PRESS RELEASE

Interposer technology revolutionizes connections in quantum computers

Together with 24 German research institutions and companies, and under the coordination of Forschungszentrum Jülich, Fraunhofer IZM-ASSID is working on a complete German quantum computer based on superconducting quantum chips and with reduced error rates. Fraunhofer IZM-ASSID provides innovative packaging technologies and has developed an interposer that optimizes the connection between qubits and control electronics.

Quantum bits, or qubits for short, are the fundamental units of information in quantum computers. Qubits can exist in a superposition state, which enables quantum computers to perform complex calculations much faster than classical computers. To build useful quantum computers, many qubits must be connected to each other. However, as the number of qubits increases, so do the sources of error and the complexity of error correction.

Qubits are extremely sensitive to even the smallest disturbances, such as heat or material impurities. The goal of the partners from science and industry in the QSolid project (short for: Quantum computer in the solid state) is therefore to develop a system with different quantum processors based on next-generation superconducting circuits and with a very low error rate. This will enable the qubits to achieve higher quality. The approach is considered to be world-leading and is also being pursued by Google, IBM, and Intel.

Milestone at the halfway point

In September last year, the first prototype of the QSolid mid-term demonstrator with 10 qubits, integrated software stack, and cloud user access was put into operation at Forschungszentrum Jülich. It enables applications and benchmarks for industry standards to be tested. By the end of 2026, the team will develop and optimize several processor types based on the results now presented. The prototype of the QSolid demonstrator is expected to multiply its performance in the future and form the basis for a future quantum computer developed in Germany.

The role of the interposer

Fraunhofer IZM-ASSID is currently working on optimizing the control and connection technology for quantum chips. To this end, the researchers are supplying innovative packaging technologies and, together with Fraunhofer IPMS and GlobalFoundries, have developed an interposer that optimizes the connection between qubits and control electronics. The electrically and thermomechanically stable interposer measures 20 by 15 millimeters and can realize over 10,000 connections in a very small space using extremely

Editorial office
Susann Thoma I susann.thoma@izm.fraunhofer.de I Phone +49 30 46403-745 I
Fraunhofer Institute for Reliablity and Microintegration IZM I Gustav-Meyer-Allee 25 I 13355 Berlin I www.izm.fraunhofer.de I

thin conductor tracks. In addition, the two-part interposer can thermally decouple the quantum chip from the control electronics.

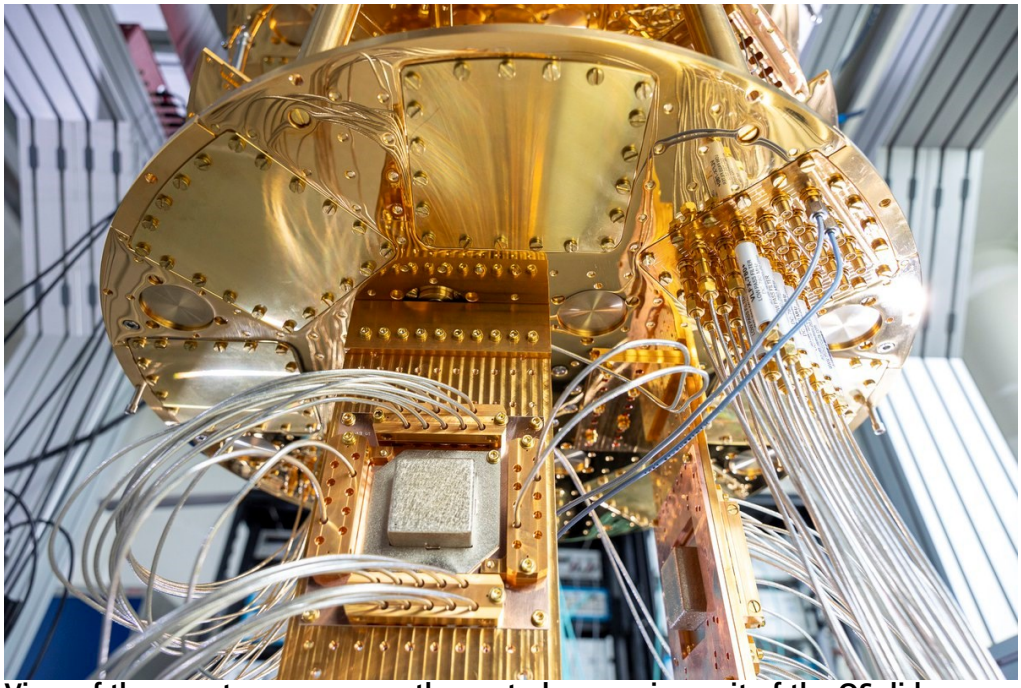
»The next step is to demonstrate whether we can scale the process to even higher wiring densities, because coaxial structures are required for high-frequency wiring«. At 20 by 15 millimeters, the interposer is relatively small for this type of wiring. Steffen Bickel and his team are now working with Forschungszentrum Jülich and RWTH Aachen University to investigate the effects on system behavior when the size of the interposer increases by a factor of two to three. A positive result for these experiments could have far-reaching implications for the project outcome and the final demonstrators.

QSolid is funded by the Federal Ministry of Research, Technology, and Space (BMFTR) with €76.3 million. The project, in which 25 institutions from Germany are participating, is part of Germany's strategy to secure technological sovereignty in the field of quantum research. The overarching goal is to strengthen Germany's industrial competitiveness and enable new applications in science and industry, for example in areas such as chemistry, materials research, and medical technology.

More Informationen about the project: https://www.q-solid.de/

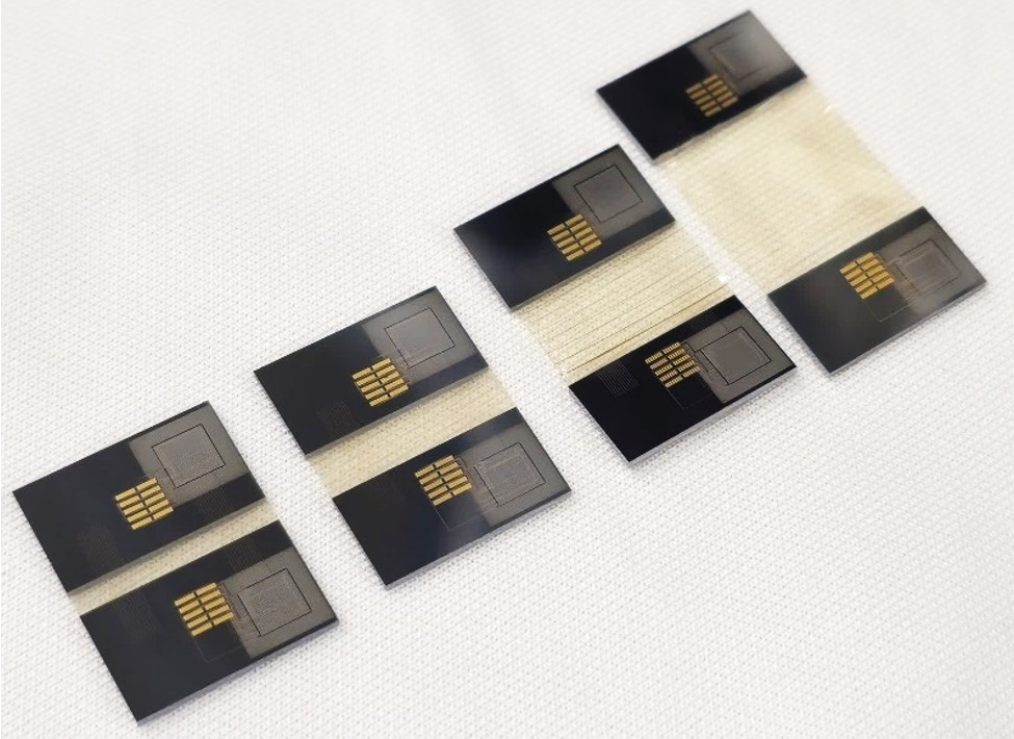
QSolid project partners:
AdMOS GmbH Advanced Modeling Solutions, MKS Atotech, CiS Research Institute for Microsensor Technology GmbH, s+c / Eviden, Fraunhofer Institute for Reliability and Microintegration IZM, Freie Universität Berlin, Globalfoundries, Heinrich-Heine-University Düsseldorf, HQS Quantum Simulations GmbH, Fraunhofer Institute for Photonic Microsystems IPMS, IQM Germany GmbH, Forschungszentrum Jülich, Karlsruhe Institute of Technology, Leibniz Institute for Photonic Technologies, LPKF Laser & Electronics AG, Parity Quantum Computing Germany GmbH, ParTec AG, Physikalisch-Technische Bundesanstalt, Qruise, Racyics GmbH, Rosenberger Hochfrequenztechnik GmbH & Co. KG, Supracon AG, University of Konstanz, University of Stuttgart, University of Ulm, University of Cologne, Zurich Instruments Germany

Technical contact
Steffen Bickel I Phone +49 351 795572-71 I steffen.bickel@assid.izm.fraunhofer.de I Fraunhofer Institute for Reliability and Microintegration IZM I Dresden Branch of the institute „All Silicon System Integration Dresden – ASSID“ I Ringstraße 12 | 01468 Dresden-Moritzburg I Germany | www.izm.fraunhofer.de



View of the quantum processor, the central processing unit of the QSolid prototype. © Forschungszentrum Jülich / Sascha Kreklau | Image in print quality: www.izm.fraunhofer.de/pics

Technical contact
Steffen Bickel I Phone +49 351 795572-71 I steffen.bickel@assid.izm.fraunhofer.de I Fraunhofer Institute for Reliability and Microintegration IZM I Dresden Branch of the institute „All Silicon System Integration Dresden – ASSID" I Ringstraße 12 | 01468 Dresden-Moritzburg I Germany | www.izm.fraunhofer.de



Connecting qubits to their control system: an interposer the size of a fingernail. © Fraunhofer IZM-ASSID / Steffen Bickel | Image in print quality: www.izm.fraunhofer.de/pics

The **Fraunhofer-Gesellschaft**, headquartered Germany, is the world's leading applied research organization. With its focus on developing key technologies that are vital for the future and enabling the commercial exploitation of this work by business and industry, Fraunhofer plays a central now and in the future. Founded in 1949, the Fraunhofer-Gesellschaft currently operates 76 institutes and research institutions throughout Germany. The majority of the organization's 32,000 employees are qualified scientists and engineers, who work with an annual research budget of 3.4 billion euros. Of this sum, 3.0 billion euros are generated through contract research.

About Fraunhofer IZM:
Highly integrated microelectronics are omnipresent and yet often evade the eye. With 4 central technology clusters**, Fraunhofer IZM** covers a wide range of areas in quantum, as well as medical, communications and high-frequency technology. With our world-leading expertise, we offer our customers cost-effective development and reliability assessment of electronic packaging technologies, as well as custom-tailored system integration technologies at wafer, chip and board level. For over 30 years and at 3 locations, we have been supporting start-ups as well as medium-sized and large international companies (with knowledge transfer) and researching key technologies for intelligent electronic systems of the future.

Technical contact
Steffen Bickel I Phone +49 351 795572-71 I steffen.bickel@assid.izm.fraunhofer.de I Fraunhofer Institute for Reliability and Microintegration IZM I Dresden Branch of the institute „All Silicon System Integration Dresden – ASSID" I Ringstraße 12 | 01468 Dresden-Moritzburg I Germany | www.izm.fraunhofer.de