Overview of ESO ALMA development studies

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***Abstract*—The development program is an integral part of the ALMA project and aims to keep ALMA at the forefront of technology. While the development studies are run per executive, the development studies are independent, following the local specifics. I will present the ESO development studies, which are issued on a 3-year cycle to allow for more substantial studies to be performed. A detailed overview of the studies is given on https://www.eso.org/sci/facilities/alma/development-studies.html . Since the start of ALMA operations, ESO has issued five calls for proposals for development studies, covering a wide range of topics, from receiver components and prototyping, digitizers, software upgrades, observing modes to archive use enhancements.**

***Keywords*—Receiver technologies, miscellaneous.**

I. Introduction

Roughly half of the approved studies are related to receiver development. These have been key preparation for the construction of ALMA Bands 5 and 2. With the completion of all originally planned ALMA receiver bands, the studies are now concentrating on the upgrades of existing bands to cover the ambitious requirements of the ALMA Wideband Sensitivity Upgrade (WSU) to expand the instantaneous IF bandwidth by up to four times the current one. For example, several studies are looking into the upgrades of Band 7 and 9 using SIS technologies, while another study aims to use an integrated system on chip approach for Band 4+5.

Further down the signal chain, several ESO development studies have performed a market study to select new digitizers allowing to sample an IF range from 2 to 20 GHz with a substantially increased overall system efficiency. This has led to a development project to install these new digitizers and upgrade the digital signal transport, which is a core part of the ALMA WSU.

Some of the studies are not specific to receivers but intend to cover multiple bands. One example is development of cryogenic low noise amplifiers on Monolithic Microwave Integrated Circuits (MMICs), which aims to cover IF bandwidths from 4 to 20 GHz, a key requirement of the WSU. Another ongoing study is looking into the development of advanced waveguide technologies to reduce the losses using microfabrication rather than milling. This is particularly important for OrthoMode Transducers (OMT) at frequencies of 300-720 GHz. Similar synergies between Bands 7 and 9 are sought in the development of small new area junctions allowing to extend the IF bandwidth.

The ESO studies aim to closely involve the member state institutes in ALMA development. The studies allow to take more risks than the projects, which is inherent in the process to go well beyond the current capabilities. ESO hopes to issue the next call for development studies in 2025 and is looking forward to a continued great interest from our member state institutes.

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