



Report ITU-R RA.2163
(09/2009)

**Astronomical use of frequency
band 50-350 THz and coexistence
with other applications**

RA Series
Radio astronomy



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Foreword

The role of the Radiocommunication Sector is to ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including satellite services, and carry out studies without limit of frequency range on the basis of which Recommendations are adopted.

The regulatory and policy functions of the Radiocommunication Sector are performed by World and Regional Radiocommunication Conferences and Radiocommunication Assemblies supported by Study Groups.

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ITU-R policy on IPR is described in the Common Patent Policy for ITU-T/ITU-R/ISO/IEC referenced in Annex 1 of Resolution ITU-R 1. Forms to be used for the submission of patent statements and licensing declarations by patent holders are available from <http://www.itu.int/ITU-R/go/patents/en> where the Guidelines for Implementation of the Common Patent Policy for ITU-T/ITU-R/ISO/IEC and the ITU-R patent information database can also be found.

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***Note:** This ITU-R Report was approved in English by the Study Group under the procedure detailed in Resolution ITU-R 1.*

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1 Introduction

The infrared and near-infrared Parts of the electromagnetic Spectrum are of large and growing interest for astronomical research. Thermal emission from dust at temperatures of a few Kelvins to hundreds of Kelvins, which is the case for most dust clouds and larger rocky bodies, is strong in these bands, which makes them ideal for studies of star and planet formation and interstellar dust clouds. Molecules important in the chemical processes taking place in these clouds produce many spectral lines in the infrared and near-infrared wavelength range.

Consequently this Part of the Spectrum has become of high astronomical interest and has led to the implementation of large ground-based facilities for observing in those frequency bands to which the troposphere is adequately transparent, and airborne and spaceborne facilities for observations at other frequencies.

This Report is intended to provide background information relevant to the task of making bands in this part of the electromagnetic spectrum accessible to future active services while ensuring that astronomical observations are adequately protected.

2 Atmospheric transmissivity

Although only Part of the Spectral Range of interest is accessible from ground-based observatories, the larger size and much greater flexibility for accommodating new projects and equipment changes makes them still a very attractive option, even in bands where there is significant atmospheric absorption. Even then, ground-based facilities are highly expensive, so most major observatories are constructed and operated by national or international consortia, at the best available sites. To maximize the amount of usefully accessible spectrum, the ground-based facilities are located at high-altitude locations, such as Mauna Kea in Hawaii (altitude about 4 200 m). Figure 1 shows a plot of atmospheric transmissivity at the site of the Gemini North Telescope on Mauna Kea. The transmissivity (α) of the atmosphere is the ratio of the power received at the telescope to that incident upon the top of the atmosphere. The corresponding attenuation is given by:

$$L = -10 \log (\alpha) \quad \text{dB}$$

The graph shows the atmospheric transmissivity at the summit of Mauna Kea Hawaii as measured at the site of the United Kingdom Infra-Red Telescope (UKIRT). The thick-lined, cross-hatched blocks close to the frequency axis represent the frequency ranges that are covered by the principal detectors on the Gemini North Telescope, which is located close to UKIRT, the thin-lined, open blocks span the bands used as (continuum observation) examples in this study. The instrumentation on the Gemini North telescope was used because it represents the front-line instruments now in use for astronomical observations.

The Gemini telescopes and most other infrared facilities are imagers. An image of the patch of sky seen by the telescope is focused on an array of detectors. Each of these detectors is equivalent to the feed on a conventional, single-antenna radio telescope. The detector array can be used for broad-band imaging or spectral imaging, with the pass-band being chosen by an appropriate filter being