NPI NATIONAL PHOTONICS INITIATIVE

QUANTUM TECHNOLOGY FREQUENTLY ASKED QUESTIONS (FAQS)

What is quantum technology?
Quantum technology uses quantum mechanics principles from physics and advanced engineering to solve real world issues. Harnessing these principles requires manipulating the smallest possible units of energy and matter.

What are its main applications?
Quantum technology can be applied in many ways. Quantum principles will be used for engineering solutions to extremely complex problems in computing, communications, sensing, chemistry, cryptography, and mechanics.

What will a quantum computer be able to do that a conventional computer can't?
A quantum computer will be able to process massive data sets in ways not possible with even today's most advanced super computers or perhaps any possible conventional computer. Though there are many applications for this kind of computing power, including transportation planning and pharmaceutical development, the use often mentioned is the ability to quickly break current encryption methods.

Will quantum computers replace computers as we know them today?
Quantum computers will solve very complex and different problems that cannot be handled by conventional computers, no matter how powerful, but will not replace them. Typical applications in fact do not admit a quantum speedup. Both types of computers will be used, depending on the application.

What is quantum encryption and why is it secure?
Quantum encryption (or quantum key distribution) allows communication between two parties that is virtually impossible to break. If a third party intercepts and views the quantum signal, it would instantly change the signal in a detectable way.

Is quantum technology already in use?
Yes, but in limited ways. Some quantum-enabled sensors, early-stage quantum computers, and limited quantum communication networks are already in use. Quantum technology will quickly become very powerful.

How will quantum technology impact Americans' everyday lives? As the research and development of this technology continues, the resulting technology will directly impact how we communicate, travel, conduct financial transactions, and even treat illnesses.

What are some of the potential everyday uses of quantum technology?
Autonomous vehicle navigation, weather prediction, transportation planning, pharmaceutical development, secure financial communications, and resource exploration are among the many uses. For example, quantum technology could potentially help a U.S. air carrier seamlessly reschedule, reroute, and rebook a cancelled flight. It would also provide much better security

when paying bills online. It would even make more precise medical imagers (MRIs) possible. Quantum computers can also improve models of chemical reactions and material design, leading to more sophisticated and effective pharmaceuticals, better batteries, and exotic materials with improved electrical or mechanical function.

What public investment is needed?

In the estimation of the NPI (see below), a minimum investment of at least $800 million over five years would be necessary to spur research and accelerate the development of commercially available quantum-based technologies. How and where this funding should be allocated is outlined in the National Quantum Initiative (NQI) Action Plan.

What are other countries spending on quantum?

China has already invested at least $10 billion in quantum development. The European Union has invested at least $1.2 billion and the United Kingdom $460 million. The United States needs to take the lead in this critical technology area or it will be left behind.

When will public investments in quantum technology pay off?

This type of technology will improve our nation's economy and national security. Like any new, advanced technology, its maturation will take time. Quantum research and technology will have direct economic and security impacts within the next decade if adequate levels of research and funding are put in place now.

Does the current U.S. workforce have the experience to work on these complex issues?

The U.S. has a world-leading high-tech industrial base, along with the best academic and government research facilities. However, the current U.S. workforce is not yet prepared to take full advantage of the tremendous promise of quantum technology. However, expanded research at research centers, as outlined in the NQI Action Plan, will help build and prepare this workforce for the future. Other countries are already building their quantum workforce.

How will quantum technology improve national security?

Quantum technology will play a critical role in the economic security of the U.S., with many applications ranging from advanced material design to modeling complex logistics problems. Quantum technology will also be a crucial component of future readiness and defense. Quantum sensors such as atomic clocks, can be made portable and even distributed over remote locations, allowing navigation and communication in a GPS-blind environment. The ability to completely secure a communication network will ensure that classified information passed through it, such as troop movements, will not be intercepted. The use of quantum computers can optimize difficult logistic problems confronting our military. The military service branches' research arms are already exploring the potential applications of quantum technology in this and other fields. These research efforts should be coordinated with civilian efforts in order to maximize the potential benefits and applications for both the public and private sector as well as for the civilian and defense sectors.

What can be done to protect consumer privacy concerns as they relate to the use of quantum technology?

Quantum technology will secure systems at all points of data flow. Standards should be put in place for these systems to ensure they are used safely and securely.

Why is government involvement necessary?

Quantum technology is not yet ready to be widely commercialized, due to the extreme technical challenges and even scientific uncertainties involved. With a solid research base and workforce founded on significant and reliable government support, the U.S will lead the creation of innovative applications by industries, thereby stimulating economic growth and job creation, which will fee back into a growing quantum-based economy. The government's financial and organizational support will also ensure that both public and private sectors will benefit. What's more, a comprehensive National Quantum Initiative will establish standards to be applied to all research and help stimulate a workforce pipeline to support research well into the future.

ABOUT THE NPI

The National Photonics Initiative (NPI) is a collaborative alliance among industry, academia and government to raise awareness of photonics (the uses of light in science and technology) and the impact of photonics on our everyday lives; increase cooperation and coordination among U.S. industry, government and academia to advance photonics-driven fields; and drive U.S. funding and investment in areas of photonics critical to maintaining U.S. economic competitiveness and national security. The initiative is being led by top scientific societies including the American Physical Society (APS), the IEEE Photonics Society, the Laser Institute of America (LIA), The Optical Society (OSA) and International Society for Optics and Photonics (SPIE).

For more information visit www.lightourfuture.org or contact David Lang at 202.416.1499 or Krisinda Plenkovich at 360.483.8786.