

Scientific Biography of Horst Rogalla

Horst Rogalla was born in Gelsenkirchen, Germany, on 8 November 1947. After finishing the education with the Abitur at the science branch of the Grillo-Gymnasium in Gelsenkirchen in 1966, he was drafted to the WestGerman Air Force for 15 months. Starting from April 1968 he studied physics and mathematics at the University of Muenster, Germany, receiving his Diploma in physics in 1972 with a diploma thesis under the guidance of Prof. Bittel and Prof. C. Heiden at the Institute of Applied Physics. The diploma thesis dealt with magnetization measurements in cylindrical superconducting samples using the first commercially available rf-SQUIDs.

He started Ph.D. work under the guidance of Prof. C. Heiden, first in Münster and then later in Giessen following Prof. C. Heiden to the Institute of Applied Physics there. During his Ph.D. work, he developed a microwave SQUID-system with a slew rate of more than $10^7 \Phi_0/s$, one of the fastest SQUID-systems at its time. The SQUID was applied to magnetization studies of type-II superconductors and later also to iron whiskers. In these studies it was found that the secondary loops in the magnetization curve of type-II superconductors were not stable but exhibited a creep and tilting effect. It was possible to explain and model this effect with a theory similar to effects observed in the motion of Blochwalls in ferromagnetic materials. He received his Ph.D.-degree in physics from the University of Muenster in 1979 with a thesis with the title “Kriech-und Kippeffekte in Sekundärschleifen von Typ-II Supraleitern”. In 1980 he received the research award of the University of Muenster for his thesis.

After finishing the Ph.D. he stayed in the Institute for Applied Physics in Giessen, Germany and built up a thin film group working on superconducting electronic devices. In first instance the materials used were Nb and NbN, followed by the (at that time) highest- T_c superconductor Nb_3Ge . In this time, relaxation oscillator SQUIDs based on Nb and Nb_3Ge were developed and operated. The measurements of the Nb_3Ge -devices took place in liquid hydrogen, for which he built a liquefier and the measurement infrastructure for superconductive electronic devices. Because of the lack of high-quality, tunnel-junction based Josephson junctions of Nb_3Ge , a nanotechnology for the preparation of nano-bridges from Nb_3Ge was developed including e-beam lithography, reactive ion-etching and a Nb_3Ge -multilayer technology. It was possible to fabricate high quality Josephson junctions and SQUIDs from these nanobridges. For material science studies and for microwave detection these bridges were also prepared on etched SiO_2 -membrans using Si micromachining techniques. The transport mechanism in these nano-bridges was studied in detail and theoretically modeled. During research visits to Prof. Tinkham, Harvard University, in 1985 and 1986 he further developed this theory and also set up the experimental

techniques for preparing first single electron devices with a shadow e-beam lithography in Harvard and took part in the research on these devices. In this time he also finished his habilitation in physics in Giessen in 1986 with a thesis with the title “High- T_c Josephson Contacts: Preparation and Properties”. After his short return to Giessen he started research on the new oxide superconductors. In 1987 he was granted the research award of the Justus-Liebig University of Giessen.

Also in 1987 he received a chair as professor for Applied Physics at the University of Twente, the Netherlands. He started a thin film and superconductive electronics group and developed in this time, among others, the high- T_c ramp-type Josephson junctions and a multilayer technology for YBCO. Using these technologies, SQUIDs, microwave devices and three-terminal devices were studied. The close cooperation between material science, solid state physics, device physics and applications of superconductors were especially important to him and led to very competent subgroups dealing with special topics in these research areas. He introduced the layer-by-layer deposition of oxide materials by Eximer-lasers and developed the high-pressure RHEED monitoring of the deposition. Among others Dave Blank and Guus Rijnders did their Ph.D under his guidance in this group and are both in meantime well known scientists in this field with own professorships. Superconducting sensors and digital devices were always very interesting to him and the sensor group developed a major part of the MEG-system of Philips Company, SQUID-amplifiers based on relaxation oscillator SQUIDs for gravitational antennas, tunnel junction radiation detectors, readout systems for detector arrays, etc. In the digital devices group a first functional HTS 4bit digitizer was developed and a sigma-delta converter with an operation frequency of up to 170GHz. The highly developed HTS multilayer technique allowed the fabrication of HTS SQUIDs with integrated input coil and was later on used for the preparation of YBCO/Au/Nb- SNSjunctions, first for interfaces between HTS- and Nb-devices and then later for applications of d- and s-wave symmetry devices. The latter became especially successful with Hans Hilgenkamp who did his Ph.D. under Rogalla’s guidance with research on an integrated multilayer HTS SQUID and after returning to Twente took over the devices subgroup. He became in meantime professor in Twente and is one of the two successors of Rogalla.

Apart from these research areas the chair also had a major activity in superconducting large-scale applications. In this group a first Nb₃Snaccelerator magnet was developed for CERN, the development and construction of the magnets for the ATLAS detector of the LHC-project was accompanied by this group and also the cable development for different applications, among them for the nuclear fusion project ITER. In a further group the cooling of large and small scale applications was studied and new ways were found especially for efficiently using microfabrication

technologies in the cooler fabrication. This group flourished under the leadership of Marcel ter Brake, who did his Ph.D. on biomagnetic instrumentation under the guidance of Rogalla and who is now the second of the two successors of Rogalla.

From 1990 till 1993 and from 1997 till 1999 Rogalla was director of the Center of Material Science at the University of Twente and a founder of the MESA+-Institute. He took part in many advisory boards of the University and helped to restructure the University into a science and technology oriented entity with weight on high-level education.

In 1999 he initiated and co-founded of the European Society on Applied Superconductivity (ESAS) and from 1999 till 2003 he was its first president. He was member of the board of the Network of Excellence 'SCENET' of the European Community and within SCENET he headed the working group on Superconducting Digital Electronics (SDE) till 2004. He co-founded the European foundry network for superconductive devices, Fluxonics. He organized the EUCAS (European Conference on Applied Superconductivity) in 1999 and the ISEC (International Superconductive Electronics Conference) in 2005 and he will organize the "Centennial Conference on Applied Superconductivity 2011 – EUCAS, ICMC and ISEC" in the Netherlands together with Prof. Kes from Leiden in the context of "100 years of superconductivity in the Netherlands". Besides this, he initiated over the years a large number of workshops and specialized conferences. From 2001 till 2007 he headed the European Science Foundation-network 'PiShift' dealing with the science and applications of d- and s-wave properties of superconductors. He was and is also member of a number of European and international advisory boards, e.g. for the institute of nano-science MRSEC at the University of Wisconsin in Madison and the Forschungszentrum Jülich in Germany. From 2000 till 2010 he was president of the European Society for Foundries for Superconducting Electronics (FLUXONICS) and initiated a strong cooperation between research groups in this field. For the European Community he took part in many advisory boards and headed and took part in a number of European projects.

In 1991 he spent a 6-months sabbatical at the IBM Watson Research Laboratory working on nano-SQUIDs for SQUID-microscopy. In 2001/2 he stayed for a 1-year sabbatical, part of it at the University of California in San Diego with Prof. Dynes and at NIST in Boulder/USA with Dr. Benz, working in both places on HTS in-line junctions for high-frequency applications. In a continuing cooperation with a research visit to NIST in 2005/2006 he worked at NIST on the very precise absolute measurement of temperature with an ac-Josephson generator based resistive noise thermometer. Recently he started work in conjunction with the US Air Force on superconducting tunable microwave structures with negative diffraction index. Since February 2010 he worked part time at NIST

Boulder and the University of Colorado in Boulder. Since 2011 he is research professor at the University of Colorado in Boulder in the Electrical, Computer, & Energy Engineering (ECEE) Department. Starting from February 2011 he is full time doing research at NIST Boulder in the Quantum Devices group in the Physical Measurement Laboratory (PML) in the context of an IPA-agreement. Starting from February 2016, he switched for one year to the NIST-PREP project organized by the Carrier Service of the CU. Since February 2017 he is working for 80% of his time at NIST in a CU/NIST IPA contract and for 20% at the CU in the context of an AFOSR research project.

In 2013 he was honored for his work for the European Society on Applied Superconductivity with a lifetime voting membership of the board of ESAS. In 2013 he agreed to serve as IEEE Distinguished Lecturer for Superconducting Electronics in 2014, 2015, 2016 and 2017. Since April 2016, he took over the task as Editor-in-Chief of the Superconductivity News Forum, organized by IEEE/CSC and the ESAS. In July 2016 he became member of the board of IEEE/CSC and member of the editorial board of the IEEE Transactions on Applied Superconductivity. In October 2018 he was honored for more than 10 years superconductivity research for NIST Boulder. Since 2014 he is Senior Member of the IEEE.

He is member of the Material Research Society, of the IEEE and of the German and American Physical Society. He was member of the editorial board of the IEEE Transactions On Applied Superconductivity in 1997/1998 and later one of the editors of Physica C from 1999 till 2009. He is author/co-author of more than 300 scientific articles and author of a number of chapters in scientific books and promoter of more than 80 Ph.D. candidates. Some of his former coworkers have in meantime own chairs. Quite a number of his students, Ph.D. Students, post-docs and co-workers reached high positions in science and industry.