
POSTER NO. : 1
NAME : Baryshev, Andrey
INSTITUTE : Kapteyn Astronomical Institute NOVA
EMAIL : andrey@astro.rug.nl
TITLE : High Frequency High Spectral Resolution Focal Plane Arrays for ATLAST
ABSTRACT :
Large collecting area single dish telescope such as ATLAST will be especially effective for medium (R~1000) and high (R~50000) spectral resolution observations. Large focal plane array is a natural solution to increase mapping speed. For medium resolution direct detectors with filter banks (KIDs) and or heterodyne technology can be employed. We will analyze performance limits of comparable KID and SIS focal plane array taking into account quantum limit and high background condition of terrestrial observing site. For large heterodyne focal plane arrays, a high current density AlN junctions open possibility of large instantaneous bandwidth >40%. This and possible multi frequency band FPSs presents a practical challenge for spatial sampling and scanning strategies. We will discuss phase array feeds as a possible solution, including a modular back-end system, which can be shared between KID and SIS based FPA. Finally we will discuss achievable sensitivities and pixel counts for a high frequency (>500 GHz) FPAs and address main technical challenges: LO distribution, wire counts, bias line multiplexing, and monolithic vs. discrete mixer component integration.

POSTER NO. : 2
NAME : Bourne, Nathan
INSTITUTE : University of Edinburgh
EMAIL : bourne@roe.ac.uk
TITLE : CI as a tracer of gas mass in star forming galaxies
ABSTRACT :
Research in galaxy evolution aims to understand the cosmic industry of converting gas into stars. While SFR and stellar mass evolution are well constrained by current data, our knowledge of gas in galaxies throughout cosmic time is comparatively lacking. Almost all high-redshift gas measurements to date rely on CO as a tracer, but this is subject to systematic uncertainties due to optically thick emission and poorly constrained dependences on gas density, distribution and metallicity. Recently, some attention has been given to dust continuum as an alternative gas tracer, which shows promise for large samples but still requires accurate calibration on a direct gas tracer at high redshift. The [CI] 492GHz emission line could overcome much of the systematic uncertainty, as it is optically thin and has similar excitation conditions to CO(1-0), but observational limitations have so far restricted CI measurements to very small samples. I will present some new data from ALMA, for the first time testing the CI/dust correlation in a representative sample of star-forming galaxies at z=1, and discuss how future observations could be designed to more widely exploit this independent gas tracer.

POSTER NO. : 3
NAME : Burkutean, Sandra
INSTITUTE : IRA-INAF Bologna
EMAIL : burkutean@ira.inaf.it

TITLE : Interferometer-single dish combination
ABSTRACT :
I will present different techniques for combining single-dish and interferometric data. In particular, the requirements for successful data combination of a large single-dish telescope and ALMA/ACA will be outlined.

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POSTER NO. : 4
NAME : Chiong, Chau Ching
INSTITUTE : Academia Sinica Institute of Astronomy and Astrophysics
EMAIL : ccchiong@asiaa.sinica.edu.tw
TITLE : Design and Performance of ALMA Band 1 Receiver and its Future Prospects
ABSTRACT :
ALMA Band 1 receiver covering 35-50 GHz is with the largest relative bandwidth among ten ALMA bands. The Band 1 receiver front-end cartridges are now in preproduction stage. Even with the large noise contribution from the warm optics (5-11 K), the first three Band 1 cartridges still exhibit state-of-the-art receiver noise temperature of 16-31 K for any combination of the RF and LO frequencies. In the presentation, we will not only present the Band 1 receiver design and system performance, but also discuss the future prospects to further enhance its performance and capabilities with lower receiver noise temperature, wider RF and IF frequency coverage, focal plane array configuration, and digital signal processing.

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POSTER NO. : 5
NAME : Desmaris, Vincent
INSTITUTE : Chalmers University of Technology - GARD
EMAIL : vincent.desmaris@chalmers.se
TITLE : Advanced technologies for heterodyne radio astronomy instrumentation - Part1 by A. Pavolotsky, and Advanced technologies for heterodyne radio astronomy instrumentation - Part2 by V. Desmaris
ABSTRACT :
We present the advanced micro/nano technological engineering at the atomic level producing state-of-the-art epitaxial NbN thin-films on GaN buffer layers. Furthermore, we report the outstanding performance of the hot electron bolometers fabricated on epitaxial NbN thin films on GaN buffer layers. Finally we present advanced passive devices such as waveguide hybrids, IF hybrids and combiners for the realization of heterodyne THz receivers.

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POSTER NO. : 6
NAME : Dicker, Simon
INSTITUTE : University of Pennsylvania
EMAIL : sdicker@hep.upenn.edu
TITLE : Large Aperture Camera for the Simons Observatory
ABSTRACT :
The Simon's observatory will consist of one large 6m telescope and three or more smaller telescopes working together with a goal of measuring the polarization in the Cosmic Microwave Background on angular scales as small as ~1' to larger than 1 degree and at a sensitivity far greater than has ever been reached before. To reach these sensitivities, needed for our science goals, we require over 90000 background limited TES detectors on the large telescope - hence a very large field-of-view. The telescope design we have selected is a copy of the CCAT-prime telescope, a Crossed Dragone with extra aspheric terms to increase the diffraction limited field-of-view. At the secondary focus will be a ~2.5m diameter cryostat containing re-imaging silicon optics which can correct remaining aberrations (mostly astigmatism) at the edge of the field of view and

allow this part of the focal plane to be used at higher frequencies. This poster will contain an outline of our optical designs and take a brief look at how they could be scaled to a larger telescope.

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POSTER NO. : 7
NAME : Hacar Gonzalez, Alvaro
INSTITUTE : Steerwacht Leiden
EMAIL : hacar@strw.leidenuniv.nl
TITLE : The best of two worlds: ALMA + IRAM30m observations of the Orion Integral Shape Filament
ABSTRACT :
We have investigated the internal gas structure of the Orion Integral Shape filament using two large-scale, 150-pointing ALMA-12m mosaics and previous IRAM30m single-dish (SD) observations. From the combination of both single-dish and interferometric data we have produced a high-dynamic range and high-sensitivity map describing the internal gas structure of this filament at scales between 2 pc and 2000 AU (Hacar et al, submitted to A&A). In a series of individual CASA reductions (w/o SD data + w/o feathering), we have investigated the impact of the different uv-coverages on both the total flux and line velocity structure of our ALMA maps. Our analysis highlights the critical role played by the zero-spacing data at the different stages of the cleaning process. The results of these ALMA+IRAM30m experiments emphasize the need of high-sensitivity SD observations for the analysis of large-scale interferometric maps. During my talk, I will discuss the implications of these experiments on the dawn of the ALMA era and in the context of the new AtLAST telescope.

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POSTER NO. : 8
NAME : Hayatsu H., Natsuki
INSTITUTE : ESO Garching
EMAIL : nhashiba@eso.org
TITLE : Star-Formation History in Early Universe Revealed by Blind Line-Search using AtLAST and ALMA
ABSTRACT :
Using blind line searches to understand the cosmic star-formation history is one of the strategies that will be pursued by AtLAST, which will have high sensitivity and mapping speed. Before moving into the 'AtLAST era', it is essential to develop a method to efficiently detect faint sources considering the completeness of source detection and contamination by false detections. Furthermore, in order to propose strategies for blind line searching using AtLAST, it is necessary to know to what extent we can constrain the luminosity function using existing ALMA archival data. In this presentation, we report the current status of tests using a blind line-searching method and show preliminary results. We plan to apply our final results to various science cases for future AtLAST observations e.g. cross-checking the luminosity density using an intensity-mapping technique or estimating the redshift evolution of ionization state or metallicity by combining with JWST or SPICA data. We plan to release our code as a CASA task.

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POSTER NO. : 9
NAME : Huang, Yau De
INSTITUTE : Academia Sinica Institute of Astronomy and Astrophysics
EMAIL : ydhuang@asiaa.sinica.edu.tw
TITLE : New 30-50 GHz Wideband Receiver for Nobeyama 45-m Telescope with Capability to Observe Three Zeeman
ABSTRACT :

Zeeman measurement is the only tool to probe the magnetic field strengths directly. A new receiver covering 30-50 GHz frequency range is proposed for Nobeyama 45-m telescope based on the design of the ALMA Band 1 receiver. With dual linear polarization feed, wide IF bandwidth and state-of-the-art noise performance, it is capable to observe three Zeeman transitions (SO at 30.0 GHz and CCS at 33.7 and 45.4 GHz) toward the pre-protostellar cores simultaneously. This feature will not only increase the survey efficiency but also provide a reliable tool to calibrate the unwanted instrumental cross-polarization. Slim receiver layout also allows easy expansion to form focal plane array. We will present the receiver design and the current status of the pro

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POSTER NO. : 10
NAME : Khudchenko, Andrey
INSTITUTE : NOVA/Kapteyn Institute
EMAIL : A.Khudchennko@sron.nl
TITLE : Study of the calibration channel width for a Digital Sideband Separating system for SIS 2SB receiver
ABSTRACT :
A Digital Sideband Separating (DSS) system has been recently applied to a full 2SB receiver, i.e., one with the analog IF hybrid still in place. This concept allows reaching IRR level around 45 dB and it presents additional advantages in calibration stability compared to the case when no IF hybrid is present. If implemented in multi-pixel cameras, the DSS system relaxes the requirements for the IRR level of the analog receiver substantially enabling to reach at least an IRR of 30 dB with relatively simple hardware. It would be ideal for spectral line surveys since it practically eliminates the line confusion in addition to rejecting the atmospheric noise in the image band. Therefore, the DSS system is a potential option for a future ALMA upgrade. Here we present our study on an important practical question: how wide should the calibration-channel width in order to reach a desired IRR level? This parameter determines, for a large part, the calibration speed of the DSS system and influences the back-end architecture. We estimate that for currently installed ALMA bands (B3-B8), the channel width of the DSS system can be at least 45 MHz to reach a 30db IRR level in entire band.

POSTER NO. : 11
NAME : Mena, Patricio
INSTITUTE : Universidad de Chile
EMAIL : fmena@uchile.cl
TITLE : Development of Suitable Technologies for Heterodyne W-Band Focal-Plane Arrays
ABSTRACT :
We present the ongoing efforts at University of Chile to develop technologies for heterodyne focal-plane arrays. We have focused in W band covering four areas of study.
1. OPTICAL SYSTEMS: We have studied the possibility of using multi-pixel receivers at ALMA-type antennas. We designed an array of 7 pixels (extensible to 19) that fits into an ALMA cartridge. The design includes a set of mirrors and a fly-eye lens that allows the system to fit on the available space. For the feed, we have studied smooth-wall horns and Vivaldi antennas.
2. COMPACT OMTS: We have been working on turnstile-type OMTs fabricated in platelets that permit integration of several OMTs in the same block.
3. LOW NOISE AMPLIFIERS: We are working on a hybrid concept that uses a single transistor mounted before a commercial MMIC. We have measured noise temperatures lower than 50 K. The aim is to produce compact blocks suitable for integration.
4. DOWNCONVERTING MIXERS: We have designed biased sub-harmonic mixers based on Schottky diodes using MMIC technology and to be fabricated in a commercial run. We expect conversion losses below 15 dB. Mixers and LNA will be packaged in a single block using a 2SB scheme.

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POSTER NO. : 12
NAME : Okada, Yoko
INSTITUTE : I. Physikalisches Institut Universität zu Köln
EMAIL : okada@ph1.uni-koeln.de
TITLE : Science cases for the velocity-resolved mid-J CO and 13CO and [NII] emissions
ABSTRACT :
When studying PDRs, the contribution of shocks to the emission of mid-J CO lines is often debated. Plane-parallel PDR models fail to reproduce strong mid-J CO emissions, frequently leading to the conclusion of a shock contribution, while clumpy PDR models predict a flatter CO ladder in agreement with observations. One way to assign the origin of the mid-J CO lines is to investigate their velocity profile. Observations of mid-J 13CO emission profiles provide additional information as these lines are more likely optically thin. With AtLAST located on Cerro Chajnantor, a better atmospheric transparency compared to the ALMA plateau would enable efficient observations of the CO(6-5) to (8-7) lines. Under best weather conditions, it would be possible to observe up to CO(13-12) and the [NII]205 micron emission, which is essential to distinguish the ionized gas contribution to the [CII] emission observed from SOFIA. High angular resolution mapping in nearby galaxies with a large single dish telescope at high frequencies has a good synergy with interferometric observations at lower frequencies. Note that being at the high site does not compromise the zero-spacing-filling at low frequencies.

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POSTER NO. : 13
NAME : Otarola, Angel
INSTITUTE : TMT International Observatory
EMAIL : aotarola@tmt.org
TITLE : PWV, temperature and wind statistics at sites suitable for mm and sub-mm wavelengths astronomy
ABSTRACT :
Atmospheric water vapor is the main limiting factor of atmospheric transparency in the mm and sub-mm wavelength spectral windows. Thus, dry sites are needed for the installation and successful operation of radio astronomy observatories exploiting those spectral windows. Other parameters that play an important role in the mechanical response of radio telescopes exposed to the environmental conditions are: temperature, and in particular temperature gradients that induce thermal deformation of mechanical structures, as well as wind magnitude that induce pointing jitter affecting this way the required accuracy in the ability to point to a cosmic source during the observations. Temperature and wind are variables of special consideration when planning the installation and operations of large aperture radio telescopes. This work summarizes the statistics of precipitable water vapor (PWV), temperature and wind monitored at sites by the costal mountain range, as well as on t he west slope of the Andes mountain range in the region of Antofagasta, Chile. This information could prove useful for the planning of the Atacama Large-Aperture Submm/ mm Telescope (AtLast).

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POSTER NO. : 14
NAME : Pavolotsky, Alexey
INSTITUTE : Chalmers University of Technology - GARD
EMAIL : alexey.pavolotsky@chalmers.se
TITLE : Advanced technologies for heterodyne radio astronomy instrumentation - Part1 by A. Pavolotsky, and Advanced technologies for heterodyne radio astronomy instrumentation - Part2 by V. Desmaris
ABSTRACT :

Modern and future heterodyne radio astronomy instrumentation critically depends on availability of advanced fabrication technologies and components. In the Part1 of the Poster, we present the thin film fabrication process for SIS mixer receivers, utilizing either AlOx, or AlN barrier superconducting tunnel junctions developed and supported by GARD. The summary of the process design rules is presented. It is well known that performance of waveguide mixer components critically depends on accuracy of their geometrical dimensions. At GARD, all critical mechanical parts are 3D-mapped with a sub-um accuracy. Further progress of heterodyne instrumentation requires new efficient and compact sources of LO signal. We present SIS-based frequency multiplier, which could become a new option for LO source. Future radio astronomy THz receivers will need waveguide components, which fabricating due to their tiny dimensions is not feasible by traditional mechanical machining. We present the alternative micro-machining technique for fabricating waveguide component for up 5 THz band and probably beyond.

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POSTER NO. : 15
NAME : Plunkett, Adele
INSTITUTE : ESO Santiago
EMAIL : aplunket@eso.org
TITLE : Protostellar outflows mapped with ALMA and techniques to include short spacings
ABSTRACT :
Protostellar outflows are early signs of star formation, yet in cluster environments -- common sites of star formation -- their role and interaction with surrounding gas are complicated. Protostellar outflows are interesting and complex because they connect protostars (scales 10s au) to the surrounding gas environment (few pc), and their morphology constrains launching and/or accretion modes. A complete outflow study must use observing methods that recover several orders of magnitude of spatial scales, ideally with sub-arcsecond resolution and mapping over a few parsecs. ALMA provides high-resolution observations of outflows, and in some cases outflows have been mapped in clusters. Combining with observations using the Total Power array is possible, but challenging, and a large single dish telescope providing more overlap in uv space is advantageous. In this presentation I show protostellar outflows observed with ALMA using 12m, 7m, and To tal Power arrays. With a new CASA tool TP2VIS we create total power ``visibility'' data and perform joint imaging and deconvolution of interferometry and single dish data. TP2VIS will ultimately provide synergy between ALMA and AtLAST data.

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POSTER NO. : 16
NAME : Schneider, Nicola
INSTITUTE : I. Physikalisches Institut Universität zu Köln
EMAIL : nschneid@ph1.uni-koeln.de
TITLE : The GENESIS project: science cases for a large submm telescope
ABSTRACT :
The formation of stars is intimately linked to the structure and evolution of molecular clouds in the interstellar medium. In the context of the ANR/DFG project GENESIS (GENeration and Evolution of Structures in the Ism, http://www.astro.uni-koeln.de/node/965), we explore this link with a new approach by combining far-infrared maps and surveys of dust (Herschel) and cooling lines (CII, CI, CO, OI with SOFIA), with molecular line maps. Dedicated analysis tools are used to characterise molecular cloud structure, and we explore the coupling of turbulence with heating- and cooling processes. The project gathers a large observational data set, from molecular line maps at (sub)-mm wavelengths from ground-based telescopes (e.g. IRAM) up to high-frequency airborne spectroscopic and continuum observations (SOFIA). Nevertheless, we identified the need for a large single-dish submm telescope, operating in the southern hemisphere at high frequencies. Only such an instrument is able to observe important ISM cooling lines, like the CI lines at 490 and 810 GHz or high-J CO lines, shock tracers, or probes of turbulence dissipation with high angular resolution in Galactic and extragalactic sources. We will discuss possible science cases and

demonstrate how those are addressed within GENESIS, and the science done with the new 6m Cologne-Cornell CCAT-prime submm telescope.

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POSTER NO. : 17
NAME : Bryan, Sean
INSTITUTE : Arizona State University
EMAIL : sean.a.bryan@asu.edu
TITLE : The TolTEC Camera for the LMT Telescope
ABSTRACT :
TolTEC is a new camera being built for the 50-meter Large Millimeter-wave Telescope (LMT) on Sierra Negra in Puebla, Mexico. The instrument will discover and characterize distant galaxies by detecting the thermal emission of dust heated by starlight. The polarimetric capabilities of the camera will measure magnetic fields in star-forming regions in the Milky Way. The optical design of the camera uses mirrors, lenses, and dichroics to simultaneously couple a 4 arcminute diameter field of view onto three single-band focal planes at 150, 220, and 280 GHz. The 7000 polarization-selective detectors are single-band horn-coupled LEKID detectors fabricated at NIST. A rotating half wave plate operates at ambient temperature to modulate the polarized signal. In addition to the galactic and extragalactic surveys already planned, TolTEC installed at the LMT will provide open observing time to the community.

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POSTER NO. : 18
NAME : Simon, Robert
INSTITUTE : I. Physikalisches Institut Universität zu Köln
EMAIL : simonr@ph1.uni-koeln.de
TITLE : Large Scale Spectral Line Mapping of Galactic Regions with CCAT-prime
ABSTRACT :
CCAT-prime is a 6-m submillimeter telescope that is being built on the top of Cerro Chajnantor (5600 m altitude) overlooking the ALMA plateau in the Atacama Desert. Its novel Crossed-Dragone design enables a large field of view without blockage and is thus particularly well suited for large scale surveys in the continuum and spectral lines targeting important questions ranging from star formation in the Milky Way to cosmology. On this poster, we focus on the large scale mapping opportunities in important spectral cooling lines of the interstellar medium opened up by CCAT-prime and the Cologne heterodyne instrument CHAI.

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POSTER NO. : 19
NAME : Wiedner, Martina
INSTITUTE : LERMA, Paris Observatory, CNRS
EMAIL : martina.wiedner@obspm.fr
TITLE : Conceptual Study of a HEtrodyne Receiver for the Origins space telescope
ABSTRACT :
The Origins Space Telescope (OST) is a mission concept of an extremely versatile observatory with 5 science instruments, of which the HEterodyne Receivers for OST (HERO) is one. HERO's main targets are high spectral resolution observations ($\Delta\lambda/\lambda$ up to 107 or Δv = 0.03km/s) of water to follow its trail from cores to YSOs as well as H2O and HDO observations on comets. HERO will probe all neutral ISM phases using cooling lines ([CII], [OI]) and hydrides as probes of CO-dark H2 (CH, HF). HERO will reveal how molecular clouds and filaments form in the local ISM up to nearby galaxies. In order to achieve these observational goals, HERO will cover an extremely wide frequency range from 468 to 2700 GHz and a window around the OI line at 4563 to 4752GHz. It will consist of very large focal plane arrays of 128 pixels between 900 - 2700 GHz and at 4.7 THz, and 32 pixels for the 468 to 900 GHz range. The instrument is exploiting Herschel/HIFI heritage.

HERO's large arrays require low dissipation and low power components. The HERO concept makes use of the latest cryogenic SiGe amplifier technology, as well as CMOS technology for the backends with 2 orders of magnitude lower power.

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POSTER NO. : 20
NAME : Wiesemeyer, Helmut
INSTITUTE : Max-Planck-Institute for Radio Astrononomy
EMAIL : hwiese@mpifr.de
TITLE : Lessons learned from six decades of radio polarimetry
ABSTRACT :
The characterization of polarized emission from continuum radiation and spectral lines across large-scale galactic and extragalactic fields is a typical application of single-dish telescopes, from radio to far-infrared wavelengths. Despite its high analytical value, in many cases polarimetry was added to the design specifications of telescopes and their frontends only in advanced development stages. While in some situations the instrumental contamination of the Stokes parameters can be corrected, this becomes increasingly difficult for extended fields. This contribution summarizes the current situation at mm/submm telescopes. Strategies for post-observing polarization calibration are presented as well as methods to optimize the components in the beam path.

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POSTER NO. : 21
NAME : Wootten, Al
INSTITUTE : NRAO
EMAIL : awootten@nrao.edu
TITLE : The Green Bank Telescope: Transformational Science for the Next Decade.
ABSTRACT :
The Robert C Byrd Green Bank Telescope has met its design goal of providing high-quality observations at 115 GHz. The accurate small beam of the telescope at high frequencies is leveraged by deployment of multi beam receivers. An overview is presented. Observers now have access to the new, 16-pixel, 3-mm Argus receiver, which is providing high-dynamic range images over wide fields for the multitude of spectral lines between 85 and 115 GHz. The successful performance of Argus, and its modular design, demonstrates that receivers with many more pixels could be built for the GBT. A 12 x 12 array of the Argus design would have mapping speeds about nine times faster than Argus without suffering any degradation in performance for the outer pixels in the array. The Observatory plans to build the next-generation Argus instrument (Argus+) with 144-pixels, a footprint 5'x5', and 7" resolution at 110 GHz. The project will be a collaboration between the Green Bank Observatory and university groups, who will supply key components. The key science drivers for Argus+ are studies of molecular filaments in the Milky Way, studies of molecular clouds in nearby galaxies, and the observations of rapidly evolving solar system objects. Observers also have access to MUSTANG-2, a 223-feedhorn bolometer camera which was commissioned on the GBT in spring 2016, and was offered for observations on a shared risk basis, in collaboration with the instrument team, in the 2018A GBO proposal call. Several features distinguish it from its predecessor, MUSTANG: A new, microstrip-coupled detector design yields higher sensitivity and less susceptibility to environmental microphonics. Detectors are feedhorn coupled, with the sum of two linear polarizations measured by a single TES per feed. The instantaneous field of view is 4 arcminutes (vs 42 arcseconds for MUSTANG). The receiver design incorporates a tilted refrigerator and receiver rotator, resulting in much lower dependence of cooling performance on telescope elevation. The detector readout is the first astronomical use of microwave resonators to multiplex TES bolometers. MUSTANG-2 has been developed by a collaboration including the University of Pennsylvania, NIST, NRAO, the University of Michigan, and Cardiff University. A 7-pixel K-band Feed Array covering 18-28 GHz with Dual polarization feeds and a noise temperature < 40-50 K has been available for several years. The array offers an

instantaneous bandwidth/beam of 1.8 GHz. Future upgrade concepts under study envision increasing the number of beams by an order of magnitude.