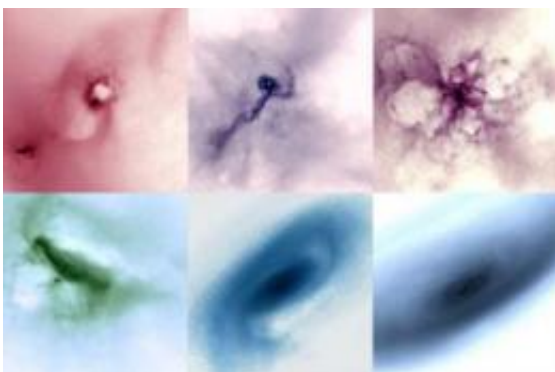


New research resolves conflict in theory of how galaxies form (w/ Video)

January 13 2010, by Vince Stricherz



These images depict various stages of galaxy formation under the cold dark matter theory using new computer simulations that account for the effects of supernova explosions. Credit: Katy Brooks

(PhysOrg.com) -- For more than two decades, the cold dark matter theory has been used by cosmologists to explain how the smooth universe born in the big bang more than 13 billion years ago evolved into the filamentary, galaxy-rich cosmic web that we see today.

There's been just one problem: the theory suggested most galaxies should have far more stars and [dark matter](#) at their cores than they actually do. The problem is most pronounced for dwarf galaxies, the most common galaxies in our own celestial neighborhood. Each contains less than 1 percent of the stars found in large galaxies such as the [Milky Way](#).

Now an international research team, led by a University of Washington astronomer, reports Jan. 14 in *Nature* that it resolved the problem using millions of hours on supercomputers to run simulations of [galaxy formation](#) (1 million hours is more than 100 years). The simulations produced dwarf galaxies very much like those observed today by satellites and large telescopes around the world.

"Most previous work included only a simple description of how and where stars formed within galaxies, or neglected star formation altogether," said Fabio Governato, a UW research associate professor of astronomy and lead author of the *Nature* paper.

"Instead we performed new [computer simulations](#), run over several national supercomputing facilities, and included a better description of where and how [star formation](#) happens in galaxies."

The simulations showed that as the most massive new stars exploded as supernovas, the blasts generated enormous winds that swept huge amounts of gas away from the center of what would become dwarf galaxies, preventing millions of new stars from forming.

With so much mass suddenly removed from the center of the galaxy, the pull of gravity on the dark matter there is diminished and the dark matter drifts away, Governato said. It is similar to what would happen if our sun suddenly disappeared and the loss of its [gravitational pull](#) allowed the Earth to drift off into space.

The cosmic explosions proved to be the missing piece of the puzzle, and adding them to the simulations generated formation of galaxies with substantially lower densities at their cores, closely matching the observed properties of dwarf galaxies.

"The cold dark matter theory works amazingly well at telling where,

when and how many galaxies should form," Governato said. "What we did was find a better description of processes that we know happen in the real universe, resulting in more accurate simulations."

The theory of cold dark matter, first advanced in the mid 1980s, holds that the vast majority of the matter in the universe - as much as 75 percent - is made up of "dark" material that does not interact with electrons and protons and so cannot be observed from electromagnetic radiation. The term "cold" means that immediately following the big bang these dark matter particles have speeds far lower than the speed of light.

In the cold dark matter theory, smaller structures form first, then they merge with each other to form more massive halos, and finally galaxies form within the halos.

Provided by University of Washington

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