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The Need for Investment in the Quantum Computing Arms Race

Chairwoman Roybal-Allard, Ranking Member Fleischmann and members of the Subcommittee:

America stands on the verge of a new Roaring Twenties. A hundred years ago, automobiles, aircraft, radio and motion pictures remade the world; similarly, in the coming decade, we will see the continued adoption of bleeding-edge technologies, which are poised to redefine our society, our general welfare and our security. Just as progress in the 1920s led to a revolution in military affairs in the 1930s —when warfare became faster, fiercer and more fatal—this decade's technological leaps will have considerable national security implications in the years to come.

I am here today to explain why we must dedicate resources to quantum computing, developing new public policy solutions and committing additional federal investment to protect U.S. homeland security.

The Quantum Computing Arms Race

Quantum computing is among the most consequential present-day technological advancements. By harnessing quantum physics to process information—instead of relying on strings of ones and zeros—computers will solve previously intractable problems. Two years ago, Google announced it had achieved "quantum supremacy," when its machine performed a task in under two minutes that would have taken Earth's fastest supercomputer 10,000 years to complete.[1] Other companies have since made major quantum computing strides.[2]

The technology's economic potential is obvious. Quantum computing will fuel breakthroughs in chemistry, healthcare, physics, and beyond, especially by "supercharging" artificial intelligence (AI) to learn more holistically, function more naturally, and solve problems more rapidly.

The homeland security and defense implications are daunting. For years, security watchers worried that quantum computers would break the encryption used to protect our emails, personal records and national security secrets. This is inevitable, but it need not be our greatest concern, since the technology can be leveraged to make encryption *harder* to crack, too. More significantly, quantum-powered AI may be used by adversaries for more sinister offensive purposes, from developing hyper-intelligent drone swarms, to deploying the world's most sophisticated cyber weapons against our critical infrastructure.

This is the arms race of the 21st Century. At this moment, nations around the world are rushing to develop fully-functioning quantum machines, which are poised to accelerate computing power to breathtaking speeds.[3] Indeed, for each "qubit"—the fundamental building block of quantum information—that is added to a machine, its processing power doubles.[4] In other words, we expect to see exponential and double-exponential growth in quantum computing power in the 2020s, leading to a highly competitive and uncertain 2030s.

Whichever nation has the computer with the most qubits will have an edge, exceeding the processing power of rivals. This means smarter weapons and stronger defenses. For years, we have thought of national security in terms of "qualitative" or "quantitative military edge" (QME)—in other words, the marginal military power one country has over another. In the near future, we will be talking about the "qubit military advantage" (QMA)—or how much processing power one country can wield against another.

The Risk of a "Quantum Winter"

The United States risks falling behind in this race. While America's quantum industry is more developed than that of other countries, competitor nations are throwing larger sums of money at the problem to catch up. Rivals such as China[5] and Russia[6] are developing high-functioning quantum computers using state-controlled investments that could enable them to leap ahead of the United States this decade.

Federal agencies have done far too little to respond. Whether it is galvanizing U.S. innovation for economic competition or preparing for quantum-related national security dilemmas, government research in quantum computing is inadequate. Much of it has focused on basic science and theoretical physics questions, rather than encouraging private industry to find near-term useful applications, such as enhancing secure communications, which might include using early versions of the technology to advance U.S. defense and homeland security interests.

The quantum industry is a vital national security sector, and is particularly vulnerable to market fluctuations. Changes might allow state-funded rivals to surpass the United States. We cannot afford to fall behind in a so-called "quantum winter," which is why the U.S. government must consider additional ways to bolster the field. What's more, too little is being done to incorporate the technology into existing government programs, where it has the potential to solve novel challenges—which is why agencies must be given access to the nascent industry's scarce quantum computing resources as soon as possible.

In the near-term, the current administration should institute competitions for the quantum industry to solve real-life problems, as the Australian Department of Defence recently did when it sought help to resupply bases with autonomous vehicles.[7] In the medium term, Congress should consider proposals that expand investment in quantum computing through programs designed to provide researchers and government stakeholders access to the technology.[8]

A Top Homeland Security Technology Investment

Specifically, in fiscal year (FY) 2022, the Department of Homeland Security (DHS) budget makes scant reference to quantum computing or quantum-powered AI, despite the fact that the technology could fundamentally reshape homeland security. The Committee should prioritize DHS investment in this

space, with a particular focus on developing near-term applications using existing, early-stage quantum computing technology. For example:

- The Committee should direct the Secretary of Homeland Security to develop a five-year investment plan on quantum computing. This plan should focus on existing and novel resources that can expand DHS access to quantum computing technology to forecast, plan for and mitigate anticipated homeland security challenges.

- The Committee should direct the DHS Under Secretary for Science & Technology (S&T) to work with DHS component agencies to launch a "grand challenge" to incentivize America's nascent quantum computing industry to solve one or more identified homeland security problems. Having the industry compete in this space will have the dual benefit of finding unique solutions to existing security dilemmas and incentivizing further innovation in the U.S. quantum computing field overall.

- The Committee should increase support for the DHS Advanced Computing Technology Centers. These Centers have historically been under-funded, and targeted increases could yield meaningful progress in ensuring the U.S. Government is prepared for the quantum future. Specifically, the Committee should consider a $10 - 20 million increase to S&T's "Quantum Information Science Research Activity" and direct the Department to establish a "quantum sandbox," which can be used by DHS component agencies to access the technology, understand its potential, and leverage it.

Finally, I encourage the Committee to exercise persistent oversight on this matter, including holding hearings on the subject to ensure DHS leaders are taking quantum computing seriously and investing appropriately to protect the country.

Conclusion

I thank the Subcommittee for holding this hearing today. If I can be of any assistance to members of the Committee, please feel free to contact me or my colleagues at the R Street Institute.

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