Workshop Proposal

Organizer(s)

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Workshop Title: Radioastronomy instrumentation

Topic:

Workshop Abstract (*the abstract should be between a quarter and half a page long in font size 10, single column, about 1500 to 3000 characters with spaces*)**:**
Radioastronomy instrumentation is a very exciting area where a huge interdisciplinary areas must work together.

This workshop aims to bring together astronomers, physicists, and engineers working on detectors and low-noise instruments for the far-infrared/submm/mm wavelength range. It will cover current and future imaging and spectroscopic arrays, both bolometric and heterodyne, for ground-based and space-borne telescopes, the physics of semiconducting and superconducting detectors and readouts, the optimization of long-wavelength optical systems, new developments in coherent receivers and spectrometers, and the design and optimization of components such as optics, filters, and local oscillators. In addition to these component technologies, the conference will examine instrument architectures as well as recent application examples.

This Radiostronomy instrumentation workshop is designed to explore the current and foreseeable state-of-the-art of space telescope and instrumentation programs, concepts and technologies from the near-ultraviolet and visible wavelengths through the infrared and millimeter regions. NASA's Hubble Space Telescope (HST), the Spitzer Space Telescope, Kepler/K2, and the airborne SOFIA programs are continuing observations and/or reviewing science proposals for new observation cycles. ESA has launched and is collecting data from the Global Astrometric Interferometer for Astrophysics (GAIA), a mission that will compile an astrometric catalogue of ~1 billion stars with a second data release in April 2018.

For this workshop, status reports on projects of all sizes and the science questions that they address are sought, as well as talks addressing topics that include, but are not limited to, the following issues and

opportunities:

- performance requirements: science drivers and fundamental limits;
- instrumentation (imaging, polarimetric, and spectroscopic): design and construction
- instrument performance: validation in the laboratory, on-sky commissioning, and scientific results;
- detectors: fundamental physics, design, fabrication techniques, performance, and numerical modeling of results;
- receiver technologies: mixers, MMICs, local oscillators, low-noise amplifiers, arrays and packaging;
- signal read-out: electronics, multiplexing techniques and back-end spectrometers;
- optical design: optical physics and simulations, optical layouts, test facilities, and performance demonstration;
- optical components: materials, filters, waveguide elements, shielding, low-temperature material properties, and numerical modeling;
- other associated technologies: mechanical design, mechanisms, coolers, and cryogenics;
- observing techniques: observing strategies, sky noise removal, atmospheric phase measurement and compensation, data acquisition and reduction;
- emerging concepts: new generation devices; industrial and commercial applications of far-infrared, submillimeter and millimeter technologies developed for astronomy.

- The science cases for space-based astronomy and astrophysics
    - Near-UV, visible, IR, submillimeter and millimeter wavelength astronomical space telescopes and instruments
    - Highly innovative space telescope and instrument concepts
    - Concepts for future large aperture space telescopes
    - Exoplanet detection and characterization using space telescopes
    - Results from astrobiology and related fields that can help determine the science needed for exoplanet observations and studies
    - Approaches to increasing insight into dark matter and dark energy using space
    - The formation and evolution of galaxies, stars, and planets
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- Approaches to mission development and implementation
    - System modeling of telescopes and space observatories, their assembly and servicing, to enable confident launch of systems too large for end-to-end ground assembly and testing and/or too large to launch on a single launch vehicle
    - Technology demonstrations
    - Collaborative flights with other missions to provide cost effective science telescopes
    - Small mission concepts and technologies
    - Innovative approaches to risk management
    - Student involvement

- Enabling and enhancing technologies for space telescopes
    - Formation flying concepts and technologies
    - Deployment, assembly, commissioning and other space infrastructure
    - Innovative real-time metrology and wavefront sensing and control
    - Interferometric instruments effects
    - Polarization effects, including observation and mitigation
    - Innovative optical designs that reduce the number of reflective surfaces
    - Active and passive cooling methods including cryocoolers
    - Technologies and architectures for achieving high thermal stability of large telescopes
    - System concepts utilizing servicing for extended mission life
    - Technologies and architectures for performing dynamic isolation of payloads

- Approaches that leverage programs in other areas
    - Synergies with ground-based or airborne astronomical observatories
    - Synergism with science missions in other spectral regions
    - Opportunities presented by crewed missions, infrastructure, and technologies
    - Astrobiological investigations that may affect the needs for science observations
    - Innovative space telescopes and instrumentation for studies of the local solar system
    - Earth observation concepts and technologies

Finally, the events and studies that will determine the future of space observatories for the next few decades are occurring right now, and the active participation of students is particularly important for this workshop. Students are encouraged to assist addressing both science requirements and technology enablers, conventional and unconventional. Opportunities to reach out to other disciplines and to the public at large are sought to increase understanding of the value of space observatories and consequently their basis of support. We look forward to a vigorous response to this workshop from across the space telescope community.

Important Information

- **Accepted workshops will be scheduled to one of the workshops days of the EuMW 2018 week. The assignment of the workshops in a given day will be conducted to satisfy the planning constraints. Hence, organizers are expected to inform their speakers accordingly.**
- Workshop fee waivers will be granted to the workshop organizers (two maximum) and workshop speakers (one per presentation) upon reception of the presentation slides (1 color slide per A4 page in pdf format) before 18th July 2018.
- Please note that, in this case, the fee waiver applies ONLY to the specific workshop and NOT to other events taking place during the week, therefore: Workshop speakers and workshop organizers must register and pay the fees for the other events they wish to attend (EuMC, EuMIC, EuRAD, conferences, WS, SC, …).

I have read and understood the above important information and transmitted this information to all the Speakers who also understood: YES

Complete the rest of the form only if your answer to the above question is Yes.

Speakers

1. Speaker's Name: Rafael Rebolo	**Confirmed (yes/no): YES**
Affiliation: Director of the Instituto Astrofísico de Canarias	
Presentation Title: Cosmic Microwave Background Detection with QUIJOTE telescope	
Speaker's Email: director@iac.es	

Abstract:

The QUIJOTE (Q U I JOint TEnerife) CMB Experiment operates from Teide Observatory with the goal of characterizing the polarization of the CMB and other galactic and extragalactic emission in the frequency range 10-40 GHz, and at large angular scales.

The main objective of the QUIJOTE project is to cover a sky area of 5,000 square degrees, with a sensitivity around 1 μK (at the highest frequencies) and an angular resolution of 1° at 11, 13, 17, 19, 30 and 40 GHz. These measurements will complement at low frequency and correct from galactic contamination those to be obtained by the Planck satellite. They will be the most sensitive measurements obtained for characterization of the synchrotron and anomalous microwave emission in our Galaxy at those frequencies.

2. Speaker's Name: Iván Cámara Mayorga	**Confirmed (yes/no): YES**
Affiliation: Max Planck Institute for Radioastronomy	
Presentation Title: Photonic local oscillators for radioastelescopes	
Speaker's Email: imayorga@mpifr-bonn.mpg.de	

Abstract:

APEX, the Atacama Pathfinder Experiment, is a collaboration between Max Planck Institut für Radioastronomie (MPIfR) at 50%, Onsala Space Observatory (OSO) at 23%, and the European Southern Observatory (ESO) at 27% to construct and operate a modified ALMA prototype antenna as a single dish on the high altitude site of Llano Chajnantor. The telescope was manufactured by VERTEX Antennentechnik in Duisburg, Germany.

Observing with APEX allows us to study cold dust and gas in our own Milky Way and in distant galaxies. Tracing the thermal continuum emission and analyzing high frequency spectral lines improve our understanding of the structure and chemistry of planetary atmospheres, dying stars, regions of star formation as well as distant starburst galaxies. We can address issues from the vast scales of the structure of the Universe down to the physics and chemistry of comets.

SOFIA, the Stratospheric Observatory for Infrared Astronomy, is a joint project of the National Aeronautics and Space Administration (NASA) and the Deutsches Zentrum für Luft- und Raumfahrt

e.V. (DLR; German Aerospace Centre, grant: 50OK0901). The German component of the SOFIA project is being carried out under the auspices of DLR, with funds provided by the Federal Ministry of Economics and Technology (Bundesministerium für Wirtschaft und Technologie; BMWi) under a resolution passed by the German Federal Parliament, and with funding from the State of Baden-Württemberg and the University of Stuttgart. Scientific operations are coordinated by the German SOFIA Institute (DSI) at the University of Stuttgart and the Universities Space Research Association (USRA) headquartered in Columbia, Maryland, U.S.A.

3. Speaker's Name: John A. Murphy	**Confirmed (yes/no): YES**
Affiliation: National University of Ireland, Maynooth.	
Presentation Title: Advances in Quasi-optical Design and Analysis for Millimetre/Submillimetre-wave Receiver systems	
Speaker's Email: anthony.murphy@mu.ie	

Abstract:

Quasi-optical design is a critical factor determining the performance of receivers systems for both ground and space-based astronomy in the millimetre- and submillimetre-wavebands. This is particularly for the case for the design of both efficient compact multi-beam and multi-mode optics for next generation receiver systems now being proposed or under development. The once-off nature of each such project generally requires a unique design solution for the quasi-optical feed system. This is necessary to underpin the ever higher sensitivities and efficiencies in terms of field of view coverage made possible with the impressive development of novel detector technologies over the past decade. In many such systems optimization of the system performance also involves improved electromagnetic design of waveguide-horn antenna systems feeding the optics.

The Terahertz Optics Group at Maynooth University are involved in the optical/electomagnetic design

of a number of ground based and space based projects for the far-infrared, terahertz and millimetre-wavebands. We report on the unique quasi-optical challenging aspects of these projects along with the approach taken and advances made in analysis techniques key to accurately predicting and optimizing their performance. We have been particularly interested in the optical design of multi-beam optical systems for CMB experiments, the modelling of multi-mode horn antennas for far- and mid-infrared astronomy, and the development of measurement strategies that will be required for next generation space projects. In the presentation examples will be given of some of these systems along, with improvements we have made in the theoretical understanding and the resultant computational solutions reached.

4. Speaker's Name: Goutam Chattopadhyay	**Confirmed (yes/no): YES**
Affiliation: NASA-Jet Propulsion Laboratory, California Institute of Technology	
Presentation Title: 1.9 THz Silicon Micromachined Multi-Pixel Receiver Instrument	
Speaker's Email: goutam@jpl.nasa.gov	

Abstract:

This talk will focus on the latest developments of a highly integrated 1.9 THz heterodyne multi-pixel array instrument assembled using silicon micromachined waveguide housing and vertical integration. The instrument will have integrated high-performance micro-lens antenna array. The antenna is composed of a waveguide feed which uses leaky wave cavity to enhance the directivity and illuminate a shallow lens efficiently. The dual-polarized balanced heterodyne receiver uses hot-electron bolometers (HEB) as mixers and efficient Schottky diode based frequency multiplied sources as local oscillator. The front-end receiver, including the antenna, can be fabricated using silicon micromachining processes and has seamless integration, which reduces the overall size and losses.

5. Speaker's Name: Jonas Zmuidzinas	Confirmed (yes/no): YES
Affiliation: Merle Kingsley Professor of Physics; Jet Propulsion Laboratory Senior Research Scientist; and Chief Technologist, Jet Propulsion Laboratory	
Presentation Title: Submillimeter Wave Astrophysics at Caltech	
Speaker's Email: jonas@caltech.edu	
Abstract: Submillimeter wave astronomy is a relatively new branch of astronomy that studies celestial objects using the *submillimeter band* of the electromagnetic spectrum, which ranges from 0.1 mm to 1.0 mm (300 GHz to 3000 GHz). This band, which lies between the far infrared and high-frequency radio bands, contains valuable astonomical information in both continuum and molecular spectral lines, but has been unavailable to astronomers until recently because most of the radiation is blocked by the Earth's atmosphere. In order to overcome this barrier, submillimeter observatories are usually placed at high altitude. The Caltech Submillimeter Wave Astrophysics group pursues research in all areas of submillimeter astronomy, including molecular spectroscopy, astrochemistry, star formation, and the structure and evolution of galaxies. With a strong tradition in instrumentation, the group operates the Caltech Submillimeter Observatory with support from the NSF. The group also developed instruments for the Herschel Space Observatory.	

6. Speaker's Name: Marianna Ivashina	Confirmed (yes/no): YES
Affiliation: Chalmers University, Sweden	
Presentation Title: Antenna-Array Digital-Beamforming and Calibration Methods for the Next Generation Multi-Beam Spaceborne Radiometers for Ocean Observations	
Speaker's Email: marianna.ivashina@chalmers.se	
Abstract: Antenna-Array Digital-Beamforming and Calibration Methods for the Next Generation Multi-Beam Spaceborne Radiometers for Ocean Observations.	

7. Speaker's Name: Xavier Barcons	Confirmed (yes/no): YES
Affiliation: European Southern Observatory Director	
Presentation Title: PLANCK mission	
Speaker's Email: dg@eso.org	

Abstract:

Planck is ESA's mission to observe the first light in the Universe. Planck was selected in 1995 as the third Medium-Sized Mission (M3) of ESA's Horizon 2000 Scientific Programme, and later became part of its Cosmic Vision Programme. It was designed to image the temperature and polarization anisotropies of the Cosmic Background Radiation Field over the whole sky, with unprecedented sensitivity and angular resolution. Planck is testing theories of the early universe and the origin of cosmic structure and providing a major source of information relevant to many cosmological and astrophysical issues.

8. Speaker's Name: Luis Enrique García Muñoz	Confirmed (yes/no): YES
Affiliation: Universidad Carlos III de Madrid	
Presentation Title: Microwave room temperature photon counting detector	
Speaker's Email: legarcia@ing.uc3m.es	

Abstract:

The nonlinear parametric up-conversion of microwave radiation to the optical domain is proposed for ultra low-noise radiometry in radio astronomy applications. The up-conversion takes place inside crystalline whispering-gallery mode (WGM) resonators, excited with a laser pump along with the microwave signal. The power of the generated optical sideband is measured with commercial photo-detectors. A cross-correlation configuration is used to reduce the thermal noise contribution of the up-converters by time-averaging the number of counted photons. By doing a theoretical study of thermal and quantum noise, it is shown that while working at room temperature, this radiometer scheme has potential for reaching sensitivities which are comparable to HEMT-based radiometry instrumentation working under cryogenic conditions.

Method of Presentation:
Oral with slides

Material to be Distributed to Attendees (if any):
Printed slides.