Launch of high-tech telescope construction to explore the mysteries of the universe

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Cerro Chajnantor peak. Credit: University of Cologne

American, German, and Canadian scientists are planning to explore the formation of stars and galaxies as well as the mysteries of the universe's beginnings with an entirely new kind of telescope. The launch of construction work on the Cerro Chajnantor Atacama Telescope (CCAT-prime) is scheduled for this year. It is named after its location, a 5,612 meter-high mountain in the Chilean Atacama Desert. At this altitude, it will be the highest telescope of its kind. CCAT-prime has a diameter of six meters, and is planned to be completed in 2021. The scientists are hopeing to gain unique new insights into the formation of stars and galaxies with this telescope and to come closer to solving the mystery of

how so-called dark matter and dark energy have influenced the expansion of the universe.

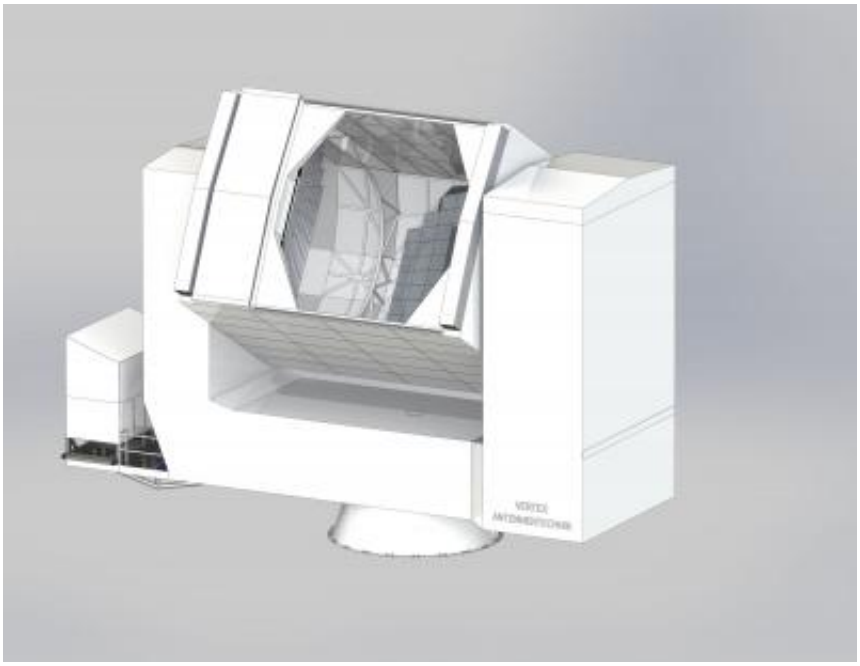
To develop this high-performance, state-of-the-art telescope, the researchers from the USA, Germany, and Canada formed a consortium called CCAT, which is headed by Cornell University. In Germany, scientists from the University of Cologne and the University of Bonn are involved. Research groups at the Max Planck Institute for Astrophysics in Garching and Ludwig Maximilians University in Munich will soon join the consortium. The high-tech telescope is from Germany as well: Vertex Antennentechnik GmbH, a company from Duisburg, are building the telescope that will reach an unprecedented degree of precision in delivering images from outer space due to its innovative optical design and its extremely high location.

"The CCAT partnership has now spent more than a decade exploring the possibility – and challenges – of building a state-of-the-art telescope at this amazing telescope site. During that time, technology and submillimeter science have advanced at a very rapid pace, and we are now ready to move forward to build a truly exciting telescope," said Project Director Martha Haynes, Goldwin Smith Professor of Astronomy at Cornell University.

The telescope will be located near the summit of Cerro Chajnantor. The extremely high elevation will allow the scientists to observe most northern and southern skies through all seasons. The telescope will be able to record radiation in the millimeter and submillimeter wavelength range – with the shortest wavelengths measuring only 0.2 mm. Radiation in the transition area between infrared and radio wavelengths originates from gas and dust between the stars from which they are formed – in our vicinity and in far-away galaxies. But this radiation can also originate from the "Cosmic Dawn," the afterglow of the Big Bang. The dry atmosphere in the Atacama Desert is ideal for these observations, as it

enables a critical degree of precision. Any water molecules in the air interfere with cosmic radiation at these wavelengths, so an atmosphere nearly devoid of water vapor is necessary.

The CCAT-prime telescope will allow the scientists to explore in detail the formation of stars in the Milky Way as well as the Magellanic Clouds and other galaxies in our neighborhood. "With CCAT we will take an important step forward towards exciting new science explorations and new technologies," said Professor Jürgen Stutzki, an astrophysicist at the University of Cologne. "The innovative design of the telescope and its location at an extreme altitude enable breathtaking new observations blocked at lower altitudes." CCAT-prime will also be an essential platform to deploy new quantum detectors at the cutting edge of physics developed in Cologne, which enable ultra-sensitive observations.



A CCAT-prime telescope rendering. Through the large seven meter opening some the primary mirror panels (right) and secondary mirror panels (left) are visible. Credit: Vertex Antennentechnik GmbH, Germany

"CCAT-prime's large visual field and the dry atmosphere on Cerro Chajnantor allow for an unprecedented mapping of the sky," explained Professor Frank Bertoldi, an astrophysicist from the University of Bonn. "This is a decisive advantage for high-precision measurements of so-called cosmic background radiation, the radio echo of the Big Bang." Together with his colleagues Komatsu and Mohr in Munich, who recently joined the consortium, Bertoldi is looking forward to taking measurements with CCAT-prime that could bring them closer to solving some of the great riddles of the universe, for example the nature of the mysterious dark energy.

The costs of designing and building CCAT-prime total 19 million euros. The American partner, Cornell University, is covering much of these costs with a contribution from the private donor Fred Young. For the telescope and an earlier study, he donated a total of 12 million USD. In Germany, the Large-scale Facilities Program of the German Research Foundation (DFG) is contributing a total of 5 million euros. Collaborative Research Center 956 "Conditions and Impact of Star Formation" is contributing to the development of the scientific instruments.

Provided by University of Cologne

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