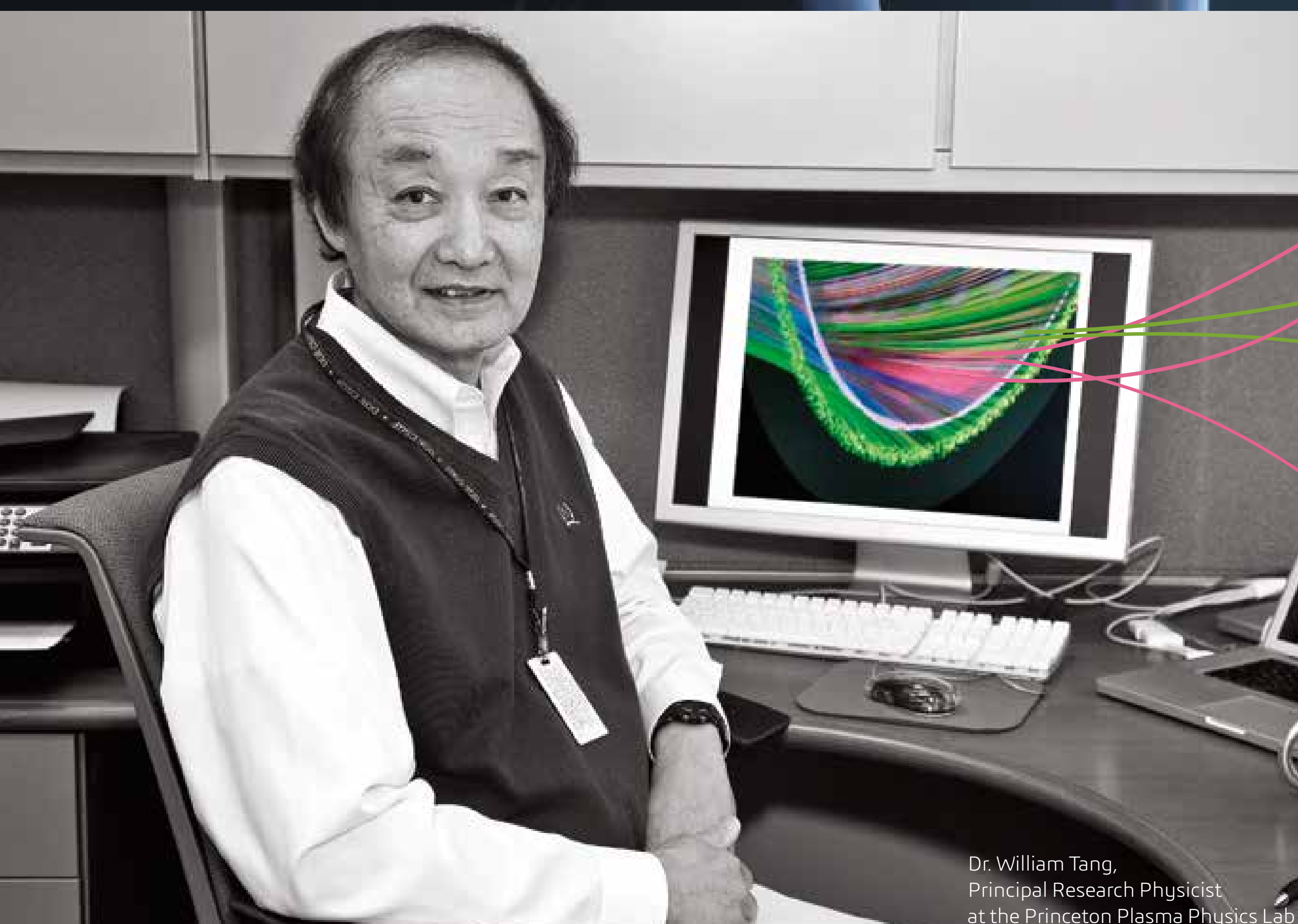
SCIENTISTS TAP AI FOR MAGNETIC CONFINEMENT OF CLEAN FUSION REACTIONS

Argonne National Laboratory's Aurora supercomputer helps spearhead renewable energy research

By Rob Johnson



Dr. William Tang,
Principal Research Physicist
at the Princeton Plasma Physics Lab

Argonne National Laboratory, based in Illinois, is well-known among researchers. Over the years their resident computers have enabled a wide array of complex scientific endeavors. Their current focus involves the development of a new flagship computing system, nicknamed Aurora. Upon its deployment in 2021, the team envisions performance levels approaching a billion-billion calculations per second. Speed of that magnitude will place Aurora among the fastest high-performance computing (HPC) systems in the nation.

Scientists like Dr. William Tang, Principal Research Physicist at the Princeton Plasma Physics Lab, eagerly await their turn on the forthcoming system. He, and a handful of other researchers have early access to Aurora through the Argonne Leadership Computing Facility's Aurora Early Science Program (ESP). In addition to Dr. Tang's work, the ESP will prioritize endeavors in fields like cosmology, cancer research, computational chemistry, aircraft design, and much more.

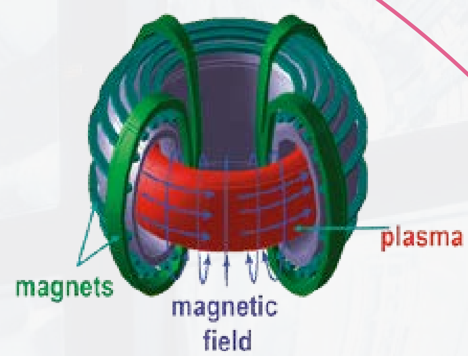
NEW APPROACHES FOR CLEAN ENERGY PRODUCTION

Dr. Tang spearheads research into the ways that artificial intelligence methods, including deep learning, can advance predictive capabilities for fusion-energy research. "Reducing or eliminating carbon emissions is not only urgent; it is critical. The energy of the future must come from clean and safe fusion. We face major challenges in making that transition. However, today, it is an achievable goal thanks to exascale computing, the emergence of AI, and deep learning," said Dr. Tang.

Fusion is the type of power the sun and the stars produce, and it represents an extremely-challenging genie to keep bottled up in a laboratory. Unlike traditional fusion reactors, though, Dr. Tang's proposed design contains less than a minute's worth of fuel at a time. Doing this offers two significant advantages: First the fuel source is the hydrogen isotope deuterium, obtained from seawater and tritium created at the facility. Because the radioactivity generated by this fusion process is quite short-lived, the new reactor design poses no risk of long-term environmental contamination. Second, the reaction chamber only sips fuel in short bursts. Therefore, a catastrophic "meltdown" of the reactor is impossible. It simply shuts down when its mouthful of fuel is consumed.

KEEPING THE GENIE IN THE BOTTLE

The ongoing fusion reaction in our Sun creates extremely high plasma temperatures reaching tens of millions of degrees. Since a fusion reactor on earth must re-create similar conditions, conventional materials can't take the heat, literally.



"We have invested a lot in the effort to deliver clean fusion energy through magnetic-confinement methods," says Tang. "However, there are many barriers to overcome. One major challenge is making quick and accurate predictions regarding so-called 'disruptive events,' which allow hot, thermonuclear plasma to escape quickly. Supervised machine-learning helps us as a predictive guide. If we can predict what we call a 'crash,' we can plan to control it."

Dr. Tang's goal of magnetic confinement addresses the challenges associated with extraordinary reaction temperatures. However, maintaining that reaction for optimal performance requires the aid of optimized neural networks to manipulate the related data sets. The neural nets must learn to decipher all the data representing the three-dimensional reaction space. They must also account for the fourth dimension—time—in the calculations.

EXASCALE LEADS TO INNOVATION

The Aurora system, built by Cray, will feature a future generation of Intel Xeon Scalable processors and Intel Optane DC Persistent Memory, plus future Intel X^e technologies. Says Tang, "These industry-laboratory collaborations are critical for developing a system that will tie together innovative science, new technologies, and AI."

He adds, "The advanced exascale systems of tomorrow will empower us to do amazing things in the coming years. Our work is exciting because we have an opportunity to do something that can benefit the world."

For More Information

www.intel.com/content/www/us/en/high-performance-computing/supercomputing/exascale-computing.html