PS3s help astrophysicists solve mystery of black hole vibrations

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An artist's concept of a growing black hole. Image credit: NASA/JPL-Caltech

(PhysOrg.com) -- Using only the computing power of 16 Sony Playstation 3 gaming consoles, scientists at The University of Alabama in Huntsville and the University of Massachusetts, Dartmouth, have solved a mystery about the speed at which vibrating black holes stop vibrating.

It may be the first time this kind of research has been conducted exclusively on a PS3 cluster: A related 2007 UMass Dartmouth/UAHuntsville project using a smaller PS3 cluster also used a "traditional" supercomputer to run its simulations.

The biggest advantage of the console cluster — the PS3 Gravity Grid — at UMass Dartmouth was the cost saving, said Dr. Lior Burko, an

assistant physics professor at UAHuntsville. "If we had rented computing time from a supercomputer center it would have cost us about $5,000 to run our simulation one time. For this project we ran our simulation several dozens of times to test different parameters and circumstances, so you can see how much that would have cost us.

"You can build a cluster like this for perhaps $6,000, and then you can run the simulation as many times as you like at no additional cost."

"Science budgets have been significantly dropping over the last decade," said UMass Dartmount Physics Professor Gaurav Khanna, who built the PS3 cluster. "Here's a way that people can do science projects less expensively."

Khanna recently launched a website — www.ps3cluster.org — which includes step-by-step instructions for building a supercomputing PS3 cluster.

The PS3 cluster was well suited to this type of astrophysical research, which requires a large number of mathematical calculations but has low demands for RAM memory, Burko said. "Not every kind of job would be suitable for that system, but it is exactly the kind of computation that we did."

The current price for supercomputing time through a center like the National Science Foundation's TeraGrid or the Alabama Supercomputing Center is about $1 per CPU hour. Each PS3 has a powerful Cell processor. The 16-unit PS3 grid can complete a 5,000-CPU-hour (and $5,000) simulation run in about a day. That is a speed comparable to a rented supercomputer.

Published in the journal, "Classical and Quantum Gravity," the new research resolved a dispute over the speed at which black holes stop

vibrating after they first form or are perturbed by something like swallowing some matter.

"Think of a bell," said Burko. "A bell rings, but eventually it gets quiet. The energy that goes out with the sound waves is energy that the bell is losing. A black hole does exactly that in gravitational waves instead of sound waves. A black hole that is wobbling is emitting gravitational waves. When those vibrations die down you get a quiet black hole."

(Most black holes are "quiet," which means the only things astronomers can measure are their mass and how fast they spin.)

Khanna and Burko used a high resolution computer simulation to "perturb" a simulated spinning black hole, then watched as it returned to its quiet state. They found that the speed at which black holes go quiet was the faster of the two competing theories.

Provided by University of Alabama

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