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Advancing Quantum Technologies in the U.S.

Two new executive orders could give quantum technologies a larger role in helping to advance U.S. technology and protect the nation's critical computer networks from cybercrime.

A class of technology that works by using the principles of quantum mechanics (the physics of subatomic particles), including quantum entanglement and quantum superposition, quantum technology made it into the headlines this month when President Biden announced a new round of cybersecurity measures.

Not new by any means, quantum technology has been around a while. What's different, according to one expert, is that "we're now starting to control quantum entanglement and quantum superposition," Paul Martin points out. Put simply, this means quantum technology is finding its way into everyday tools and improving navigation and timing systems; communications solutions; healthcare imaging (through quantum sensing); and computing as a whole.

"…the truth is, you don't need to know exactly what quantum technology is to make use of it," Martin writes. "Your smartphone is a type of quantum technology – its semiconductors use quantum physics to work – but neither you nor the engineer who designed it need to know the ins and outs of quantum mechanics."

Driving New Innovations

The White House thrust quantum technology into the spotlight earlier this month when it announced two presidential directives centered on advancing national initiatives in quantum information science (QIS). It says the two directives lay the groundwork for continued American leadership in an "enormously promising field of science and technology," while also mitigating the risks that quantum computers pose to the nation's national and economic security.

The White House says recent breakthroughs in QIS have shown the potential to drive innovations across the American economy—from energy to medicine, through advancements in computation, networking and sensing. "Breakthroughs in QIS are poised to generate entirely new industries, good-paying jobs and economic opportunities for all Americans," it adds.

The first of two executive orders enhances the National Quantum Initiative Advisory Committee, the federal government's principal independent expert advisory body for quantum information science and technology.

The executive order places the advisory committee directly under the authority of the White House. This will help ensure that the president, Congress, federal departments and agencies, and the general public receive "the most current, accurate, and relevant information on quantum information science and technology to drive forward U.S. policymaking and advance our technological edge," the White House states.

Fostering Innovation and Continued Growth

Known as the National Security Memorandum, the second executive order outlines the Biden Administration's plan to address the risks posed by quantum computers to US cybersecurity. "Research shows that at some point in the

not-too-distant future, when quantum computers reach a sufficient size and level of sophistication, they will be capable of breaking much of the cryptography that currently secures our digital communications on the Internet," the White House states in its fact sheet.

To address this risk, the National Institute of Standards and Technology (NIST) will publish new quantum-resistant cryptographic standards that can protect against these future attacks. Specifically, the National Security Memorandum:

- Positions the U.S. to remain a global leader in technology development, and Quantum Information Science in particular.
- Initiates collaboration between the federal government and the private sector (e.g., it directs NIST to establish a Migration to Post-Quantum Cryptography Project at the National Cybersecurity Center of Excellence, among other things).
- Sets requirements for federal agencies to update cryptographic systems—a move that will help ensure that these agencies get the support they need to protect their networks from future exploitation.

The National Security Memorandum will also help protect U.S. technology from theft and abuse. By directing federal agencies to develop comprehensive plans to safeguard American intellectual property, research and development, and other sensitive technology from acquisition by America's adversaries, the NSM continually educates industry and academia on the threats they face.

"It encourages engagement with international partners to ensure a competitive and fair global marketplace," the White House states, "that fosters innovation and continued growth in the field."