# **ISSTT 2017**

## March 13–15, 2017 Cologne | Germany

#### THE 28TH INTERNATIONAL SYMPOSIUM ON SPACE TERAHERTZ TECHNOLOGY

Hosted by the Kölner Observatorium für Submm-Astronomie (KOSMA), I. Physikalisches Institut, Universität zu Köln

# Overview for online proceedings

www.astro.uni-koeln.de/isstt2017



**Radiometer Physics** 

# **ISSTT 2017 in Cologne**



group photo

It was an honour to host the 28th International Symposium on Space Terahertz Technology (ISSTT 2017). The I. Physikalisches Institut of the Universität zu Köln (University of Cologne), also known as the Kölner Observatorium für Submm Astronomie (KOSMA), organized the conference that was held from March 13th to 15th 2017.

We want to thank all participants for their contribution.

# **Local Organizing Committee**

Patrick Pütz, Netty Honingh, Jürgen Stutzki, Frank Schlöder, Florian Blauth, Johanna Böhm, Denis Büchel, Sina Fathi, Sina Widdig

# **Scientific Organizing Committee**

The scientific organizing committee had met for during the lunch break on Monday. For this year we decided to invite all the reviewers, the traditional SOC members and a few more in order to have a more complete representation of the research groups worldwide. In particular, we wanted to express our gratitude towards the reviewers that ensured a fair and unbiased review process of all submissions.

Legend: <sup>x</sup> Reviewer, <sup>+</sup> not attending symposium.

Andrey Baryshev <sup>x</sup>	(University of Groningen, The Netherlands)
Victor Belitsky	(Chalmers University of Technology, Sweden)
Sergey Cherednichenko <sup>x</sup>	(Chalmers University of Technology, Sweden)
Tom Crowe	(Virginia Diodes Inc., USA)
Brian Ellison <sup>x +</sup>	(Rutherford Appleton Lab, UK)
Anne-Laure Fontana	(IRAM, France)
Jian-Rong Gao	(TU Delft, SRON)
Gregory Goltsman <sup>x</sup>	(Moscow State Pedagogical University, Russia)
Christopher Groppi <sup>x</sup>	(Arizona State University, USA)
Jeffrey Hesler <sup>x</sup>	(Virginia Diodes Inc., USA)
Netty Honingh <sup>x</sup>	(University of Cologne, Germany)
Heinz-Wilhelm Hübers <sup>x</sup>	(DLR Institute of Planetary Research, Germany)
Boris Karasik	(Jet Propulsion Laboratory, USA)
Valery Koshelets <sup>x</sup>	(Kotelnikov IREE RAS, Moscow, Russia)
Arthur Lichtenberger <sup>x +</sup>	(University of Virginia, USA)
Alain Maestrini <sup>x</sup>	(LERMA, CNRS, France)
Imran Mehdi <sup>x</sup>	(Jet Propulsion Laboratory / Caltech, USA)
Patrico Mena	(Universidad de Chile, Chile)
Patrick Pütz <sup>x</sup>	(University of Cologne, Germany)
Christophe Risacher <sup>x</sup>	(Max Planck Institute for Radio Astronomy, Germany)
Yutaro Sekimoto <sup>x +</sup>	(National Astronomical Observatory of Japan, Japan)
Sheng-Cai Shi <sup>x</sup>	(Purple Mountain Observatory, China)
Jan Stake <sup>+</sup>	(Chalmers University of Technology, Sweden)
Karl Schuster <sup>x +</sup>	(Institut de Radioastronomie Millimétrique, France)
Edward Tong <sup>x</sup>	(Harvard-Smithsonian Center for Astrophysics, USA)
Yoshinori Uzawa	(NICT, Japan)
Christopher Walker <sup>x +</sup>	(University of Arizona, USA)
Ghassan Yassin	(Oxford University, UK)

# **Invited talks**

We were happy to present invited contributions from following speakers:

Alfred Krabbe (Deutsches SOFIA Institut, University of Stuttgart)

"SOFIA, the First Three Years of Full Operation"

Teun M. Klapwijk (Kavli Institute of Nanoscience, Delft University of Technology)

"Engineering the physics of superconducting hot-electron bolometer mixers"

Stephan Schlemmer (I. Physikalisches Institut, Universität zu Köln)

"Application of Terahertz Technologies in Laboratory Astrophysics"

### Website

For detailed information on the conference and the final version of the abstract book in pdf format, please refer to the website:

#### http://www.astro.uni-koeln.de/isstt2017

# Sponsors

We greatly value the contribution of our sponsors.

Raith GmbH and Radiometer Physics GmbH have a booth in our coffee break room.



Sonderforschungsbereich / Collaborative Research Council 956 funded by the Deutsche Forschungsgemeinschaft DFG

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http://www.radiometer-physics.de

Beside our standard products for mmWave & Terahertz and Microwave Remote Sensing we are specialists in customized solutions for space projects.

In cooperation with the University of Cologne we developed the 4.7 THz electroformed smooth-wall spline feedhorns for the HEB mixers of the upGREAT instrument onboard SOFIA aircraft.





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RF section of a 1.9 THz waveguide HEB device with microbridge for SOFIA Karl Jacobs, KOSMA, University of Cologne, Germany

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# **Overview of program**

Time	Sunday Mar 12th	Monday Mar 13th	Tuesday Mar 14th	Wednesday Mar 15th	Thursday Mar 16th
8:00 AM					
8:30 AM		Registration			
9:00 AM		Welcome	Inv. talk T. Klapwijk	Inv. talk S. Schlemmer	
9:30 AM		Session M1	Session T1	Session W1	
10:00 AM		Receivers 1	Superconductor Devices	MKID	
10:30 AM		(4 talks)	(4 talks)	(4 talks)	
10:50 AM		Coffee break	Coffee break	Coffee break	
11:20 AM		Casaian MD	Session T2		
11:50 AM		Mixers & Backends	HEB Device	Optics & Waveguide	
12:10 PM		(4 talks)	(4 talks)	(4 talks)	
12:40 PM		Lunch break and SOC	l unab break	l unab break	
1:10 PM		lunch meeting	Lunch break	Lunch break	Excursion to the Effelsberg radio
2:00 PM		Inv. talk A. Krabbe	Section T2	Cassian W/2	telescope
2:30 PM		Session M3	Receivers 2	Session ws Sources	only 40 seats)
3:00 PM		Space & Calibration	(5 taiks)	(5 taiks)	
3:40 PM		(5 taiks)	Coffee break	Coffee break	(near Physics
4:10 PM		Coffee break	Section T4	Session W4	building)
4:40 PM			Supra-THz Mixers	Semiconductor Devices & Receivers	return around 6:00 PM
5:10 PM		Poster Session (cont'd to Wedn.)	(5 taiks)	(4 talks)	
5:50 PM		· · · ·		Wrap-up & Farewell	
6:00 PM					
6:30 PM	Registration	Tour of institute I		Tour of institute II	
7:00 PM	and Welcome		Reception for		
7:30 PM	at the		(Wolkenburg)		
8:00 PM	vvoikenburg				
8:30 PM					
9:00 PM					
9:30 PM			Conference dinner		
10:00 PM			at the Wolkenburg		
10:30 PM					
11:00 PM					
11:30 PM					
12:00 AM					Version V.1.4 Mar 09 2017

# Symposium schedule

#### Sunday, March 12

6:00 PM	Welcome Reception and	Wolkenburg, Mauritiussteinweg 59
	Registration	
9:00 PM	End	

#### Monday, March 13

8:00 AM 9:00 AM	Registration Welcome	seminar rooms in front of lecture hall lecture hall
		"Großer Hörsaal Botanik" Gyrhofstr. 15
Session M1	Receivers 1	Chair: Edward Tong
9:30 AM	The upGREAT THz heterodyne 1.9 THz and 4.7 THz first result	e arrays for SOFIA: ts
	Christophe Risacher	Max-Planck-Institute for Radio Astronomy
9:50 AM	Demonstration and stabilizatior based on a Fourier phase grati José Silva	n of a 4x2 HEB array receiver at 1.4 THz ng LO SRON
10:10 AM	The Ice Cloud Imager Front En Preliminary Design and Results	d Receivers onboard MetOp-SG satellite - s
	Bertrand Thomas	Radiometer Physics GmbH
10:30 AM	Stratospheric Terahertz Observ McMurdo, Antarctica	vatory 2016, Sub-orbital flight from
	Abram Young	University of Arizona
10:50 AM	Morning Coffee Break, 30 min seminar rooms in front of lectur	n <sup>.</sup> e hall
Session M2	Mixers & Backends	Chair: Christopher Groppi
11.00 AM		

11:20 AM A High-Performance 650 GHz Sideband-Separating Mixer — Design and Results Ronald Hesper University of Groningen

11:40 AM	67-116 GHz receiver developm Pavel Yagoubov	ent for ALMA Ban European Southe	d 2+3 ern Observatory (ESO)
12:00 PM	Achieving Ultra-High Sideband Millimeter Receivers	Separation in Milli	meter and Sub-
	Patricio Mena	Universidad de C	hile
12:20 PM	Back-ends for THz systems: Fa Bernd Klein	ast Fourier Transfo Max-Planck-Instit	rm Spectrometer tute for Radio Astronomy
12:40 PM	Lunch Break, 100 min walk to University "Mensa" dini	ng hall (for those w	vith lunch tickets)
Invited talk 1			Chair: Imran Mehdi
2:00 PM	SOFIA, the First Three Years of Alfred Krabbe	of Full Operation Deutsches SOFI University of Stut	A Institut, tgart
Session M3	Space & calibra	tion	Chair: Andrey Baryshev
2:30 PM	The Far Infrared Spectroscopic in the Universe	Explorer: probing	the lifecycle of the ISM
	Dimitra Rigopoulou	University of Oxfo	ord
2:50 PM	Spaceborne superconducting s atmosphere observation	ounder (SMILES-2	2) for the upper-
	Satoshi Ochiai	NICT	
3:10 PM	RF and thermal aspects of the Microwave Sounder Instrument	ground calibration t	system for the
	Manju Henry	RAL Space	
3:30 PM	Development of Calibration Tai Arne Schröder	rgets for MetOp-SC University of Berr	G Microwave Instruments า
3:50 PM	165-229 GHz Front End Receiv Microwave Imager Instruments Design and Results Simon Rea	vers for the Microw onboard MetOp-S	ave Sounder and G satellites - Preliminary
4:10 PM	Afternoon Coffee Break, 30 n	nin, and start of	
	seminar rooms in front of lectur	re hall	

Poster Session		seminar rooms in front of lecture hall
	note: posters can stay up until	noon Wednesday
P01	withdrawn	
P02	A 350 GHz waveguide coupled Florian Blauth	MKID design University of Cologne
P03	Design of simply structured me Johanna Böhm	tamaterial filters at sub-THz frequencies University of Cologne
P04	1.9 THz balanced superconduc integrated on chip	ting Hot Electron Bolometer mixer fully
	Sina Fathi	University of Cologne
P05	Schottky components for ESA Oleg Cojocari	MetOp SG space mission ACST GmbH
P06	Design and optimization of wide	eband micro-patterned quasi-optical
	Jake Connors	Harvard University
P07	Micro-Machined Integrated Wa Feedhorn Blocks	veguide Transformers in THz Pickett-Potter
	Kristina Davis	Arizona State University
P08	The SAFARI grating spectrome	eter for SPICA
	Gerhard de Lange	SRON
P09	Design of Planar Antenna Array Duccio Delfini	ys for Heterodyne Receivers Paris Observatory, PSL
P10	Spectral Domain Simulation of	SIS Frequency Multiplication
	John Garrett	University of Oxford
P11	Wideband waveguide power co Local Oscillator	ombiner for ALMA Band 7+8 (275-500 GHz)
	Alvaro Gonzalez	National Astronomical Observatory of Japan
P12	withdrawn	
P13	Modelling proximity effects in x space-based applications	-ray Transition Edge Sensors (TESs) for
	Rebecca Harwin	University of Cambridge

P14	A Four Pixel Smooth Walled Andre Hector	Feed Horn Array Operating at 1.4 THz University of Oxford
P15	Evaluation of aperture efficier a wide field-of-view telescope	ncy by using ray-tracing software in designing
	Hiroaki Imada	ISAS / JAXA
P16	Simultaneous phase-locking o comb generator	of two THz-QCLs using an HEBM and a
	Yoshihisa Irimajiri	NICT
P17	Development of Quantum Ca detection	scade Lasers at 2.7 THz for Heterodyne
	Francois Joint	Paris Observatory, LERMA
P18	A 4.745 THz Local Oscillator	for the upGREAT receiver
	Matthias Justen	University of Cologne
P19	Superconducting diamond filr detectors	ns as perspective material for direct THz
	Anna Kardakova	Moscow State University of Education
P20	Measurement of THz perform aluminum	ance of plasmonic absorbers made of bulk
	Irmantas Kasalynas	Center for Physical Sciences & Technology
P21	Study of mid infrared hot elec	tron bolometer mixers
	Akira Kawakami	NICT
P22	Performance of SIS mixers for	or upgrade of CHAMP+ 7-pixel arrays
	Апагеу Клиаспепко	University of Groningen / NOVA
P23	The Advanced Microwave Ra Instrument for Sentinel-6	idiometer – Climate Quality (AMR-C)
	Jenna Kloosterman	Jet Propulsion Laboratory
P24	Performance of a wide IF SIS (385-500 GHz)	-mixer-amplifier module for ALMA band 8
	Takafumi Kojima	National Astronomical Observatory of
P25	Material Study for a THz SIS	Mixer
	Matthias Kroug	National Astronomical Observatory of Japan
P26	A Terahertz Time-Domain Re	flectometer
	Bram Lap	University of Groningen

P27	withdrawn	
P28	Feasibility Studies on Photon C Hiroshi Matsuo	Counting Terahertz Interferometry National Astronomical Observatory Japan
P29	Dielectric deposition for tuning lasers	the frequency of THz quantum cascade
	Behnam Mirzaei	Delft University of Technology
P30	4 and 8-pixel THz Fourier phas Behnam Mirzaei	e gratings Delft University of Technology
P31	Design of an Optical Beam Col ALMA	mbiner for Dual Band Observation with
	Daniel Montofre	University of Groningen
P32	As grown ultra-thin MgB2 films Evgenii Novoselov	for superconducting detectors Chalmers University of Technology
P33	InGaAs Schottky technology fo Diego Pardo	r THz mixers STFC-Rutherford Appleton Laboratory
P34	Frequency triplers at 94 GHz a Carlos Pérez-Moreno	nd 300 GHz for millimeter-wave radars Technical University of Madrid
P35	A cryogenic solid state LO sou Nicolas Reyes	rce at 1.9THz Universidad de Chile
P36	A 211-275 GHz receiver protot Kirill Rudakov	ype University of Groningen
P37	AC-Biased Superconducting H Frequency-Domain Multiplexing	ot-Electron Bolometric Direct Detector for g
	Sergey Seliverstov	Moscow State Pedagogical University
P38	Design and Fabrication of a Du Integrated Circuit	al-Polarization, Balanced SIS Mixer
	Wenlei Shan	National Astronomical Observatory of Japan
P39	Design of Large-Band Room-T Receivers for Planetary Science	emperature On-Chip Diplexed Schottky
	Jose V. Siles NASA	Jet Propulsion Laboratory
P40	Millimetron Space Observatory Andrei Smirnov	, Lebedev Physical Institute

presenter: Thijs de Graauw

P41 withdrawn

P42	Cryogenic IF Balanced LNAs B	ased on Superconducting Hybrids for
	Wideband 2SB THz receivers	
	Erik Sundin	Chalmers University of Technology

- P43 An 8-Pixel Compact Focal Plane Array with Integrated LO Distribution Network Boon Kok Tan University of Oxford
- P44 An All Solid-State Receiver at 2 THz for Atmospheric Sounding Jeanne Treutel, Jet Propulsion Laboratory presenter: Imran Mehdi
- P45 Theoretical consideration of SIS up-converters for frequency division multiplexing Yoshinori Uzawa NICT
- P46 Pre-prototype ALMA Band 2+3 Down-Converter & Local Oscillator System Hui Wang STFC-Rutherford Appleton Laboratory
- P47 Noise Temperature of a Wideband Superconducting HEB mixer Kangmin Zhou Purple Mountain Observatory
- P48 GREAT's Internal Beam Scanner Urs Graf University of Cologne
- P49 Resonant Modes in Parallel Josephson Junction Arrays for Submm Oscillator Applications
   Faouzi Boussaha Observatoire de Paris

Tour of institute (part 1)

I. Physikalisches Institut, Zülpicher Str. 77

6:00 PM Walk to institute 7:30 PM End

Tuesday, March '	14	
Invited talk 2		Chair: Gregory Goltsman
9:00 AM	Engineering the physics of sup Teun Klapwijk	erconducting hot-electron bolometer mixers Kavli Institute of Nanoscience, Delft University of Technology
Session T1	Superconductor devices	Chair: Sergey Cherednichenko
9:30 AM	THz Heterodyne Sensors Using Boris Karasik	g Superconducting MgB2 Jet Propulsion Laboratory
9:50 AM	Shot Noise in NbN/AlN/NbN Su Dong Liu	uperconducting Tunneling Junctions Purple Mountain Observatory
10:10 AM	Effect of local non-uniformities capacitance of Nb/Al-AlOx/Nb product	of the tunnel barrier on the specific SIS junctions with extremely low RnA
	Parisa Yadranjee Aghdam	Chalmers University of Technology
10:30 AM	Titanium nitride for kinetic-indu an engineering opportunity?	ctance detectors: a problematic material or
	Eduard Driessen	IRAM
10:50 AM	Morning Coffee Break, 30 min seminar rooms in front of lectur	<b>n</b> re hall
Session T2	HEB device development	Chair: Boris Karasik
11:20 AM	MgB2 THz HEB mixer with an Sergey Cherednichenko	11GHz bandwidth Chalmers University of Technology
11:40 AM	IF bandwidth of NbN HEB mixe oscillator frequency	ers on GaN buffer layer at 2 THz local
	Sergey Antipov, presenter: Gregory Goltsman	Moscow State Pedagogical University
12:00 PM	Design of a wideband balanced buffer-layer for the 1-1.5 THz b	d waveguide HEB mixer employing a GaN and
	Sascha Krause	Earth and Space Science, Chalmers
12:20 PM	MgB2 THz HEB mixer operatio Evgenii Novoselov	n from 5K till 20K Chalmers University of Technology

12:40 PM	Lunch Break, 100 min walk to University "Mensa" dini	ng hall (for those with lunch tickets)
Session T3	Receivers 2	Chair: Jacob Kooi
2:00 PM	The wSMA receivers - a new w Submillimeter Array Paul Grimes	ideband receiver system for the Harvard-Smithsonian Center for Astrophysics
2:20 PM	NOEMA Receivers: Upgrade fo Anne Laure Fontana	or simultaneous dual band observations IRAM
2:40 PM	A Cartridge-type Multi-pixel Re GLT Yen-Ru Huang	ceiver for the 1.5 THz Frequency Band of ASIAA
3:00 PM	4GREAT: A multiband extension Carlos Duran	on of GREAT from 490 GHz to 2.7 THz Max-Planck-Institute for Radioastronomy
3:20 PM	Results from the Kilopixel Array 6mm 650 GHz Heterodyne Mix Permanent Magnet Christopher Groppi	/ Pathfinder Project (KAPPa): a 6mm × er Pixel with Integrated SiGe LNA and Arizona State University
3:40 PM	Afternoon Coffee Break, 30 n seminar rooms in front of lectur	nin re hall
Session T4	Supra-THz mixers	Chair: Sheng-Cai Shi
4:10 PM	Development of a 16-pixel mon HEB mixer Jonathan Kawamura	olithic 1.9 THz superconducting waveguide Jet Propulsion Laboratory
4:30 PM	4.7 THz flight mixers for upGRE Patrick Pütz	EAT University of Cologne
4:50 PM	4-Pixel Heterodyne Receiver at Jenna Kloosterman	t 1.9 THz using a CMOS Spectrometer Jet Propulsion Laboratory
5:10 PM	Performance of NbN and NbTil upGREAT	N HEB waveguide mixers for GREAT and
5:30 PM	Silicon Micromachined Integrat Goutam Chattopadhyay	ed 4-Pixel Heterodyne Receiver at 1.9 THz NASA-JPL/Caltech

Conference dinne	er	Wolkenburg, Mauritiussteinweg 59
7:00 PM 8:00 PM	Reception Dinner	walk from institute
Midnight	End	
Wednesday, Mar	ch 15	
Invited talk 3		Chair: Netty Honingh
9:00 AM	Application of Terahertz Techr Stephan Schlemmer	nologies in Laboratory Astrophysics I. Physikalisches Institut, University of Cologne
Session W1	MKID	Chair: Karl Jacobs
9:30 AM	Performance and surface wave inductance detector arrays Andrey Baryshev	e reduction in large monolithic kinetic University of Groningen
9:50 AM	Deep Neural Networks for Tun Rupert Dodkins	ing MKID Digital Readouts University of Oxford
10:10 AM	The effects of changes in bath Detectors	temperature on Kinetic Inductance
	Tejas Guruswamy	University of Cambridge
10:30 AM	Photon-Counting with KID Res Spectroscopy	conators for THz/Submillimeter Space
	Omid Noroozian	NRAO / NASA GSFC
10:50 AM	Morning Coffee Break, 30 min seminar rooms in front of lecture	n re hall, <b>note: please remove posters</b>
Session W2	Optics & Waveguide	Chair: Ghassan Yassin
11:20 AM	Compact diffractive optics for T Linas Minkevicius	ΓHz imaging Center for Physical Sciences and Tech.
11:40 AM	Complex Beam Mapping of La Kristina Davis	rge MKID Focal Plane Arrays Arizona State University

12:00 PM	A spline-profile diagonal horn v lobes, suitable for integration in Hugh Gibson	with low cross-polarization and reduced side nto waveguide split-block THz devices. Gibson Microwave Design EURL	
12:20 PM	Measurement and design of a waveguide probe based WR3.4 optically controlled modulator		
	Jake Connors	Harvard University	
12:40 PM	Lunch Break, 100 min walk to University "Mensa" dining hall (for those with lunch tickets)		
Session W3	Sources	Chair: Jiang-Rong Gao	
2:00 PM	Ultra-Compact THz Multi-Pixel Local Oscillator Systems for Balloon-born Airborne and Space Instruments		
	Jose V. Siles	NASA Jet Propulsion Laboratory	
2:20 PM	A continuous wave terahertz m cascade laser	nolecular laser pumped by a quantum	
	Jean-Francois Lampin	IEMN/CNRS	
2:40 PM	Local Oscillator for a 4.7-THz Multi-Pixel Heterodyne Receiver Based on a Quantum-Cascade Laser		
	Heiko Richter presenter: Heinz-Wilhelm Hübers	German Aerospace Center (DLR)	
3:00 PM	A single-mode BCB-embedded quantum cascade laser for het Lorenzo Bosco	d antenna-integrated continuous wave erodyne measurement at 4.745 THz ETH Zürich	
3:20 PM	Solid State Terahertz Sources Thomas Crowe	Virginia Diodes, Inc.	
3:40 PM	Afternoon Coffee Break, 30 min seminar rooms in front of lecture hall		
Session W4	Semiconductor devices and	receivers Chair: Jeffrey Hessler	
4:10 PM	Local oscillator requirements and noise performance of a cryogenic 360 GHz Schottky diode subharmonic mixer Diego Pardo RAL Space		

Spectroscopy around 245 GHz based on a SiGe Transmitter and 4:30 PM

	Heterodyne Receiver		
	Nick Rothbart	German Aerospace Center	
4:50 PM	The diode heterostructures for THz devices		
	Dmitry Pavelyev	Lobachevsky State University	
		N. Novgorod	
5:10 PM	Qualification of Direct Detectior	n Technology for ESA MetOp-SG Space	
	Matthias Hoefle	ACST GmbH	
5:30 PM	Wrap-up & Farewell		

#### Tour of institute (part 2)

I. Physikalisches Institut, Zülpicher Str. 77

6:00 PM Walk to institute 7:30 PM End

#### Thursday, March 16

#### Excursion to Effelsberg Radio Telescope

- 12:15 PM departure behind Physics building, see map
  - 6:00 PM approx. return