Current Status of Single-Dish Data Analysis Software for ALMA

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Outline

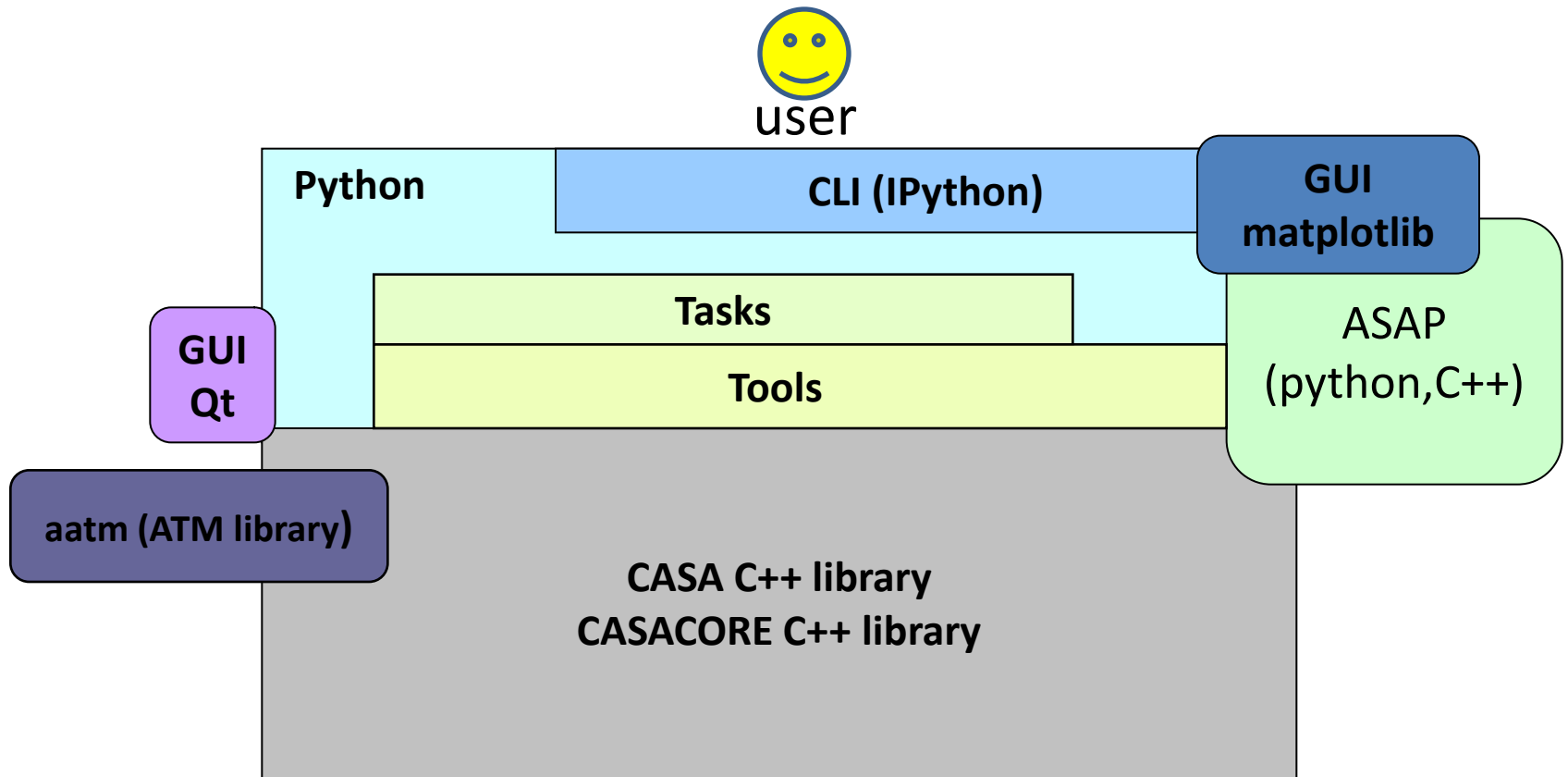■ Overview of Whole Software System

■ Single-Dish Data Reduction Parts

  ✓ Organization

  ✓ Software Configurations and Features

  ✓ Examples

  ✓ New Features of Next Release

■ Summary

CASA

(**C**ommon **A**stronomical **S**oftware **A**pplications)

■ Software for radio astronomical data reduction and analysis

- ✓ For the next generation telescope such as ALMA
- ✓ Interferometric and single-dish data
- ✓ Interactive data reduction
- ✓ Pipeline reduction using Python script

■ Configuration

- ✓ CASA and CASACORE C++ libraries and Python interface
- ✓ CLI (IPython) and GUI (Qt, matplotlib)
- ✓ Software for single-dish data (ASAP)

Architectural View of CASA

user

Python	CLI (IPython)	GUI matplotlib

Tasks

Tools

GUI Qt

ASAP (python,C++)

aatm (ATM library)

CASA C++ library
CASACORE C++ library

✓Tools are direct interface to C++ Classes
✓Tasks are more user friendly commands

Single-Dish Software Development

- **Development**
  - ✓ Based on ASAP but independent (CASA ASAP is an extension of original ASAP)
  - ✓ We have own subversion repository for development
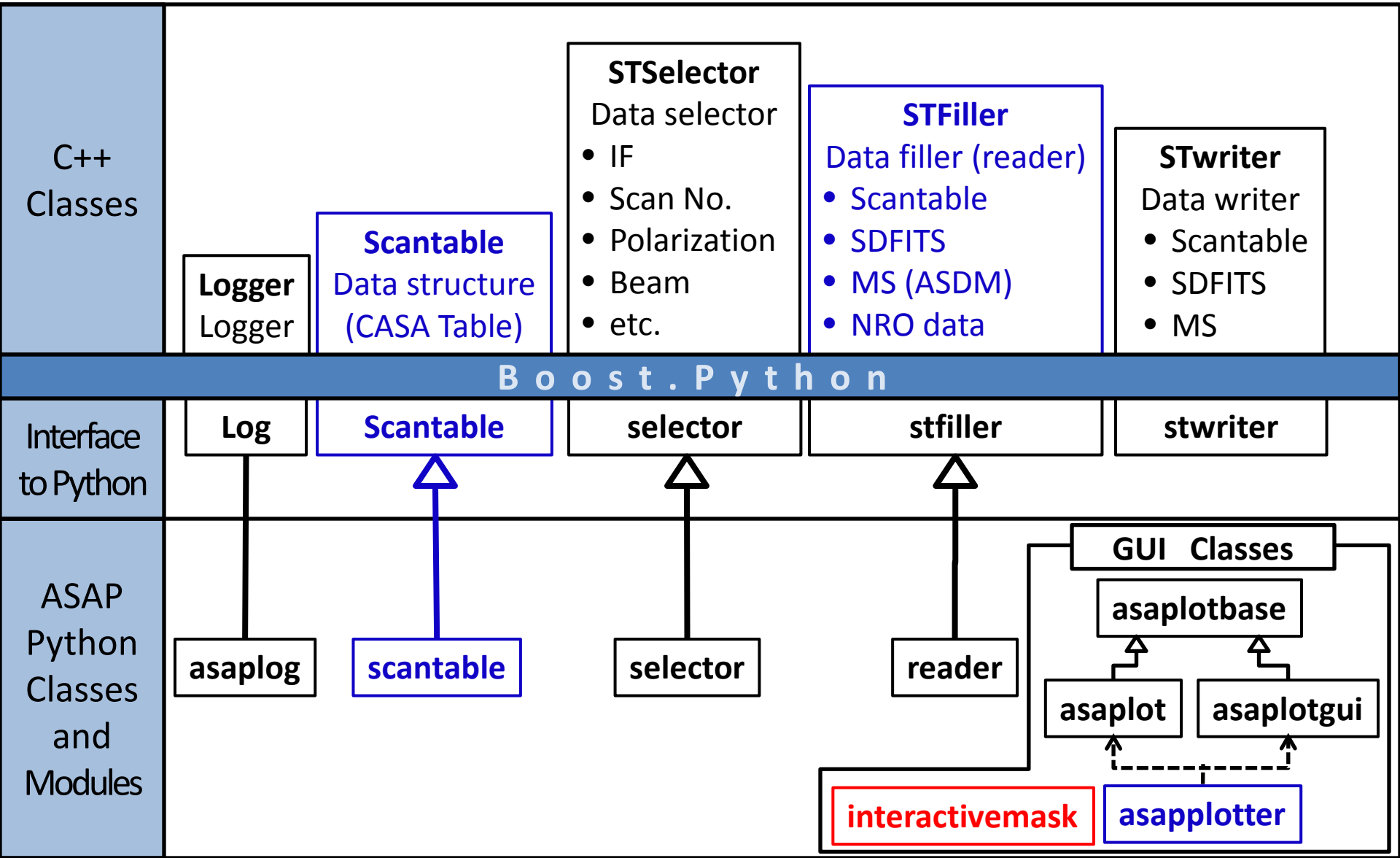- **Member**
  - ✓ Management: George Kosugi, Nick Elias (entire CASA)
  - ✓ Support: Takahiro Tsutsumi
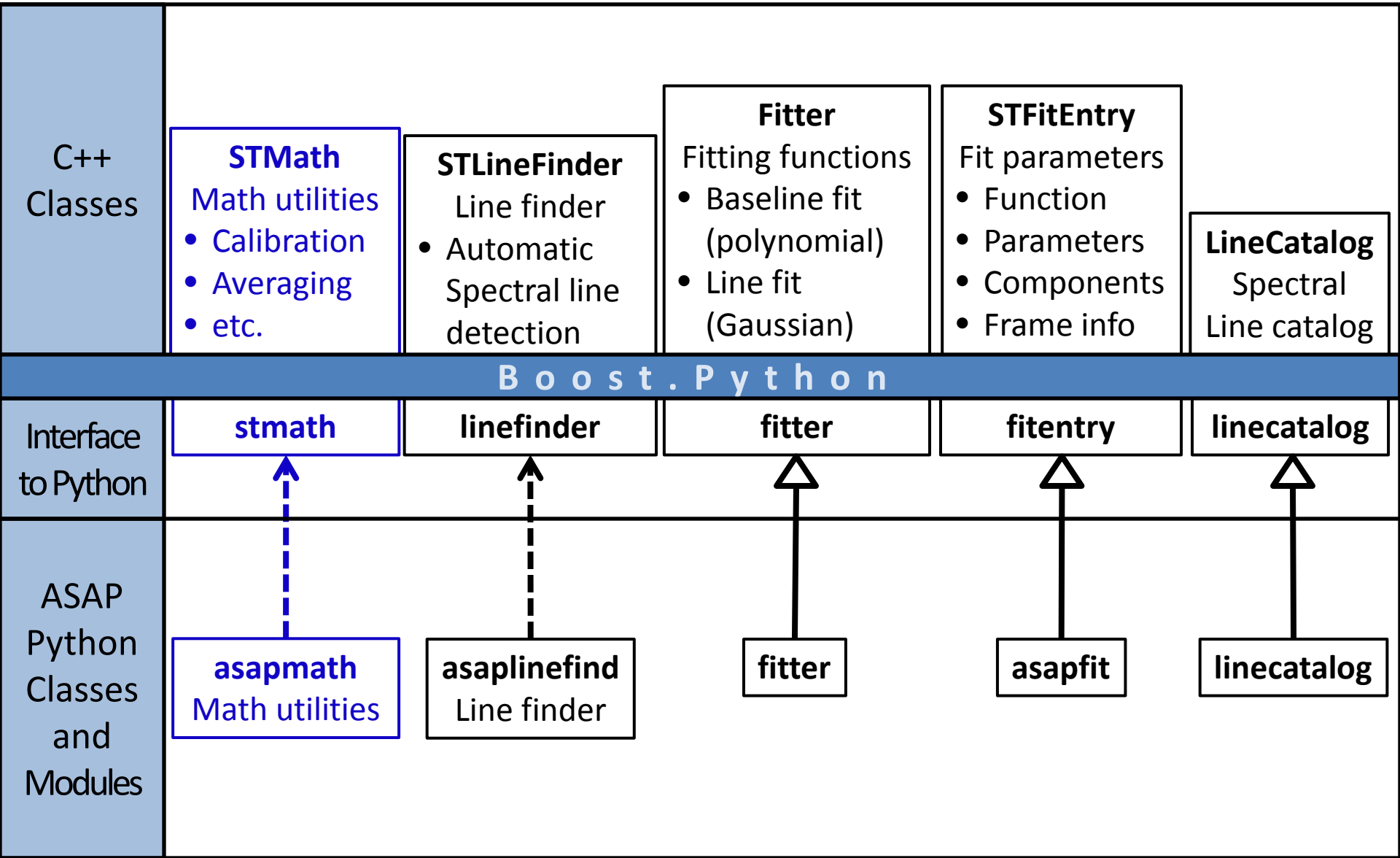 - ✓ Development: Kanako Sugimoto, Wataru Kawasaki, Takeshi Nakazato

Single-Dish Data Reduction and Analysis

■ **ASAP** (**A**TNF **S**pectral **A**nalysis **P**ackage)
  - ✓ Software for single-dish data reduction and analysis
  - ✓ ASAP is imported as 'sd' tool (tool for single-dish data reduction) from CASA
  - ✓ ASAP depends on both CASA and CASACORE C++ libraries

■ **Single-dish tasks** (SD tasks)
  - ✓ Defined as part of CASA tasks (not included in ASAP)
  - ✓ SD tasks are constructed using sd tool (ASAP)
  - ✓ SD tasks are defined for each data reduction stage

Software Configuration of ASAP

C++ Classes

Logger
Logger

Scantable
Data structure
(CASA Table)

STSelector
Data selector
- IF
- Scan No.
- Polarization
- Beam
- etc.

STFiller
Data filler (reader)
- Scantable
- SDFITS
- MS (ASDM)
- NRO data

STwriter
Data writer
- Scantable
- SDFITS
- MS

Boost.Python

Interface to Python

Log | **Scantable** | **selector** | **stfiller** | **stwriter**

ASAP Python Classes and Modules

asaplog | **scantable** | **selector** | **reader**

GUI Classes

asaplotbase

asaplot | **asaplotgui**

interactivemask | **asapplotter**

Software Configuration of ASAP

C++ Classes	STMath Math utilities • Calibration • Averaging • etc.	STLineFinder Line finder • Automatic Spectral line detection	Fitter Fitting functions • Baseline fit (polynomial) • Line fit (Gaussian)	STFitEntry Fit parameters • Function • Parameters • Components • Frame info	LineCatalog Spectral Line catalog

Boost.Python

Interface to Python	stmath	linefinder	fitter	fitentry	linecatalog

ASAP Python Classes and Modules	asapmath Math utilities	asaplinefind Line finder	fitter	asapfit	linecatalog

Single-Dish Tasks

| Procedure	Task Name		Remarks
Data Flagging	sdflag		channel based flag only
Intensity Calibration	sdaverage	sdcal	GBT data only
Averaging			
Smoothing	sdsmooth		
Baseline Fitting	sdbaseline		**interactive mask**
Line Fitting	sdfit		
Imaging	sdtpimaging		total power data only
Statistics	sdstat		

Example: Interactive Baseline Fitting
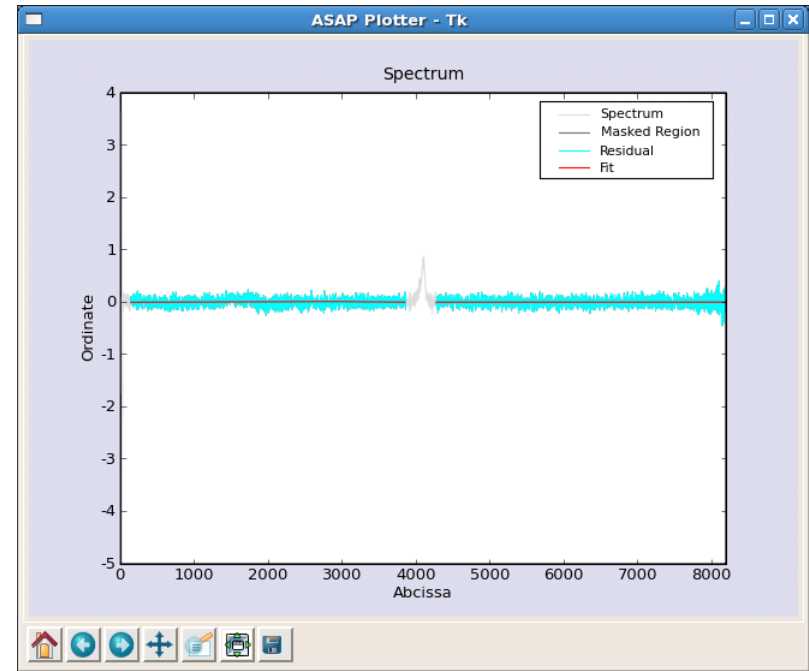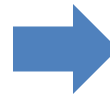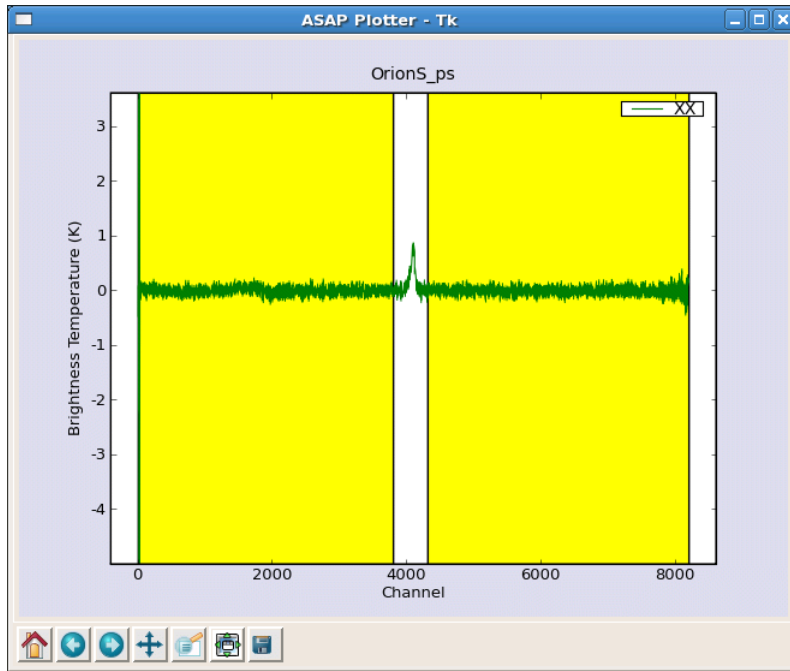
The user can select a region that is used for baseline fitting interactively

Fitting is performed except for masked region

Example: Total Power Imaging
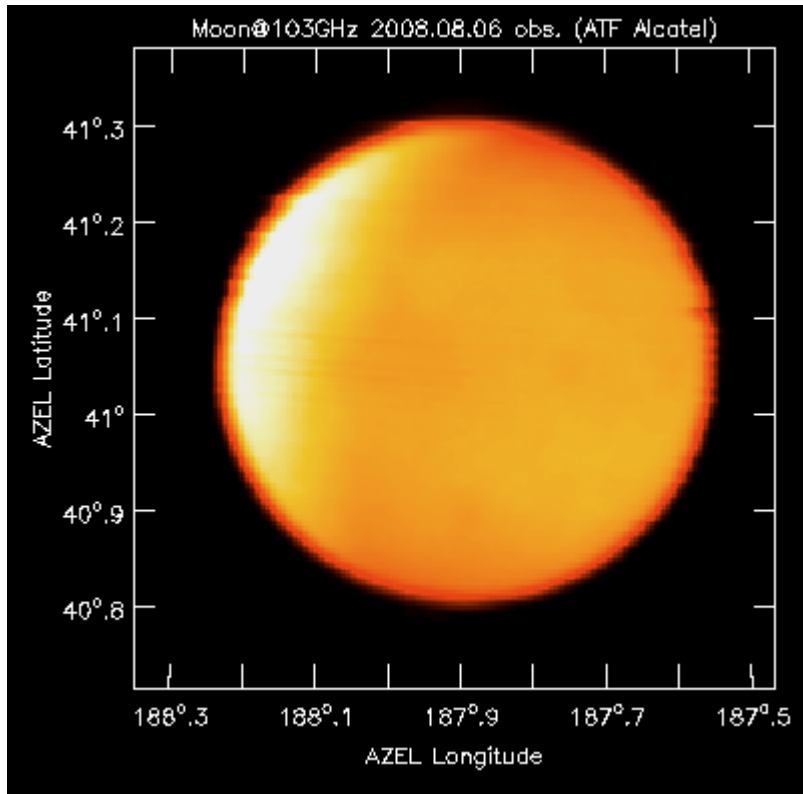
Raster scan image of the
Moon @103GHz (ATF data)
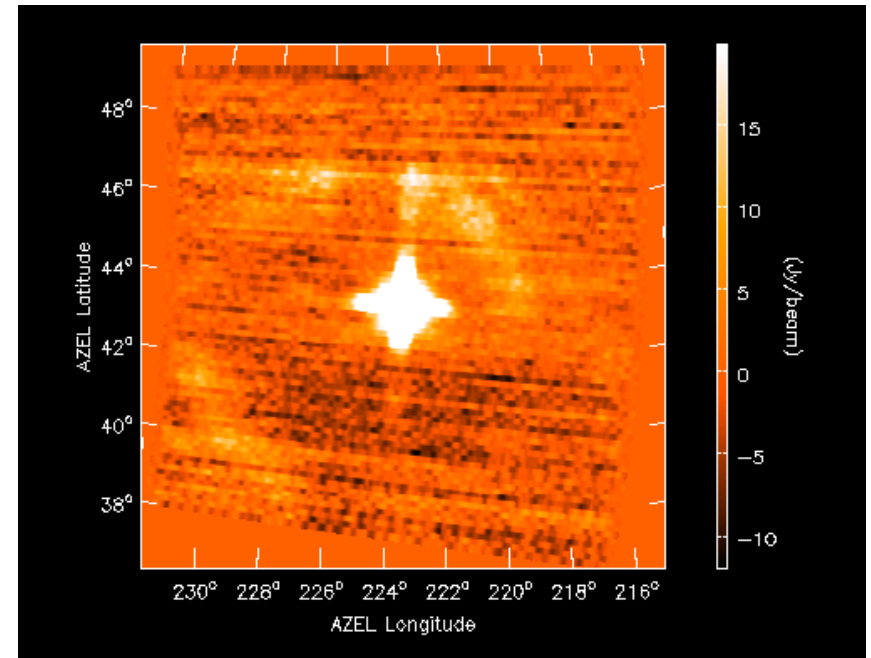
Measurement of sidelobe
(raster scan of the Sun)

3.0 Release (Dec. 2009)
First Public Release

- ■ Improved calibration capability
  - ✓ Intensity calibration (Chopper-Wheel, APEX, ALMA)
  - ✓ Support On-The-Fly observation data
- ■ Imaging task for spectral line data (sdimaging)
- ■ More flexible data flagging
- ■ GUI processing
  - ✓ Interactive masking for line fitting and line statistics
  - ✓ GUI based task processing
- ■ Task to remove scanning effect
  - ✓ "Pressed-Out" method (Sofe & Reich 1979)
  - ✓ "Basket-Weaving" (Emerson & Gräve 1988)

Summary

- We have described a current status of single-dish analysis capability of CASA
  - ✓ The development is continuing based on ASAP
  - ✓ Basic data reduction tasks are available
  - ✓ There are several issues and limitations that should be improved or fixed
  - ✓ We are now working toward the next release that is scheduled at the end of 2009