



Managing the role and expectations of general users in the lifecycle of scientific software

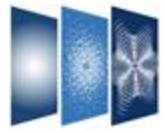
Bjorn Emonts (NRAO – CASA User Liaison)



National Radio
Astronomy
Observatory

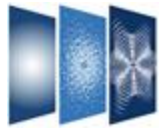


JIVE
Joint Institute for VLBI
ERIC



This talk

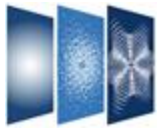
- 1). Introduction CASA software and lifecycle
- 2). Managing role of general users: users as stakeholder
- 3). Managing user expectation: support & feedback
- 4). Future of CASA: Radio Astronomy Data Processing System
(ngVLA and ALMA WSU)



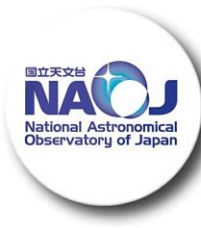
1. The CASA Software

Common Astronomy Software Applications

- Data processing software for radio astronomy (interferometry & single dish)
- Official software ALMA, VLA, Nobeyama 45m (supports pipelines)
- Best-effort other telescopes (EVN, GMRT, etc.)



1. CASA Team



JIVE

Joint Institute for VLBI
ERIC

CASA-VLBI

Mark Kettenis (JIVE)	<i>VLBI, development</i>
Des Small (JIVE)	<i>VLBI, development</i>
Marjolein Verkouter (JIVE)	<i>VLBI, management</i>
Aard Keipema (JIVE)	<i>VLBI, Jupyter kernel</i>

Spencer Whitten (NRAO-ALBQ)
Sandra Castro (ESO)
Josh Marvil (NRAO-SO)
George Moellenbrock (NRAO-SO)
Takeshi Nakazato (NAOJ)
Darrell Schiebel (NRAO-CV)
Ville Suoranta (NRAO-CV)
Akeem Wells (NRAO-CV)

CASA Lead
RADPS Test Lead
Project Scientist
Lead Calibration, VLBI
Lead Single Dish, Scientific development
Lead visualization, Infrastructure development
Lead Infrastructure Development, Release Engineering
Lead Verification testing

Victor de Souza Magalhaes (NRAO-ALBQ)
Bjorn Emonts (NRAO-CV)
Enrique Garcia (ESO)
Bob Garwood (NRAO-CV)
Kumar Golap (NRAO-SO)
Pam Harris (NRAO-SO)
Ihor Ilnatiev (NAOJ)
Andrew McNichols (NRAO-CV)
Dave Mehringer (NRAO-CV)
Renaud Miel (NAOJ)
Federico Montesino (ESO)
Inna Muzychenko (NAOJ)
Dirk Petry (ESO)
Urvashi Rau (NRAO-SO)
Srikrishna Sekhar (NRAO-SO)
Tak Tsutsumi (NRAO-SO)

Scientific development
User Community Liaison
Infrastructure development
Infrastructure, Verification testing
Scientific development
Data visualization, Infrastructure
Scientific development, Single Dish
Infrastructure, Scientific development
Scientific development, Verification testing
Scientific development, Single Dish
Infrastructure, Scientific development
Scientific development, Single Dish
Scientific development
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Scientific development, Verification testing

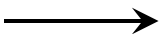
ARDG (Algorithm Research & Development Group)

Sanjay Bhatnagar (NRAO) - ARDG Lead
Mingyu (Genie) Hsieh (NRAO)
Preshanth Jagannathan (NRAO)
Felipe Madsen (NRAO, IDIA)



1. The CASA Software

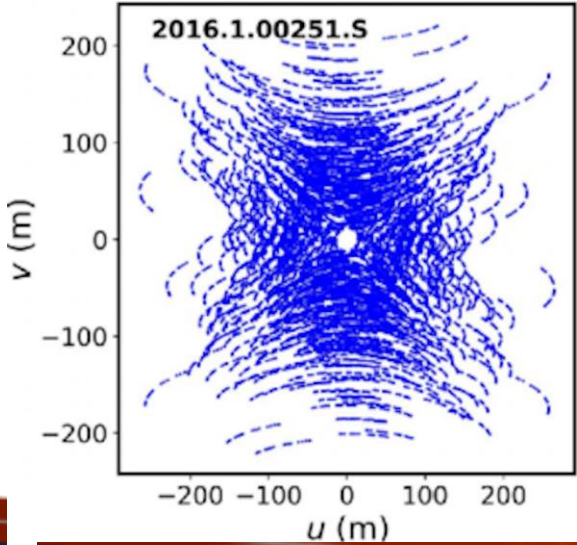
Visibilities +
meta-data



calibration + imaging

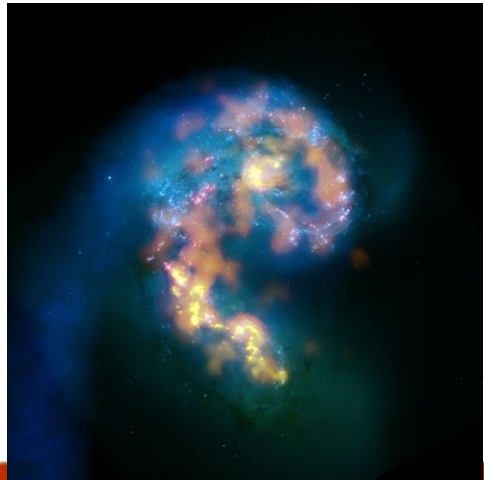
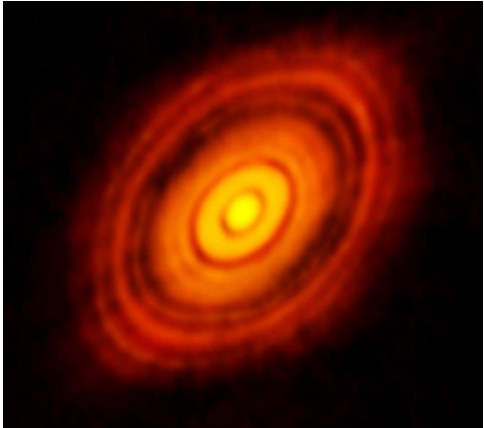


Data
products



CASA

Common Astronomy
Software Applications



1. The CASA Software

- **Tools:** basic C++ functions linked to Python interface → *basic operations*
- **Tasks:** bundle tools + Python functionality → *specific data reduction step*
→ *user friendly, parameter input*
- **GUIs:** Graphical User Interfaces to visualize and examine data/images
- **Data Repository:** Earth Orientation Parameters, reference frames, ephemeris data, beam models, simulator config files, etc



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- **Not Visualization:** Viewer deprecated, remove from Mac OS

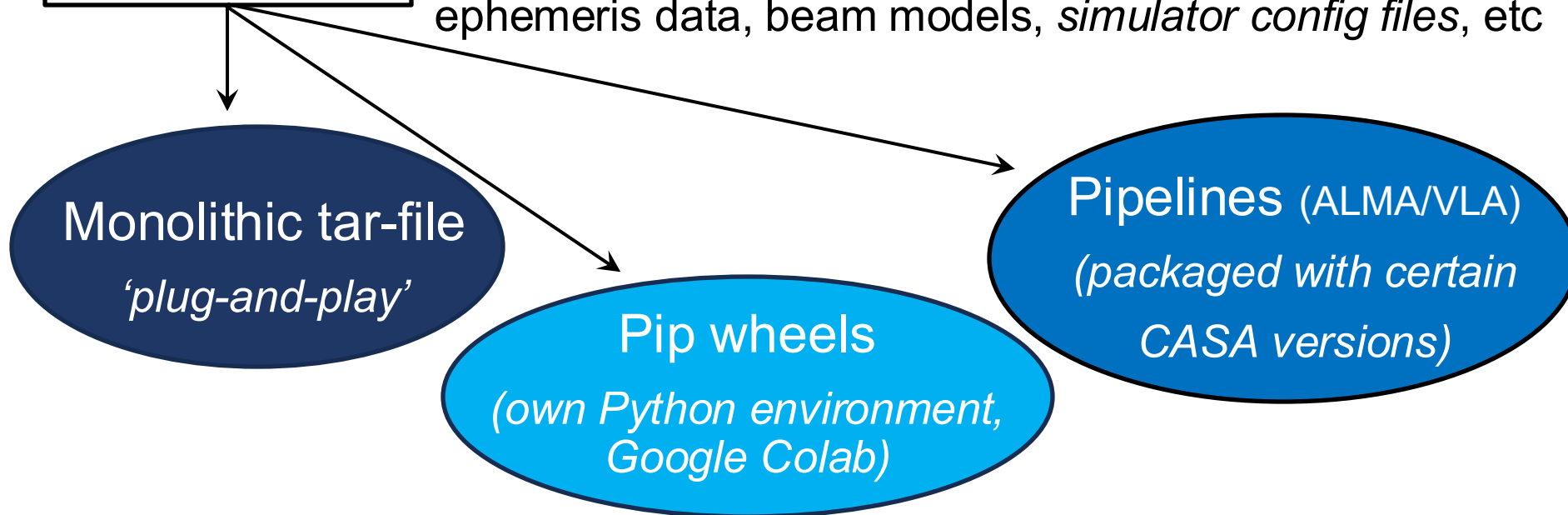


CARTA: <https://cartavis.org>

(external:    )

1. The CASA Software

- **Tools:** basic C++ functions linked to Python interface → **basic operations**
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1. The CASA Software

- **CASA website:** download, general info, team, contact →

<https://casa.nrao.edu>





Latest version: CASA 6.7

The [Release Notes](#) and [Known Issues](#) of the 6.7 release are available in [CASA Docs](#)

CASA 6.7 is based on Python 3, and available either as a downloadable tar-file distribution with Python environment included, or as a modular version that can be installed with [pip-wheels](#).

Manual processing can be done with any CASA version, but ALMA and VLA pipelines may differ and are not always included, so download the correct CASA version for pipeline use.

	 Linux (RedHat 8, 9)	 Mac (OS 12, 14, 15)
General Use (version info)	CASA 6.7.2 (RH8/Py3.12) CASA 6.7.2 (RH9/Py3.12)	CASA 6.7.2 (OS15/Py3.12) ^[a]
ALMA Pipeline (version info)	CASA 6.6.6 (RH8)	CASA 6.6.6 (OS14) ^[a]
VLA Pipeline (version info)	CASA 6.6.6 (RH8)	CASA 6.6.6 (OS14)* ^[a,b] CASA 6.6.6 (OS12)* ^[a,b]

Notes:

[a] The CASA Viewer has been removed from Mac OS packages from CASA 6.6.5 onward. See [this CASA Docs page](#) for details.

[b] The OS 14 versions is a native ARM build. For Intel machines, please use the OS 12 pipeline version (this OS 12 version is also expected to run on ARM machines through Rosetta, provided a Python interpreter with universal support is used).

 The above CASA versions can also be downloaded from our [NAOJ CASA mirror site](#) and [NAOJ CASA-pipeline mirror site](#), or via [Google Drive](#).

CASA is only fully validated against the operational configuration of NRAO instruments (currently RHEL 8/Python 3.10)

1. The CASA Software

- **CASA website:** download, general info, team, contact
- **CASA Docs:** official CASA code documentation (readthedocs)

<https://casa.nrao.edu>



<https://casadocs.readthedocs.io>

Open in Colab: <https://colab.research.google.com/github/casangi/casadocs/blob/791ea5e/docs/notebooks/introduction.ipynb>

Release Information

These are the release notes for CASA 6.7. Changes compared to the [CASA 6.6 release](#) are listed below.

Highlights

- **iclean**: new interactive clean widget. (CASA 6.7.2)
- **msuvbinflag**: new experimental task to flag outliers in the UV plane. (CASA 6.7.2)
- **appendantab**: new task for appending antab files to an MS. (CASA 6.7.2)
- **hanningsmooth**: new parameter *smooth_spw* for selecting spws to smooth. (CASA 6.7.2)
- **sdbaseline**: added applying of sinusoid fitting parameters using baseline table. (CASA 6.7.2)
- **feather/sdintimaging**: support added for per-plane beams in feather. (CASA 6.7.2)
- **importfitsidl**: now labels source positions in the ICRS reference frame (VLBI). (CASA 6.7.2)
- **atmosphere**: ATM (atmosphere) library updated to ALMA Cycle 12. (CASA 6.7.2)
- **casacconfig**: new options and updates available. (CASA 6.7.2)
- **import/export**: "Beam Waveguide" antennas (ALT-AZ+BWG-R / ALT-AZ+BWG-L mount types) now experimentally supported. (CASA 6.7.2)
- **config files**: The configuration files for ngVLA version Rev.F and ALMA Cycle 12 are now included. (CASA 6.7.2)
- **Mac Intel**: CASA dropped support for MacOS Intel machines. (CASA 6.7.0)
- **casaviewer**: the CASA Viewer has been removed from MacOS. stable

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(RedHat 8, 9)

 **Mac**
(OS 12, 14, 15)

General Use

([version info](#))

[CASA 6.7.2](#) (RH8/Py3.12)
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[CASA 6.7.2](#) (OS15/Py3.12) ^[a]

ALMA Pipeline

([version info](#))

[CASA 6.6.6](#) (RH8)

[CASA 6.6.6](#) (OS14) ^[a]

VLA Pipeline

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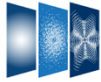
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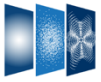
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1. The CASA Software: lifecycle

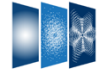
Q1 | CASA release (~ quarterly)



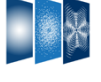
Q2 | CASA release (~ quarterly)



Q3 | CASA release (~ quarterly)



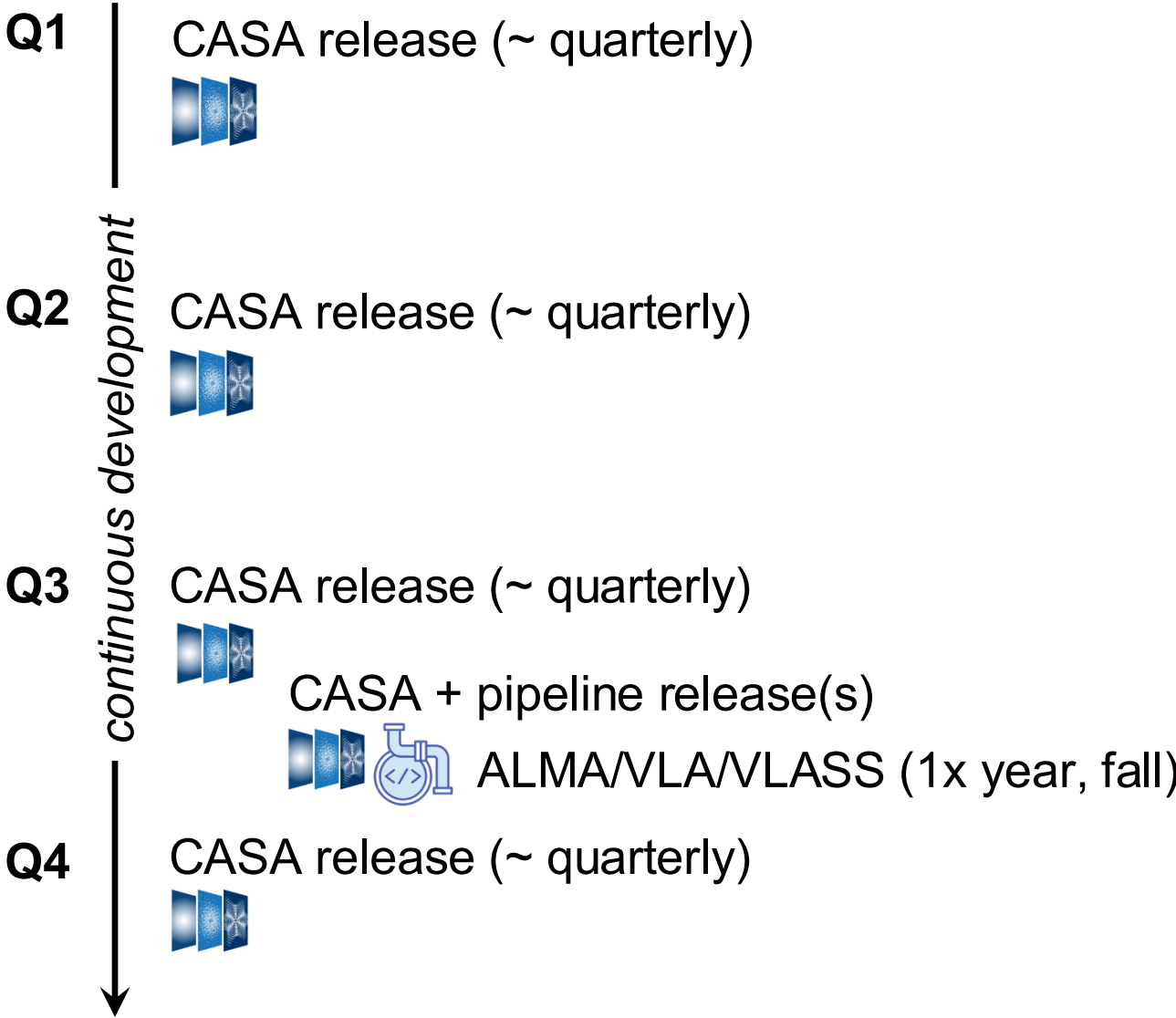
Q4 | CASA release (~ quarterly)



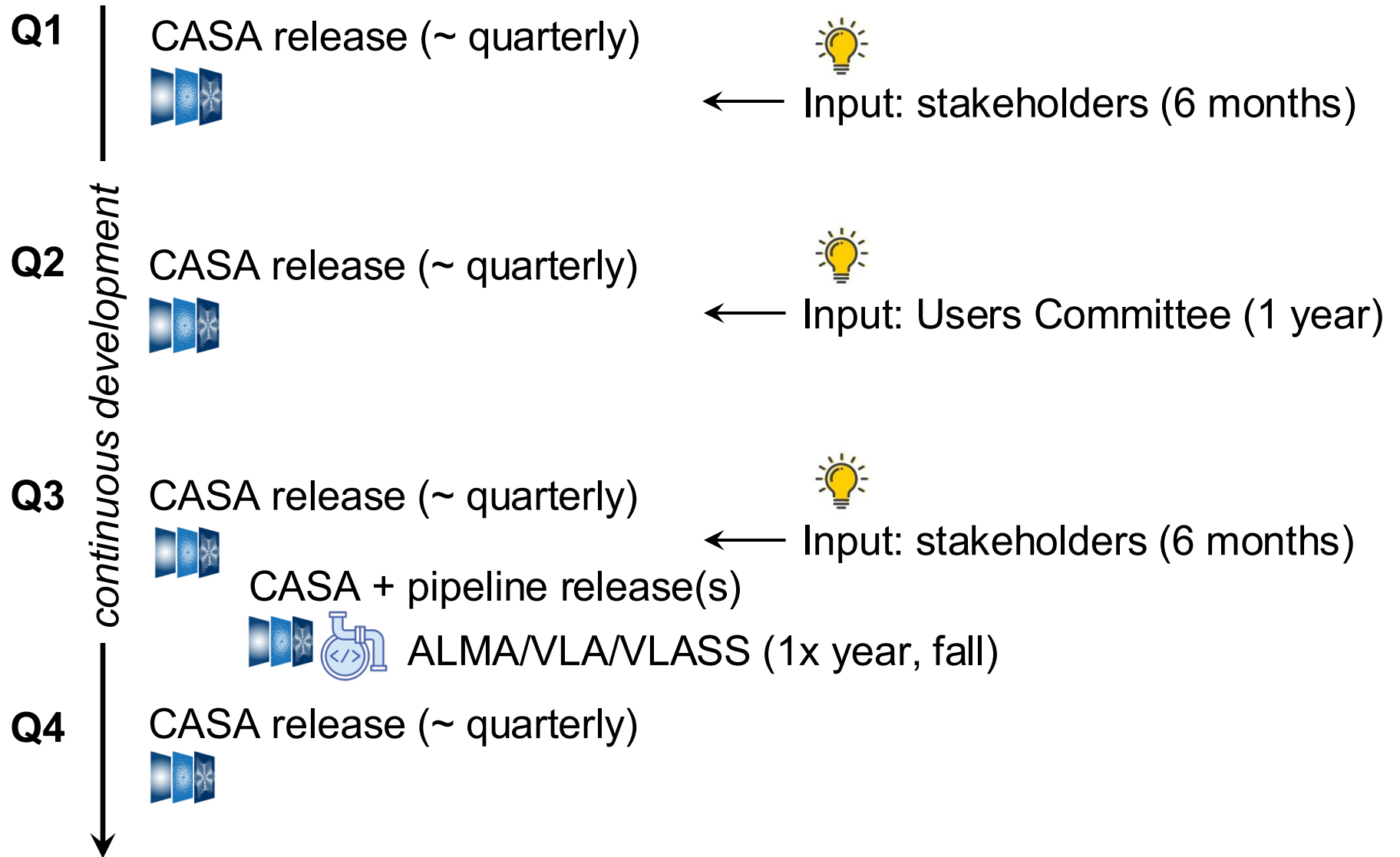
continuous development



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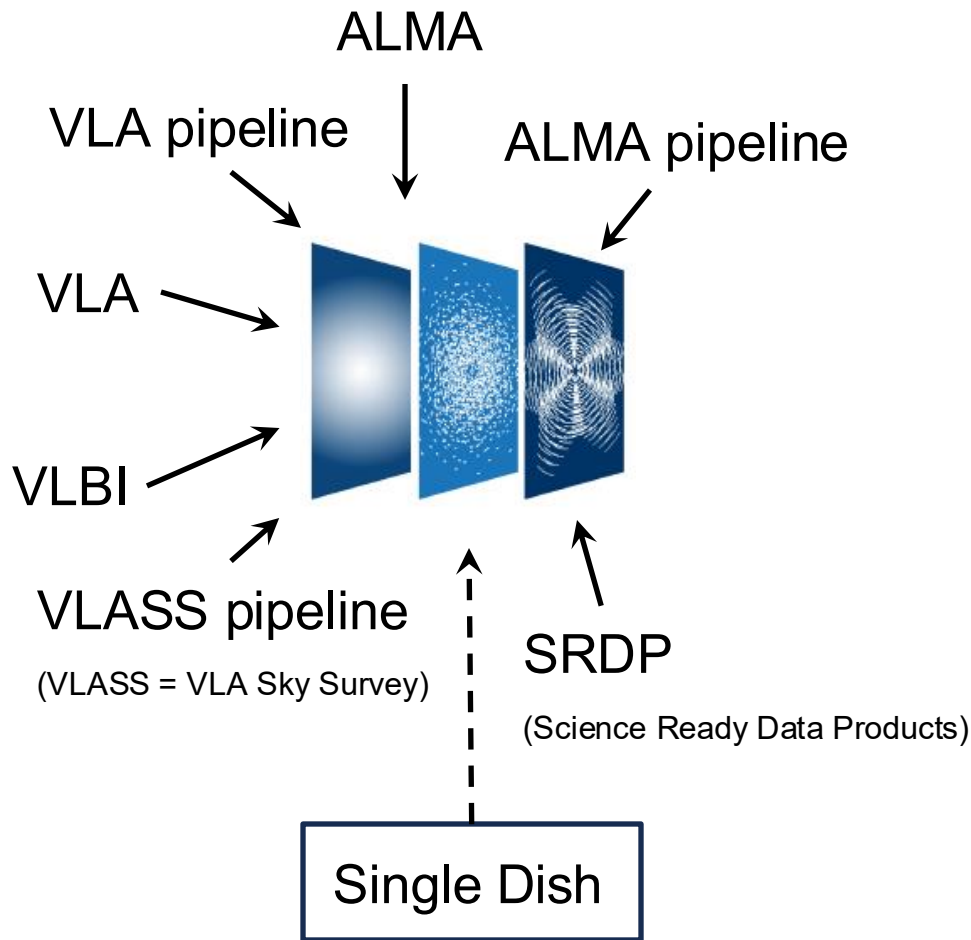


1. The CASA Software: lifecycle



2. Managing Role of Users: stakeholder input

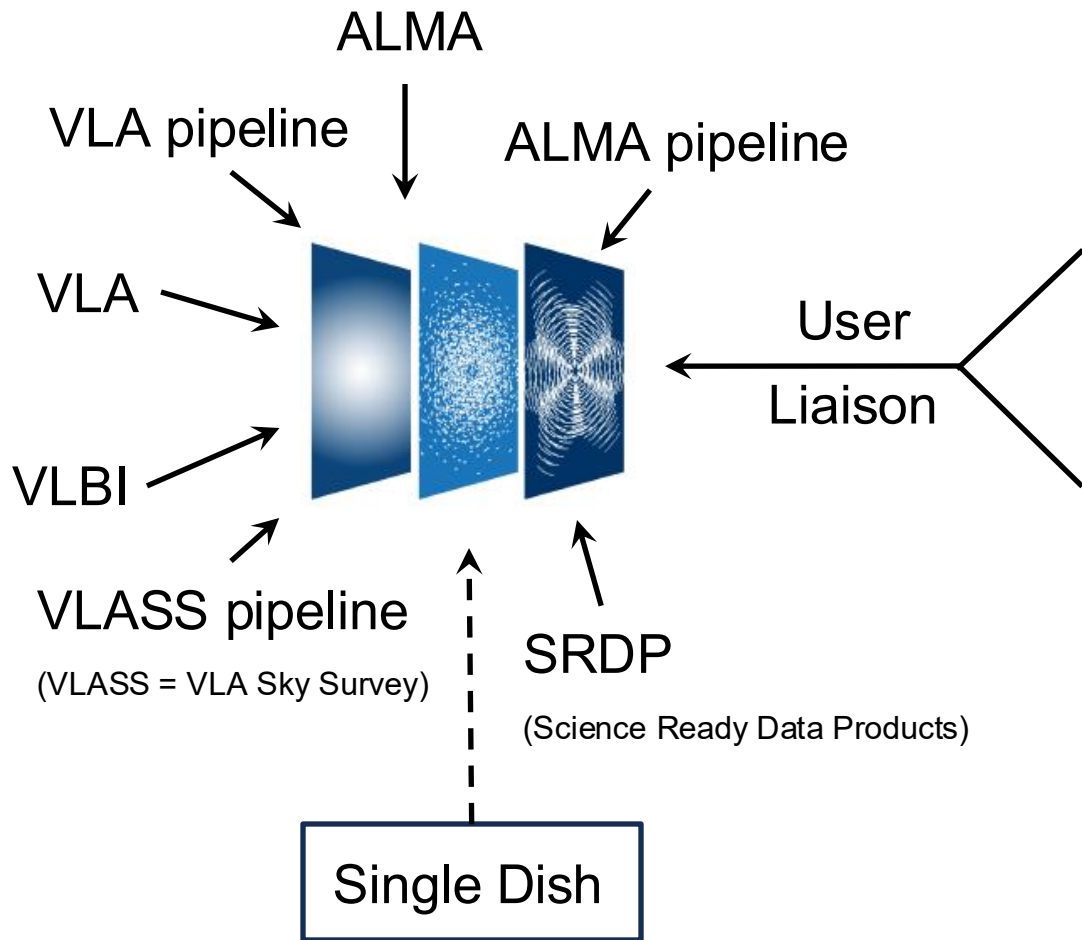
“Internal” stakeholders



2. Managing Role of Users: stakeholder input

“Internal” stakeholders

“External” stakeholder = Users



DPUC (DMS Panel Users Committee)

- 10 external experts
- Software Panel NRAO UC
- Yearly Meeting + Report with recommendations

<https://safe.nrao.edu/wiki/bin/view/Software/CASA/CASAUUsersCommittee>

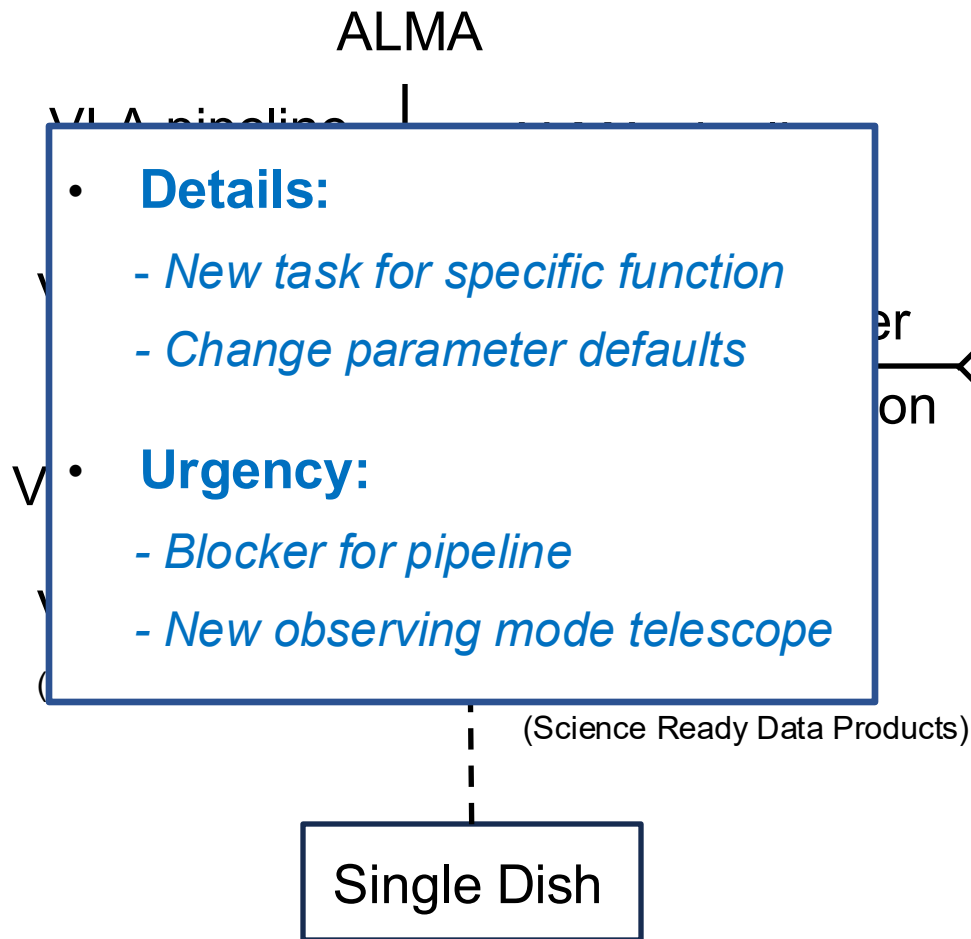
General Users

- casa-feedback@nrao.edu

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2. Managing Role of Users: stakeholder input

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“External” stakeholder = Users

ALMA

VLBA pipeline

- **Details:**
 - *New task for specific function*
 - *Change parameter defaults*
- **Urgency:**
 - *Blocker for pipeline*
 - *New observing mode telescope*

er
son

(Science Ready Data Product)

Single Dish

- **Larger picture:**
 - *OS compatibility (Mac support)*
 - *Reliability of CASA (testing philosophy → see talk Sandra Castro)*
- **Long term requirements:**
 - *Joint deconvolution*
 - *Visualization (e.g., interactive iclean)*
 - *VLBI*
- **Other telescopes**

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 - VLBI
- **Other telescopes**

Now available!

https://casadocs.readthedocs.io/en/stable/notebooks/interactive_clean.html

2. Conclusions Role of Users

Lesson: General Users (= ultimate customers) → unique / important input for long-term software development, especially if intended for broad use.

Problem: silent majority, not as vocal internal stakeholders, institutional experts, and power users.
(software = means-to-end, not end-goal)

Solution: capture input from general users:

Active:

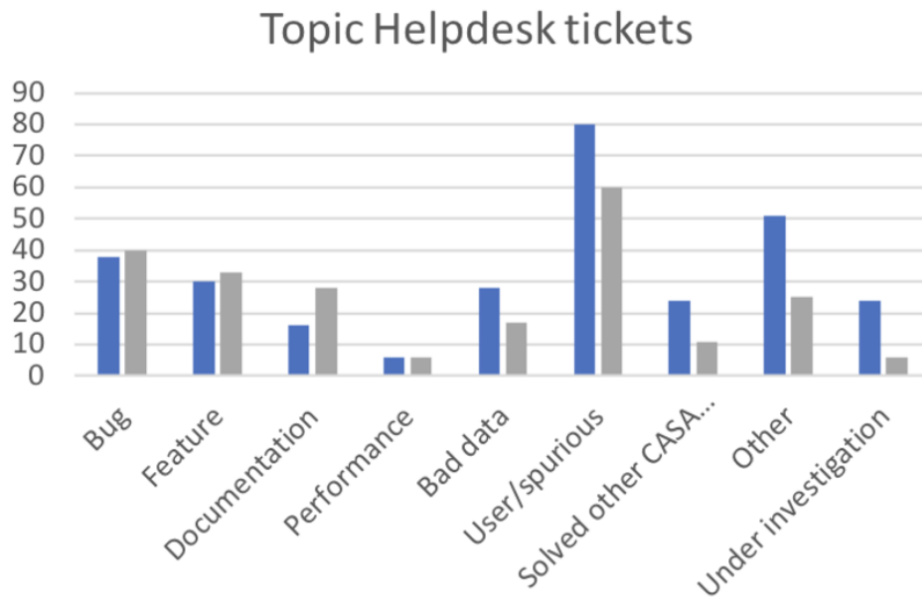
- Direct contact (email / Helpdesk / github)
- External review (panel / users committee)
- User surveys

Passive:

- Software statistics
 - Telemetry
 - Crash Reporter
 - Download statistics

3. User support

CASA-related tickets ALMA & NRAO Helpdesks:
(handled by telescope support staff)



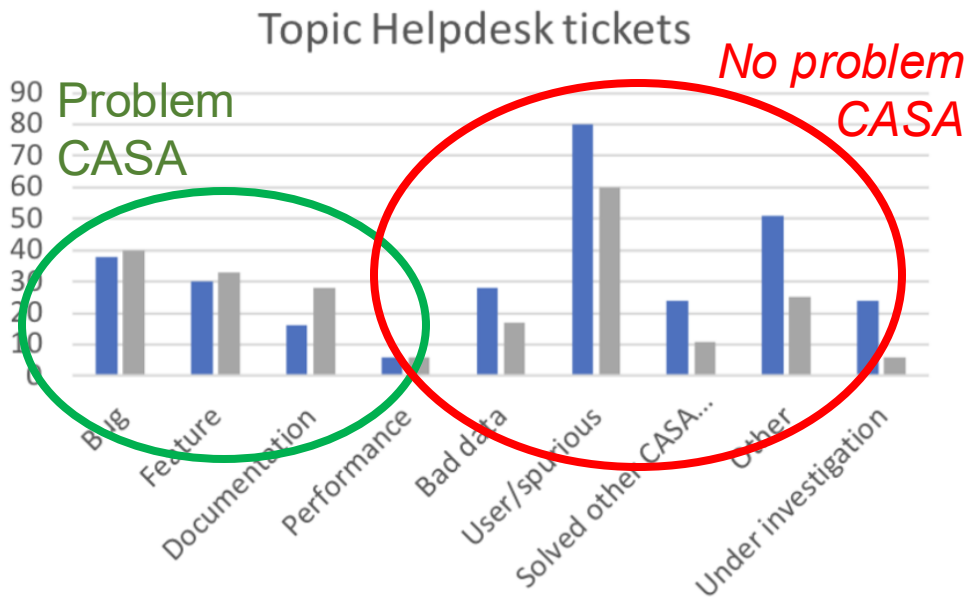
Source: CASA Memo 6

User Survey & Helpdesk Statistics

<https://casadocs.readthedocs.io/en/stable/notebooks/memo-series.html>

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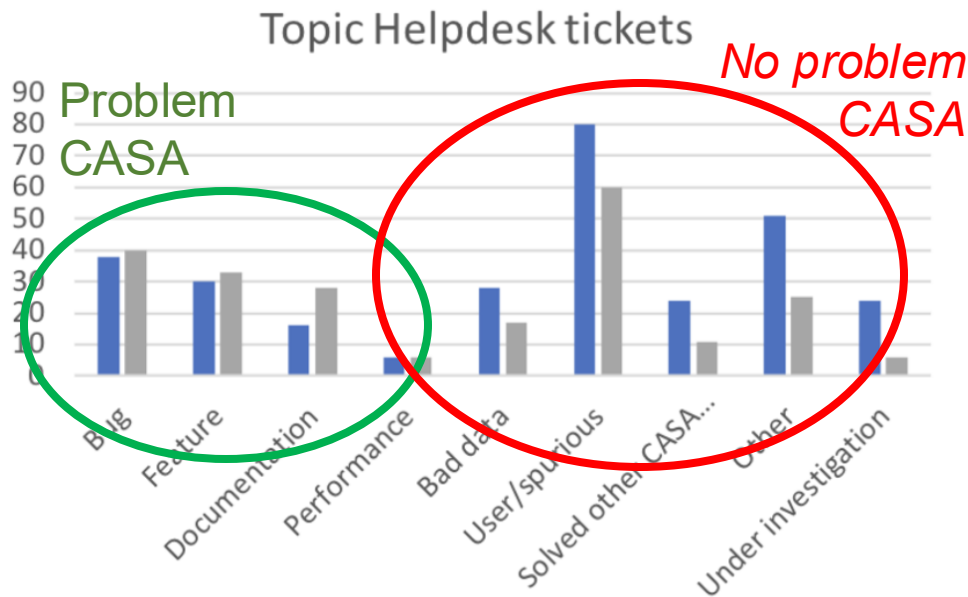
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CASA Team

- <0.2 FTE direct user support
- Developers loaded
- *Support = best effort*

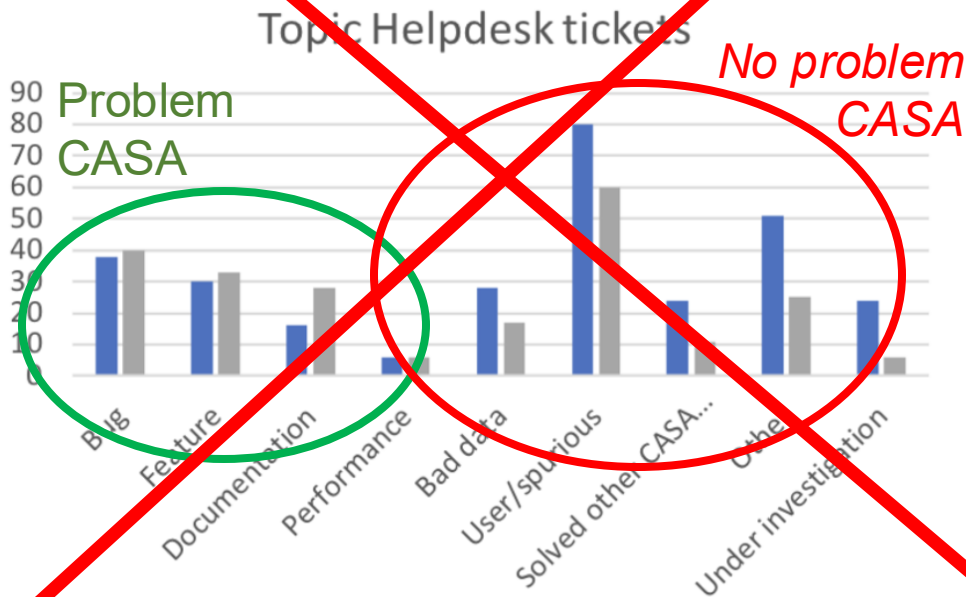
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User Survey & Helpdesk Statistics

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3. User support

CASA help on ALMA & NRAO Helpdesks:
(mostly by telescope support staff)



CASA Team

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User Survey & Helpdesk Statistics

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3. User support: best-effort, but dedicated

`casa-feedback@nrao.edu`

- Best-effort (-)
- No archiving (-)
- Multiple eyes on incoming message (+)
- Direct contact for Helpdesk (+)
- Feedback channel (also for CASA's successor RADPS) (+)

→ Majority casa-feedback questions: OS support and installation

3. User support: best-effort, but dedicated

OS support

- CASA only fully validated for **Linux/RedHat** NRAO/ALMA operations
- Official support latest version(s) Linux/RedHat and **Mac OS**

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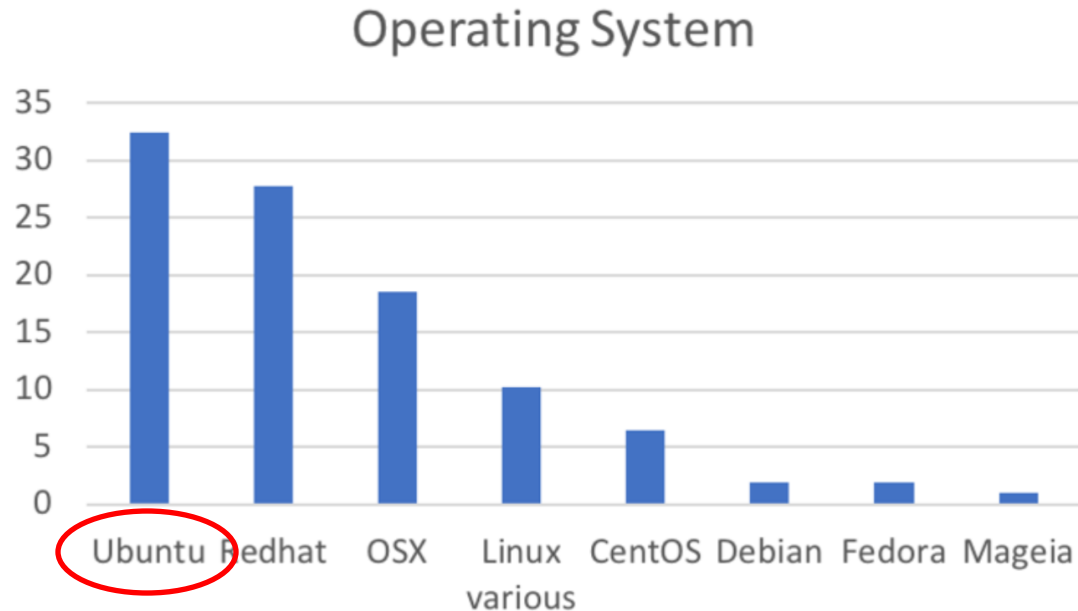


- *Large overhead developers*
 - *Difficult to keep up versions*
 - *Problems with Viewer (taken out)*
- *Continued support explicitly for users (user committee).*

3. User support: best-effort, but dedicated

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Source: CASA Memo 6
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3. User support: best-effort, but dedicated

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- Official support latest version(s) Linux/RedHat and **Mac OS**
- Testing includes Ubuntu → CASA should work, bugs will be addressed

CASA compatibility table - see CASA Docs:

<https://casadocs.readthedocs.io/en/stable/notebooks/introduction.html#Automated-testing-table>

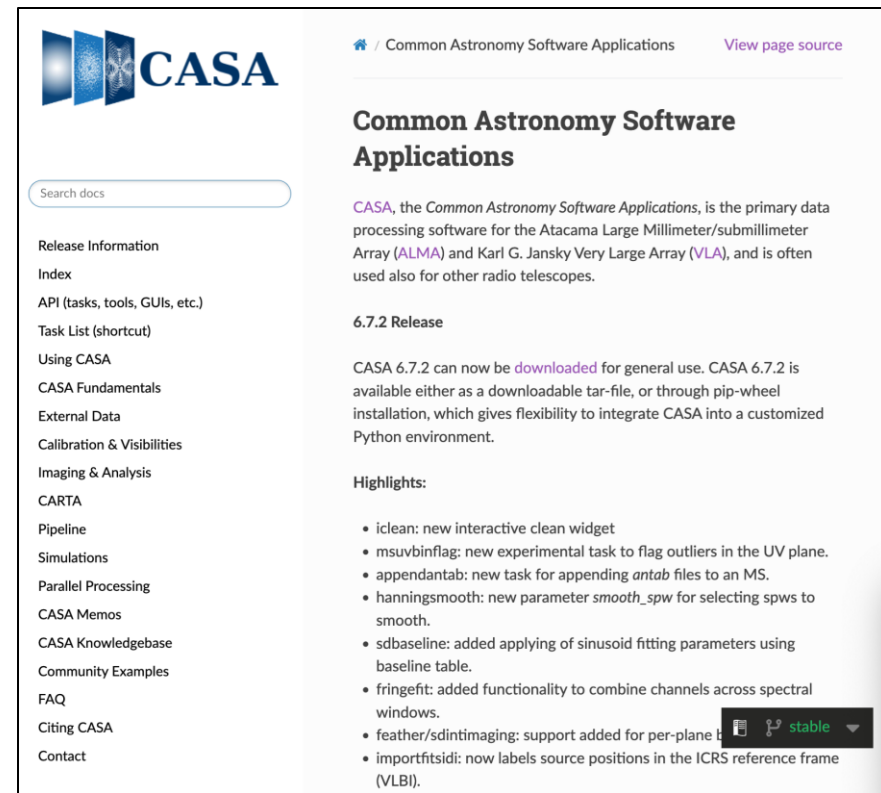
OS	casatools	casatasks	casashell	aux repos	stakeholders	regressions	mpi*
RHEL 8 + Py 3.12	T	T	T	T	T	T	T
RHEL 8 + Py 3.13	T	T					
RHEL 9 + Py 3.12	T	T		T		T	T
RHEL 9 + Py 3.13							
Ubuntu 24 + Py 3.12	T	T		T			
Ubuntu 24 + Py 3.13							
MacOS 15 + Py 3.12	T	T					
MacOS 15 + Py 3.13	T	T					

3. User support: ~~best effort~~, but dedicated

Documentation

- Essential!
- Version-specific (released with codebase)
- CASA code testing written against documentation → reliable
- `How the code works' → make use of CASA Docs resources!
 - *Release information*
 - *Known Issue*
 - *Installation instructions*
 - *OS support*
 - *API*
 - *Task and parameter descriptions*
 - *General chapters CASA use*
 - *Memos/Knowledgebase/FAQ*
 - *Notebook examples*
 - *And more...*

<https://casadocs.readthedocs.io>



The screenshot shows the CASA documentation website. The header includes the CASA logo and the text 'Common Astronomy Software Applications' with a 'View page source' link. A search bar is present. The main content area is titled 'Common Astronomy Software Applications' and contains an introduction to CASA as the primary data processing software for the Atacama Large Millimeter/submillimeter Array (ALMA) and the Karl G. Jansky Very Large Array (VLA). It also mentions the 6.7.2 release and provides a list of highlights, including new features like 'iclean', 'msuvbinflag', 'appendantab', 'hanningsmooth', 'sdbaseline', 'fringeft', 'feather/sdintimaging', and 'importfitsidi'. A 'stable' dropdown menu is visible in the bottom right corner of the page.

3. Conclusions User support

Lesson: User support requires FTE investment.

Balanced user support → avoid distractions development

Solutions: Avenues providing balanced user support:

Active:

- Personal contact
- Email list
- Helpdesk

Passive:

- Tutorials / Demos
- Newsletters
- Open forum

Technical:

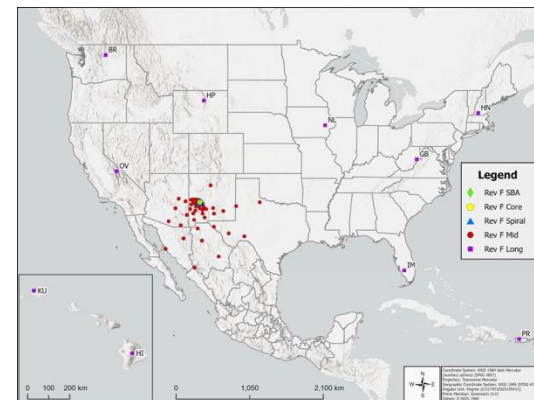
- Documentation
- Testing suite OSs

Challenge: Manage user expectations

4. Future CASA → RADPS

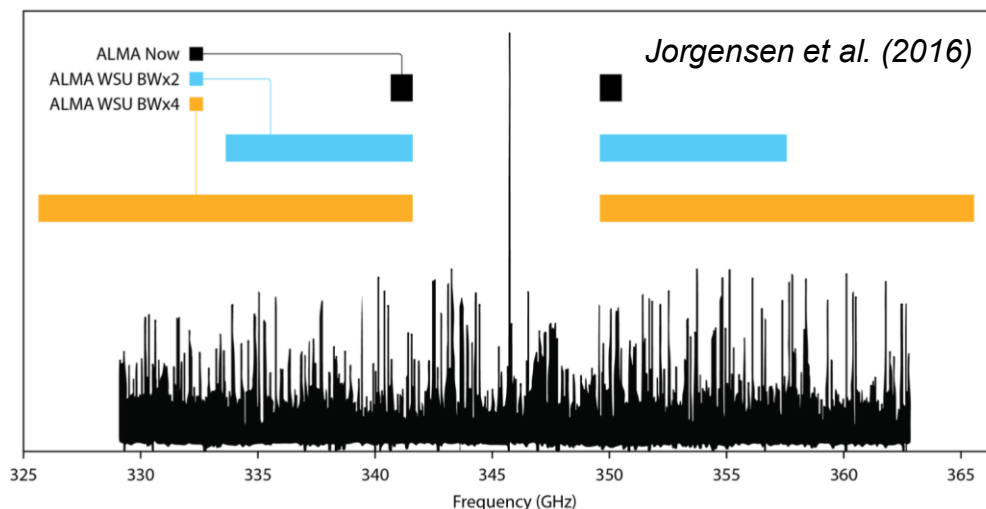
Next-Generation VLA (ngVLA)

- Continental array US
- 244 Antennas
- 8 GB/sec average data rate



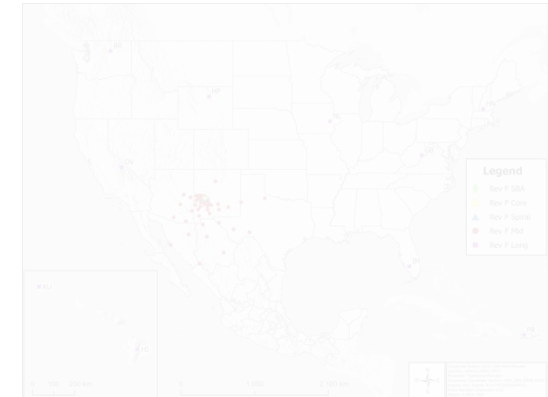
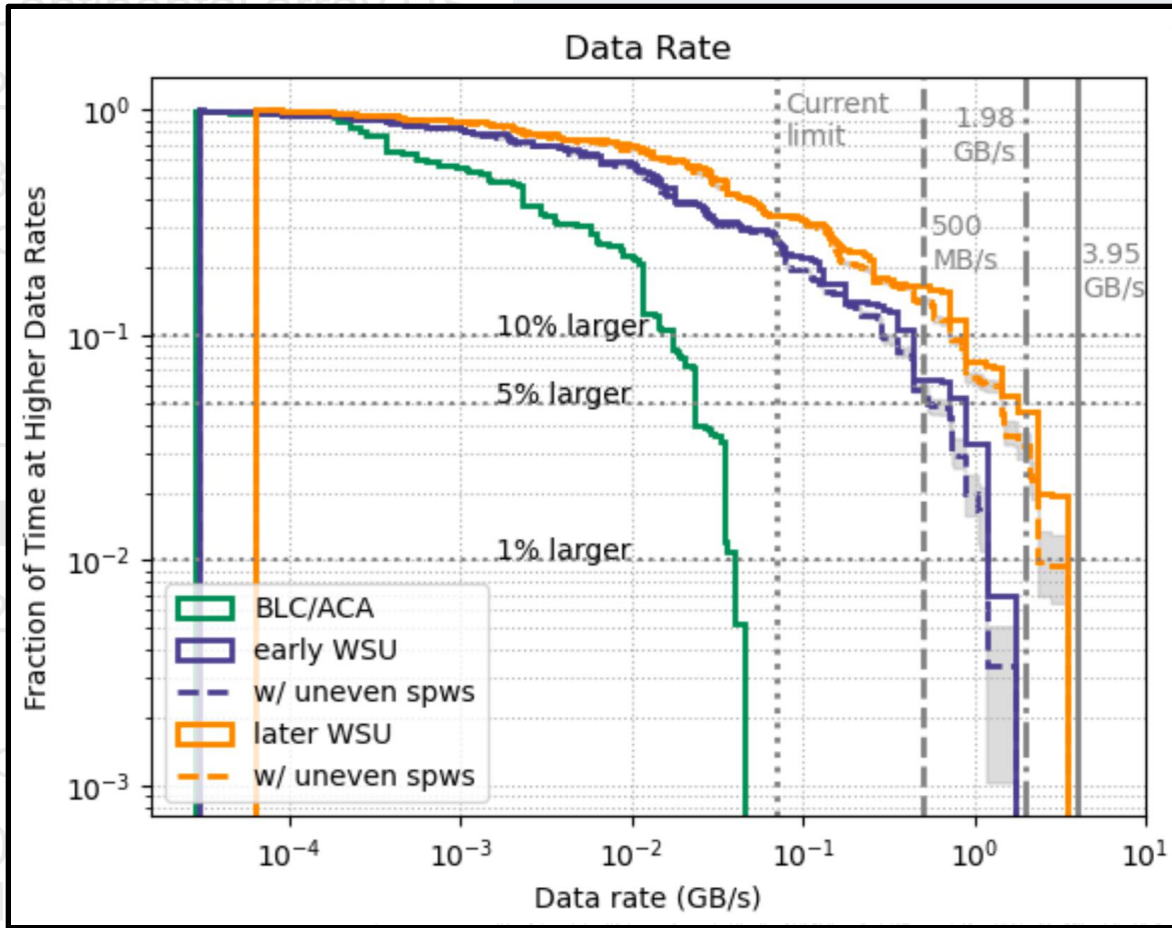
ALMA Wideband Sensitivity Upgrade (WSU)

- 2-4x bandwidth
 - 1.2 million channels!
 - 0.5 GB/s avg. data rate
- (Kepley et al. 2024, ALMA Memo 626)



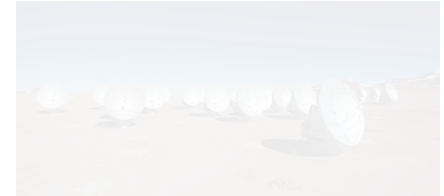
4. Future CASA and RADPS

Next-Generation VLA (ngVLA)



Large and larger data products...

(Kepley et al. 2024, ALMA Memo 626)



4. Future CASA and RADPS

Radio Astronomy Data Processing System (RADPS)

- Primary: production of high-level data products ALMA-WSU and ngVLA
- Secondary: support evolution radio astronomy data processing through widely accessible package
- RADPS (Led by NRAO, also ESO, NAOJ):
 - Scalable data-processing capabilities (“next-generation CASA”)
 - Off-the-shelf technologies
 - Workflow and resource management
 - Interactive processing application
 - User interfaces
- Status: Conceptual System Design
(System Requirements Review passed in Feb 2025)

RADPS Demonstrator

Packages: <https://github.com/casangi>

4. Future CASA and RADPS

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(System Requirements Review passed in Feb 2025)

RADPS Demonstrator

Packages: <https://github.com/casangi>

(Near) future of CASA

- CASA developer resources → transition to RADPS
- CASA sunset → move towards maintenance mode

Conclusions

1). Introduction CASA software and lifecycle

- Versatile data processing software for radio astronomy
- Stakeholders drive development cycle

2). Managing role of general users: users as stakeholder

- General users bring unique long-term development priorities
- Silent majority, input needs to be actively acquired
- CASA: external DMS Panel Users Committee → highly successful

3). Managing user expectation: support & feedback

- Support \leftrightarrow FTE investment, to avoid distracting development
- Manage user expectations accordingly
- CASA: casa-feedback@nrao.edu → best-effort direct line to CASA team

4). Future of CASA

- RADPS (processing needs ngVLA and ALMA WSU)
- CASA: developer resources → RADPS
- CASA: move towards maintenance mode

CASA Resources

CASA documentation

- CASA Website
<https://casa.nrao.edu>
- CASA Docs (“*how the code works*”)
<https://casadocs.readthedocs.io>
- CASA Guides (“*how to work the code*”)
→ tutorials by instrument teams
https://casaguides.nrao.edu/index.php/Main_Page
- CASA Reference paper
(CASA Team et al. 2022, PASP, 134, 114501)
<https://iopscience.iop.org/article/10.1088/1538-3873/ac9642>

CASA Code

- Github
<https://github.com/casangi>
- Bitbucket
<https://open-bitbucket.nrao.edu/projects/CASA/repos/casa6/browse>

Contact CASA Team

- casa-feedback@nrao.edu

DPUC

(DMS Panel of the Users Committee)

- Public wiki with contact info
<https://safe.nrao.edu/wiki/bin/view/Software/CASA/CASAUUsersCommittee>
 - Jane Huang (NA - outgoing chair)
 - Abhijeet Borkar (EU - incoming chair)
 - Adam Leroy (NA) - Ruta Kale (IN)
 - Olga Bayandina (SA) - Jongho Park (EA)
 - Kristina Nyland (NA) - Toshiki Saito (EA)
 - Kuo-Song Wang (NA) - Alex Akins (NA)