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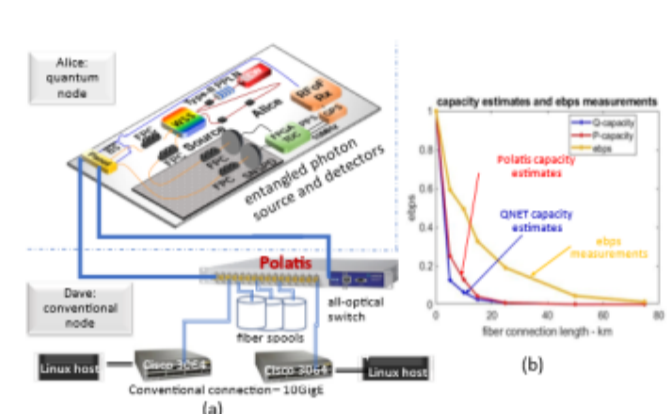
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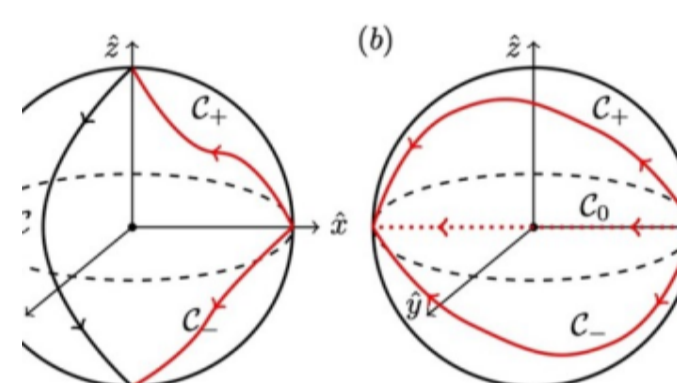
Highlights

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Scientists Compare Throughput for Quantum vs. Conventional Networks

A comparison of throughput measurements and analytical capacity estimates for quantum networks finds surprising patterns.



Novel Hardware Approach Produces a New Quantum Computing Paradigm

New theoretical approach to quantum computing hardware design via an algorithm avoids some of the complex difficulties in modern quantum computers.

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Artificial Intelligence (AI)

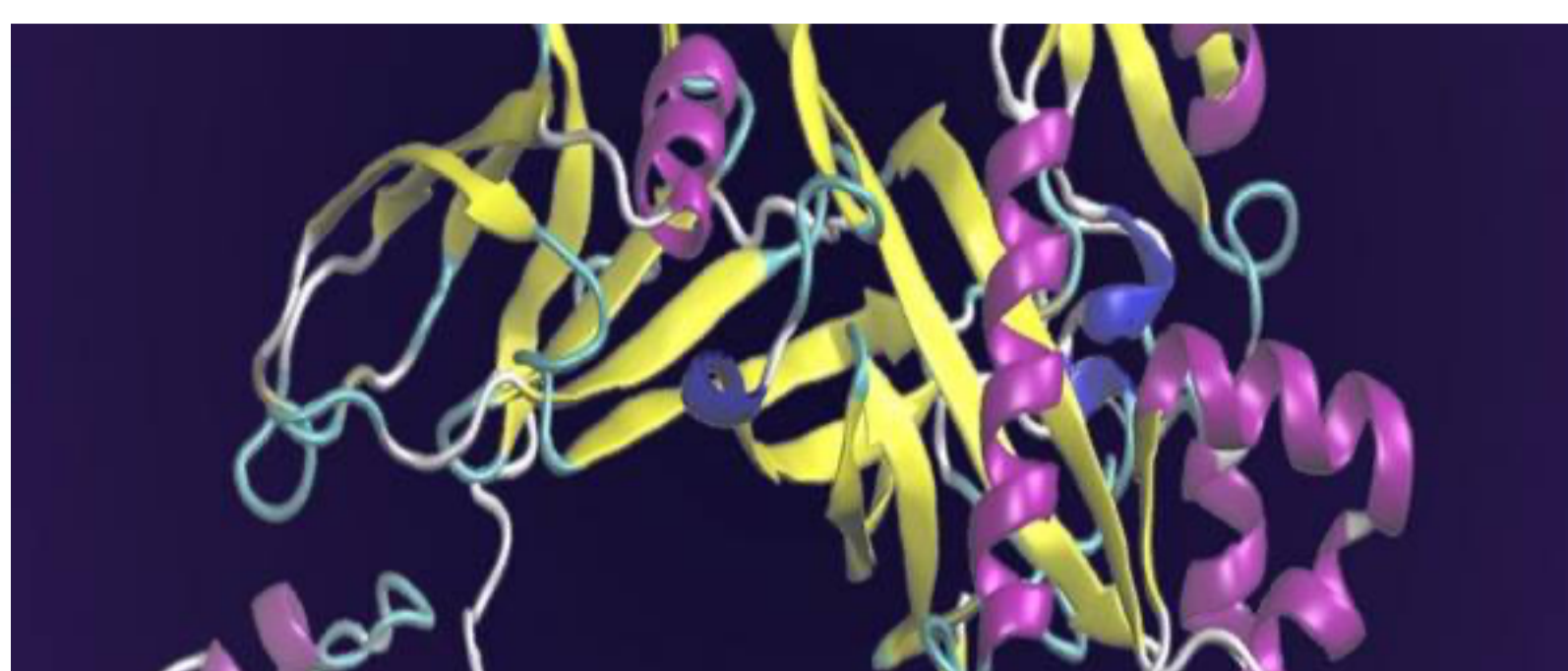


Image courtesy of Oak Ridge Leadership Computing Facility

Researchers used supercomputing and deep learning tools to predict protein structure, which has eluded experimental methods such as crystallography.

DOE and its national laboratories have invested in AI development and use since the early 1960s, developing cutting-edge AI tools, data science capabilities, and high-performance computing leadership. Advanced Scientific Computing Research (ASCR) supports research in many Artificial Intelligence (AI) areas, including: scientific machine learning (SciML) for complex systems; generative AI, large language models (LLMs), and foundation models; interpretable and explainable AI; privacy-preserving AI and federated learning; AI for visualization; and co-designed hardware and neuromorphic computing to accelerate scientific discovery. The ASCR-sponsored user facilities support and further research initiatives in AI. For example, ASCR's sustained support for leading-edge high-performance computing led to the world's first [exascale computing ecosystem](#) that is providing the hardware and software needed to power future generations of frontier AI.

ASCR has held several workshops on AI. Some of the priority research directions include:

- Domain-Aware Scientific Machine Learning
- Interpretable Scientific Machine Learning.
- Robust Scientific Machine Learning
- Data-Intensive Scientific Machine Learning.
- Machine Learning-Enhanced Modeling and Simulation
- Intelligent Automation and Decision Support.

The ASCR High Performance Computing (HPC) Facilities are leading venues for AI research and development. Today they offer advanced supercomputers and data systems including [Aurora](#) at the [Argonne Leadership Computing Facility \(ALCF\)](#), [Frontier](#) at the [Oak Ridge Leadership Computing Facility \(OLCF\)](#), and [Perlmutter](#) at the [National Energy Research Supercomputing Center \(NERSC\)](#). Collectively, these systems have over 100,000 GPUs from AMD, Intel, and NVIDIA. The distinct architectures provide deployments of large-scale AI software infrastructure for training and inference across these diverse GPU offerings, enhancing, diversifying, and hardening the AI software landscape. These systems are proving invaluable to advancing AI research and for applying AI methodologies to a variety of data-intensive research challenges, spanning extreme-scale modeling and simulation and extreme-scale experimental and observational data. The ASCR HPC Facilities also host exploratory efforts with hardware vendors. For example, the [ALCF AI Testbed](#) is a growing collection of some of the world's most advanced AI accelerators, including Cerebras, Graphcore, Groq, and SambaNova systems, available for open scientific research. ASCR's high-performance network facility, [ESnet](#), also plays a vital role in enabling data-intensive science across geographic, institutional, and domain boundaries.

By investing in AI, ASCR hopes to make advances that accelerate scientific discovery and transform science and energy research by harnessing DOE investments in massive data from scientific user facilities, software for predictive models and algorithms, high-performance computing platforms, and the national workforce.

ASCR Funding

- FY2024: EXPRESS: 2024 Exploratory Research for Extreme-Scale Science: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2024: Advancements in Artificial Intelligence for Science: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2023: Scientific Machine Learning for Complex Systems: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2022: Randomized Algorithms for Combinatorial Scientific Computing: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2022: EXPRESS: 2022 Exploratory Research for Extreme-Scale Science: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2021: Bridge2AI and Privacy Preserving Artificial Intelligence Research: [Press Release](#), [Award List](#), [Lab Funding Opportunity](#)
- FY2021: EXPRESS: Randomized Algorithms for Extreme-Scale Science: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2021: Data-Intensive Scientific Machine Learning and Analysis: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2021: Neuromorphic Computing for Accelerating Scientific Discovery: [Press Release](#), [Award List](#), [Funding Opportunity](#)
- FY2020: Artificial Intelligence and Decision Support for Complex Systems: [Press Release](#), [Award List](#), [Funding Opportunity](#), [Lab Funding Opportunity](#)
- FY2020: Scientific Machine Learning for Modeling and Simulations: [Press Release](#), [Award List](#), [Funding Opportunity](#), [Lab Funding Opportunity](#)
- FY2020: FAIR Data and Models for Artificial Intelligence and Machine Learning: [Press Release](#), [Award List](#), [Funding Opportunity](#), [Lab Funding Opportunity](#)
- FY2020: Scientific Discovery through Advanced Computing: Scientific Machine Learning and Artificial Intelligence for Fusion Energy Sciences: [Press Release](#), [Award List](#), [Funding Opportunity](#), [Lab Funding Opportunity](#)
- FY2019: Scientific Machine Learning and Artificial Intelligence: Uncertainty Quantification: [Press Release](#), [Award List](#), [Funding Opportunity](#), [Lab Funding Opportunity](#)
- FY2019: Artificial Intelligence, Machine Learning, and Data Analytics CoDesign: [Press Release](#), [Award List](#), [Lab Funding Opportunity](#)

Award abstracts and information about awards made prior to FY2018 can be found [here](#).

ASCR Workshops and Reports

- [AI for Science: Report on the Department of Energy Town Halls on Artificial Intelligence for Science \(February 2020\)](#)
- [Data and Models: A Framework for Advancing AI in Science \(December 2019\)](#)
- [Workshop Report on Basic Research Needs for Scientific Machine Learning: Core Technologies for Artificial Intelligence \(February 2019\)](#)
- [Machine Learning and Understanding for Intelligent Extreme Scale Scientific Computing and Discovery \(December 2015\)](#)

Press Releases

- [DOE Announces \\$29 Million for Ultramodern Data Analysis Tools \(March 2021\)](#)
- [The White House Office of Technology Policy, National Science Foundation and Department of Energy announce over \\$1 billion in awards for Artificial Intelligence Institutes and Quantum Information Science Research Centers \(August 2020\)](#)

Other Notable Reports

- [National Artificial Intelligence Research and Development Strategic Plan, 2023 Update \(May 2023\)](#)
- [Advanced Research Directions on AI for Science, Energy, and Security: Report on Summer 2022 Workshops \(May 2023\)](#)
- [Opportunities and Challenges from Artificial Intelligence and Machine Learning for the Advancement of Science, Technology, and the Office of Science Missions \(September 2020\)](#)

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