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**30th International Symposium on Space Terahertz Technology** 

## Proceedings Book

## 15-17 April 2019 Gothenburg, Sweden

Onsala Space Observatory, 25m telescope - photo J. Bodell

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List of Registered Symposium Participants

 $\mathbf{240}$ 

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Waveguide Band (GHz)	<b>WR28</b> 26-40	<b>WR15</b> 50-75	WR12 60-90	WR10 75-110	WR8 90-140	WR6.5 110-170	WR5.1 140-220	WR4.3 170-260	<b>WR3.4</b> 220-330	WR2.8 260-400	WR2.2 325-500	WR1.5 500-750	WR1.0 750-1,100	
<b>Dynamic Range</b> (BW=10Hz, dB, typ) (BW=10Hz, dB, min)	120 110	120 110	120 110	120 110	120 110	120 110	120 110	115 110	115 105	100 80	110 100	100 80	65 45	
Magnitude Stability (±dB)	0.15	0.15	0.15	0.15	0.15	0.25	0.25	0.3	0.3	0.5	0.5	0.4	0.5	
Phase Stability (±deg)	2	2	2	2	2	4	4	4	6	6	6	4	6	
<b>Test Port Power</b> (dBm)	13	13	13	11	6	9	-1	-2	-6	-10	-8	-25	-30	



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#### Committees

The Local Organizing Committee (LOC) was responsible for the planning and organizing activities. LOC also decided on accepting of the 6 late contributions in the Poster Session. The LOC consists of the following persons affiliated with the Chalmers University of Technology, Gothenburg, Sweden:

Belitsky Victor (Chair) Desmaris Vincent Pavolotsky Alexey Sjögren Paulina Stake Jan

The LOC can be reached at isstt2019info@gmail.com

The Scientific Advisory Committee (SAC) members were responsible for reviewing the abstracts and making recommendations on acceptance and format of presentation for each abstract. This Committee will also decide on the place and dates for the next ISSTT2020, proceedings publication policy and the Best PhD Student Contribution Award committee.

The SAC members are:

Andrey Baryshev	University of Groningen, the Netherlands
Victor Belitsky	Chalmers University of Technology, Sweden
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#### 2019 30th Insternational Symposium on Space Terahertz Technology (ISSTT 2019)

April 15 – 17, 2019, Gothenburg, Sweden

#### Technical Program<sup>1</sup>

<sup>&</sup>lt;sup>1</sup>In the Technical Program, it is only the submitting author names along with the titles of the contributions, which are listed. The full lists of authors could be found in the corresponding paper.

#### Monday, April 15, 2019

#### 08:45 – 09:00 Welcome

#### 09:00 – 10:20 Session I. Instruments, Devices and Technologies for Small Satellites *Chair: Vincent Desmaris*

- 09:00–09:20 Goutam Chattopadhyay Planetary/Cometary Submillimeter-Wave Instruments on Ultra-Small Platforms. Page 19
- 09:20–09:40 Maria Alonso del Pino Fly's Eye Lens Phased Array for Submillimeter-Wave Space Instruments. Page 20
- 09:40–10:00 Jonathan Hoh Development of an Integrated Dual-Band Schottky Receiver in the Terahertz Regime for Use in Cubesat Systems. Page 21
- 10:00–10:20 Christine P. Chen Design and Fabrication of Silicon Stacked Architecture for 2.06 THz Receiver Front End. Page 22

#### $10{:}50$ - $11{:}30$ Invited talk I

**Donal Murtagh**, *Chalmers University of Technology* - Mm and sub-mm spectroscopy in atmospheric science.

#### 11:30 - 12:30 Session II. Schottky Receivers and Technologies Chair: Jan Stake

- 11:30–11:50 Diego Moro-Melgar Reliability and Reproducibility of Discrete Schottky Diodes-Based Sources up to 370 GHz. Page 26
- 11:50–12:10 Jeanne Treuttel Development of Room-Temperature Schottky Diode Technology for applications in the Tera-Hertz ranges. Page 27
- 12:10–12:30 Karl Jacob Radiometric Performance of the 530 to 625 GHz Receiver Unit of the Submillimetre Wave Instrument on JUICEs. Page 28

#### 13:50 - 14:30 Invited talk II

**Karl-Friedrich Schuster**, *Institut de Radioastronomie Millimétrique* - General Development Strategies for Millimeter-wave Astronomy and historic and current approaches at IRAM.

#### 14:30 - 15:30 Session III. SIS Receivers and Mixers Chair: Christopher Groppi

- 14:30–14:50 Raymond Blundell A 1.3 mm Superconductor Insulator Superconductor Mixer Receiver with 40 GHz Wide Instantaneous Bandwidth. Page 33
- 14:50–15:10 Takafumi Kojima Performance of a 275-500 GHz SIS mixer with 3-22 GHz IF. Page 34
- 15:10–15:30 Wenlei Shan Experimental Study of a Monolithic Planar-integrated Dual Polarization Balanced SIS Mixer. Page 35

#### 16:00 - 17:00 Session IV. THz sources Chair: Imran Mehdi

- 16:00–16:20 Bertrand Thomas Digitally tunable 150 GHz Local Oscillator chian for the Submillimeter Wave Instrument onboard the ESA JUICE mission. Page 37
- 16:20–16:40 Jose V. Siles High-power broad-band room-temperature 2.46-2.70 THz LO sources to enable high-spectral resolution mapping of HD and [NII]. Page 38
- 16:40–17:00 Nickolay Kinev Superconducting flux-flow oscillator as the terahertz external local oscillator for heterodyne receiving. Page 39

#### 17:00 - 19:30 Poster Session

#### MM and Microwave Passive and Active Components

P1-1	Cristian López - Design and implementation of a broadband and compact 90-degree waveguide twist with simplified layout. Page 41
P1-2	Daniel Montofre - Study and Development of two Low-Cost and Easy-Construction Horn Antennas for Astronomy Applications. Page 44
P1-3	Jie Hu - Design of a Silicon-based $160-320\rm{GHz}$ tanh-profile wide-band Corrugated Horn. Page $46$
P1-4	Cristian Lopez - Broadband Waveguide-to-Substrate Transition Us- ing a Unilateral Etched Finline Structure. Page 47
P1-5	Hawal Rashid - Compact Wideband Passive and Active Component Chips for Radio Astronomy Instrumentation. Page $50$
P1-6	Isaac Lopez-Fernandez - Compact Cryogenic Wide-Band Balanced Amplifiers with Superconducting $90^\circ$ Hybrids for the IF of Submillimeter-Wave SIS Mixer. Page 57
P1-7	Patricio Mena - Modelling dielectric losses in microstrip traveling- wave kinetic-inductance parametric amplifiers. Page $63$
P1-8	Vincent Desmaris - Characterization of GaN-based Low Noise Amplifiers at Cryogenic Temperatures. Page $67$

- P1-9 Marko Neric Design and Prototyping of Novel Cryogenic Flexible Stripline Transmission Lines as an Alternative to Semi-Rigid Coaxial Cables. Page 69
- P1-10 Penghui Zheng A Robust 24-29 GHz Low Noise Amplifier with 1dB Noise Figure and 23 dBm P1dB. Page 72
- P1-11 Masui Sho Design of a Radio Frequency Waveguide Diplexer for Dual-band Simultaneous Observation at 210-375 GHz. Page 73

#### SIS Mixers and Receivers

- P2-1 Tobias Vos Advanced tuning algorithms for increasing performance of high-frequency SIS mixers. Page 76
- P2-2 Urs Graf CHAI, the CCAT-prime Heterodyne Array Instrument. Page 77
- P2-3 Kirill Rudakov 240 GHz DSB receiver performance. Page 78
- P2-4 Sina Widdig Design and Fabrication of an on-Chip Sideband Separating (2SB) Balanced SIS Mixer for 400 500 GHz on a  $9\,\mu\text{m}$  Silicon Membrane. Page 80
- P2-5 Andrey Khudchenko First Results of the Sideband Separating Mixer for 850 GHz. Page 81
- P2-6 Christophe Risacher Instrumentation development for the 2020 decade at the NOEMA and 30m telescopes. Page 83
- P2-7 Doug Henke Configuring the ALMA Band 3 Cartridge into a Balanced 2SB Receiver. Page 84

#### SIS technology and other processing

- P3-1 Matthias Kroug Barrier Reduction and Sub-gap Leakage in Niobium Based SIS Junctions. Page 86
- P3-2 Leonid Kuzmin Array of Multichroic Double-Slot Antennas with Cold-Electron Bolometers for the 220/240 GHz channels of the LSPE Instrument. Page 87
- P3-3 Alexey Pavolotsky Specific capacitance of Nb/Al-AlN/Nb superconducting tunnel junctions. Page 92
- P3-4 Alexander Lubenchenko Native oxide on ultra-thin NbN films. Page 95
- P3-5 Kah Wuy Chin Design of On-chip Broadband Band Selection Filter for Multi-chroic mm/submm Camera. Page 99
- P3-6 Jing Li NbN/AlN/NbN Superconducting Tunnel Junctions Fabricated for HSTDM. Page 100

#### HEB Mixers

P4-1	Narendra Acharya - ${\rm MgB}_2$ HEB Terahertz Mixers: Diffusion- or phonon- cooled? Page 101
P4-2	Andrey Trifonov - An ultrathin normal metal bolometer as a promis- ing terahertz mixer. Page 102

P4-3	Johanna Böhm - Development of a HEB mixer for the observation of molecular hydrogen on SOFIA. Page $104$
P4-4	Sergey Cherednichenko - MgB <sub>2</sub> HEB Mixers with Nanopatterned

- Surfaces: Effect on the Noise Temperature and the LO Power. Page 105
- P4-5 Wei Miao Development of a Ti hot electron bolometer based on Johnson noise thermometry. Page 106
- P4-6 Yoshihisa Irimajiri Measurements of Receiver Noise Temperature of a Ni-NbN HEBM at 2-THz band. Page 107

#### THz Optics and Devices

P5-1	Yuner Gan - Bandwidth of a 4.7 THz asymmetric Fourier grating. Page 109
P5-2	Eduard Driessen - A planar silicon metamaterial lens with integrated anti-reflection coating for frequencies around 150 GHz. Page 113 $$
P5-3	Behnam Mirzaei - Asymmetric phase grating as 4.7 THz beam multiplexer for GUSTO. Page $114$
P5-4	Shinsuke Uno - Development of mm/submm Frequency Selective Filters made with FPC Fabrication Technology. Page 117
P5-5	Tai Oshima - Development of mm/submm broadband anti-reflection coating exploiting the various expanded PTFEs measured with THz-TDS. Page $118$
P5-6	Cassandra Whitton - Design of a Narrow-band 600GHz Metamaterial Flat Focusing Element. Page $119$
P5-7	Sofia Rahiminejad - Low-loss Silicon MEMS Phase Shifter at 550 GHz. Page 122
P5-8	Haotian Zhu - Multilayer dielectric diagonal horn for reshaping THz QCL beam pattern. Page $123$
P5-9	Cecile Jung-Kubiak - Broadband Antireflective Silicon Optics for Terahertz instruments. Page 124
P5-10	Irmantas Kasalynas - Optical performance of laser-patterned high-resistivity silicon wafer in the frequency range of $0.1 - 4.7$ THz. Page 125

#### THz Sources

P6-1	Valery Koshelets - Spectral measurements of THz radiation from intrinsic BSCCO stacks; Phase locking of the DSCCO oscillators. Page 128
P6-2	Peter Sobis - 4.7 THz GaAs Schottky Diode Receiver Components. Page 133
P6-3	Josip Vukusic - Reliability assessment of GaAs and InP THz mixers and frequency multipliers fabricated on 3" wafers. Page $134$
P6-4	Leonid Revin - YBaCuO Josephson generators as THz sources for

	bolometer characterization. Page $135$
P6-5	Sajjad Mahdizadeh - A $4.7~\mathrm{THz}$ QCL phase locking experiment. Page $136$
P6-6	Fei Yang - A 900GHz Broadband Balanced Frequency Quadrupler. Page 137
P6-7	Peng Chen - A 410-510GHz Local Oscillation Source for SIS Mixers. Page 138
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P7-1	Axel Murk - Characterization of Digital Real-Time Spectrometers for Radio Astronomy and Atmospheric Remote Sensing. Page 139
P7-2	Grigoriy Bubnov - Astroclimate investigations review for coming radio astronomy projects. Page $143$
P7-3	Sylvain Mahieu - Atmospheric Phase Monitoring Interferometer for the NOEMA Observatory. Page $149$
P7-4	Igor Lapkin - New Optics for SEPIA – Heterodyne Facility Instrument for APEX Telescope. Page $150$
Antennas ar	nd Telescopes
P8-1	Hayato Takakura - Far-sidelobe Measurements of LiteBIRD Low Frequency Telescope Scaled Model. Page 155
P8-2	Xiaodong Ren - Holographic Measurement System for the CCAT- prime Telescope – System Design and Novel Software Approach. Page 157

#### Tuesday, April 16, 2019

#### 08:45 - 10:05 Session V. SIS Devices and Receivers Chair: Christophe Risacher

- 08:45–09:05 Edward Tong Noise Analysis of SIS Receivers Using Chain Noise Correlation Matrices. Page 163
- 09:05–09:25 Denis Meledin A 1mm SIS Receiver Utilizing Different IF Configurations. Page 164
- 09:25–09:45 Boon Kok Tan Noise Characterisation of a Flux-Pumped Lumped-Element Josephson Parametric Amplifier using an SIS Mixer. Page 168
- 09:45–10:05 John Garrett Multi-tone Spectral Domain Analysis of a 230 GHz SIS Device. Page 169

P8-3 Yuan Qian - Characteristics Investigation on Thermal Deformation of Large Size Terahertz Reflector Antenna in Space. Page 158

#### 13:50 - 14:30 Invited talk III

**Leonardo Testi**, European Organisation for Astronomical Research in the Southern Hemisphere - The ALMA 2030 Development Roadmap: science goals and instrument development vision.

#### 11:30 - 12:30 Session VI. Future Missions and Projects - I Chair: Patricio Mena

- 11:15–11:35 Paul Goldsmith A Space Mission to Probe the Trail of Water. Page 172
- 11:35–11:55 Christopher Groppi First Generation Heterodyne Instrumentation Concepts for the Atacama Large Aperture Submm/mm Telescope. Page 173
- 11:55–12:15 Andrei Smirnov Millimetron Space Observatory: progress in the development of payload module. Page 180

#### 13:30 - 14:10 Invited talk IV

**Paola Caselli**, *Max-Planck-Institute for Extraterrestrial Physics* - Astrochemistry at the dawn of star and planet formation.

#### 14:10 - 15:10 Session VII. THz Optics and Antennas Chair: Hiroshi Matsuo

- 14:10–14:30 Richard Hills Wide-Field Designs for Off-Axis Telescopes: Application to the Optics of CCAT-prime. Page 183
- 14:30–14:50 Andrey Baryshev In Flight Measurements System of Millimetron Primary Mirror Surface. Page 184
- 14:50–15:10 Jose Silva Far-field beam pattern technique for high pointing accuracy characterization of GUSTO HEB mixer arrays. Page 185

#### 15:40 - 17:20 Session VIII. HEBs and KIDs Chair: Gregory Goltsman

- $15:40-16:00 {\rm Yuan Ren Mid-infrared heterodyne receiver based on a super$ conducting hot electron bolometer and a quantum cascade laser. Page 187
- 16:00–16:20 Akira Kawakami 2 THz Hot Electron Bolometer Mixer using a Magnetic Thin Film. Page 188
- 16:20–16:40 Changyun Yoo Demonstration of a TACIT Heterodyne Detector at 2.5 THz. Page 191
- 16:40–17:00 Tess Skyrme Understanding dissipative behaviour in superconducting microresonators over a wide range of readout power. Page 192

17:00–17:20 Eduard Driessen - Increased multiplexing of kinetic-inductance detector arrays by post- characterization adaptation of the individual detectors. Page 193

#### 17:40 - 18:20 Session IX. Future Missions and Projects - II Chair: Valery Koshelets

- 17:40–18:00 Hiroshi Matsuo Prospects of High Angular Resolution Terahertz Astronomy from Antarctica. Page 195
- 18:00–18:20 Viacheslav Vdovin New stage of the Suffa Submm Observatory in Uzbekistan Project. Page 196

#### Wednesday, April 17, 2019

#### 08:45 - 10:05 Session X. Future Missions and Projects - III Chair: Edward Tong

- 08:45–09:05 Jose V. Siles COMETS Comets Observation & Mapping Enhanced THz Spectrometer at 210-580 GHz: Objectives and Development Status. Page 203
- 09:05–09:25 Martina Wiedner The Origins Space Telescope and the Heterodyne Receiver HERO. Page 204
- 09:25–09:45 Christopher Groppi The Terahertz Intensity Mapper (TIM): a Next-Generation Experiment for Galaxy Evolution Studies. Page 208
- 09:45–10:05 Satoshi Ochiai Study for proposal of SMILES-2 to JAXA M-class mission. Page 216

#### 10:35 - 11:15~ Invited talk V

**Susanne Aalto**, *Chalmers University of Technology* - Molecules as probes of galaxy evolution - exploring the hidden growth of galaxies.

#### 11:15 - 12:35 Session XI. QCL THz Sources Chair: Heinz-Wilhelm Hübers

- 11:15–11:35 Marc Mertens A Double-Metal QCL with Backshort Tuner. Page 221
- 11:35–11:55 Martin Wienold Frequency tuning of terahertz quantum-cascade lasers by optical excitation. Page 222
- 11:55–12:15 Till Hagelschuer A compact 4.7-THz source based on a high-power quantum-cascade laser with a back-facet mirror. Page 223
- 12:15–12:35 Yuner Gan 81-beam supra-THz local oscillator by a phase grating and a quantum cascade. Page 224

#### 13:45 - 15:25 Session XII. Radars, Systems, Backend Chair: Sheng-Cai Shi

- 13:45–14:05 Bernd Klein Digital high-resolution wide-band Fast Fourier Transform Spectrometer. Page 226
- 14:05–14:25 Ken Cooper Validation Measurements of Humidity Profiling in Rain Using a 170 GHz Differential Absorption Radar. Page 227
- 14:25–14:45 Theodore Reck Cold-Source Noise Temperature Measurements with a Vector Network Analyzer Frequency Extender at WR-6.5. Page 228
- 14:45–15:05 Gabriel Santamaria Botello On the Comparison Between Low Noise Amplifiers and Photonic Upconverters for Millimeter and Terahertz Radiometry. Page 229
- 15:05–15:25 David Monasterio A broadband down-conversion module for the extended W-Band. Page 233

#### 16:05 - 17:25 Session IV. New Devices and Technologies Chair: Jian-Rong Gao

- 16:05–16:25 Sergey Cherednichenko Quantum transport at Dirac point enables graphene for terahertz heterodyne astronomy. Page 236
- 16:25–16:45 Hajime Ezawa Design and Evaluation of SIS Photon Detectors at Terahertz Frequencies. Page 237
- 16:45–17:05 Wen Zhang Near infrared photon detectors using titanium-based superconducting transition-edge sensors. Page 238
- 17:05–17:25 Andrey Pankratov On-chip refrigerator integrated into a photonnoise-limited detector for high-performance Cosmology missions. Page 239