News from the AAS

January 8, 2007
by Robert Naeye

About 3,000 scientists from around the world gathered Sunday in Seattle, Washington, for the 209th meeting of the American Astronomical Society. Hundreds of discoveries were announced on the conference's first day, and among the highlights are:

A large international team has made the most detailed 3-D map yet of how dark matter is distributed in the universe. The group observed a 1.6-square-degree patch of sky (9 times the area of the full Moon) with ground- and space-based telescopes, including a whopping 600 orbits of observing time with the Hubble Space Telescope — the most time ever allotted for a single project.

The Cosmic Evolution Survey (COSMOS) found that dark matter is distributed in the same web-like structure as galaxies, and that dark matter, a mysterious form of matter that is invisible to telescopes but that accounts for about 6 times more mass than familiar "atomic" matter, and visible matter clump together as simulations of cosmic evolution have predicted. To tease out the location of dark matter, the team painstakingly studied how foreground concentrations of matter subtly distort the shapes of thousands of more distant galaxies, a phenomenon predicted by Einstein known as gravitational lensing.

The results bolster the prevailing view that dark matter provided the gravitational muscle that allowed galaxies to form in the early universe, and that binds them together in giant clusters. "We don't have an answer on what dark matter is yet," says team leader Nicholas Scoville (Caltech). "But we have made a first step: we know where it is."

A team led by Stella Kafka (National Optical Astronomy Observatory) has found the first strong observational evidence that a star's powerful magnetic field is penetrating a binary companion and stirring up starspots, flares, and prominences.

The system, EF Eridani, consists of a white dwarf and a brown dwarf in an orbit so tight it would fit inside the Sun. The system is normally active when material from the brown dwarf flows along magnetic field lines, smashing into the white dwarf's magnetic pole. But occasionally the flow of material ceases, and the system settles down into a state of relative quiescence, which allows observations of the much fainter brown dwarf. Using telescopes in Chile and

Arizona, Kafka and her colleagues found that during these periods, the system still emits very bright hydrogen-alpha light, a key indicator of magnetic activity. The pattern of the hydrogen-alpha light suggests strong magnetic activity on the brown dwarf of the type that the Sun would normally generate internally, but that rarely occurs in substellar objects.

“The magnetic field of the white dwarf penetrates the brown dwarf and acts like a conductor,” says Kafka. “It makes it come alive and leads to hyperactivity.” The system, adds Kafka, gives astronomers insights into some of the complex magnetic interactions that must be occurring in hot Jupiters: massive planets that orbit their host stars at close range.

A team of astronomers have been keeping their eye on a peculiar eclipsing binary star inside the Orion Nebula (M42).
S&T: Rick Fienberg.

Using several ground-based telescopes in Arizona and Chile, a group led by Phillip Cargile (Vanderbilt University) has monitored an eclipsing binary star in the Orion Nebula (M42) that confounds stellar-evolution models. The two stars periodically pass in front of each other as they orbit a common center of mass, blocking each other’s light. The observations have yielded precise measurements of the mass and size of each star. Both objects weigh in with the same mass: 40 percent the mass of the Sun. Given that the stars are in a binary, they almost certainly formed at the same time, a few million years ago — the same age as most stars in the nebula. According to theory, two stars with the same mass, age, and composition should have the same size. But to the surprise of Cargile and his colleagues, one star is nearly twice as large as the other: 1.94 solar diameters versus 1.03 solar diameters.

“This shows us something we can’t explain right now,” says Cargile, who adds that according to models of how newborn stars shrink as they contract, the larger star should be 8 million years older than its companion. “But all the evidence shows that these stars should be the same age,” he says.