Why do some galaxies stop making new stars?

July 13 2016, by Michael J. I. Brown, Amelia Fraser-Mckelvie And Kevin Pimbblet

Spiral galaxy NGC 3953 is a veritable star making machine, but why do some galaxies stop forming new stars? Credit: NASA-Sloan Atlas

Galaxies are star-making machines, churning out new stars fuelled by cold gas collapsing under the force of gravity. Some galaxies can produce hundreds of new stars in a single year, and individual galaxies can contain many billions of stars.

Our own galaxy, the Milky Way, is dotted with star-forming regions. One of these, the Orion Nebula, is so bright you can see it with the unaided eye. Look at the middle "star" of Orion's sword, and you are actually seeing stars being born.

But something can break these star-making machines; many elliptical galaxies have stopped forming new stars. What stops them is one of the biggest questions in astronomy.

Breaking the machines

A distinctive feature of elliptical galaxies is their ellipsoidal shapes, much like an Aussie rules or rugby ball.

The Milky Way, and many other large star-forming galaxies, are spiral galaxies. In spiral galaxies, stars and the gaseous fuel to make new stars circle around the galaxy in a vast flat disk.

Does the formation of new stars critically depend on galaxy shape? It seems plausible given most spiral galaxies are forming stars and most elliptical galaxies aren't.

But how then do elliptical galaxies grow? Back in 1972, the brothers Alar and Juri Toomre showed that new elliptical galaxies could be created by merging spiral galaxies together. Indeed, billions of years from now, our own Milky Way will collide with the Andromeda galaxy to create a new elliptical galaxy.

The middle star in Orion's sword is actually the Orion Nebula, where new stars are being born. Credit: NASA, C.R. O'Dell and S.K. Wong (Rice University)

Perhaps it is the process of galaxy mergers that breaks star-making machines. But not all plausible mechanisms for stopping star formation clearly depend on galaxy shape.

For example, galaxies ploughing through hot plasma can have star-forming gas stripped from them, but this process shouldn't transform spiral galaxies into elliptical galaxies.

There are some elliptical galaxies that are forming stars, but are there any spiral galaxies without any star formation? Is star formation intimately linked to galaxy shape or not? We decided to find out.

Searching for star formation

How do you find galaxies that are forming stars versus those that are not? Easy. You look for stars that die young.

Our yellowish sun is about halfway through its 10-billion-year life. But very luminous hot blue stars have lifetimes of just 30 million years.

In cosmological terms, 30 million years is a blink of the eye. Find a galaxy with these blue stars, and you are seeing a galaxy forming stars (or that formed stars very recently). Conversely, a red galaxy may not be forming any new stars.

There are other ways of looking for star-forming galaxies too. Hot stars warm the dust within galaxies, and that warm dust glows in infrared light . Hot stars also cause surrounding gas to glow, producing a distinctive spectrum of light.

Red and dead?

We weren't the first to look for spiral galaxies that aren't forming stars. In 1976, Canadian astronomer Sidney van den Bergh found "anaemic" galaxies that have far less star formation than typical spiral galaxies.

Many elliptical galaxies have effectively stopped making new stars. Credit: NASA Sloan Atlas

And British astronomer Karen Masters has identified thousands of red spiral galaxies using the citizen science GalaxyZoo Project.

But the spectra of red spiral galaxies identified by van den Bergh and Masters show the distinctive glow of hydrogen gas surrounding hot blue stars. These galaxies must still be forming new stars.

We decided to take a different approach to finding spiral galaxies without star formation, utilising images from NASA's Wide-field

Infrared Survey Explorer.

We searched for spiral galaxies without the infrared glow of warm dust heated by short-lived hot blue stars. The galaxies we found turned out to be red in ultraviolet and visible light, as expected if they aren't forming new stars.

To be totally sure these spiral galaxies are truly dead, we decided to obtain their spectra, using the Siding Spring 2.3-metre telescope, near Coonabarabran in New South Wales.

Star-forming galaxy NGC 3310 is blue because it contains short-lived hot blue

stars. Credit: Sloan Digital Sky Survey

None of the six spectra had the distinctive signature of glowing gas heated by short-lived stars. We had finally found spiral galaxies that aren't forming stars.

Our letter announcing this discovery was recently accepted for publication in *Monthly Notices of the Royal Astronomical Society*.

So what stops star formation?

Clearly, star formation can be turned off without transforming spiral galaxies into elliptical galaxies. But just what is stopping star formation? There are several possibilities.

One option is ram pressure stripping, where gas is stripped from a galaxy plunging through hot plasma. But this process should only work in clusters of galaxies, and many of our galaxies aren't in galaxy clusters.

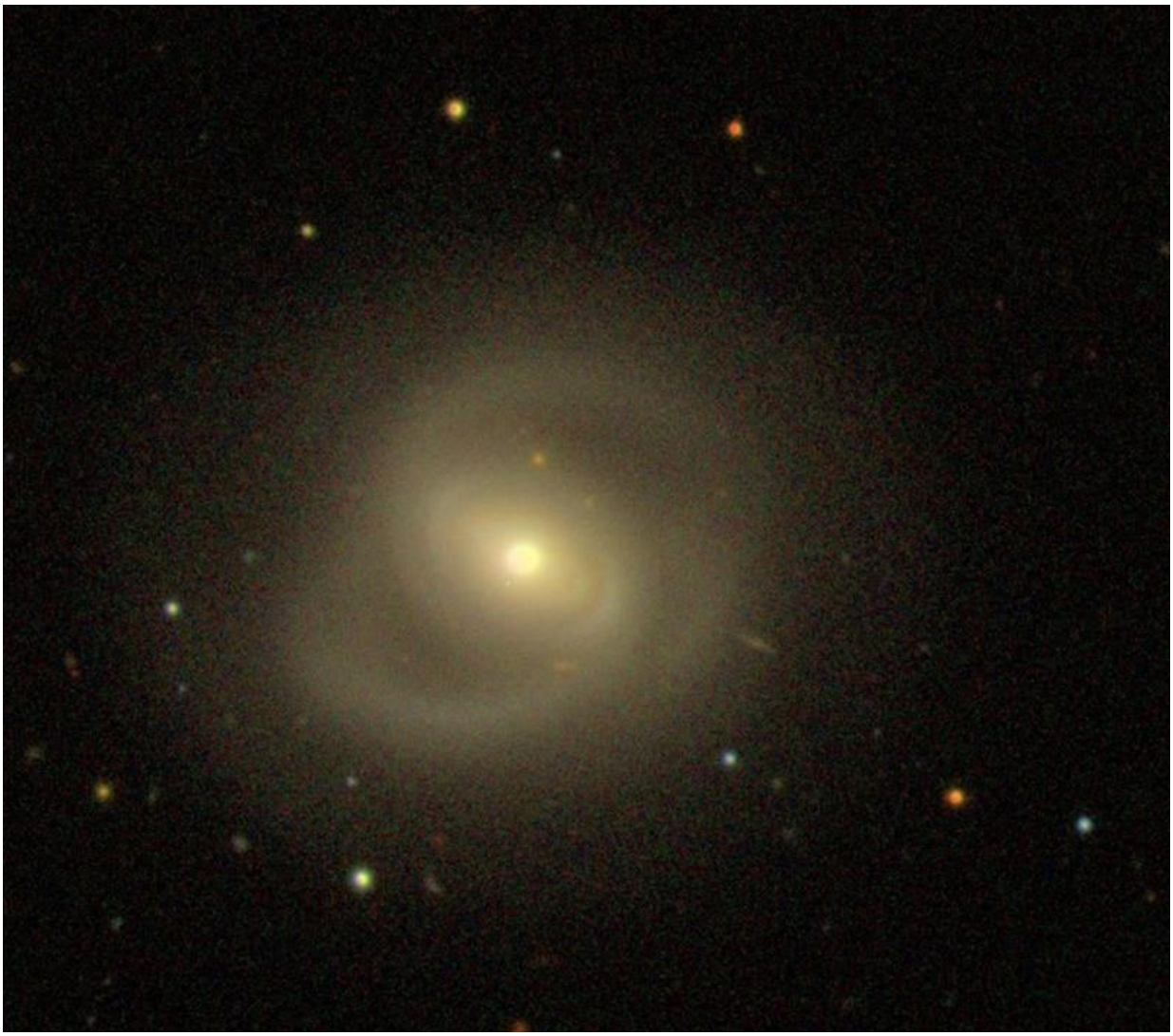
Glowing hydrogen gas produces a distinctive spectrum of light. Credit: Jan Homann/Wikipedia

Perhaps gas cannot cool to produce new stars because of heating by

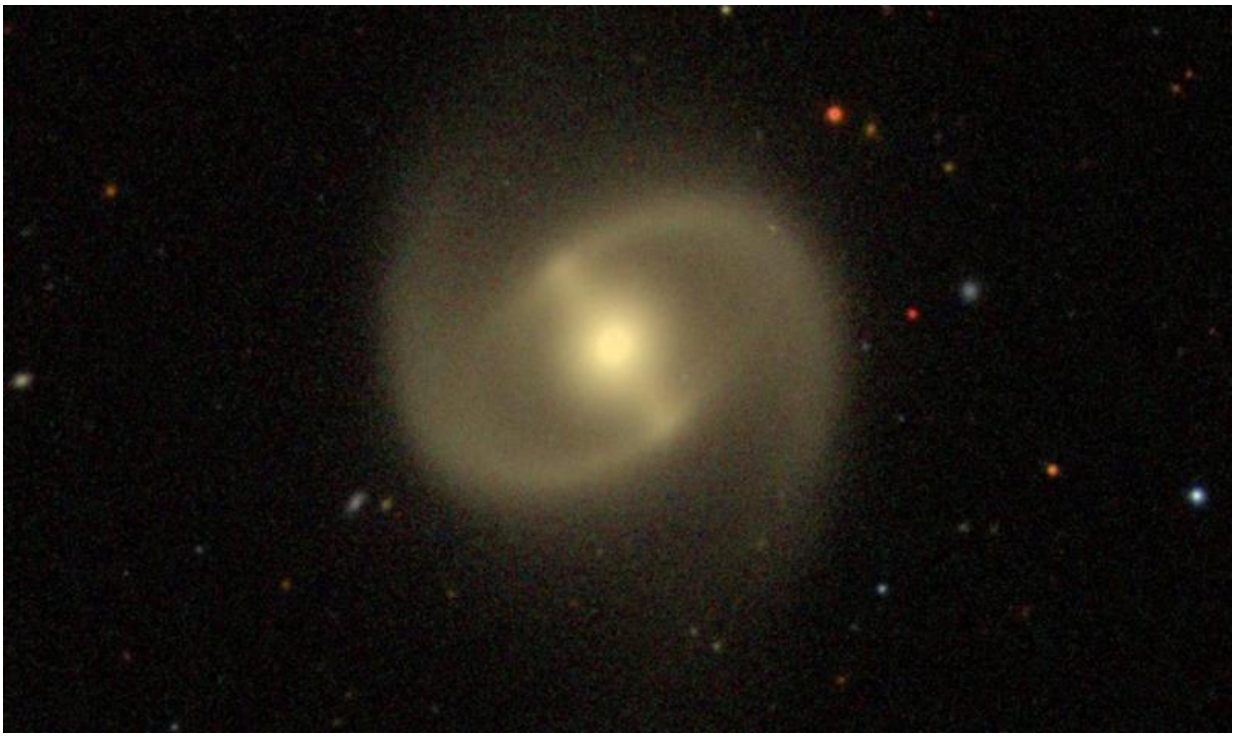
active galactic nuclei, which are powered by the in-fall of matter towards enormous black holes. This may be true in some instances, but we didn't see evidence for active galactic nuclei in most of our galaxies.

We now have a new mystery on our hands. What stops star formation in these unusual spiral galaxies?

Funnily enough, galaxy shapes may provide a clue. The British astronomer Karen Masters finds that spiral galaxies with little star formation often feature prominent "bars" straddling their centres. This also seems to be true for spiral galaxies without star formation. Perhaps galaxy shape plays a critical role breaking star-making machines after all.



Sidney van den Bergh identified NGC 718 as an anaemic spiral galaxy, with just a trickle of star formation. Credit: Sloan Digital Sky Survey



NGC 4440, like many spiral galaxies with little or no star formation, features a distinctive bar straddling its centre. Credit: Sloan Digital Sky Survey

This article was originally published on The Conversation. *Read the* original article.

Source: The Conversation

Citation: Why do some galaxies stop making new stars? (2016, July 13) retrieved 9 April 2024 from https://phys.org/news/2016-07-galaxies-newstars.html