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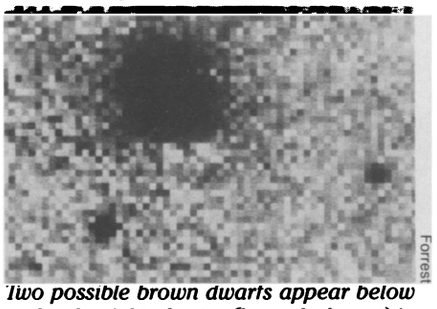
Brown dwarfs caught in the heat of youth

What's bigger than a planet but smaller than a star? The answer is a brown dwarf — a galactic denizen that forms in the same way as a star but has too little mass to become hot enough inside to trigger hydrogen fusion. Such "failed" stars are notoriously difficult to detect, and astronomers so far have come up with only a handful of candidates. However, by focusing on a region of the Milky Way where stars are now forming, a team of astronomers has discovered a number of objects that truly seem to be brown dwarfs. These objects have surprisingly low masses and appear by themselves rather than as partners of larger stars.

"I believe we've been successful in our search," says William J. Forrest of the University of Rochester in New York. "We have eight or nine probable brown dwarfs." Forrest reported his team's findings at last week's American Astronomical Society meeting in Ann Arbor, Mich.

Whereas previous, largely unsuccessful searches focused on brown dwarfs that would reveal their presence by their effects on the motion of visible companion stars (SN: 8/13/88, p.103), Forrest and his collaborators decided to look for young brown dwarfs only a million or so years old. Such newly formed objects should still be hot and bright enough to observe with optical or infrared detectors. The astronomers chose to study a small portion of an active star-forming region 450 light-years from Earth in the direction of the constellation Taurus. "We immediately began finding interesting objects," Forrest says.

Of more than 20 dim objects discovered so far, nine have the distinctive red color characteristic of cooler stars and young brown dwarfs. Of these nine, four have the right kind of motion to belong to the Taurus star-formation region. The remaining five have characteristics that appear to rule out the possibility that they are more distant, giant stars or brighter stars obscured by dust.



Two possible brown dwarfs appear below and to the right of a star (large dark spot) in this infrared photo of an area in the Taurus constellation.

The brown-dwarf candidates are all low in mass, ranging from five to 20 times the mass of Jupiter. Such masses are much lower than that required for stable nuclear burning. Astronomers are puzzling over why low-mass brown dwarfs are so abundant while brown dwarfs having 20 to 80 times Jupiter's mass appear to be absent. There's no known theoretical reason for such a gap, says Jonathan I. Lunine of the University of Arizona in Tucson.

If these low-mass but apparently abundant brown dwarfs prove to be "free floating" rather than members of multiple-star systems, such objects may make a significant contribution to a galaxy's total mass. "They're a mass to be reckoned with," Forrest says. After a few hundred million years, such brown dwarfs would become too cool to be detectable and may account for a portion of the universe's "missing" mass. Current theories indicate that visible matter accounts for as little as 10 percent of the universe's total mass.

The evidence for brown dwarfs, though good, is still not completely convincing, says Michael F. Skrutskie of the University of Massachusetts in Amherst. Adds Forrest, "We need more confirming evidence." Astronomers need to study more of the Taurus region and survey other, nearby star-formation regions.

— I. Peterson