

# Calibration PDR Summary

*R. Lucas*

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# Meeting purpose

- ASAC suggested 1% calibration specification for absolute intensity.
- What can ALMA be expected to achieve?
- Should this differ among frequency bands? Submillimeter?
- The meeting did not include:
  - polarization
  - single dish
- Final report not yet available

# Background

- **Optics design** (M.Carter):
  - ambient + semi transparent vanes for bands 1-6 (7-10 ambient only).
  - pattern of foam loads moved in one plane with properly placed windows. Testing should be organized.
  - potential problems with standing waves; temperature of loads difficult to control
- **Site report** (S. Radford).
- **Atmospheric modelling** (J. Pardo): ATM Model up to 10 THz.
  - excess compared to FTS spectra
  - pseudo continuum due to water
  - cirrus in high submm windows
  - one needs at least 1 measurement above 183GHz.
  - current FTS system about 20 mins for 1 measurement.

# Amplitude Calibration

- Memo 372 (Guilloteau and Moreno)
  - 1% appears feasible at 3mm but 3% at submm is more reasonable (integration times for relative amplitude calibration).
  - absolute ('ab initio', i.e. using known antenna gains) method may reach 3% accuracy at submm.
  - suggests specification of standing waves at  $\sim 2\%$  in power
  - maintain an antenna model using holography measurements
  - non heterodyne mixing in receivers (Woody) could be a problem
  - two temperature scale calibration schemes: dual load in secondary and semi-transparent and ambient vanes.
  - large-scale bandpass calibration and especially sideband gain ratio measurement, needs the longest integration times (up to 7min using the strongest quasars at submm freq.)

# Amplitude Calibration

- **calibration of antenna gain** (J. Welch)
  - relative to a small but calculatable standard horn. Test at Hat Creek at low freq. on Jupiter.
  - Calibrate one of the antennas and then the fluxes of standard sources for the next observing period.
- **beam shape calibration** (M. Holdaway) unpublished memo. Need of service calibration observations to get 2d beam models as a function of elevation and frequency, for calibration in image plane (beam shape errors tie calibration to the imaging). Strong implication for reduction software.
- **optical pointing** Welch discussed the possibility of optical guiding.
- **vlbi** Mel Wright

# Phase Calibration

- **183 GHz WVR** reviewed by R. Hills  
goal 10  $\mu\text{m}$  needs 0.1K sensitivity at 183GHz. unknown temperature profile, dry component contribution, ... could limit precision on 1km baseline.
- **photonic** source calibration (Vaccari) would primarily be used for polarization. Standing waves may affect the result for bandpass measurements.
- **fast switching** revisited by Mark Holdaway for ALMA antennas. Tradeoffs between fast switching and WVR to be studied.
- **isoplanetic angle measurements** proposed by D. Woody using a WVR receiver and a scanning mirror.
- **450 GHz continuum sounding** proposed by Matsuo.
- **simulations** of phase correction (Pardo, Viallefond) being developed.
- **22 GHz WVR's** being tested at OVRO, BIMA, and prepared at IRAM, ATCA. BIMA system seems limited to improving phase by  $\sim 40\%$ . OVRO system more effective at following slow variations.
- **183 GHz** at JCMT already close to ALMA specs.

# Other atmospheric measurements

- **IRMA** (Avery, Gom): use infrared emission at  $20\mu\text{m}$ . Very sensitive, but difficult to match the beam to the mm or summm beam.  
Plan to deploy 2 systems to the site in 2002.
- **temperature sounder** at 60 GHz proposed by Welch: commercial systems exist.
- **all-sky monitor** presented by Matsuo. Operated at  $10\mu\text{m}$ .
- **wide-band, fast scan FTS** presented by Matsuo (3 GHz, 10 deg beam).

# ALMA and ACA calibration

- calibrating the ACA at high frequencies requires longer integration times than for ALMA (assumes 4 12m antennas are borrowed for ACA). Integration times as high as 30 min for amplitude calibration.

	ALMA 1% < 350GHz	ALMA 3% > 350GHz	ACA 1% < 350GHz	ACA 3% > 350GHz
Sideband	4 s	5 min	60 s	7 min
1MHz bandpass	1 min	10 s	16 min	2 min
Point	< 5 s	< 5 s	20 s - 2.5 min	20 s - 2.5 min
Focus	< 5 s	< 5 s	< 27 s	< 27 s
Amplitude	6 s	1 min	50 s - 5 min	30 min
Phase	< 2 s	< 2 s	fast	fast

# Software implications

- Need to include atmospheric modelling in pipeline(s)
- How is the dual-load scheme in subref handled?
- Radio pointing: may be use 'local pointing model' rather than simple reference pointing
- nothing really unexpected for ALMA
- ACA may cause problems, need to wait for availability of strong source for some calibrations, or schedule the observing in consequence
- single dish and polarization not covered
- no detailed phase calibration plan yet
- keep in close contact with calibration group and receiver group