

Millimetre Astronomy and Antarctica

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The thermal emission from a cold, dense molecular cloud peaks in the far-IR, and the spectrum is rich in molecular lines in the sub-millimetre and millimetre bands. Observation of these bands is hindered, however, by atmospheric water vapour, which absorbs the incoming radiation. Ground-based mm observations from Australia, where the atmospheric water vapour content typically contains ~ 10 mm precipitable (ppt) H_2O , can only probe a few of the molecular transitions from the heavier molecules, such as CO, CS, HCO^+ and HCN. Sub-mm observations would enable the higher rotational lines from many of these molecules to be studied, and open up other spectral features to scrutiny, such as the lines from hydrides (*e.g.*, CaH, NH, SH) and neutral carbon at 370 & $610 \mu\text{m}$. However they cannot be made from Australia. While sites such as Mauna Kea, which has ~ 1 mm ppt H_2O on the best days, open the sub-mm band to partial viewing, their utility is limited in comparison to the opportunities possible from the antarctic plateau. Here the column of H_2O drops to 100 – $250 \mu\text{m}$.

The antarctic plateau provides unique conditions for astronomical observations from the surface of the Earth. This is primarily due to the extremely cold, dry and tenuous air, and the stable climate. For mm-astronomy it is the dry and stable air that offers the promise of spectacular gains over other sites. The transmission is significantly improved, especially in the sub-mm where new windows will be opened up virtually continuously. The great sta-

bility improves sensitivity levels that can be reached in the mm, and makes interferometry considerably easier. For instance, measurements of the optical depth of the atmosphere from Mauna Kea at 225 GHz over a one week period were mostly in the range 0.1-0.2, but with peak values reaching to 0.3-0.4 at times. A corresponding series of measurements at the South Pole had a mean optical depth of 0.04, with deviations of less than 0.01 from the mean. Sub-mm interferometry may only be possible on a regular basis from the antarctic plateau.

There is a path to Australian participation in the construction of the mm and sub-mm interferometers that are likely to be built in Antarctica during the next century. We need first to gain experience of mm astronomy, which we can through the use of the Mopra mm-wave receiver. Then we need to gain experience of mm-interferometry, which is possible through upgrading of the Compact Array. This upgrade not only provides a window of opportunity for us before any mm-array that might be built in Chile in the next decade, but it opens the door to future participation in any antarctic project that may develop.