Podcast Name: *ACM ByteCast*
Episode: Episode 66 - Travis Humble

Welcome to the *ACM ByteCast* podcast, a series from the Association for Computing Machinery! The podcast features conversations with researchers, practitioners, and innovators at the intersection of computing research and practice about their experiences, lessons learned, and visions for the future of computing. In this episode, host Rashmi Mohan is joined by Dr. Travis Humble, a distinguished scientist at Oak Ridge National Laboratory, where he directs quantum computing research. He is also the Editor-in-Chief of *ACM Transactions on Quantum Computing* and a leader in multiple quantum initiatives.

To begin, Travis describes his journey into quantum computing, which began with his background in theoretical chemistry. Initially, he studied quantum processes in chemical reactions. At Oak Ridge National Laboratory, his work now focuses on applying quantum mechanics to solve complex scientific problems, particularly in chemistry and energy innovation. In the early days of quantum science, there were no clear pathways into the field, and many researchers transitioned from other disciplines. Today, structured educational pipelines exist to train future quantum scientists.

Travis explains the difference between classical and quantum computing. Unlike classical computers that process information using binary bits (0s and 1s), quantum computers use *qubits*, which can exist in a superposition of states. This key distinction enables quantum computers to solve problems in ways that classical computers cannot. Travis discusses two prevailing perspectives on the role of quantum computing. Some researchers believe that quantum computers will vastly outperform classical computers in certain problem domains, while others view them as complementary, working alongside traditional computing systems. He emphasizes that quantum computing is particularly well-suited for modeling physical and chemical processes at the atomic level, which could lead to major breakthroughs in areas like drug discovery and energy solutions. However, quantum computers will not replace classical computers entirely.

At Oak Ridge National Laboratory, quantum computing research is not conducted in isolation. The lab collaborates with industry partners across the country, including companies developing quantum computing hardware and software. These partnerships are essential for scaling up quantum technologies and testing real-world applications. Researchers interested in leveraging Oak Ridge's quantum computing capabilities can apply through the Oak Ridge Leadership Computing Facility. Their newly released *Quantum Computing User Program* (QCUP) provides access to quantum computing resources for high-quality research projects. QCUP operates as a merit-based program, ensuring that only the most impactful proposals receive access to cutting-edge quantum systems. Over the past seven to eight years, QCUP has provided valuable insights into the evolution of quantum computing research.

A compelling example of quantum computing's potential impact is its application to chemical simulations, particularly in understanding nitrogen fixation. If quantum computers could accurately model and understand the bacterial nitrogen fixation process, scientists could develop more energy-efficient methods for ammonia production. The ability of quantum computers to tackle such complex chemical interactions underscores their potential to revolutionize industries ranging from agriculture to pharmaceuticals.

As quantum computing becomes more widely available through cloud providers and institutional programs, the conversation shifts to education. The key question is whether academic institutions, including colleges, universities, and even primary schools, are keeping up with the rapid advancements in the field. Education plays a crucial role in ensuring that the next generation of scientists, engineers, and developers are prepared to work with quantum technologies. Travis highlights the importance of integrating quantum computing concepts into curricula at multiple educational levels. Early exposure to quantum mechanics and computing principles can help bridge the knowledge gap and cultivate interest in the field. In closing, Travis shares his predictions for the near future of quantum computing.

Key takeaways:
0:00 - Welcome to ACM ByteCast.
1:47 - Travis Humble's background and path to Quantum Computing.
5:56 - Defining Quantum Computing vs. Classical Computing.
9:10 - Quantum Computing in real-world applications.
13:29 - Challenges and future directions in Quantum Computing.
16:42 - How researchers can access Oak Ridge's Quantum Computing resources.
21:49 - Real-world applications: Quantum Computing and nitrogen fixation.
24:55 - Cloud-based Quantum Computing platforms.
29:34 - The role of education in advancing Quantum Computing.
32:35 – Travis' predictions for the future of Quantum Computing.

Links
Learn more about Dr. Travis Humble.
Learn more about the ACM ByteCast podcast at https://learning.acm.org/bytecast.