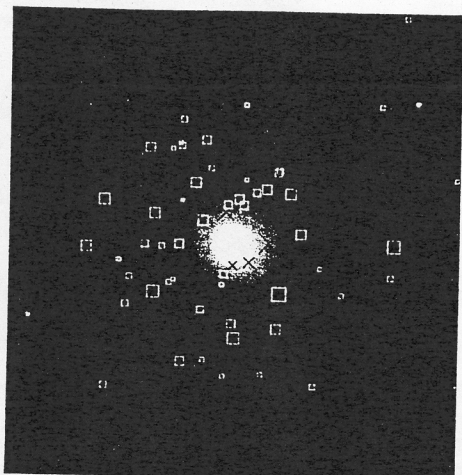


No need for dark matter

Astrophysicists will be scratching their heads following the recent discovery that some galaxies seem to contain little or no dark matter. A team led by Aaron Romanowsky of the University of Nottingham in the UK has found that the dynamics of three elliptical galaxies can be explained without the need for dark matter, in contrast to the motion of spiral galaxies. The result challenges current theories of galaxy formation in which elliptical galaxies are born in collisions between galaxies rich in dark matter (A Romanowsky *et al.* 2003 *Science* **301** 1696).

Dark matter was originally proposed to explain the motion of galaxies, which appear to rotate as though they contain much more matter than is visible with telescopes. This invisible mass and its gravitational pull on ordinary matter has become a cornerstone of modern cosmology, but the new results cast doubt on the existence of dark matter in certain galaxies.

Romanowsky and colleagues in the Netherlands, Italy and Australia measured how much the rotational speed of three elliptical galaxies changed from their centres to their outer edges using the 4.2m Herschel telescope in La Palma. The researchers measured the Doppler shift of spectral lines in shells of gas called planetary nebulae, which are ejected by Sun-like stars at the end of their lives. The values of these Doppler shifts enabled the researchers to calculate the velocities of hundreds of nebulae, and therefore the velocities of their galactic neighbourhoods (see figure).



Dark surprise – the velocity of the elliptical galaxy NGC 3379 decreases towards its outer edge, which means that dark matter is not required to explain its motion: red crosses (blue squares) represent receding (approaching) velocities, and their size is proportional to the magnitude of the velocity.

To their surprise, Romanowsky and co-workers found that the rotational speed of the elliptical galaxies falls towards their outer edges – a result that Johannes Kepler would have predicted long before the advent of dark matter. In contrast, the rotational speed of matter beyond the visible edge of spiral galaxies remains constant. Astronomers think that this arises from the gravitational effect of “halos” of dark matter that surround spiral galaxies. Now they must explain why dark matter is only found in some galaxies and not in others.