http://stephenbrooks.org/muon1

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Muon1 Distributed Particle Accelerator Design Project reaches 25 Quadrillion Milestone

The Muon1 Distributed Particle Accelerator Design Project proudly announces that today, at 01:23:23 UTC, it reached the 40 quadrillion (40,000,000,000,000,000) particle timesteps (pts) milestone.

The Muon1 project attempts to assist in the design of the most efficient particle accelerator to form part of the Neutrino Factory project using the spare computing power available while volunteers' PCs are idle. It is run semi-independently by Rutherford Appleton Laboratory's Stephen Brooks on a shoestring budget.

The project works in a very different way to traditional distributed computing clients, as it does not use a standard work-unit allocation system to brute-force the task. Instead of a central server assigning blocks of work to users which are crunched and returned, clients start off with random designs, which are are then modified in an attempt to improve things. Results are returned to the servers with the best designs available to clients to incorporate into their future designs.

“While brute force systems are very efficient at dealing with small (10^{15} permutations) projects,” explains project head Stephen Brooks, “each of our design ranges are incredibly vast, with between 10^{300} and 10^{1200} possible design points. It's just not possible to work in that way.”

Genetic algorithms allow for extremely rapid progress in design work, as designs with potential are examined closely, while designs that don't perform as required are given a basic investigation and stored for later use, significantly reducing the amount of processing time wasted on unproductive designs. In some tasks, it has already been found to increase yield efficiency three-fold over the best designs traditional methods have devised.

“Muon1's optimiser continues to be a flexible tool for designing many kinds of accelerator beamline.” says Brooks, “It is regularly producing good designs for the neutrino factory front end and we're also using the data gathered to improve the algorithm further. It is also producing excellent results when tried on completely different accelerator design problems, which may be rolled out to the distributed network over the coming years.”

The flexible design process also means that as new theories or hypothesis are made or published the field, the project can be returning results within as little as six hours. This enables the project to stay at the cutting edge with minimal modifications.

There is also the ability for end-users to manually enter designs to be simulated with no physics knowledge needed, allowing people at any level of expertise to positively interact with the client.

Muon1 has won acclaim for its accurate and colourful 3D visual mode, which allows the viewpoint to be manipulated at will and has supported stereoscopic 3D viewing (via Anaglyphic red-blue glasses) for many years. The client can be run in visual, command-line, hidden, and screensaver modes. Alternatively it can be run though the BOINC client, as part of the Yoyo@home project.

About Muon1

Muon1 is a Windows-based distributed computing project that was started in 2001. Initially simulating 2500 particles, with a handful of people, now thousands of computers run the client simulating tens of thousands of particles at a time. Simulations work using 0.01 nanosecond increments (a 'timestep'), which define the project's workload measure - **p**article-**t**ime**s**teps, or **pts**. An internet connection is preferred, but not required to participate. The client requires no integration with Windows, and can be run from a portable drive, and switched between computers as required.

The aim of the project is to design the central section of a particle accelerator which will be used to determine the masses of different types of Neutrinos. Currently, their properties are largely unknown, with recent questions about their velocity.

The average size of a simulation run is 400 million particle timesteps, and will take between 15 and 90 minutes for a typical modern multi-core computer, depending on hardware.

Further information about the project can be found at http://stephenbrooks.org/muon1/info/

About Stephen Brooks

Stephen Brooks, 29, is a research associate with the UK Neutrino Factory project, based at the Rutherford Appleton Laboratory (RAL) in Oxfordshire. He studied mathematics, computation and mathematical physics first at the Open University and then at Oxford, graduating in 2001 and 2003, respectively. Research interests centre around the application of numerical analysis methods to scientific and engineering problems, currently in particular the simulation of particle beams in accelerators.

Notes for Editors

40 quadrillion (or million-billion) particle timesteps is the equivalent of simulating a single particle for 111 hours, 6 minutes .

In the simulation, approximately 3 millimetres (3/32 of an inch) is travelled every timestep (0.01 nanoseconds) by the particles, which have near light-speed velocity.

After 40 quadrillion timesteps, that particle would have travelled about 120,000,000,000km (74,560,000,000 miles), or roughly 802 Astronomical Units (1AU is the distance from the Earth to the Sun). For comparison, Voyager 1, the most distant man-made object, is 123.4AU from the Sun.

Past milestones were 20 Quadrillion on July 16 2010, 25 Quadrillion on June 10 2011, and 30 Quadrillion on December 29 2011; a doubling of the work done in the last 2.5 years.

40 Quadrillion timesteps is roughly 1 timestep for every 11 seconds the universe has been in existence.

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For more information contact
Stephen Brooks: sb@stephenbrooks.org
http://stephenbrooks.org/muon1/
Video footage of the client in operation is available on request.

http://facebook.com/Muon1DPAD

http://twitter.com/muon1