US supercomputer Titan does calculations for HZDR cancer research

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Supercomputer Titan is at the Oak Ridge National Laboratory in the state of Tennessee, USA. Credit: ORNL/U.S. Dept. of Energy

For their calculations, researchers at the Helmholtz-Zentrum Dresden-Rossendorf (HZDR) will now, starting in 2015, have access to the World's second-fastest computer. The Dresden research initiative is one of 56 projects the US Department of Energy has granted access to Titan as part of their INCITE program. HZDR's 3D simulations of laser-accelerated ions is listed as one of their six 2015 highlights. The Dresden scientists are hoping that the computations will yield new insights that may prove useful in proton-based cancer therapy.

"I'm thrilled we've been selected as one of the six INCITE highlights; I think it's a sign the work of our team is being appreciated," says HZDR's Dr. Michael Bussmann, Junior Group Leader for Computational

Radiation Physics. The scientists will be one of only a handful of foreign teams to be granted access to US supercomputer Titan at the Oak Ridge National Laboratory, Tennessee, USA. With its 18,688 graphics cards and as many 16-core processors, Titan is currently the World's second-fastest computer.

Its special design, with graphics cards as the components that bear most of the brunt, makes this high performance computer particularly well suited to concurrently running several different computations in parallel - which is exactly what the Dresden researchers are hoping to do. "Titan is one of the few supercomputers with enough computing power and storage to allow for comprehensive 3D simulations of laser-accelerated ion beams for use in cancer therapy," Bussmann explains. The goal of the simulation is to help the researchers grasp and control all of the relevant physical effects. In the future, this could help with development of more compact, cost-effective particle accelerators, which are desperately needed, especially in the field of medicine. Worldwide, only 30 centers have the capabilities of offering high-precision proton therapy for cancer treatment. Soon, Dresden's OncoRay Center, whose operating partners include the HZDR, the Dresden University of Technology, and Dresden University Hospital, will also make the list. This type of cancer therapy benefits from the accelerator research that is being at the HZDR.

For Michael Bussmann and his team it is the second time that they will use Titan to perform such complex calculations. Their first exposure to Titan was back in 2013 when they used the supercomputer to simulate plasma jets - rays of matter that emanate from the centers of stars and black holes. They managed to simulate these jets so accurately that they were able to trace the course of the roughly one hundred billion charged particles. To this end, a special kind of simulation code called PIConGPU was used, which has also been used at Titan to set the record for greatest number of calculations performed per second using this type

of code.

The researchers will again be using PIConGPU in their latest project: "It allows us to perform large-scale simulations in a matter of days and then study our findings in more depth later on at the HZDR", says Ph.D. student Axel Hübl, who will be performing the simulations and who has helped co-develop PIConGPU. In addition to having to perform the calculations themselves, a lot of diligent and hard work will go into the analysis stage: The currently planned simulations will yield some 200 Terabytes worth of data that will need to be analyzed by the team over the course of next year.

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