The new, but confusing, clue about the nature of the faint emission from NGC5907 has been obtained by comparing the spectral energy distribution of the halo — the proportion of light emitted at different wavelengths — to theoretical stellar populations with a given chemical composition and mix of light and heavy stars. Broadly speaking, stars of low mass and those with compositions rich in the elements heavier than helium ('metal-rich' stars) have cooler atmospheres than their high-mass or metal-poor counterparts, and thus emit more of their energy in 'redder' or longer-wavelength regions of the spectrum. Because low-mass stars are more numerous and emit less light per unit mass than high-mass stars, they have been considered plausible dark-matter candidates in the past.

The best match to the new data of the models tested by Rudy and collaborators is a stellar mix that is overwhelmingly dominated by low-mass stars (every 10-fold decrease in stellar mass resulting in a 30,000-fold increase in numbers) with the same metal-richness as the Sun. This conclusion is both tantalizing and disturbing. Tantalizing because such a population could indeed be responsible for all of the dark mass in NGC5907. Disturbing for two reasons. First, stars in the halo of our own Galaxy are much more metal-*poor* than the Sun, presumably because they formed before most heavy elements were released from stellar interiors in the later stages of stellar evolution. Second, recent Hubble Space Telescope observations sensitive enough to count the numbers of even very faint low-mass stars in the halo of our own Galaxy have failed to find them[4–7] in the numbers being inferred for NGC5907. If the spectral energy distribution of NGC5907 has been properly measured and interpreted, it would seem that the dark-matter halos of our Galaxy and NGC5907 are composed of entirely different constituents, even though the two galaxies are similar in many other ways — a conclusion that is, to put it mildly, uncomfortable.

But what other possibilities remain open for the origin of the observed faint halo emission from NGC5907? Could the light be emitted from an ordinary stellar halo, which is faint but does not contain much mass? Probably not. At all wavelengths the spatial distribution is considerably more extended than that of typical stellar halos. Furthermore, the optical colours indicate a population nearly devoid of giant stars[3], and combined with the infrared colours suggest a population that is too metal-rich and far too highly dominated by low-mass stars to be typical[2].

Could the light be from the stellar debris of a small satellite galaxy that has been sheared apart and accreted onto NGC5907 through a gravitational merger, like those sometimes observed for other galaxies, including our own? Unlikely. That might account for the extended spatial profile of faint light, the asymmetry seen in some observations, and perhaps the presence of metal-rich stars in a halo environment. But the colours are extremely odd, and if the stellar mix is as Rudy and collaborators suggest, the 'satellite' would have been much more massive than NGC5907!

Could the interpretation of the peculiar halo colours for NGC5907 be wrong? Possibly. Calculating the colours of metal-rich, low-mass stars is complicated by the presence of many molecular absorbers in the cool, outer stellar atmospheres. Recently refined models, however, were used by Rudy and collaborators. A critical step will be to verify the prediction that the IR emission is being generated by a large number of dim dwarf stars rather than a small number of bright giants.

Could the measurements themselves be in error? For a single observation, possibly. The faint emission levels mean that detector response and backgrounds must be calibrated precisely[8]. But the unusual colours of the NGC5907 halo rest on several independent measurements[1–3,9]. A conventional explanation would require that more than one of these measurements be wrong.

This is not the first time in recent months that an unconventional stellar population has been proposed for halo dark matter. Based on its first two years of microlensing results, the MACHO team has suggested that 50 per cent of the Milky Way's dark matter may be in the form of white dwarfs[10] — compact, faint end-products of stellar evolution, each about half the Sun's mass. But they point out that their results are also consistent with our Galaxy's dark mass being mostly stars and brown dwarfs in the 0.1-solar-mass range. Both possibilities require extremely peculiar mixes of faint objects too dim to be detected by current direct searches in the Milky Way.

So, where does all this leave astronomers? Arguing about dark matter. □

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Evolutionary biology

A chilling tale from the ends of the Earth

As summer time approaches and temperatures soar, the warming seas entice many people to take a dip. But spare a thought for the fish that live in the waters of the Antarctic and Arctic, which can reach a low of −1.9 °C. As well as finding food in the frigid polar oceans, these fish must ensure that they do not, literally, freeze.

Fortunately, they have special blood-serum 'antifreeze' glycoproteins (AFGPs) that deter the growth of ice crystals and lower the freezing temperature of the fish to below that of the surrounding sea. Now, in the 15 April issue of *Proceedings of the National Academy of Sciences* (Chen, L. *et al. Proc. Natl Acad. Sci. USA* 94, 3811–3822;1997), Liangbiao Chen and colleagues report that they have found that fish from opposite ends of the Earth have very similar AFGPs but, incredibly, the genes for these antifreeze proteins evolved through completely different pathways.

Members of the Antarctic notothenioid family of fish (pictured) have an AFGP that is made up of a simple sequence of repeating tripeptide units, and it is thought to have evolved from the pancreatic enzyme trypsinogen. Arctic cod also have a tripeptide-repeat-based AFGP, but this shares no sequence similarity with the trypsinogen gene. Moreover, morphological and palaeoclimatic findings indicate that the AFGPs from the two types of fish could not have evolved from the same ancestor. So they must have evolved their respective AFGPs separately and, through convergent evolution, arrived at the same sequence. A chilling tale indeed.

Alison Mitchell

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