
  - CSV of CAT8W, IFDC, and XFFTS
  - Then, normal operation will restart.



Updated – digital spectrometer and IF down converter

- RPG eXtended bandwidth FFT Spectrometer (XFFTS)
  - Supported by the KAKENHI project (P.I. Tosaki; JUEN)
  - 2.5 GHz BW / 32K channels [/Spw]
    - Δv=0.047 km/s, velo. width ~1500 km/s@492 GHz
  - 10-bit ADC, 5Gsps
    - Good linearity
- IF Down Converter (IFDC)
  - 4 spectral windows (2.5 GHz BW) from 4 IF signals of a receiver
  - Support of IF BW = 4-8GHz (**DASH345**, **CAT10**) and 4-18 GHz (**CAT8W**)

x4



Spectrometer	WHSF	XFFTS
IF bandwidth	2 / 4 GHz	2.5 GHz
# of channels	2,048 *1	32,768
# of IFs	4 / 2	4

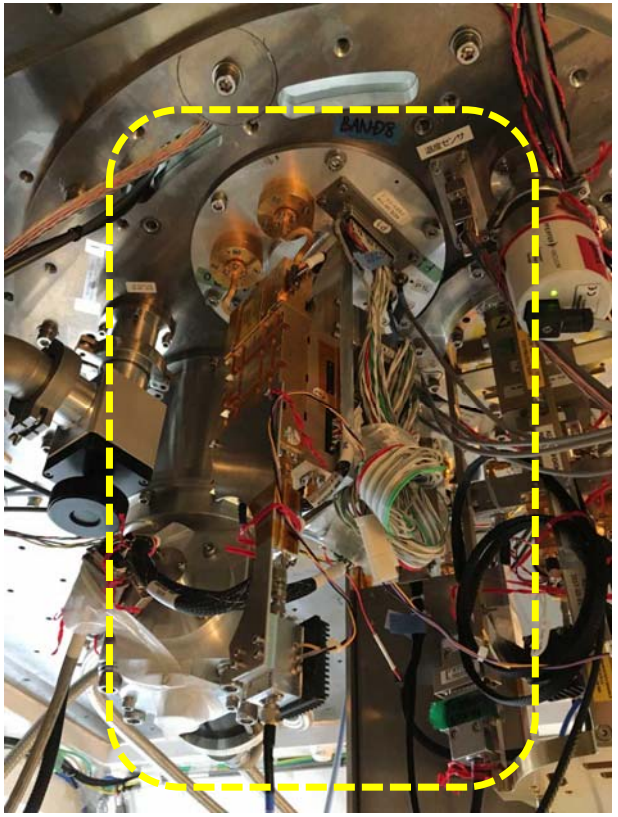
*1 NEWSTAR/NOSTAR limit

Updated – wide-IF-bandwidth Band8 receiver cartridge

- **Wide-IF-bandwidth Band8 receiver (CAT8W)**
  - Supported by the KAKENHI project (P.I. Oka; Keio U.)
  - The current Band8 receiver cartridge is upgraded with SIS mixers employing high-*Jc* junctions developed by ATC
  - Same RF range, but IF bandwidth is expanded from 4-8 GHz to 4-18 GHz

    e.g.) Simultaneous observations of CO and [CI] in Band 8 become available.
    - Trec ~150-250 K, IRR ~10-15 dB at Mitaka

Receiver	Band8	CAT8W
Beam	1	
RF range	387-498 GHz	
IF range	4-8 GHz	4-18 GHz
Sideband	USB, LSB	
Polarizations	X, Y	

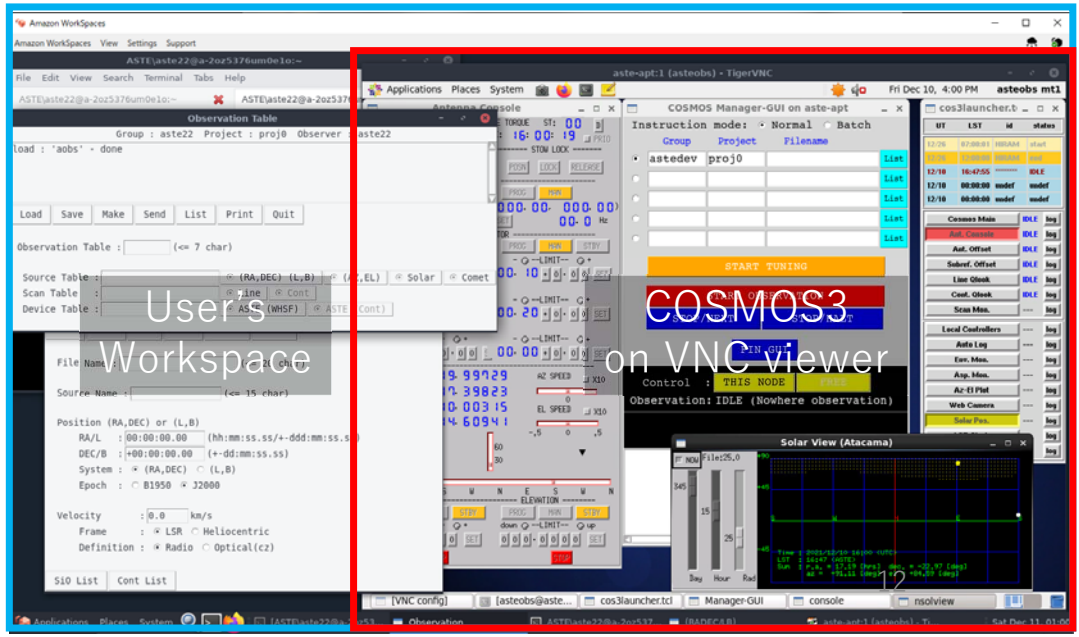


Updated – User's workspace, remote control terminal

- **Amazon Workspaces** – Virtual Desktop Infrastructure
  - A workspace is provided for a user
    - Observation preparation
    - VNC viewer to access the remote-control Virtual PC (on Amazon Web Services)

  - A user can connect its own workspace using AWS client (Win, Mac, Linux, …) from EA (even from Chile if network is stable)

Hardware and software tests for CAT8W, IFDC, and XFFTS are already operated from this workspace.

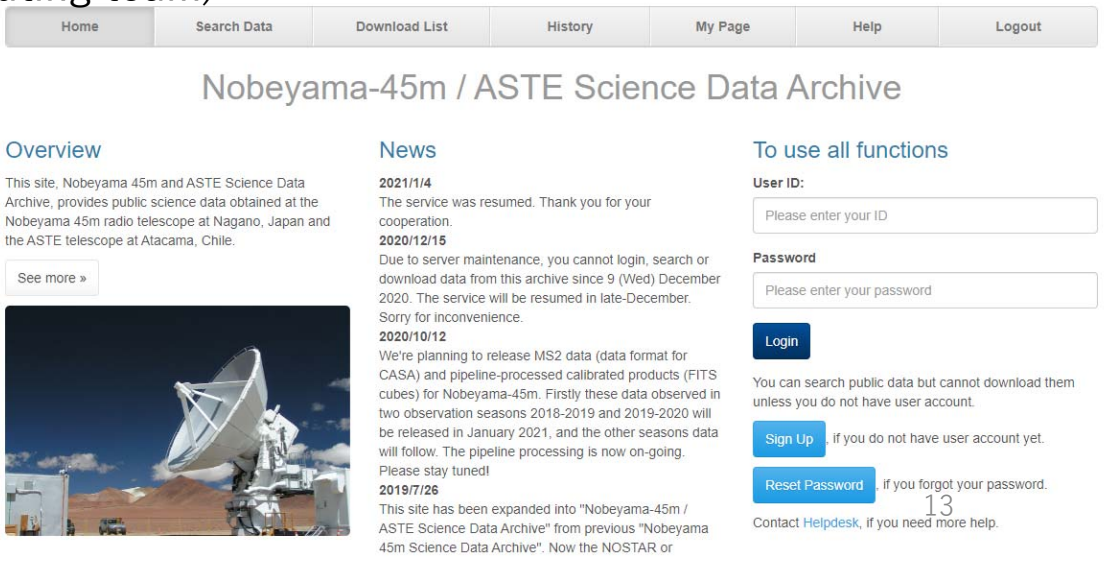


Updated – data reduction with CASA

- **Data reduction with CASA**
  - XFFTS data are reduced with CASA.
    - No plan to update NEWSTAR and NOSTAR to support XFFTS data.
  - MSv2 data generator (aka MERGE2) for WHSF and MAC is also under testing.

  - These CASA MSv2 format data will be delivered and distributed through the NRO/ASTE archive. (Collaboration with ALMA-J computing team)

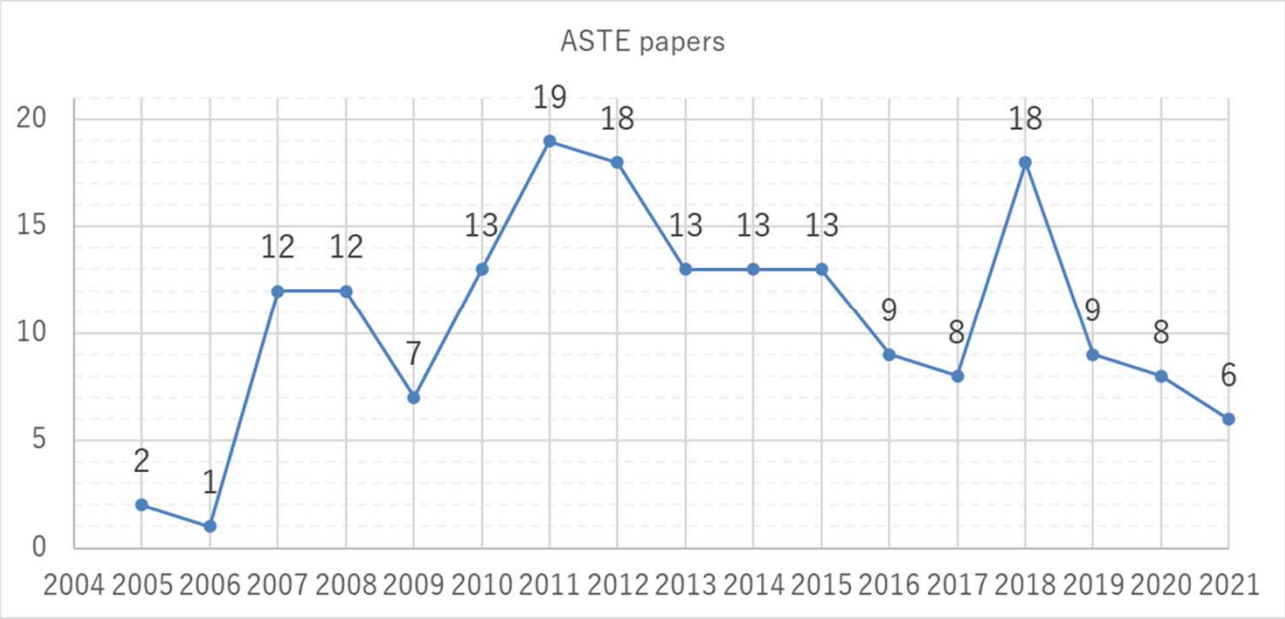
    NRO45m/ASTE Science Data Archive
    (https://nobeyama-archive.nao.ac.jp/)



ASTE related Publications

Trends in the number of publications.

- In 2021, 3 of 6 publications are Band8 observations.
- A paper of the Band8 demo science data was published.



(source: http://aste.nao.ac.jp/publication_list.html)

ASTE Operation Plan in 2022

– Operation plan –

- The A-project application started to renew the ASTE project.
- The plan after April in 2022 needs to be approved by NAOJ.

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This plan can change depending on the COVID-19 situation in the world and the sub-reflector problem.

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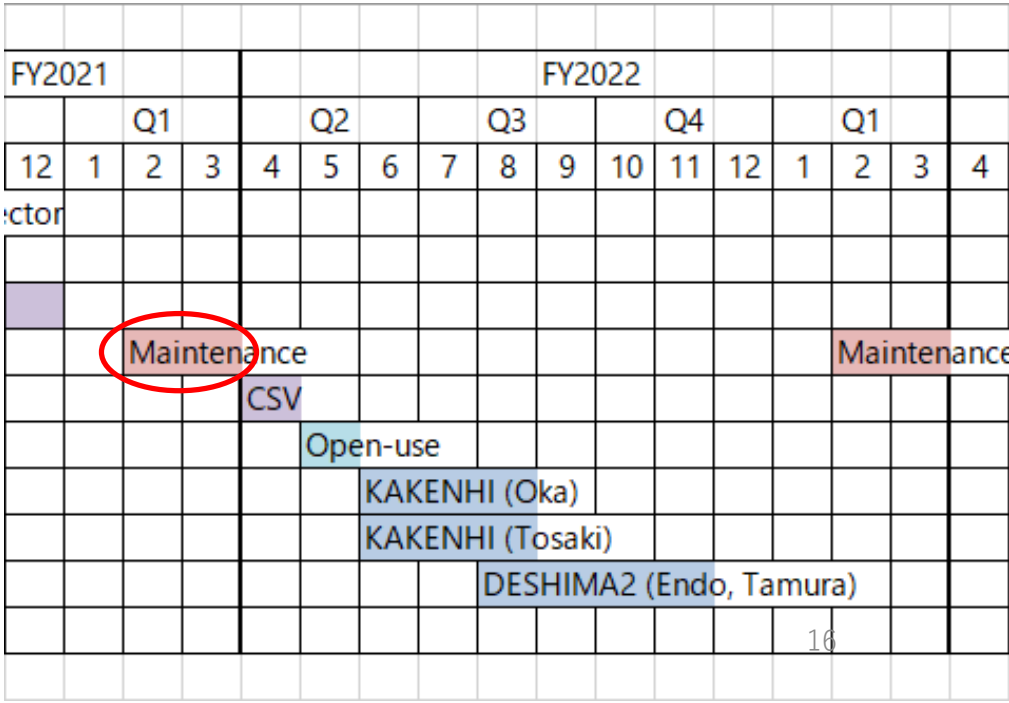
Operation in 2022 (late 02~03)

- **On-site work to recover the sub-reflector**
  - The jack motor will be replaced.
- **Regular antenna maintenance**
  - Mechanical and electrical maintenance will be done.

These activities will be done
by on-site ASTE staffs
with remote support by MELCO.

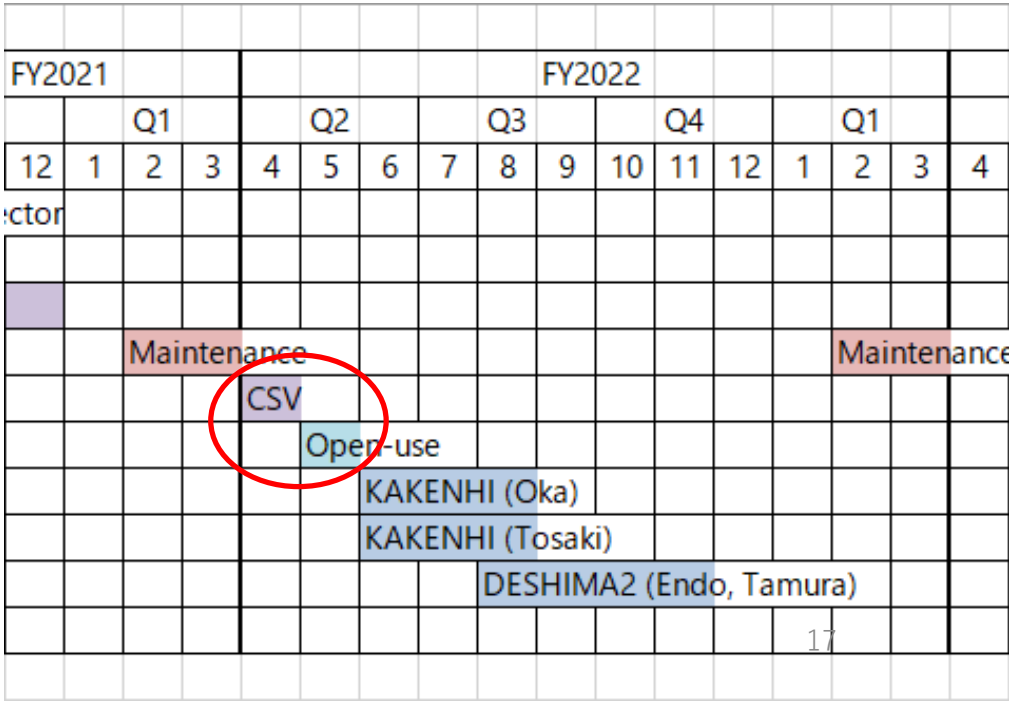
Manlift work is required to replace the malfunction motor



Operation plan (2022-04~05)

- 2022-04 CSV
  - CSV of CAT8W + IFDC + XFFTS
  - Performance check of the system.

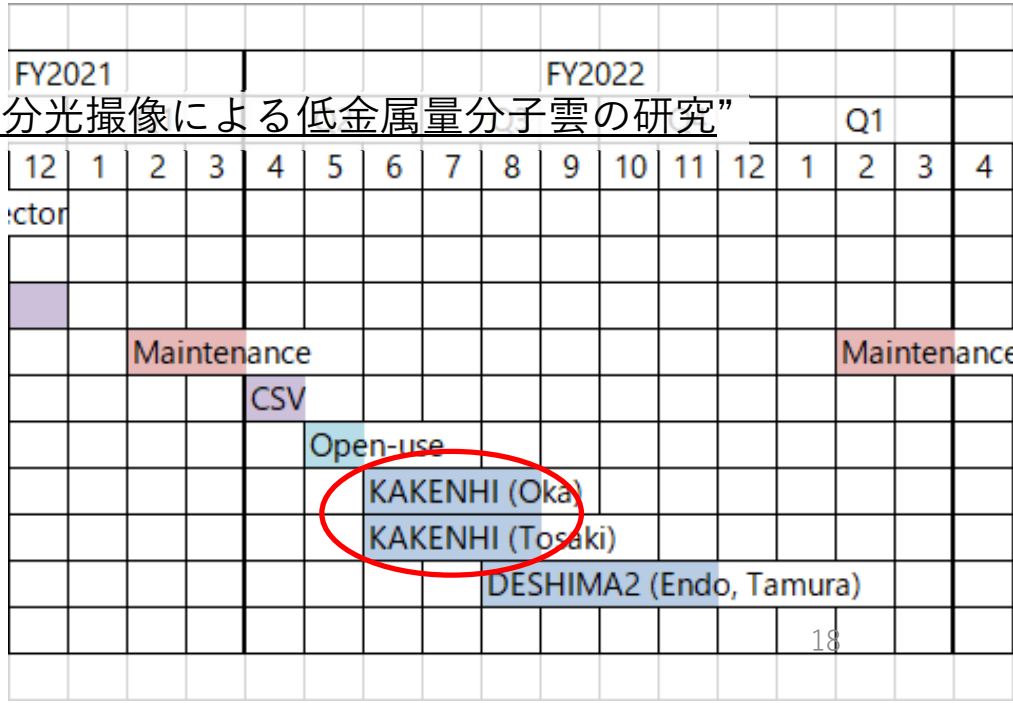
- 2022-05(~06) Open-use program observations
  - Open-use program observations
    carried over from 2021
    - Total number of accepted proposals = 7
    - Total observation time = 211 hours
    - Risk shared observations
      with the new backend



Operation plan (2022-06~mid 08)

- 2022-06~08 Two KAKENHI projects
  - P.I. Oka (Keio U.) (FY2020~2024)
    “サブミリ波観測に基づく銀河系内ミッシング・ブラックホールの探査”
    - CO and [CI] observations of High-Velocity Compact Clouds in our Galaxy
  - P.I. Tosaki (JUEN) (FY2020~2023)
    “ALMA受信機を活用した中性炭素原子輝線の広域分光撮像による低金属量分子雲の研究”
    - [CI] observations of an entire region of NGC6822

These projects are introduced later
in the ASTE session.

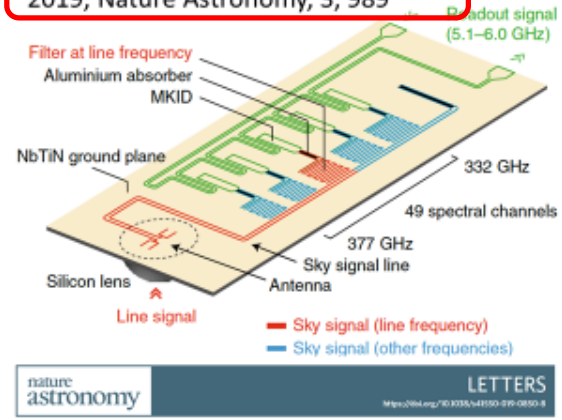


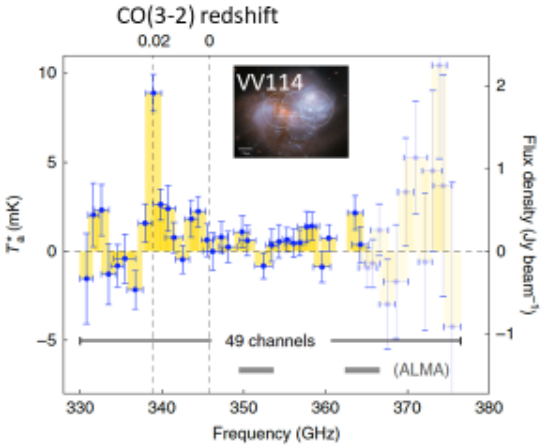
Operation plan (2022-mid 8~11)

- 2022-08~11 CSV and science observations of DESHIMA 2.0

First demonstration of the DESHIMA concept

Endo, A., Karatsu, K., Tamura, Y., et al.
2019, Nature Astronomy, 3, 989





nature astronomy — LETTERS

First light demonstration of the integrated superconducting spectrometer

	DESHIMA 1.0	DESHIMA 2.0
Frequency range	332 – 377 GHz	220 – 440 GHz
[CII] redshift range	4.0 – 4.7	3.3 – 7.6
Spectral resolution R = f/df	380 (dv = 790 km/s)	~500 (±50) (dv ~ 500 km/s)
Number of MKIDs	49	347

"Sub-mm version of X-SHOOTER"

KAKENHI project
by P.I. Kohno (U. Tokyo)

FY2022														
Q1		Q2			Q3			Q4			Q1			
2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
Maintenance												Maintenance		
		CSV												
			Open-use											
				KAKENHI (Oka)										
				KAKENHI (Tosaki)										
						DESHIMA2 (Endo, Tamura)								


2021-12-05