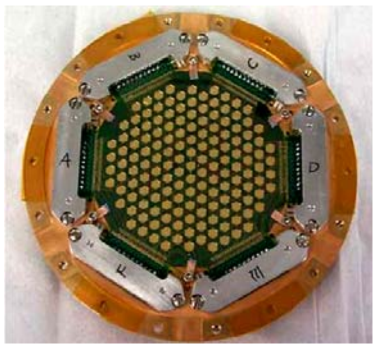
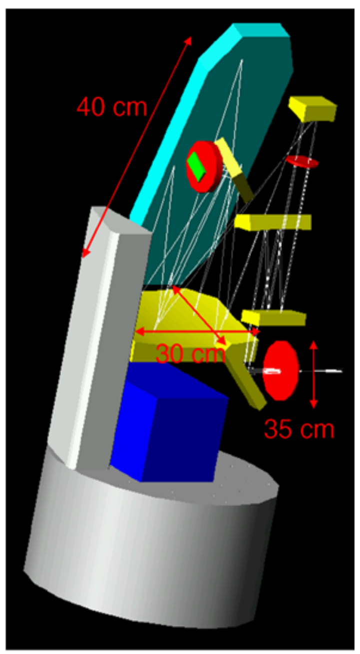
INSTRUMENTATION

The CCAT will provide a platform for state of the art instrumentation, including bolometer cameras, spectrometers, and heter-odyne receivers. These focal plane instruments will complement the capabilities of interferometer arrays, such as ALMA. Large format, large bandwidth, bolometer cameras offer unequalled sensitivity and mapping speed. Moderate resolution grating, Fabry-Perot, or Fourier transform spectometers provide rapid, wide bandwidth spectra with integral imaging in some cases. These direct detection instruments are not compatible with large scale interferometry, so require a large telescope for profitable deployment. High frequency heterodyne receiver arrays excel at detailed spectral mapping to study interstellar, for example, gas kinematics and astrochemistry. In all cases, advances in device fabrication and system integration promise instruments for CCAT with fields of view many times larger than existing instruments.

An example of a bolometer array with 144 pixels. CCAT will be capable of supporting much larger arrays and is designed to accommodate predicted growth in the size of arrays for the anticipated life of the telescope.





CCAT will utilize both wide field imagers and spectrometers. Shown is the ZEUS spectrometer, built by Cornell astronomers and very similar to concepts proposed for use with CCAT. JPL and Caltech also have plans and concepts for first light instruments which allow CCAT to reach its full potential very quickly after first light.

PERFORMANCE GOALS

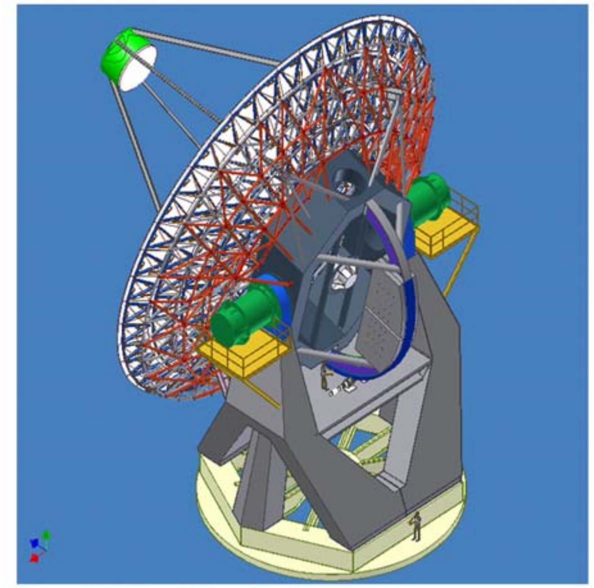
Aperture	25 M Diameter
Wavelength	200-1500 Microns
Field of View	20 Arc Minutes
Pointing	0.35 Arc Seconds
Surface	10 Microns (RMS)
Primary Focal Ratio	0.6
Naysmyth Focal Ratio	8.0
Site Altitude	>5000 Meters
Water Vapor (Median)	<1 Millimeter

PROJECT SCHEDULE

Feasibility Study	Jan 2005 to June 2006
Eng. Concept Design	June 2006 to June 2007
Subsystem Development	June 2007 to April 2010
Integration	April 2010 to Feb 2012
First Light	February 2012
Commissioning	Feb 2012 to Jan 2013

http://www.astro.cornell.edu/research/projects/atacama/

CORNELL CALTECH ATACAMA TELESCOPE (CCAT)

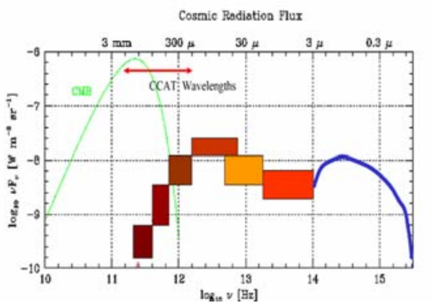


THE CCAT PROJECT

In 2004 February Cornell University and the California Institute of Technology signed an agreement that will lead to the construction and operation of a 25 meter class telescope for submillimeter astronomy at high altitude in the Andean highlands of the Atacama desert in northern Chile. Scheduled for completion at the beginning of the next decade, this Cornell Caltech Atacama Telescope (CCAT) will be the largest and most sensitive facility of its class as well as the highest altitude astronomical facility on Earth. The project is now in a concept feasibility phase, developing the technical specifications and studying possible technological approaches.

SCIENTIFIC OBJECTIVES

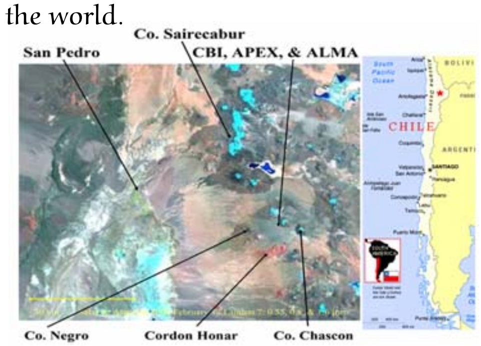
The scientific objectives of the CCAT are submillimeter wavelength studies of cosmic origins, from planets to the distant universe. The main areas of study include distortions in the cosmic background radiation; the formation, evolution, and structure of distant and nearby galaxies; the interstellar medium in the Galaxy, particularly in star formation regions; evolved stars and astrochemistry; circumstellar debris disks and planet formation; and Solar system bodies, particularly Kuiper belt objects. CCAT will ride the technological wave of development of large format bolometer arrays to provide rapid and efficient surveys.



Light in the Universe appears in three major features: the microwave cosmic background radiation, the direct optical radiation from stars and the far infrared and submillimeter radiation from dust cocoons surrounding sites of star formation in both nearby and distant galaxies. The CCAT will explore this important third spectral range.

THE SITE

The high mountains in the vicinity of San Pedro de Atacama in northern Chile, among the driest places on Earth. At the 5000 m ALMA Site, where the existing CBI and APEX telescopes are located, measurements of the atmospheric transparency at 225 GHz and 350 µm and of the water vapor content with 183 GHz radiometers demonstrate conditions are among the best known in the world.

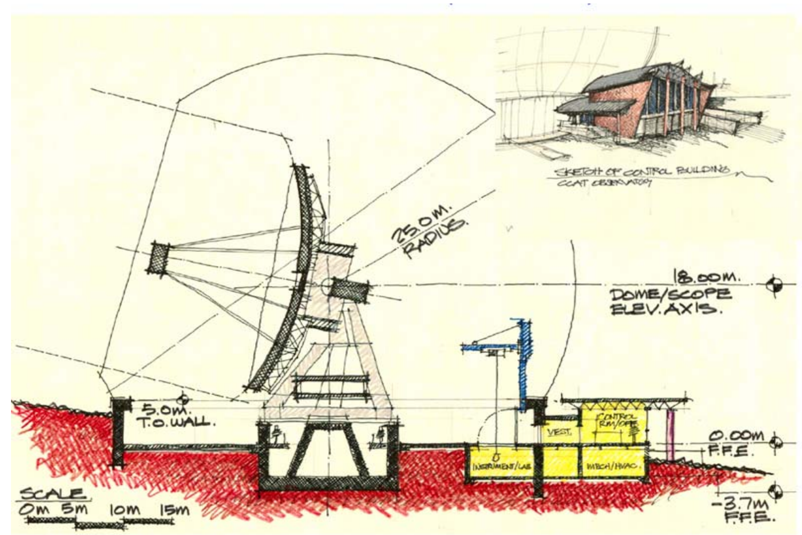


While the extreme altitude will require oxygen enrichment in the facility and make construction and integration challenging, the unique atmospheric transparency in the wavelengths that CDAT will work in makes it well worth the effort. At other locations on Earth, water in the atmosphere absorbs a major fraction of the radiation between 200 microns and 1 mm.

TELESCOPE CONCEPT (VERTEX RSI, DALLAS)

During the CCAT's scientific lifetime, bolometer arrays will become available that are many times larger than present instruments. To accommodate these large format cameras, the Ritchey-Chrétien optical design is optimized for a wide field of view. The telescope has an azimuth-elevation mount and is enclosed in a Calotte style dome. Two Naysmyth foci outboard of the elevation bearings provide ample space for instruments. To achieve high aperture efficiency for short wavelength (200 micron) observations, an active surface adjustment system will be used with closed loop positioning of the primary mirror panels. Edge sensors and laser metrology are among the techniques under study for measuring and maintaining the panel alignment. A concept for the mount has been provided by Vertex RSI, Richardson, TX under a study funded by CCAT.

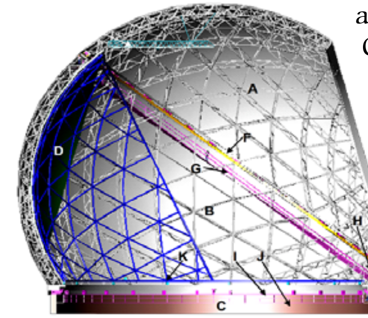
CCAT FACILITY DESIGN (M3, TUCSON)



The concept design for the CCAT facility includes all necessary spaces and capabilities for operation and maintenance of the telescope and instruments. At over 5000 meters of altitude, the facility will feature oxygen enriched atmosphere within the control building to enhance operator safety and efficiency. Selection of building systems is keyed to Chilean capabilities and the logistics requirements of the high site.

A support facility near San Pedro will provide housing and offices for the scientists and support personnel.

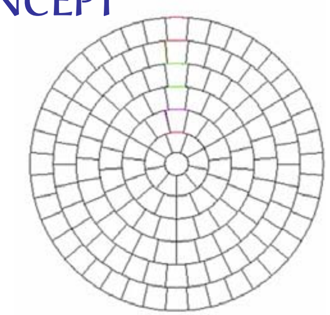
TELESCOPE DOME (AMEC STRUCTURES, VANCOUVER)



Because of its required 50 meter diameter, CCAT will likely employ a unique dome which uses two planes of rotational motion to achieve full sky coverage. This Calotte" style dome is lighter, stiffer and less expensive than extrapolations of existing large telescope domes to the size required for CCAT. In addition, as both axes of motion are balances, much less powerful motors are required providing lower power consumption. The dome's geodesic type of structure makes it structurally efficient and compatible with shipping and erection at the remote Atacama peak. This type of dome will be substantially less expensive than existing designs.

PRIMARY MIRROR CONCEPT

25 meter OD
2 meter ID
2 meter Nom. Panel
145 Panels
6 Masters



The CCAT primary mirror will be made up of multiple segments. The design shown above requires 145 panels but only six different types. This suggests the use of a replication technique which can yield substantial savings over making each panel to the requires precision.

Studies to date have focused on approaches using glass and carbon fiber. Shown is a sample segment manufactured by ITT Industries, in Rochester, NY.

Segments will be actively positioned on a steel truss using computer controlled actuators and laser position sensors.