Majorana 1

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1 Introduction

Microsoft unveiled the Majorana 1, a quantum chip powered by a new state of matter called topological superconductivity, aiming to enable quantum computers that can solve complex problems in years, not decades.

2 Proposed Content

Majorana 1 Chip: Microsoft's Majorana 1 is a quantum chip built using a new class of materials called "topoconductors" that allow for the creation and control of topological qubits. Topological Qubits: These qubits are based on a new state of matter called topological superconductivity, which is neither liquid, solid, nor gas. Potential Benefits: Microsoft believes this approach will lead to quantum computers that are more stable and scalable, potentially reaching a million qubits on a single chip. Solving Complex Problems: The company envisions these quantum computers being able to tackle problems in areas like materials science, chemistry, medicine, and AI, that are currently unsolvable with classical computers. Azure Quantum: Microsoft is integrating this quantum technology into its Azure cloud platform, allowing users to access and utilize these capabilities. Timeline: Microsoft CEO Satya Nadella put the timeline for these quantum computers to be available between 2027-29.

3 Conclusion

The quantum chip doesn't work alone. It exists in an ecosystem with control logic, a dilution refrigerator that keeps qubits at temperatures much colder than outer space and a software stack that can integrate with AI and classical computers. All those pieces exist, built or modified entirely in-house, she said.

To be clear, continuing to refine those processes and getting all the elements to work together at accelerated scale will require more years of engineering work. But many difficult scientific and engineering challenges have now been met, Microsoft said.

Getting the materials stack right to produce a topological state of matter was one of the hardest parts, Svore added. Instead of silicon, Microsoft's topoconductor is made of indium arsenide, a material currently used in such applications as infrared detectors and which has special properties. The semiconductor is married with superconductivity, thanks to extreme cold, to make a hybrid.

"We are literally spraying atom by atom. Those materials have to line up perfectly. If there are too many defects in the material stack, it just kills your qubit," Svore said.

"Ironically, it's also why we need a quantum computer – because understanding these materials is incredibly hard. With a scaled quantum computer, we will be able to predict materials with even better properties for building the next generation of quantum computers beyond scale," she said.