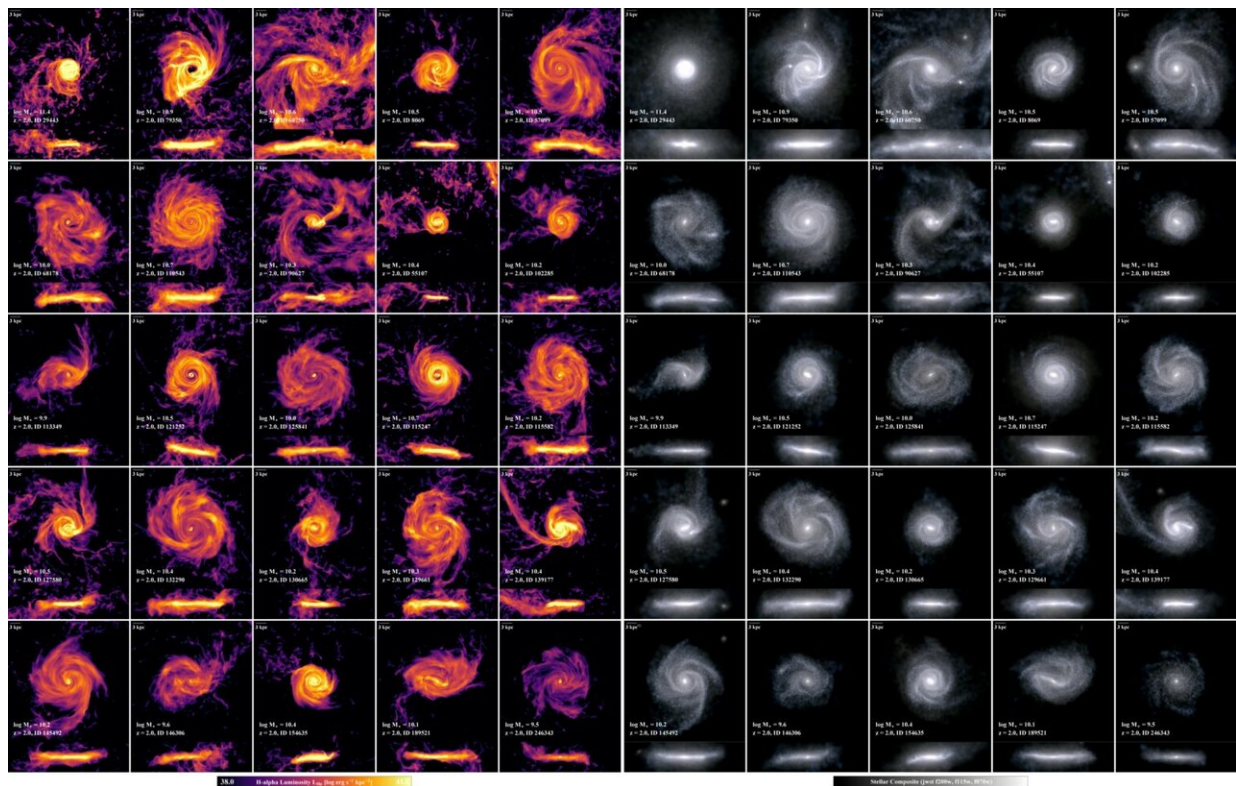


At cosmic noon, puffy galaxies make stars for longer

February 3 2021



An ensemble of twenty-five disk galaxies. The view on the left shows light emitted in the H-alpha line from interstellar gas as a result of ongoing star-formation, while the panels on the right shows the optical light emitted by a mix of young (bluer) and old (redder) stars. Each galaxy can be seen rotated edge-on below its face-on view. Credit: TNG Collaboration

Massive galaxies with extra-large extended "puffy" disks produced stars for longer than their more compact cousins, new modeling reveals.

In a paper published in the *Astrophysical Journal*, researchers led by Dr. Anshu Gupta and Associate Professor Kim-Vy Tran from Australia's ARC Center of Excellence in All Sky Astrophysics in Three Dimensions (ASTRO 3-D), show that the sheer size of a galaxy influences when it stops making [new stars](#).

"There's a period in the life of the universe known as the 'cosmic noon,' which occurred about 10 billion years ago," said Dr. Gupta.

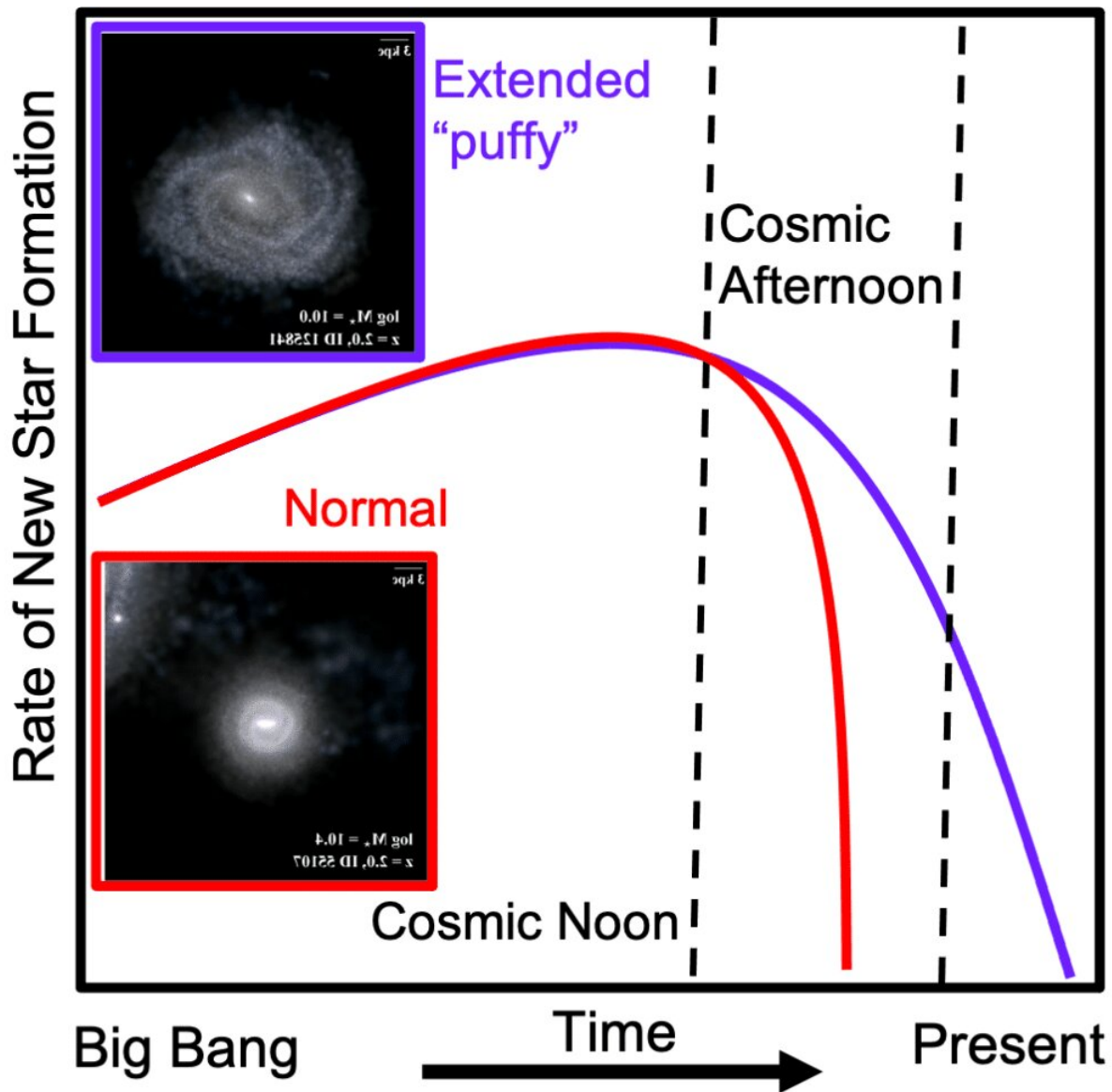
"That was when [star formation](#) in [massive galaxies](#) was at its peak. After that, gas in most of these [galaxies](#) grew hot—in part because of the [black holes](#) in the middle of them—and they stopped forming [stars](#). In galaxies that are really, really stretched out, however, we found that things didn't heat up as much and the black holes didn't exert such a great influence, so stars kept getting made over a longer period."

Dr. Gupta and Dr. Tran, both of whom are based at the University of NSW, Sydney, found that they could predict the end of star formation based on the size of a galaxy's disk—the flat, circular region surrounding its center, comprising stars, hydrogen gas and dust.

"Where the stars in the disk are widely distributed—you could call it 'puffy' – the gas stays cooler, so continues to coalesce under gravity and form new stars," said Dr. Gupta.

"In galaxies with more compact disks, the gas heats up quite quickly and is soon too energetic to mash together, so the formation of stars finishes by just after cosmic noon. Puffy disks keep going much longer, say as far as cosmic afternoon tea."

To make their findings, the researchers, with colleagues from Melbourne, Germany, Mexico and the United States, used cosmological galaxy formation simulations from an [international collaboration](#) known as the IllustrisTNG project.



A graph showing how extended or ‘puffy’ galaxies continue to make stars longer into the cosmic afternoon than compact ones. Credit: Anshu Gupta

This was integrated with deep observations from an Australian-led project known as the Multi-Object Spectroscopic Emission Line (MOSEL) Survey.

"The IllustrisTNG simulations required millions of hours of supercomputer time," said Dr. Tran.

"And the MOSEL survey needs both the WM Keck Observatory in Hawai'i and the Hubble Space Telescope.

"The results mean that for the first time we've been able to establish a relationship between [disk](#) size and star-making. So now astronomers will be able to look at any galaxy in the universe and accurately predict when it will stop making stars—just after lunch, or later in the cosmic afternoon."

The Milky Way, incidentally, is a massive galaxy that is still making stars. That's because it was something of a cosmic late-starter. When cosmic noon arrived it was very small—containing only one-tenth of the star mass it hosts today—and did not attain 'massive' status until much, much later.

As a result, the gas and dust within it has not yet warmed up enough to quench the star-making process.

It is not, however, an extended puffy galaxy, so it will quench, relatively speaking, sooner rather than later.

"Cosmic noon was a long time ago," said Dr. Gupta. "I'd say that by now the universe has reached cosmic evening. It's not night-time yet, but things have definitely slowed down."

More information: Anshu Gupta et al. MOSEL and IllustrisTNG:

Massive Extended Galaxies at $z = 2$ Quench Later Than Normal-size Galaxies. Anshu Gupta et al 2021 *ApJ* 907 95
iopscience.iop.org/article/10.1088/1538-4357/abca98

Provided by ARC Centre of Excellence for All Sky Astrophysics in Three Dimensions (ASTRO-3D)

Citation: At cosmic noon, puffy galaxies make stars for longer (2021, February 3) retrieved 11 July 2024 from <https://phys.org/news/2021-02-cosmic-noon-puffy-galaxies-stars.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.