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Nanoscience & Nanotechnology Powering the Digitization of Our World

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For decades Moore's law has been the driving force of semiconductor technology and miniaturization has resulted in microprocessors with billions of transistors thus enabling today's information technology. The past 20 years exemplified this trend, with nanotechnology research spearheading the extension of Moore's Law past prophesies of its demise. Heroic engineering and scaling efforts have propelled the development of successive generations of technology for the acquisition, processing, and storage of digital information reaching now the 3nm and 2nm-technology node. Reducing the power consumption and increasing the performance as well as density will remain the driving force for future innovation. Therefore, the precise control and characterization of nanoscale materials and devices will increase in importance.

Beyond scaling and digital computing completely new computing paradigms are explored and developed such as quantum computing and specialized hardware for AI including non-von Neumann architectures. Despite the continued computational advances, there are still many important and relevant problems that are intractable to classical computers but could be addressed by Quantum Computers. Quantum computing systems are built from the bottom up and are reaching today the limits of what can be classically simulated. Significant advances have been recently achieved that enabled to scale superconducting qubits to a 127-qubit processor and increase quality and speed to improve the performance of quantum computation.

In this presentation I will discuss developments in nanoscale science and technology that have transformed the digital world over the past two decades and looks into the future how today's nanotechnology discoveries are likely to impact the next 20 years. The talk will include a brief overview of our activities in the field of new computing paradigms of AI hardware technologies and quantum computing.

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