



**Atacama  
Large  
Millimeter  
Array**

# ALMA Atmospheric Temperature Profiler Detailed Specifications

ALMA-90.03.00.00-007-A-SPE

2006-08-29

*Specification Document*

Jeff Mangum



# ALMA Atmospheric Temperature Profiler Detailed Specifications

Doc#: ALMA-90.03.00.00-007-A-SPE  
Date: 2006-08-29  
Status: Draft  
Page 2

## *Change Record*

Revision	Date	Author	Section/ Page affected	Remarks
1	2006-08-29	Jeff Mangum	All	Initial Draft

\$Id: AncillaryCalInst.tex,v 1.1 2006/08/29 19:04:19 jmangum Exp jmangum \$

## Contents

<b>1 Purpose</b>	<b>3</b>
<b>2 Temperature Profiler</b>	<b>3</b>
<b>3 Potential Vendors</b>	<b>3</b>



## 1 Purpose

The purpose of this document is to list the detailed description and potential vendors of the ALMA atmospheric temperature profiler (ATP). See [1] and [2] for a full description and justification.

## 2 Temperature Profiler

The purpose of this device is to measure the atmospheric temperature profile as a function of altitude. It is assumed that this will be done using a multi-channel radiometer operating at the wing of the  $O_2$  absorption band at  $\sim 60$  GHz. Semi-commercial systems exist but will probably require modification (*e.g.* different channel frequencies) to give optimum performance on the ALMA site.

One instrument that would be able to measure the temperature profile to the required accuracy is a seven-channel radiometer that measures emission from oxygen lines between 51-59 GHz. Typically these oxygen radiometers can measure temperature profiles with an RMS error of less  $< 1$  K up to 1 km above ground level, increasing to 1.5 K at 6 km. There is some uncertainty about the vertical resolution of such an instrument, and in particular it may not resolve higher level temperature inversions, which could increase the uncertainty in temperature to about 3 K at an inversion. The dominant water vapour fluctuations, however, are expected to be concentrated at lower levels where inversions are better represented. In this case, the instrument would allow us to reduce the uncertainty in path due to temperature to about 1%.

The detailed requirements for the atmospheric temperature profiler are:

- *Height Resolution*: 1 km from 5 to 8 km and 2 km from 8 to 12 km (altitude above sea level)
- *Precision*: 1 K and accuracy of 2 K from 5 km to 8 km and twice these figures from 8 to 12 km.
- *Time for Measurement*: 10 minutes<sup>1</sup>

## 3 Potential Vendors

---

<sup>1</sup>Numbers are based on estimates of accuracy that can be achieved on existing systems. Modeling is needed to find whether this performance is adequate.



## ALMA Atmospheric Temperature Profiler Detailed Specifications

Doc#: ALMA-90.03.00.00-007-A-SPE  
Date: 2006-08-29  
Status: Draft  
Page 4

## References

- [1] Richer & Mangum (2006), “Ancillary Calibration Instruments; Specifications and Requirements (SCID-90.05.13.00-001-A-SPE)”
- [2] Stirling, Hills, Richer, & Pardo (2004), “183 GHz Water Vapour Radiometers for ALMA: Estimation of Phase Errors Under Varying Atmospheric Conditions”