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Cornell Caltech Atacama Telescope

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Abstract.

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 m class telescope for submillimeter astronomy at a high altitude site 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.

Light in the universe appears in three spectral major spectral 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 is will explore this important submillimeter range to study cosmic origins, from planets to the distant universe. Primary topics include include studies of distant luminous galaxies, circumstellar debris disks, star formation, the cosmic background radiation, the interstellar medium, and Kuiper belt objects. For many of these areas, the CCAT will be particularly effective in carrying out large scale surveys.

The CCAT will provide a platform for state of the art instrumentation, including bolometer cameras, spectrometers, and heterodyne 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 spectrometers provide rapid, wide bandwidth spectra with integral imaging in some cases. These direct detection instruments do not lend themselves to large scale interferometry, so require a large telescope for profitable deployment. High frequency heterodyne receiver arrays excel at detailed spectral mapping to study, 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.

During the CCATs 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, $15'$ diameter, field of view. Two Naysmyth foci outboard of the elevation bearings provide ample space for instruments. To achieve high aperture efficiency for short wavelength (350-200 μm) observations, the surface accuracy goal is $\leqslant 10\,\mu$m rms. The pointing and tracking specifications are commensurate. To attain these goals, the telescope will be enclosed in a Calotte style dome and 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.

In recent years, the high Andes near the village of San Pedro de Atacama in the desert of northern Chile have been recognized as a superb site for submillimeter astronomy. Observing conditions at the high altitude ($\geqslant 5000$ m) sites in the region are substantially better than on Mauna Kea. Several projects have been established in the vicinity and the international ALMA project is now under construction there. Adjoining the ALMA site, several mountain peaks rise 500-600 m above the surrounding terrain. Even better conditions likely prevail on these peaks. The CCAT project is evaluating observing conditions on the most promising of these peaks.