Galaxies grow bigger and puffier as they age: study

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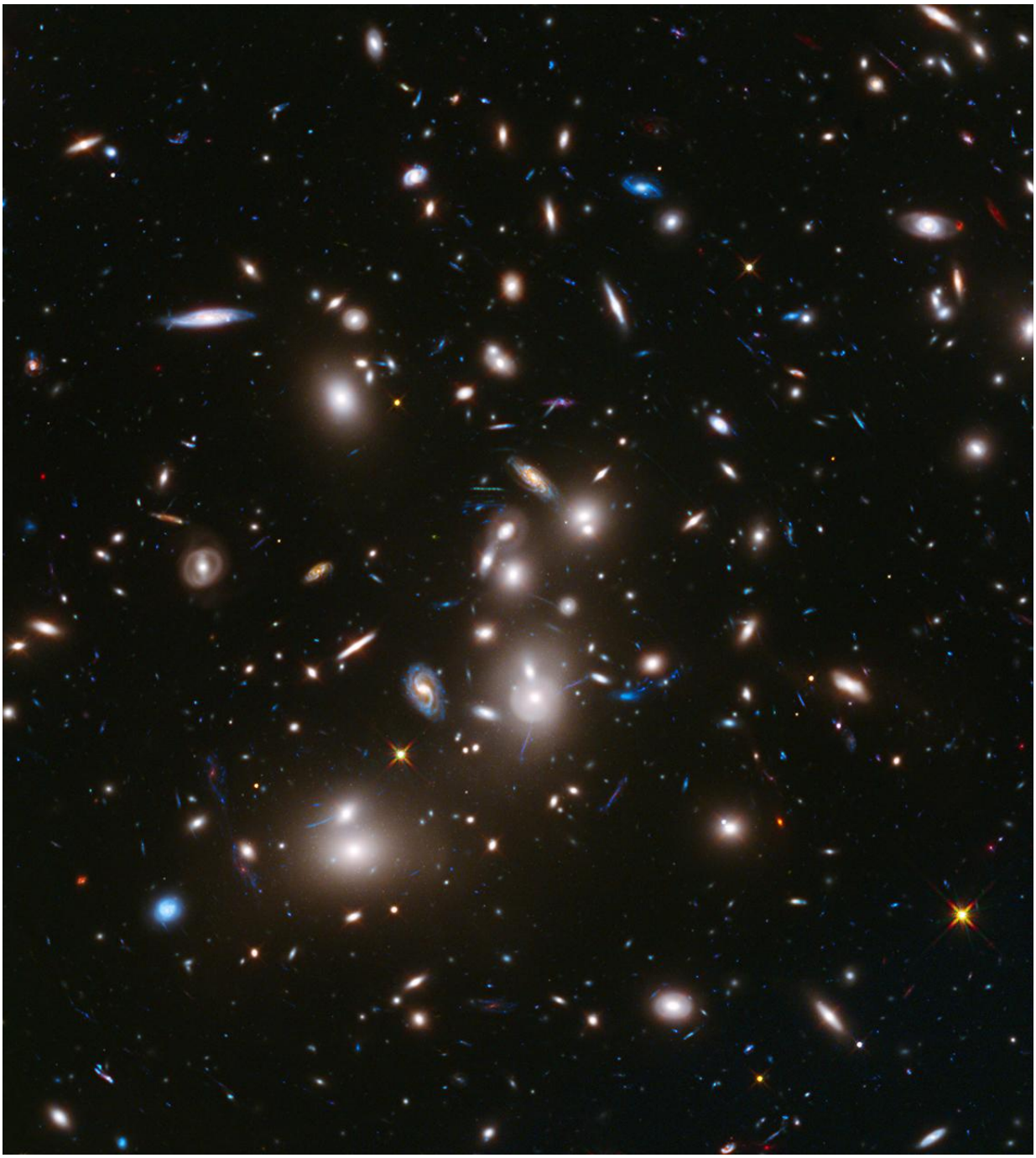

This is a long-exposure image from NASA's Hubble Space Telescope of massive galaxy cluster Abell 2744. It shows some of the faintest and youngest galaxies detected in space. Credit: NASA/ESA/STScI

A new international study involving The Australian National University (ANU) and The University of Sydney has found that galaxies grow bigger and puffier as they age.

Co-researcher Professor Matthew Colless from ANU said that stars in a young galaxy moved in an orderly way around the galaxy's disk, much like cars around a racetrack.

"All galaxies look like squashed spheres, but as they grow older they become puffier with stars going around in all directions," said Professor Colless, who is the Director of the ANU Research School of Astronomy and Astrophysics and a Chief Investigator at the ARC Centre of Excellence in All-Sky Astrophysics in 3D (ASTRO 3D).

"Our Milky Way is more than 13 billion years old, so it is not young anymore, but the galaxy still has both a central bulge of old stars and spiral arms of young stars."

To work out a galaxy's shape, the research team measured the movement of stars with an instrument called SAMI on the Anglo-Australian Telescope at the ANU Siding Spring Observatory.

They studied 843 galaxies of all kinds and with a hundred-fold range in mass.

The study, which is published in *Nature Astronomy*, was funded by ASTRO 3D at ANU and the ARC Centre of Excellence for All Sky Astrophysics (CAASTRO) at The University of Sydney.

Lead author Dr Jesse van de Sande, from The University of Sydney and ASTRO 3D, said that it was not obvious that galaxy shape and age had to be linked, so the connection was surprising and could point to a deep underlying relationship.

"As a galaxy ages, internal changes take place and the galaxy may collide with others," Dr van de Sande said.

"These events disorder the stars' movements."

Co-author Dr Nicholas Scott, from the University of Sydney and ASTRO 3D, said scientists measured a galaxy's age through colour.

"Young, blue stars grow old and turn red," he said.

"When we plotted how ordered the galaxies were against how squashed they were, the relationship with age leapt out. Galaxies that have the same squashed spherical shape, have stars of the same age as well."

Dr van de Sande said scientists had known for a long time that shape and age were linked in very extreme galaxies, that is very flat ones and very round ones.

"This is the first time we've shown shape and age are related for all kinds of galaxies, not just the extremes - all shapes, all ages, all masses," he said.

University of Sydney co-author Dr Julia Bryant, lead scientist for the SAMI instrument, said the team was still searching for the simple, powerful relationships like shape and age that underlie a lot of the complexity scientists see in galaxies.

"To see those relationships, you need detailed information on large numbers of galaxies," she said.

The Anglo-Australian Observatory (AAO) is building SAMI's successor instrument, Hector, which is designed to observe 100 galaxies at a time.

More information: Jesse van de Sande et al, A relation between the characteristic stellar ages of galaxies and their intrinsic shapes, *Nature Astronomy* (2018). DOI: 10.1038/s41550-018-0436-x