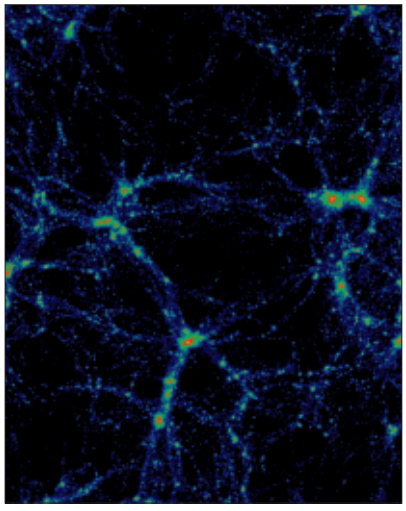
About the Cover

This month's cover was produced by Joerg Colberg of the Virgo Consortium (http://www.mpa-garching.mpg.de/Virgo/). He writes:



"The image shows a slice through a simulation of N-body structure formation in a cosmological volume done by our group. Matter is represented by millions of computer particles subject to their mutual gravity. Calculating the gravitational forces between N particles is an $O(N^2)$ problem, which becomes computationally too expensive unless sophisticated algorithms are used. The total force acting on a particle is split into long-range and short-range components. The former can be computed using very fast Fourier transformations. The latter remains an $O(N^2)$ problem, albeit one of much reduced scale. Simulations with large particle numbers are typically quite slow, since cosmologists are interested in resolving smaller and smaller scales while keeping the size of the simulation box large enough to contain a cosmologically representative volume. In other words, while programmers try to keep the N^2 direct force calculations small, the requirements of cosmologists ensure they're always as close to the computer's limits as possible.

Despite the vast improvements in efficiency gained from advanced algorithms for the force calculation, the simulation still took about a month of computer time on a 128-processor Cray T3E parallel supercomputer at the Max Planck Society's Computer Center in Garching, Germany.

Simulations of N-body behaviour have become invaluable tools of cosmologists since the early 1970s. Every decade, N has increased by about two orders of magnitude, with the latest biggest computational effort, also done by the Virgo Consortium, exceeding ten billion particles. While the earliest N-body simulations were mainly concerned with testing the different models available, cosmology has since then become a precision science where a canonical model is investigated in as much detail as possible. Computer simulations have played an important role in this development and, along with better observations, we hope they will lead us to an understanding of the Holy Grail of cosmology, the formation of galaxies and structure from the uniform initial distribution of gas in the very early universe."

—Bill Casselman, Graphics Editor
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