Users Expectations from the ALMA Software

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- ALMA Software: the users view
- Current status and goals
  - Observation Preparation
  - Science Pipeline
  - Data Reduction Package
- What the users are (or should be) expecting for Early Science

The "Camera" Goal

- ALMA delivers **images**
- The astronomer specifies the **science requirements**:
  - **angular resolution**
  - **field of view**
  - Image fidelity required
  - Spectral configuration and calibration precision
- The observing preparation tools derive the observation **Stringency**
- **Stringency concept**: (inverse of the) Fraction of time in which the observing conditions are better than required to perform the project.
- Full service observing with dynamic scheduling
- The ALMA imaging pipeline ensures optimal (within current knowledge) data processing to produce the image

The "Camera" Goal

Remaining difficulties for Astronomers

- Proper definition of the science requirements
  - Compromise Sensitivity / Angular Resolution
  - The spectral correlator configuration definition (the correlator is very flexible...)
  - a minimum understanding interferometry may still be important.
- High fidelity or very wide field images may require post-processing.
- Full polarization imaging may require post-processing
- Special observations (e.g. moving targets, ...)
- ...

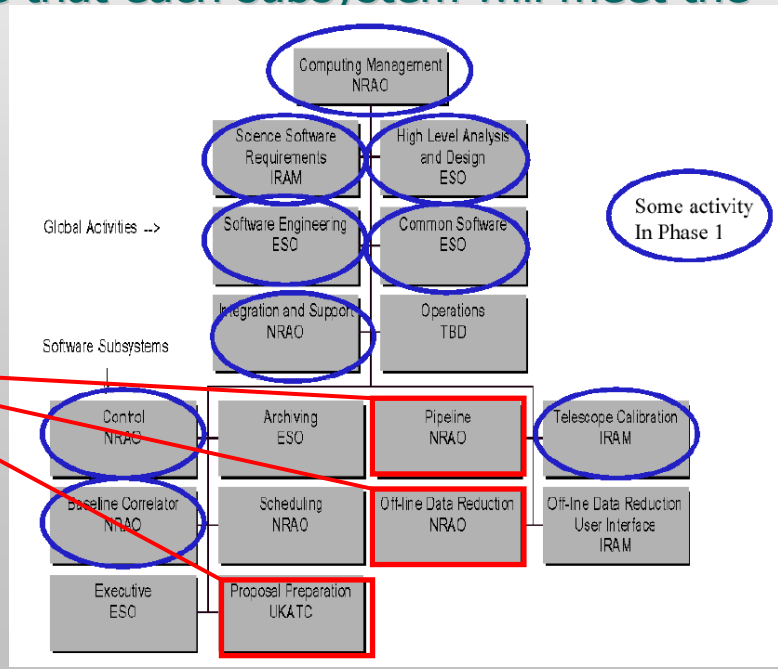
The ALMA software system

- Developed by the Computing IPT (B. Glendenning & G. Raffi)
- Designed to meet a set of Science Requirements prepared by the Science Software Requirements Commettee (R. Lucas)
- Subsystems Scientists (SSR members) are responsible for supporting the developers teams and ensure that each subsystem will meet the scientific requirements.

Observation Preparation
(Leonardo Testi)

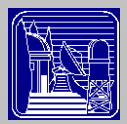
Offline Data Reduction
(Debra Shepherd)

(Science) Pipeline
(Christine Wilson)

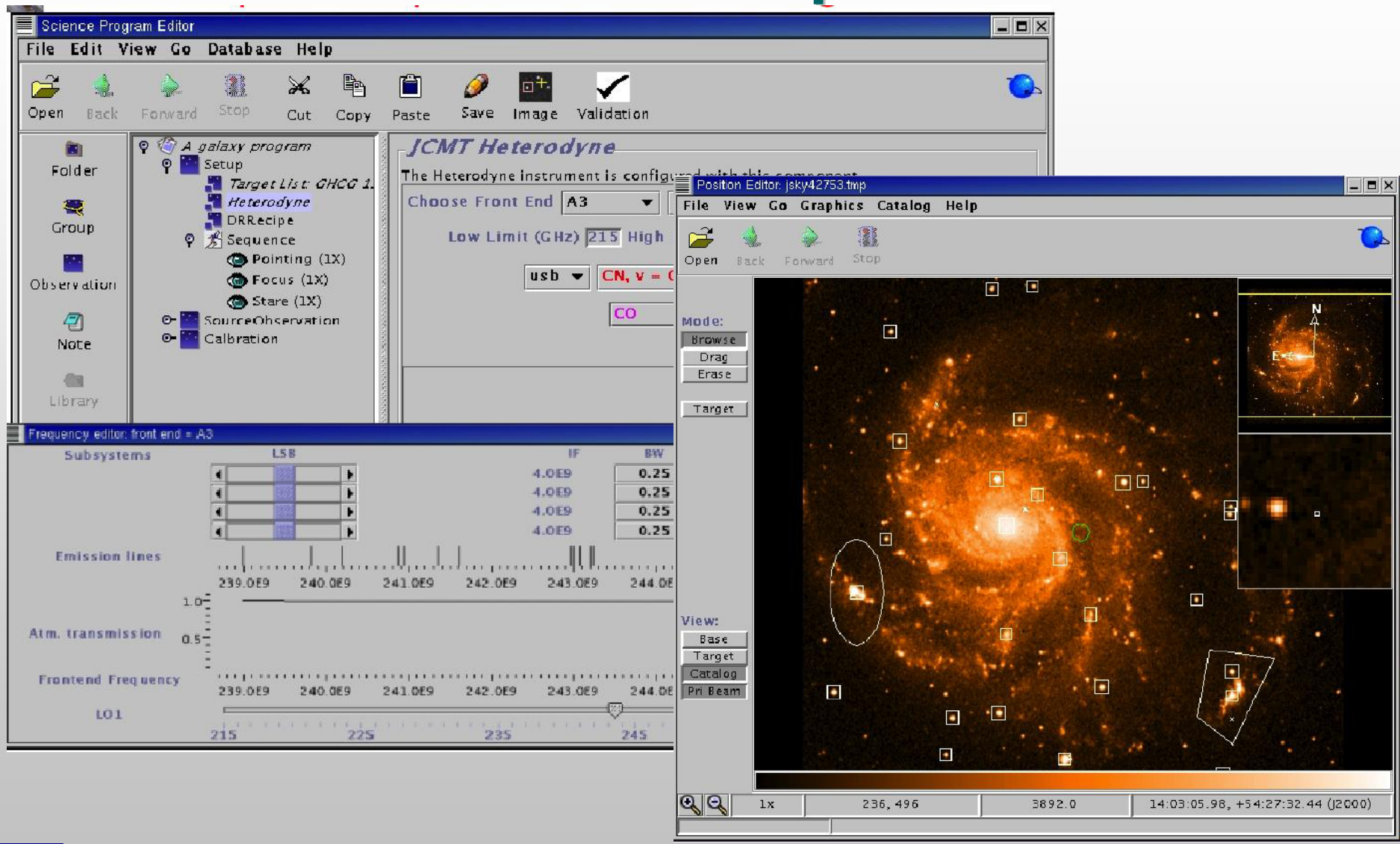


Observation Preparation

- Handles all user interaction with ALMA up to the execution of the observations
  - Phase I (proposal preparation and submission)
  - Phase II (observing programme preparation)
  - Interactive observing
- Concept based on existing tools (Gemini, JCMT, …)
- Supports an "Expert" mode for observatory staff and a "Novice" to "Experienced" user mode for external users

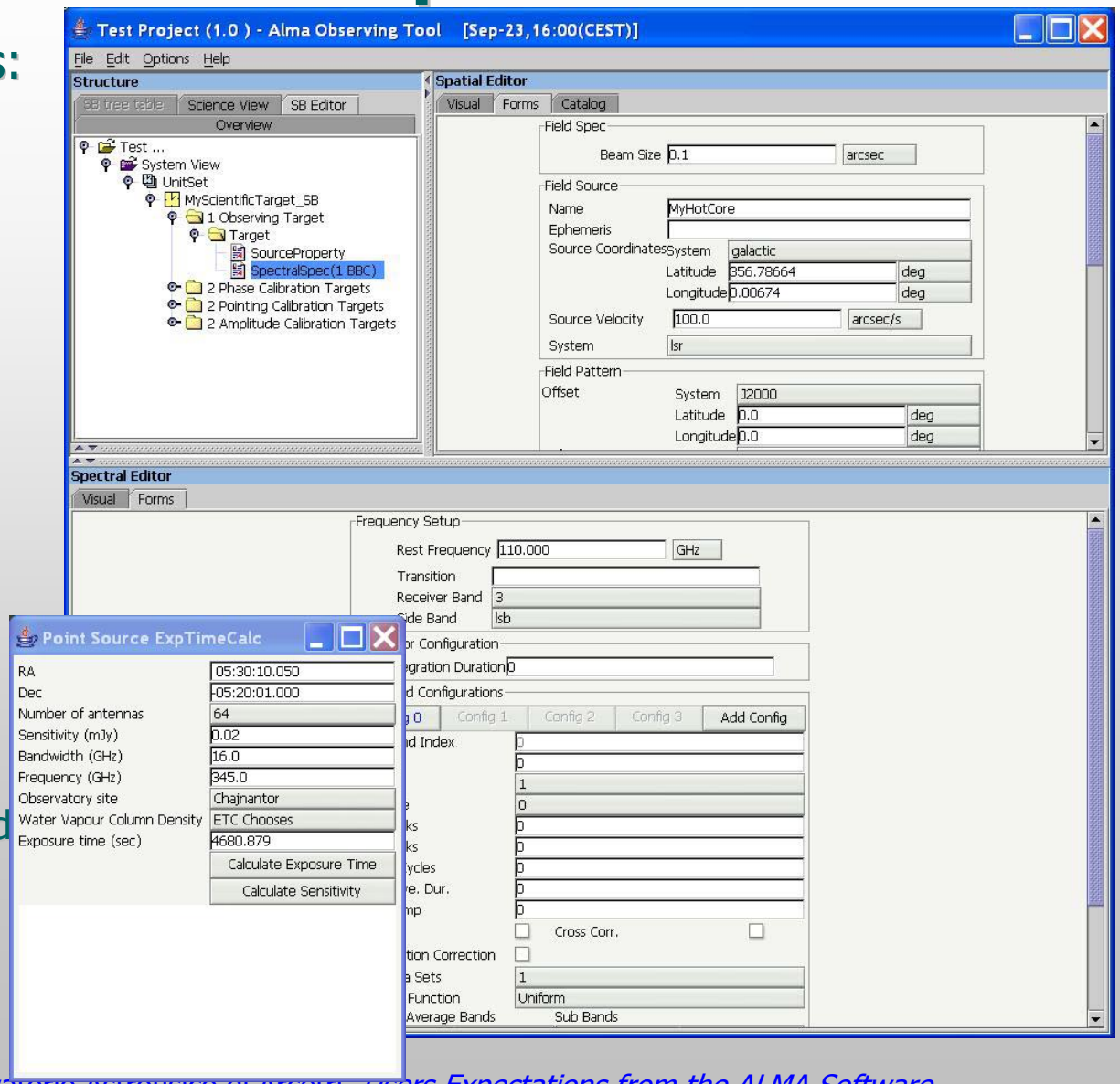


Observation Preparation



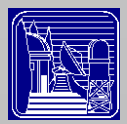
Observation Preparation

- ALMA-OT Current status:
  - Phase II Expert mode developed for Integration/Testing and ATF support
  - Point source sensitivity calculator developed
- Full ALMA simulator being developed within the Offline Data Reduction Package
- Test plan
  - External user tests started (Jan 2004);
  - next test Nov 2004;
  - ATF testing 1-2Q2005



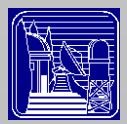
Offline Data Reduction Package

- The ALMA Offline DRP will be based on AIPS++
- A dedicated set of science requirements have been developed for the DRP by the SSR
- At the time of the previous European Community Day (Nov 2002) AIPS++ was undergoing a deep scrutiny by ALMA to verify its useability
  - Requirements Audit (based on available AIPS++ documentation)
  - A so called "IRAMTEST"
    - Phase 1: Implement PdBI calibration routines in AIPS++
    - Phase 2: Use of AIPS++ to reduce PdBI data by experienced mm astronomers
    - Phase 3: Accurate absolute and comparative benchmarking



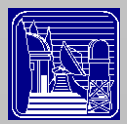
Offline Data Reduction Package

- Audit and all phases of IRAMTEST were completed between the end of 2002 and spring 2003
- IRAMTEST results:
  - Phase 1: Partly succesful; it was possible to complete the implementation of routines but it took more time than expected
  - Phase 2: Essentially failed
    - The user interface was found totally inadequate and the software too difficult to use
    - The software was not stable against user mistakes
    - The software failed on requirements that were found to be acceptable in the documentation based a
  - Phase 3: The package was found to be on average a factor of 4 slower than GILDAS (and AIPS/MIRIAD)

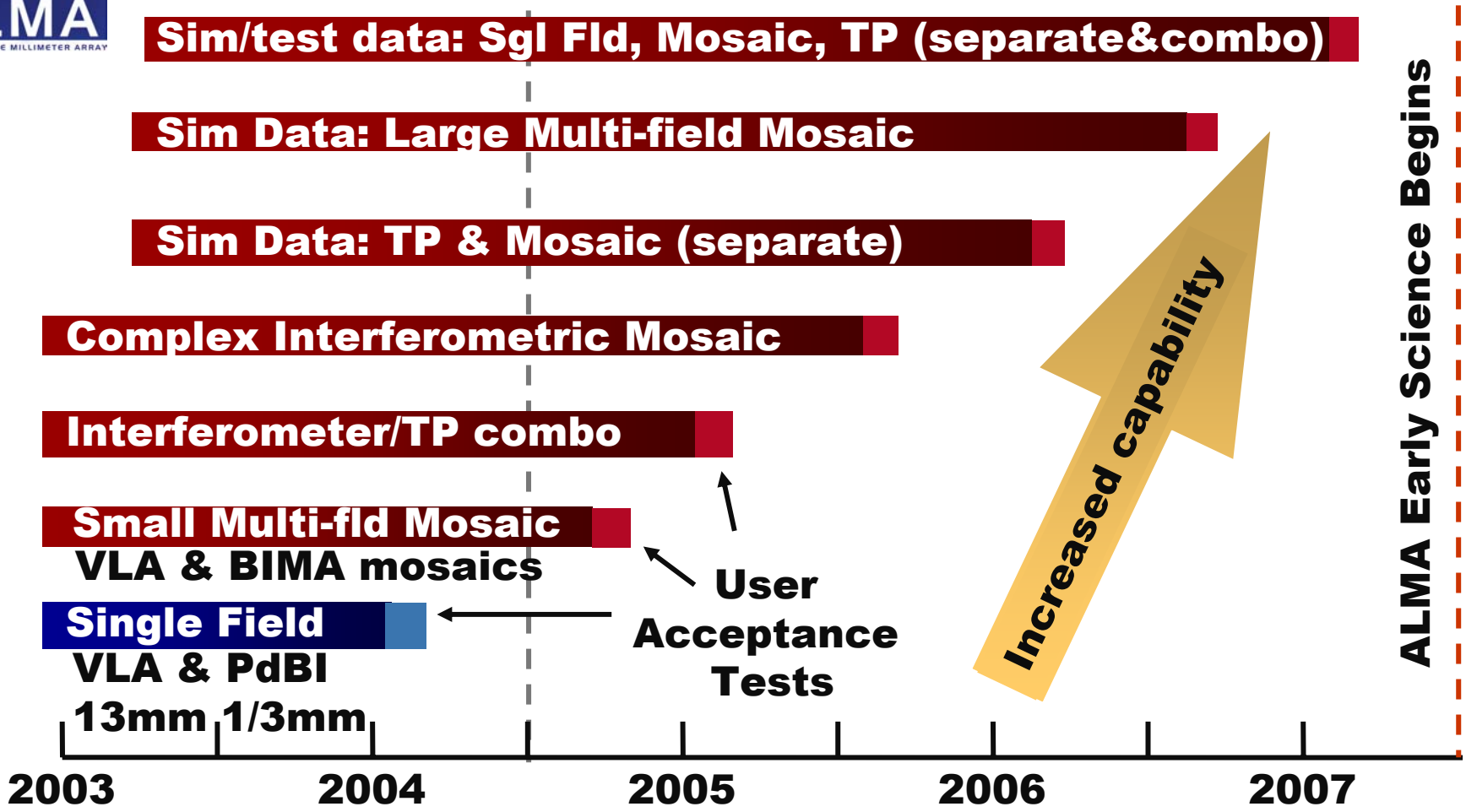


Offline Data Reduction Package

- The ALMA project (and NRAO) took an aggressive attitude to attack and solve the AIPS++ problems
- A series of Technical reviews have been performed:
  - NRAO-AIPS++ Technical Review 1Q2003
  - ALMA PDR/CDR1&2 1Q2003, 2Q2003, 2Q2004
- The software is now project driven (to fit ALMA/VLA needs) and it is no more offered as a general package
- An Internal and External User Test Plan has been implemented
- Periodic benchmarking on every subsystem of the package is being performed
- Transition from the old Glish to ACS/Python. Redesign of the (Graphical) User Interface



Offline Science Software Development & Test Schedule



Requirements Audit:

- 106 requirements graded:
  - 57% A: Adequate (all necessary functionality available)
  - 27% A/E (some enhancement would be nice)
  - 12% Inadequate (function not possible or severely limiting).

  None of the requirements graded I prevented processing of any dataset
- Comparison of the first ALMA Offline Subsystem Audit (based mostly on documentation, limited testing of *VLA data only*). Percentage of requirements with A and A/E grades increased from 72% to 84% during TST2.

Grade	First Audit Results	TST1 Audit Results
A	66%	57%
A/E	6%	27%
I	26%	12%
U	2%	4%

Offline Subsystem Performance Requirements
AIPS++ & Gildas Comparison

PdBI GG Tau at 1 & 3mm spectral line, extended to 64 ants via simulation

(All timings in seconds				AIPS++ v1.9	AIPS++ v1.9	AIPS++ v1.9	AIPS++ v1.9	AIPS++ v1.9	AIPS++ v1.9	AIPS++ v1.9	A/G
of wallclock time.)	Gildas/CLIC	Gildas/CLIC	Gildas/CLIC	Build #67	Build #75	Build #75	Build #187	Build #275	Build #355	Build #549	(#549 vs
Task \ Date	20/08/03	25/08/03	27/08/03	25/08/03	27/08/03	10/09/03	23/10/03	10/02/04	30/01/04	22/04/04	27/08/03)
Filler	743	597	628	3942	3954	3880	4037	3214	4616	3254	5.2
Init (write hdr info)	319	201	212								-
Fill model/corr data cols				1527	1714	1645	1732	1521	1520	1592	-
PhCor (Check Ph-corr data)	440	327	343	1145	1087	1104	1101	746	735	727	2.1
RF (Bandpass cal)	2943	2787	2313	1333	1356	1353	1346	1323	502	480	0.2
Phase (Phase cal)	1294	1275	1450	677	819	806	797	923	983	920	0.6
Flux (Abs flux cal)	942	914	850	769	946	927	938	748	756	763	0.9
Amp (Amplitude cal)	933	917	955	262	297	299	311	303	317	313	0.3
Table (Split out calib src data)	607	442	480	1927	2105	2080	726	786	791	778	1.6
Image	124	126	125	287	274	272	223	215	231	215	1.7
Total	8345	7586	7356	11869	12552	12366	11211	9779	10451	9042	1.2
A/G (AIPS++/Gildas)				1.6	1.7	1.7	1.5	1.3	1.4	1.2	
Notes	RH8	RH8	RH8	RH8	RH8	RH8	RH8	RH9	RH9,RPM	RH9,RPM	

* Phase III AIPS++/Gildas comparison with same data: A2/G = 4 (Mar 2003)

Offline Subsystem Performance Requirements
AIPS++, AIPS & Miriad Comparison

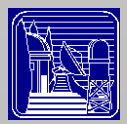
VLA gravitational lens in polarized cm continuum, self-cal, time extended via simulation

(Timings are in seconds	Miriad	Miriad	AIPS	AIPS	AIPS++ v1.9	AIPS++ v1.9	AIPS++ v1.9	AIPS++ v1.9	A2/A	A2/M
of wallclock time)	V 3.1.0	V 3.1.1	31DEC03	32DEC03	Build #187	Build #275	Build #355	Build #549	(#549 vs	(#549 vs
Task \ Date	20/11/03	12/02/04	19/02/04	08/03/04	20/11/03	11/02/04	12/02/04	22/04/04	08/03/04)	12/02/04)
Filling from UVFITS		16		7	15.76	15.79	18.88	15.16	2.2	0.9
SetJy		0	2	8	0.29	0.28	0.38	0.33	0.0	-
Phase & Amplitude Cal		1	8	7	23.52	25.37	30.77	6.50	0.9	6.5
D-calibration		0	5	5	29.49	29.32	34.39	18.13	3.6	-
Image 1		23	34	34	43.88	41.18	43.8	45.22	1.3	2.0
Selfcal		3	47	11	101.79	102.96	123.04	34.26	3.1	11.4
Image 2		13	316	38	39.79	36.81	39.82	33.61	0.9	2.6
Listed Task Total		56	412	110	254.52	251.69	291.08	153.21	1.4	2.7
Total Running Time	56	56	425	120	266.13	261.52	302.58	163.18	1.4	2.9
A2/A (AIPS++/AIPS)					2.2	2.2	2.5	1.4		
A2/M (AIPS++/Miriad)					4.8	4.7	5.4	2.9		
Notes	RH8	RH9	RH9 (AIPS compiled with RH8)	RH9	RH8	RH9	RH9,RPM	RH9,RPM		

* AIPS++/AIPS comparison with same data: A2/A ~ 4 (Aug 2003)

(Science) Pipeline

- Based on AIPS++ routines called by the pipeline infrastructure
- Heuristics being developed in Europe
- First User Tests (1Q2004) succesful: the pipeline automatically calibrated and imaged the same datasets used for the AIPS++ tests
- Pipeline heuristics will require a "learning" period with real ALMA data hence data processed through the science pipeline will not be offered to the general users in the early days of ALMA



Pipeline User Test 1 Results

(http://www.aoc.nrao.edu/~dshepher/alma/testreports/Pipeline.TestReport1.txt)

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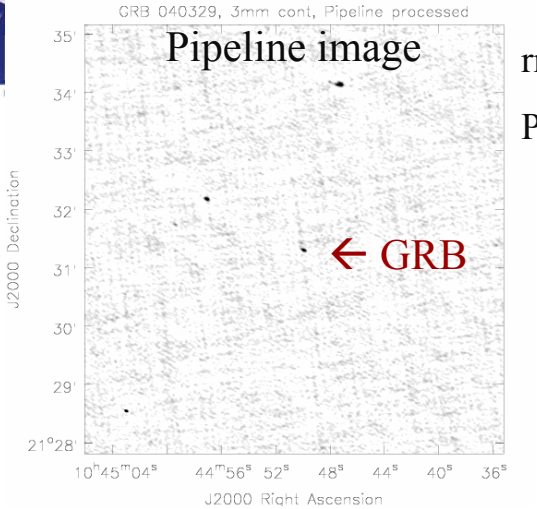
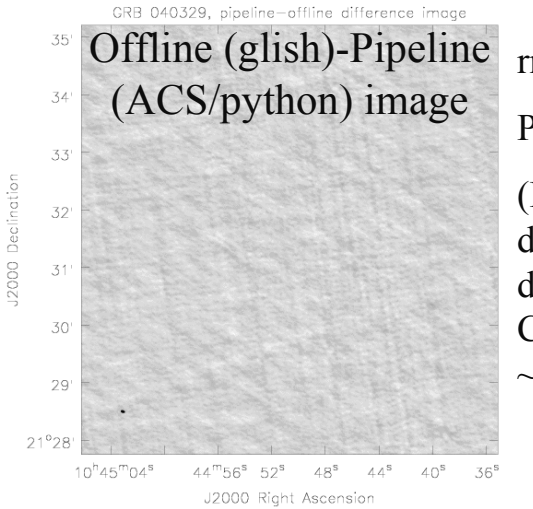


rms=0.0025mJy/bm

Peak=0.49mJy/bm

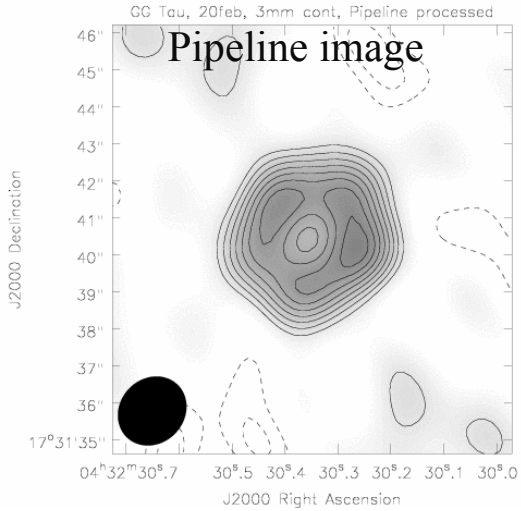


rms=7.8e-4mJy/bm

Peak=7.5e-3mJy/bm

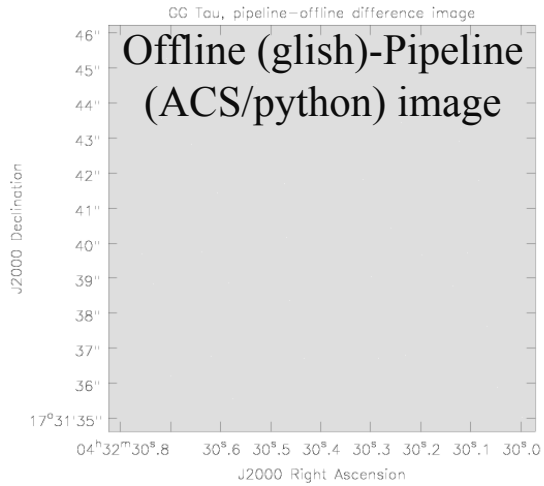
(Less than 1% difference, slight divergence after CLEAN iteration ~800)

GG Tau, 3mm continuum



rms = 0.47mJy/bm

Peak = 7.2 mJy/bm



rms = 0.0mJy/bm

Identical images

Expectation for Early Science

- Observation Preparation
  - All modes offered to the users will be supported from the Novice to the Expert levels.
  - At the very beginning of Early Science, the Novice mode behaviour will be mostly based on expectation from simulation and initial testing rather than on a solid experience with ALMA
- Science Pipeline
  - Not available to the users for Early Science (it will be in the learnig phase)
- Offline Data Reduction Package
  - All modes offered will have been fully tested and supported
  - No Graphical User Interface will be available for Early science
  - A solid well tested User Interface and scripting language based on Python will be available