# The Prospects of THz Technology for ALMA 'Band 11'

**Ghassan Yassin[1], Stafford Withington[2], Brian Ellison[3] and Peter Huggard[3]**

***1 Department of Physics University of Oxford, Keble Road, Oxford, OX1 3RH,UK***
***2 Department of Physics University of Cambridge, Madingley Road, Cambridge, CB3 OHE, UK***
***3 Millimetre Technology Group, Rutherford Appleton Laboratory, Harwell Oxford, Didcot, OX11 0QX***

***e-mail: g.yassin1@physics.ox.ac.uk***

The mm/submm part of the spectrum is rich in atomic, ionic and molecular lines that allow us to probe the interstellar medium (ISM) in our own and distant galaxies. As evidenced by the advent of the Herschel Space Observatory, observations at supra-THz frequencies with relatively low angular resolution provide important scientific return and demonstrate the relevance of observations deep into the submillimetre wave region. For instance, a number of important ISM diagnostic lines such as the, relatively unexplored, [NII] 205 micron fine structure emission line and a number of high-J CO transitions can be accessed. Future ground-based observations with ultra-high angular resolution will provide a unique window that will allow high-finesse study of the ISM structure formation at the redshift regime of 0.5.

The Atacama Large Millimetre/Submillimetre Array (ALMA) is the largest sub-millimetre telescope in existence and is located at one of the best observing sites on Earth at an altitude of 17000 feet in the Chilean Andes. Upon its completion in 2013, ALMA will comprise of 66 high precision antennas with each equipped with state-of-the-art receivers covering all the atmospheric windows up to 1 THz. Given that ALMA has a collecting area and angular resolution of at least 1000 times greater than all current and planned submillimetre wave telescopes, and given that interferometric observations allow deep integration to faint flux levels even in the presence of atmospheric fluctuations, it is hardly surprising that serious efforts have already started to explore the possibility of extending ALMA's capability into the highest frequency window accessible from the best ground-based site.

In this paper we will review the scientific driver, and technological prospects, for constructing a new cartridge covering the frequency range 1.0-1.5 THz known as ALMA Band 11. We will show that the development of THz technology for a receiver in this frequency range is clearly challenging, but also realistic; our confidence being based upon recent technical advances in new materials such as NbN and NdTiN for SIS tunnel junctions, power simulations tools that allow the prediction of device performance, availability of coherent sources at THz frequencies, and improvements in micromachining technology. Following a brief review of the impressive work that has been achieved by international detector groups pursuing research in this area, we will compare and contrast technologies that are most likely to meet the requirements of supra-THz observation relevant to astronomy. We will then discuss the development strategy and the development route that will lead to the provision of a high performance receiver in this frequency range suitable for use on ALMA. Our presentation will also include novel methods of THz mixer blocks fabrication, full 3-D simulations of the mixer, including the waveguide and the IF interface.