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NEWS LETTER

on Superconducting Electronics

S-PULSE
Shrink-Path of Ultra-Low Power Superconducting Electronics
www.S-PULSE.eu

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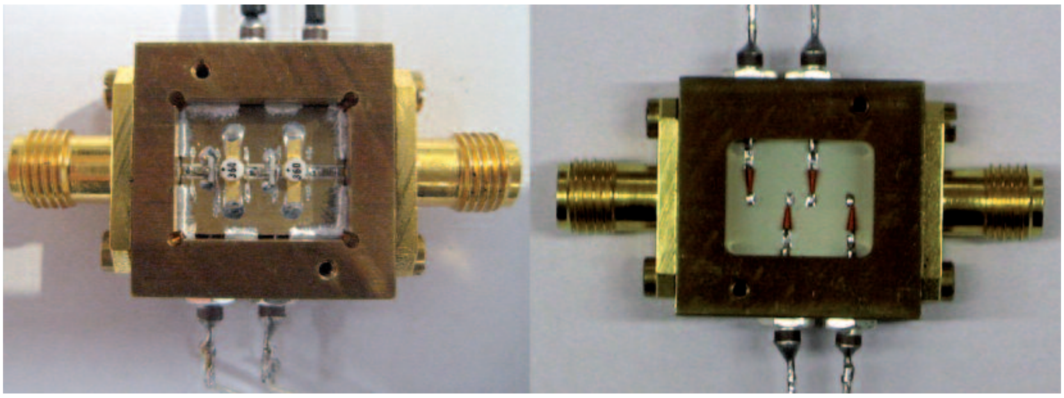
DEVELOPMENTS OF INTERFACE AMPLIFIERS FOR DETECTOR & RSFQ APPLICATIONS IN A CRYOGENIC ENVIRONMENT

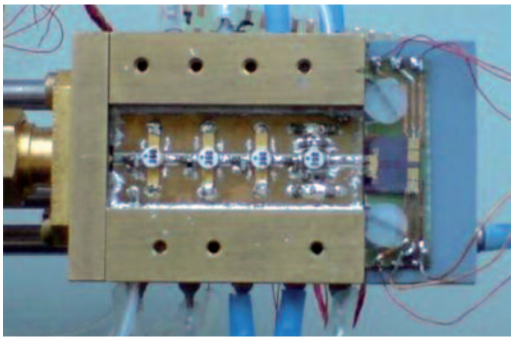
by Stefan Wuensch

Institut fuer Mikro- und Nanoelektronische Systeme Universitaet Karlsruhe, Germany



Micrograph of a two stage coplanar amplifier with separated RF (left hand side) and DC (right hand side) part at different sides of the PCB.

The interfacing between cryogenic and room temperature electronics or even between different cryogenic stages is a challenging field for amplifier design. Opposed requirements, namely low power consumption, high voltage gain and extremely high bandwidth at the same time complicate enormously the development for such type of amplifiers. These amplifiers can be useful in detector systems or as high-speed RSFQ readout.

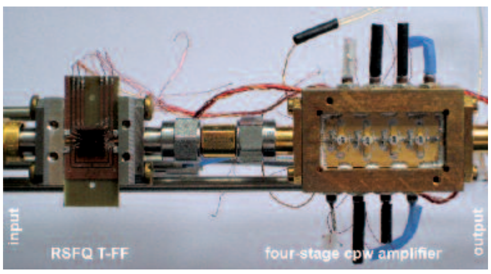


Micrograph of the combination of a four stage coplanar amplifier (left hand side) and the Josephson array quantizer (right hand side). The Josephson array quantizer chip was developed and fabricated at the IPHT Jena.

The core element of our amplifier developments was a commercial available p-HEMT transistor which allows a low power consumption operation. Thus it was possible to reduce the total power consumption to values less than 10 mW even for the four-stage versions at 4.2 K. At the same time, the amplifiers performed a large bandwidth and voltage gain. Our amplifiers were embedded in a microwave design using a CPW transmission line technique which offered the advantage to separate the RF and DC part to the top and bottom of the printed circuit board (PCB). They are built-in gold-coated brass housings whereas the SMA connectors are easily removable to allow a direct connection between detector or RSFQ circuitry and amplifier at chip level via bond wires.

After the design process, the multi-stage amplifiers were characterized and tested in different setups at liquid helium temperature. They showed a high sensitive input and no pulse distortion during pulse operation mode. The excellent pulse transmission of the amplifiers was demonstrated in combination with a Josephson array quantizer (JA-Q) chip from IPHT Jena which was fabricated in the Fluxonics foundry [1]. Furthermore we measured the applicability as high-speed interface in combination with a RSFQ Toggle Flip-Flop from the RSFQ design group in Ilmenau. In this case we have demonstrated data rates up to 3 Gbps [2]. This limitation could be allocated to the present crosstalk between the input and output of the RSFQ chip.

The overall performance of our amplifiers can be summarized by a bandwidth BW ≈ 12 (15) GHz, power consumption $P_V \approx 4$ (8) mW, voltage gain $A_V \approx 20$ (35) dB and a noise temperature of 60 K at liquid helium temperature (values in parenthesis are valid for the four-stage versions).



Micrograph of the connected combination RSFQ Toggle Flip Flop and four-stage coplanar amplifier ready for measurements. In- and output lines were coaxial semi-rigid cables. After assembling the devices a cryoperm shield tube was installed and the whole setup cooled with liquid helium.

[1] S. Wuensch, et al., Cryogenics, 2009, doi:10.1016/j.cryogenics.2008.12.021

[2] S. Wuensch, et al., IEEE Trans. On Appl. Superconductivity, Vol. 19, Issue 3, Part 1, pp. 574-579, June 2009. doi:10.1109/TASC.2009.2018425

www.FLUXONICS.org

by Hideo Suzuki

Low Temperature Superconducting Device Laboratory, Superconductivity Research Laboratory, International Superconductivity Technology Center, Koto-ku, Tokyo, 135-0062, Japan

PROGRESS OF THE I/O INTERFACE, CRYOPACKAGE, AND CRYOSYSTEM FOR SUPERCONDUCTING ELECTRONICS AT ISTEC-SRL

Technology for system level implementation of superconducting electronics

>> High speed input/output interfaces, cryopackaging and a cryocooling system have been developed for superconducting electronics at ISTEC, which is supported by the New Energy and Industrial Technology Development Organization (NEDO) as Development of Next-Generation High-Efficiency Network Device Project.

>> Several kinds of output interface circuits for converting an SFQ pulse to some voltage level (SQUID, AC stacked, and DC latch drivers) have been developed, which have a trade-off in occupation area, operating speed, output voltage etc. The AC stacked driver with the SRL-2.5K-Nb process improved the operation speed up to 9 Gbit/s with a return-to-zero 5 mV output level by adopting recently a ground hole under the stacked junctions [1]. The DC latch driver containing a self-resetting L-R circuit with the SRL-2.5K-Nb process also operated up to 6 GHz with return-to-zero 2 mV output [2]. The SQUID driver using sixteen SQUIDs with the SRL-10K-Nb process, which have a larger occupation area than the other drivers, operated up to 10 Gbit/s and 25 Gbit/s with 2 mV at return-to-zero and non-return-to-zero format, respectively [3-4]. The uni-traveling-carrier photodiode (UTC-PD) operating at low-temperature (4 K) with non-magnetic packaging was developed for superconducting electronics. Optical input links using the UTC-PD and the PD-SFQ converter for converting PD output signal to SFQ signal have been developed. An optical signal was applied using a room temperature optoelectronic signal source through an optical fiber to the UTC-PD cooled to 4 K in the cryocooler system. High-bit-rate over 50-Gbit/s operation was confirmed [5-6].

>> Cryopackaging technology, which includes multi-chip modules (MCMs) using flip chip bonding and cryoprobes, was developed for implementing practical superconducting electronic systems. Small size (50 um in diameter) and reduced height (8 um) of the InSn solder bumps enable the propagation of SFQ pulses between chips through the bumps and MCM carrier [7].

>> A prototype liquid helium free cryocooling system with the UTC-PD, MCM, and cryoprobing module has been developed using a two stage 4K-GM cryocooler and used for demonstrating high-speed operation of SFQ circuits. A low noise GaAs cryogenic amplifier with a bandwidth of 25 GHz operated at 50 K was successfully developed in collaboration with SHF Communication Technologies AG [8] and was installed into the cryostat. Using the cryocooling system and the SFQ chip which consisted of a PD to SFQ signal converter, DEMUX and SQUID drivers, we have achieved 47 Gbit/s optical input and 23.5 Gbit/s x 2 output link experiments between 4 K and 300 K [6].

>> Recently, the National Institute of Advanced Industrial Science and Technology (AIST) and ISTEC have demonstrated a Josephson arbitrary waveform synthesizer (JAWS) driven by programmed high-data-rate optical pulse trains for a future high precision quantum ac voltage standard using the ISTEC's cryocooling system, which is well suited to this metrology application [9-10]. The chip is designed with an overdamped Josephson junction array (JJA), an NbN-based superconductor/ normal metal/ insulator/ superconductor (SNS) array or superconductor/ insulator/ normal metal/ insulator/ superconductor (SINIS) array. Unipolar sine waves were successfully generated in the frequency range from 60 Hz to 152 kHz with amplitude of about 1mV.

[1] H.Suzuki et al., International Superconductive Electronics Conference Extended Abstract, (2009), SP-P11.

[2] H.Suzuki et al., IEEE Trans. Appl. Supercond., 19 (2009), 611-616.

[3] Y.Hashimoto et al., IEICE Trans. Electron., E91-C (2008), 325-332.

[4] Y.Hashimoto et al., IEEE Trans. Appl. Supercond., 19 (2009), 1022-1025.

[5] H. Suzuki, T. Hato, M. Maruyama, H. Wakana, K. Nakayama, Y. Ishimaru, O. Horibe, S. Adachi, A. Kamitani, K. Suzuki, Y. Oshikubo, Y. Tarutani, K. Tanabe, T. Konno, K. Uekusa, N. Sato, and H. Miyamoto, Physica C 426-431, pp. 1643-1649, 2005.

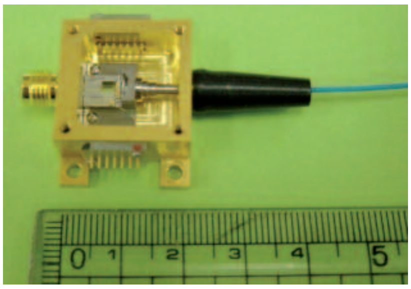
[6] Y.Hashimoto et al., Electronics letters vol. 45 No.1, January (2009).

[7] Y.Hashimoto et al., Appl. Phys. Lett., 87 (2005), 022502.

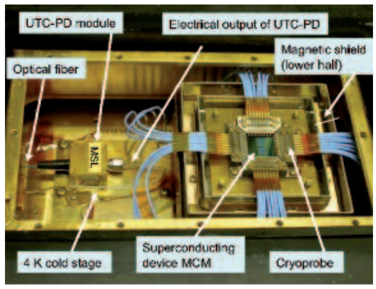
[8]http://www.shf.de/en/communication/products/rf_broadband_products_for_cryogenic_applications/

[9] M. Maruyama et al., International Superconductive Electronics Conference Extended Abstract, (2009), HF-P24.

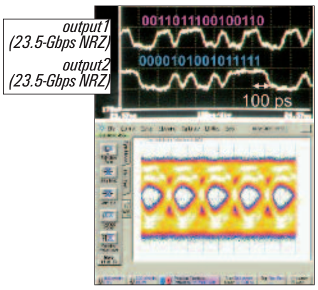
[10] C. Urano et al.,International Superconductive Electronics Conference Extended Abstract, (2009), HF-01.



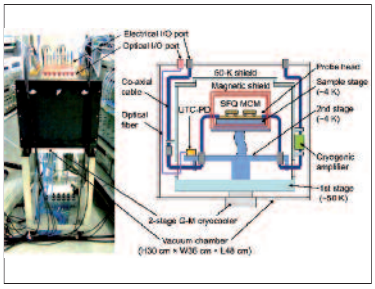
Custom made UTC-PD module operable at 4K for superconducting devices, which use non-magnetic package and direct coupling between the optical fiber and the photodiode chip.



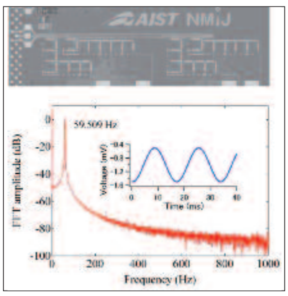
Arrangement on the 4 K cold stage in the cooling system, which included cryoprobe with MCM surrounded by double magnetic shield (right side), and the UTC-PD module operable at 4 K to introduce high frequency optical signal into the cryostat through optical fiber.



Optical Input data link and electrical output data link experiments have been successfully performed, where 47 Gbit/s NRZ optical signal was fed to UTC-PD on 4 K stage through optical fiber and 23.5 Gbit/s x 2 electrical signal was read with SQUID drivers. The above waveforms show the output signal and the lower shows the eye diagram of output1.



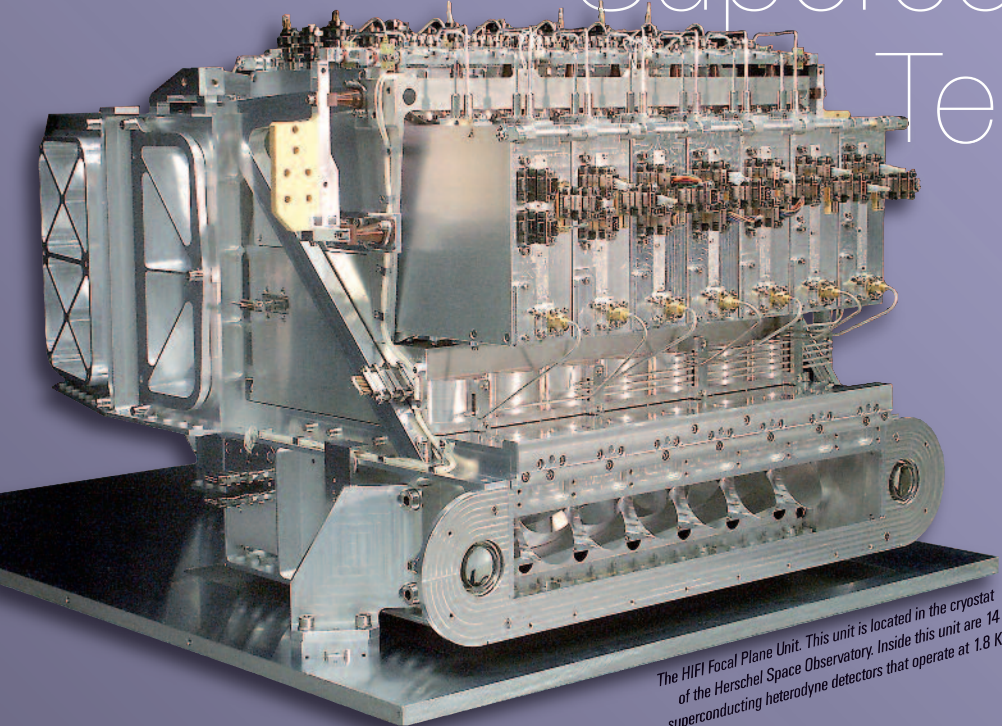
4 K cryocooling system for superconducting devices. Left picture of the system. Right: cross-sectional illustration.



Josephson junction array (JJA) chip fabricated with NbN based SNS junctions (photograph). Frequency spectrum of a synthesized 59.509 Hz sine wave signal with the overdamped JJAs excited with programmed optical pulse trains (trace). The inset is the synthesized output waveforms, where the experiment has been conducted with ISTEC's cryocooling system.

Superconducting Technology Highlight

Performance of the Superconducting mixers on-board of the Herschel Space Observatory

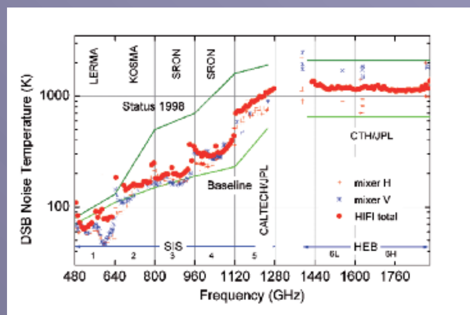


The HIFI Focal Plane Unit. This unit is located in the cryostat of the Herschel Space Observatory. Inside this unit are 14 superconducting heterodyne detectors that operate at 1.8 K.

by Gert de Lange

SRON Netherlands Institute for Space Research

After several years of development and qualification the Herschel Space Observatory (HSO) was successfully launched on May 14 2009 with an Ariane 5 from the Europe's Spaceport in Kourou, French Guiana. The HSO is currently in its final L2 orbit at about 1.5 million kilometers from Earth. On-board of the Herschel Space Observatory are two cameras/medium resolution spectrometers (PACS and SPIRE) and the heterodyne instrument HIFI. Herschel provides a unique window to the sub-millimeter and THz frequency range. This frequency range is largely obscured for ground based astronomy due to the presence of water vapor in the Earth's atmosphere. Herschel/HIFI therefore makes it possible to do detailed spectroscopic studies of water lines in the star forming regions of our galaxy. Commissioning of the three instruments on-board of Herschel is ongoing, and first light images and spectra have been released, showing the unique capabilities of the HSO.



Noise temperature of the HIFI instrument (filled bullets) together with the results as measured by the mixer groups (for the horizontal and vertical polarisation mixers). Also shown are the sensitivity status in 1998 (at the start of the project) and the baseline performance as specified in the HIFI proposal.

It is mainly because of the superconducting devices that the Herschel satellite has been equipped with a cryogenic tank carrying about 2300 liters of liquid Helium. HIFI is the first satellite instrument that employs superconducting detector technology. The estimated lifetime of Herschel is about 3.5 years, and in order to take full benefit of the limited observing time, much effort has been put into the optimization of the performance of the superconducting detectors.

An international consortium led by the PI institute, SRON, has built HIFI. Within HIFI, 7 frequency bands cover the spectral range from 480-1250 GHz (SIS mixers) and 1.41-1.91 THz (HEB mixers). Six research groups have contributed to the delivery of the 7 mixer bands. Different device technologies had to be employed to achieve the most sensitive mixers. Main driver for this is the superconducting gap frequency of the materials used. A variety of electrode materials (Nb, NbTiN) and junction topology has been applied.

The progress in sensitivity has been enormous between the beginning of the project and the instrument delivered to be launched, especially by taking into account that the status of 1998 was achieved with many narrowband mixers at some selected frequencies. The performance of the HIFI instrument is excellent and has an unprecedented sensitivity over the frequencies covered. All bands deliver state of the art performance. This performance combined with the absence of atmospheric attenuation, results in system noise temperatures that will never be achieved at any ground based observatory.

SUPERCONDUCTING DEVICES AT CEA INSTITUTE NANOSCIENCES & CRYOGENICS

by Jean-Claude Villégier

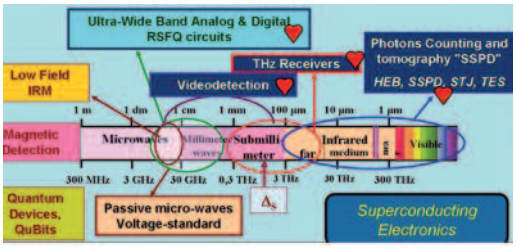
CEA INAC – Grenoble France

The CEA INAC Superconducting Devices Group has been focusing its researches since 20 years in developing emerging and disruptive technologies in Superconducting Electronics and Optoelectronics, benefiting from niobium nitride (Tc~117K), the only BCS superconductor whose frequency gap overcomes 1.4THz. Devices and circuits achieved with wafers up to 8-inch diameter at INAC are based on Josephson and Hot Electron diodes, leading to 1.9 THz frequency record obtained from self-shunted NbN SNS junctions. Such junction is the building block of RSFQ logic gates patterned at LETI, allowing the development of an analog-to-digital converter for satellite telecoms. Extremely sensitive infrared Superconducting Nanowire Single Photon Detectors benefit from the best quality obtained at INAC in crystalline growth of NbN and YBaCuO nanolayers. Superconducting 'weak links' characteristics produced with unsurpassed performances in the 0.1K to 10K temperature range have been fitted by TDGL model, hot electron effects and nanoscopic kinetic energy driven mechanisms. Several applications and collaborations are pursued in telecommunications, quantum cryptography, astronomy and medical imaging.

INAC is studying NbN & YBCO, SDE devices covering with quantum limited sensitivity, frequency spectrum with a larger bandwidth than semiconductor devices.

J-C. Villégier et al, IEEE Trans. on Appl. Supercond. 19-No.3, 3375-3378 (2009)

Research Team: M. Aurino, S. Bouat, P. Cavalier, Ph. Feautrier, L. Maingault, V. Michal, R. Setzu, J-C Villégier*
(*) Affiliation : LAOG, UJF, CNRS-Grenoble



Superconducting optoelectronic devices studied at INAC

• **Superconducting Nanowire Single Photon Detectors** (SNSPD) and THz Hot Electron Bolometer receivers (HEB) are benefiting from the high crystalline quality of 4nm thick niobium nitride (NbN) and NbTiN layers reactively sputtered at 600°C on large area (4') sapphire, silicon or SiN membrane substrates.

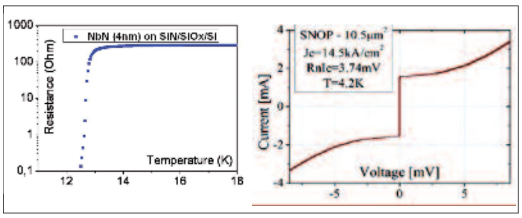
• **NbN-TaN-NbN Josephson junctions** with a good crystal match of 8nm thick TaN barrier operating at the metal-insulator transition up to 12K with a record 1.9THz characteristic frequency has been developed under CNES and ANR-TCOM programs as a building block of Rapid Single Flux Quantum NbN logic circuits.

• **A compact Fourier Transform spectro-interferometer** is under development in collaboration with LAOG, able to spatially sample the interferometer color field extracted from 2 telescopes. An array of 16 NbN, 50nm width, nanowires SSPDs located in the near field of a SiN waveguide is applied. The capability to discriminate single photon regime from double or triple photon regimes has been demonstrated with others merits of SSPD vs APDs such as very fast jitter (~15ps), during the STREP-SINPHONIA (2006-2009).

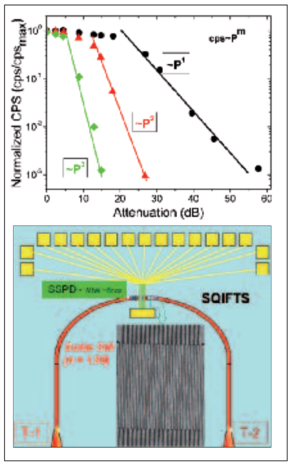
• **A 8 bits 'HyperSCAN' ADC circuit** on 8-inch Si wafers, based on NbN multi-layers and self-shunted Josephson junctions operating at 9K is elaborated in collaboration with LETI under the project ANR-TCOM 'HyperSCAN'.

• **A new generation of NbN and YBaCuO 'nano-links'** are produced with unsurpassed performances in the 0.1K to 10K temperature range, physically well understood through collaborations with ENS-Paris and Naples University by applying the Time Dependant Ginzburg-Landau theory, completed by a modeling of hot electron generation and recombination, and taking also into account the major role played in nanoscopic junctions by the kinetic energy driven switching mechanisms.

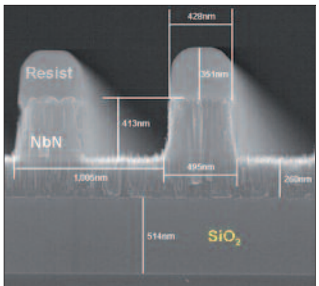
NbN allows the on-chip integration of fast SSPD and THz detectors with read-out & SFQ circuits: ADC, multiplexers (MUX), digital signal processors (DSP), interfaced with room temperature electronics. Development of several applications and collaborations are underway in the fields of space telecommunications, astronomy, quantum cryptography, medical imaging (optical and magnetic).

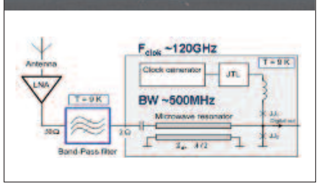


Superconducting transition of a 4nm NbN film on a SiN membrane; Record Josephson frequency (1.9THz) extracted from I-V characteristics of a NbN-TaN-NbN junction at 4.2K.



1D array of 16 parallel SSPDs (each 100nm wide) sampling the photon flux propagating into a patterned SiN rib waveguide.





Input stage of a single channel Rapid Single FQ Σ-Δ modulator receiver. The bandpass filter increases the SNR and provides impedance matching.

S-PULSE WORKSHOP: APPLIED SUPERCONDUCTOR ELECTRONICS IN QUANTUM METROLOGY

Physikalisch-Technische Bundesanstalt (PTB), Braunschweig, Germany, 5 – 7 May 2009

by Johannes Kohlmann

PTB, Braunschweig
Germany

>> A major goal of the Support Action S-PULSE is the exchange and dissemination of knowledge and ideas about superconductor electronics. An important and fundamental area of applications of superconductor electronics is the electrical quantum metrology consisting of measurements at the highest level of accuracy. The S-PULSE workshop "Applied superconductor electronics in quantum metrology" was intended to bring together scientists and engineers working as developers and users of superconductor electronics for electrical metrology and precision measurements. The aim of the workshop was to present and discuss the wide range of applications offered by superconducting electronics for electrical precision measurements and electrical metrology. The workshop was hosted by the Physikalisch-Technische Bundesanstalt and held 5 – 7 May 2009 at the Penta Hotel in Braunschweig, Germany. 30 participants from France, Italy, New Zealand, Singapore, and Germany attended the workshop.

>> The workshop program consisted of 4 main topics, namely quantum current and capacitance standards, quantum voltage standards, quantum interferometer devices, and quantum devices. The contributions reviewed recent research and development results in these areas of electrical quantum metrology and high-precision measurements as well as technologies for the fabrication of corresponding devices. Detailed discussions happened subsequent to the presentations and were continued during and after dinner in the evening of both workshop days.

>> The first day of the workshop started with presentations on quantum current and capacitance standards including discussions of the metrological triangle and a possible new definition of the SI base unit ampere. The presentations of the second day dealt first with quantum voltage standards and secondly with quantum interferometer devices. The presentations ranged from new technological developments to current applications for metrology and precision measurements. The fabrication technology for quantum devices and their applications were presented at the third day.

>> The last session of the workshop allowed the participants for a detailed discussion on further and improved applications, apparent limitations for their realization (technological or others), and possible ways to overcome them. The discussion showed that a lot of promising ideas are available. Some technological challenges were identified; promising approaches exist in part. Ideas for improved measurement systems and set-ups were also discussed. To broaden the applicability of superconductor electronics in the fields of high-precision measurements, future R&D activities have to focus on improved technology, which mean e.g. fabrication processes being more reproducible, having higher yield, allowing integration of more junctions, getting rid of background charges of the substrate etc... Forthcoming developments of novel Josephson junctions and arrays were intensively discussed which offer attractive solutions for future needs in measurement techniques.

>> Several workshop participants visited selected labs at PTB in the afternoon of 7th May, to see fabrication facilities for quantum standards and their applications in reality. In conclusion, the workshop was successfully hosted and made possible fruitful discussions and exchange of ideas among the workshop participants.

“France, Italy, New Zealand, Singapore, and Germany”

SIXTH FLUXONICS RSFQ DESIGN WORKSHOP

Ilmenau University of Technology / Germany – July 26 – 29, 2009

by Hannes Toepfer

Ilmenau University of Technology Germany

>>RSFQ is the abbreviation for Rapid Single-Flux-Quantum and specifies an microelectronic integrated circuit technology. It is based on effects taking place in superconductive materials and therefore is considered as one branch of superconductive electronics. It is of special interest as it combines very low power consumption on chip-level with operation clocks in the Gigahertz range at the same time.

The FLUXONICS RSFQ design workshops were established following the foundation of the FLUXONICS e.V. [1] and have been held every second year since 2001. From 2008 on, this activity was included in the European S-PULSE activity to support superconductive electronics. As goals of this support action are focused on knowledge dissemination with particular attention to inspire industrial interest as well as on the assessment of application fields for superconductive electronics, the design workshops take place every year within the S-PULSE framework. Also in this year, the number of participants increased to 27 which demonstrates the growing interest in design and simulation aspects of superconductive electronics. Besides the significant international character of the event, it is for sure worth to note that of all participants the fraction of students reached 35%.

The 6th RSFQ design workshop took place in Ilmenau from July 26 - 29, 2009. The general intention behind the programme was to assess the current status of superconductive electronics as well as to provide a critical review about possible application fields in order to identify required research issues to enable these applications. Furthermore, the education of young scientists and students should be fostered by incorporating them into the scientific and technical discussions.

For these reasons, the workshop was organised in seven topical chapters ranging from Basics to fabrication technology for circuits and devices and circuit design for particular applications.

As usual, the first day of the workshop was of educational character. Lectures on basics of RSFQ electronics were given by internationally recognized experts. Although mainly thought for the young scientists and students among the participants, this is a proven means for maintaining the capability within the FLUXONICS society to provide a concise introductory course in superconductive electronics for interested audiences. Prof. V.K. Semenov from State University of New York in Stony Brook (USA) presented a lecture on fundamental energy considerations in superconductive electronics circuits. After this theoretical part, a description of the practical implementation capabilities at the FLUXONICS Foundry in Jena / Germany [2] has been given.

The next part was dedicated to an assessment of practical design and development of RSFQ circuit structures. Professor Y. Yamanashi from Yokohama National University, Japan, introduced RSFQ circuits with the capability of being dynamically programmed. The second day started with an overview on the application potential of RSFQ circuits in detector applications, given by Prof. A. Fujimaki from Nagoya University, Japan.

The final day was dedicated to design technology. Here the S-PULSE team of the University of Stellenbosch, South Africa contributed significantly. Dr. C. Fourie and Dr. R. Gerber demonstrated the NioCAD design framework for superconductive electronics. The participants emphasized that this tool will be very useful both for education and engineering work.

[1] http://www.fluxonics.org
[2] http://fluxonics-foundry.de

Statistics:

27 participants, representing most of the important European groups, 5 participants from outside Europe:

Germany: Ilmenau University of Technology (12), University Karlsruhe (2), University Tübingen (2), IPHT Jena (2), PTB Braunschweig (1), IMMS Erfurt (1)

France: University of Savoie (1), Thales R&D (1)

Japan: University of Nagoya (1), Yokohama National University (1)

South Africa: University of Stellenbosch (2)

U.S.A.: State University of New York Stony Brook (1)

EUROFLUX2009: FROM DEVICES TO CIRCUITS AND SYSTEMS

Avignon, France, September 21-23, 2009

by Denis Crété

THALES Research & Technology France

>> The aim of the second International Conference on Superconductive Electronics, organized within the S-PULSE Support Action of the European Community, is to disseminate the knowledge to interested industry and research laboratories in three principal sub-domains: digital electronics, superconducting sensors and microwave devices and systems.

The conference was organised by THALES, and hosted by the Université d'Avignon et des Pays du Vaucluse, Avignon, France. Dr. Denis Crété and Pr. Georges Waysand were responsible for the scientific program. The conference attracted nearly 60 attendees essentially from Europe and Russian Federation but also from Australia, India, Japan and South Africa. The 43 contributions included 7 invited talks, 22 oral contributions and 14 posters. Each of the invited talk was given 45mn; contributed talks (22) were 25 mn long.

T. Skotnicki (ST Microelectronics) opened the first session by giving an industrial view on semiconductor perspectives, comparing the frequency limit of various technologies. Then, V. Lacquaniti (INRIM Torino) presented the Nb/Al-AlOx/Nb process for Josephson junction (JJ) fabrication with an on-wafer spread of 4%. E. Tarte reported on Nb/Co/AlOx/Nb π-junctions for Qubit applications. T. Ortlepp has measured a deviation of about 7% with the usual current-phase relationship $I=I_c \sin\varphi$. J. Lesueur introduced a new process for damaged high critical temperature (HTc) nano-JJ with high IcRn products. G. Gol'tsman (Moscow St. Ped. Univ.) opened the session on radiation sensors by reviewing NbN hot electron bolometers with ultimate performance, and single photon detector with photon counting capability. Y. Divin presented a Hilbert spectrometer based on HTc JJ. I. Kawayama measured the optical response of Josephson vortex-flow transistor. N. Curz presented FIB technology on YBCO nanowires. L. Lolli reported on photon resolving Ti/Au or Ti-Pd TESs. V. Koshelets has developed integrated SIS receivers for balloon-borne instruments (T_{DSB}=120 K over 450-650 GHz). J. Kohlmann (PTB Braunschweig) made a survey of the technologies developed for the voltage standard. N. Yoshikawa (Yokohama Nat. Univ.) presented the new 10kA/cm² technology for high performance computing. P. Desgreys reported on the design of an I/Q mixer for band-pass Σ-Δ ADC. A. Andreski introduced the π-loop as basis for logic gates. A. Bounab presented the digital baseband feedback for extending the bandwidth of SQUID readout circuits. M. Pannetier-Lecoeur (CEA Saclay) reviewed magnetometers using superconducting flux concentrators with different types of sensors.

E. Pozzo di Borgo has measured the contribution of the ionosphere to magnetic noise at very low frequency. T. Schönau described dc-SQUIDs or SQIF with high transfer functions. M. Sen discussed on the preparation of various Bi compounds. A. Braginski presented the advantage of low field NMR when SQUID sensors are used. S. Henry made a SQUID magnetometer for the cryoEDM – neutron electric dipole measurement. M. Mück (Univ. Giessen) reviewed different techniques for SQUID microwave amplification. I. Soloviev introduced the Bi-SQUID for linearity. D-G. Crété presented TRT advances in resonators with high power handling capability. J-C. Villégier showed progress in fabrication of NbN SFQ IC. X. Jin proposes HTc qubits with intrinsic SQUIDs in Bi2212 loops. G. Oelsner proposed a readout of flux qubits using ballistic fluxons. M. Blamire presented how to control the Relative Phase of Cooper Pairs in a Josephson junction with synthetic antiferromagnetic coupling.

The poster session, at 18:00 on Monday, was allowed to extend during the full duration of the conference to promote discussions and exchange on specific topics. Most of these presentations will be available on http://www.euroflux.org and http://www.s-pulse.eu.

One of the interesting facts during this conference is the visit of the Laboratoire Souterrain Bas Bruit de Rustrel-Pays d'Apt mainly devoted to research in multidisciplinary physics (http://lsbb.oca.eu/spip.php?article95). It took place on Tuesday afternoon, just before the conference social event (visit of the « Palais des Papes » and a dinner nearby, in former cisterns of the town).

**"http://www.euroflux.org
http://www.s-pulse.eu"**

Upcoming events

>> S-PULSE International RSFQ Technology Workshop - October 22-23, 2009.
This workshop will take place at the Institute of Photonic Technologies (IPHT) Jena, Germany from October 22nd to 23rd, 2009. The prior workshop in this series in 2008 was a RSFQ circuit fabrication training at the European FLUXONICS Foundry. The objective of the workshop in 2009 is to give an overview about facilities for RSFQ circuit fabrication in Europe, United States and Japan. The lectures introduce the different RSFQ technologies, circuit examples and applications. One item discusses the possibilities for unified characterisation and testing. A round table discussion concludes the workshop with a comparison of future developments of RSFQ technologies in Japan, United States and Europe. The workshop is addressed to students, young and senior scientists as well as engineers. For more information see http://www.s-pulse.eu or contact the organization committee under juergen.kunert@ipht-jena.de - Phone: +49 3641 206 112.

>> ASC2010, Washington DC, USA
The next edition of the Applied Superconductivity Conference (ASC 2010) will be held in Washington DC, USA in August 1-6, 2010. More information available at www.ascinc.org

Announcements

>> Kick-off for final version of European roadmap of superconductor electronics
On September 24th, 2009 in conjunction with the international symposium EUROFLUX 2009 in Avignon (France) the preparation of the final version of the European roadmap of superconductor electronics has been started. This roadmap document is a main target of the European project S-PULSE. The Roadmap advises the necessary steps to strengthen the European research and competitiveness on superconductor electronics. A draft version was delivered to the European Commission in April 2009. The final version is planned to be published in March 2010.
H.-G. Meyer, S-PULSE project coordination.

>> New apppointment in RSFQ design group at Ilmenau University of Technology, Germany
On July 1, 2009, Hannes Toepfer was appointed a full professor at Ilmenau University of Technology where he is now heading the department of Advanced Electromagnetics. He was born in 1962 and studied Electrical Engineering at the Institute of Technology Ilmenau. From 1991-2002 he worked as a scientific assistant at the Ilmenau University of Technology. In 1996, he gained the Dr.-Ing. (equiv. PhD) with a thesis on the design of SQUID sensors and in 2003 the habilitation degree with a work on superconductive digital electronics (RSFQ). In 2002 he joined the Institute for Microelectronic and Mechatronic Systems (IMMS gGmbH) where he has been heading the System Design department with a research focus on embedded systems and sensor networks. He is a member of the IEEE.
Research in the department comprises the topics theory and computation of electromagnetic fields as well as simulation of heterogeneous systems with the aim of utilising novel physical principles in innovative applications. In particular, research contributions in the areas: ultra-sensitive superconductive sensors with quantum accuracy, single-flux-quantum electronic circuits, solution of inverse problems in electromagnetics as well as analysis of non-linear systems are supporting this main research direction. The RSFQ design group acts as a design centre in the European research network for superconductive electronics (FLUXONICS) and is a member of the European FLUXONICS Foundry. As by means of research for superconductive electronics valuable insights of fundamental nature are gained, these activities can be considered as a contribution to the design of future microelectronic devices and circuits in the "beyond-CMOS" branch.

>> Something NIO from NioCAD *By retief GERBER - NioCAD - P.O.Box 2334 - Dennesig • 7601 - South Africa*
NioPulse is now a complete EDA Toolkit and the first beta program was installed successfully and is currently being tested by the Technical University of Ilmenau. The program is specifically designed for superconductive electronics. It is used to design, analyse, optimize, layout and verify Rapid Single Flux Quantum electronic circuits and it delivers closed circuit designs that are ready for fabrication.
During the final phase, before commercialisation, we developed and enhanced the suite's closed cycle design process and program flow, increased usability, established real-time physical design guidance and verification and created multi-core support for parallelisation of simulation, analysis and extraction.
The completion of our first phase of development coincided with the 6th FLUXONICS RSFQ Design Workshop in Ilmenau, Germany (see page 6). We demonstrated the NioPulse capabilities and those that followed our progress, were impressed with the advances made over the last 3 years. After initially being skeptical, attendees from the United States and Japan, who saw the work for the first time, commented that the program exceeded their expectations.
We invite interested parties to join the discussions at http://www.niocad.co.za/forum. The first NioPulse commercial package will be available in December 2009. With this release we specifically focus on the needs of the research community. As our product matures we hope to make it easier for anyone to design operational circuits.
If you have specific queries or need information, please contact Retief Gerber at retiefgerber@niocad.co.za or Coenrad Fourie at coenrad@sun.ac.za. Comments and suggestions from the superconductive electronics community, as well as other fields of specialised electronics, are always welcome. You can also look out for us at applied superconductivity conferences and workshops.

Contributions to this newsletter
If you wish to write an article, mention an event or make an announcement about Superconducting Electronics in this Newsletter, please send the content in text or word format with separate files for pictures (with high resolution: 300 dpi minimum) at the following e-mail address, one month before publication: Pascal.Febvre@univ-savoie.fr Next publications are planned for January 2010 and June 2010.

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