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Canada weighs scientific consequences of moving a mega-telescope

Uncertain location for Thirty Meter Telescope prompts soul-searching about its research value.

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Babak Tafreshi/NGC

Existing telescopes atop Mauna Kea take advantage of the mountain's world-class astronomical observing conditions.

Is second-best good enough? That's the question Canadian astronomers will confront this week as they analyze how relocating the planned Thirty Meter Telescope (TMT) could affect their science plans. A study looking at the consequences of such a move, which researchers will present on 31 May at a meeting of the Canadian Astronomical Society in Edmonton, finds that they'll still be able to do most of what they want to do — but not everything.

Legal challenges to the construction of the TMT on the Hawaiian mountain of Mauna Kea meant the international collaboration behind the facility had to consider an alternate site. But less than ideal observing conditions at their back-up site could keep scientists from pursuing what is likely to be one of the hottest topics in astronomy in the coming decade: investigating exoplanet atmospheres.

The mega-telescope is “a critical component of the Canadian astronomical landscape”, says Michael Balogh, an astronomer at the University of Waterloo in Ontario. The country — one of six major international partners — has committed Can$243 million (US$180 million) to the project. “If we have to move, it’s effectively a de-scope in the project,” says Balogh.

A long, hard look

The back-up site, Roque de los Muchachos in La Palma, the Canary Islands, is lower in elevation than Mauna Kea, and its skies are more turbulent than those above the Hawaii mountain. That means that observing conditions are not quite as good; in particular, the extra atmosphere above La Palma interferes with much of the observing in mid-infrared wavelengths of light, the sweet spot for looking at exoplanet atmospheres.

“Everyone agrees that Mauna Kea is the best site,” says Doug Welch, an astronomer at McMaster University in Hamilton, Ontario, who is on the TMT governing board. “But if it’s impossible to develop there, there’s still plenty of excellent science to be done.”

For instance, the TMT will have a built-in adaptive optics system to correct for turbulence in Earth’s atmosphere; this will compensate for most of the blurriness of the skies above La Palma, Welch says. And adopting a flexible schedule, in which the telescope tackles different projects depending on what the sky conditions are like on a given night, would allow operators to squeeze the best science out of it.

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But if turbulence near the ground turns out to be worse than expected, then a TMT at La Palma won’t perform as well as a leading competitor, the European Extremely Large Telescope that is under

construction in Chile. A third mega-telescope, the Giant Magellan Telescope, is also being built in Chile.

Under pressure

So the pressure is on to build the TMT and start observing runs on it as quickly as possible. “In the end, these facilities need to justify themselves on their science,” says Raymond Carlberg, an astronomer at the University of Toronto who left the TMT’s governing board late last year in a dispute over the choice of La Palma as the alternative site.

But time is running out to build the TMT in Hawaii. Project officials want to begin construction by April 2018, regardless of the location. In order to move forward on Mauna Kea, the facility needs a fresh construction permit; in the coming months, following 44 days of testimony from both sides, a retired judge is expected to make a recommendation to the state’s board of land and natural resources. And if the board then issues a permit, the decision will almost certainly prompt an appeal to the state supreme court. To complicate matters further, a separate legal challenge to the University of Hawaii’s right to sublease the mountaintop site to the TMT is a long way from being resolved.

Wherever it ends up, the TMT will shape astronomy for decades to come, says Alan McConnachie, an astronomer at the NRC Herzberg research centre in Victoria, British Columbia. “The question the community has to figure out is, are we still excited about the science potential of the TMT?” he asks. “I think absolutely. The TMT is going to be transformative wherever it is.”

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