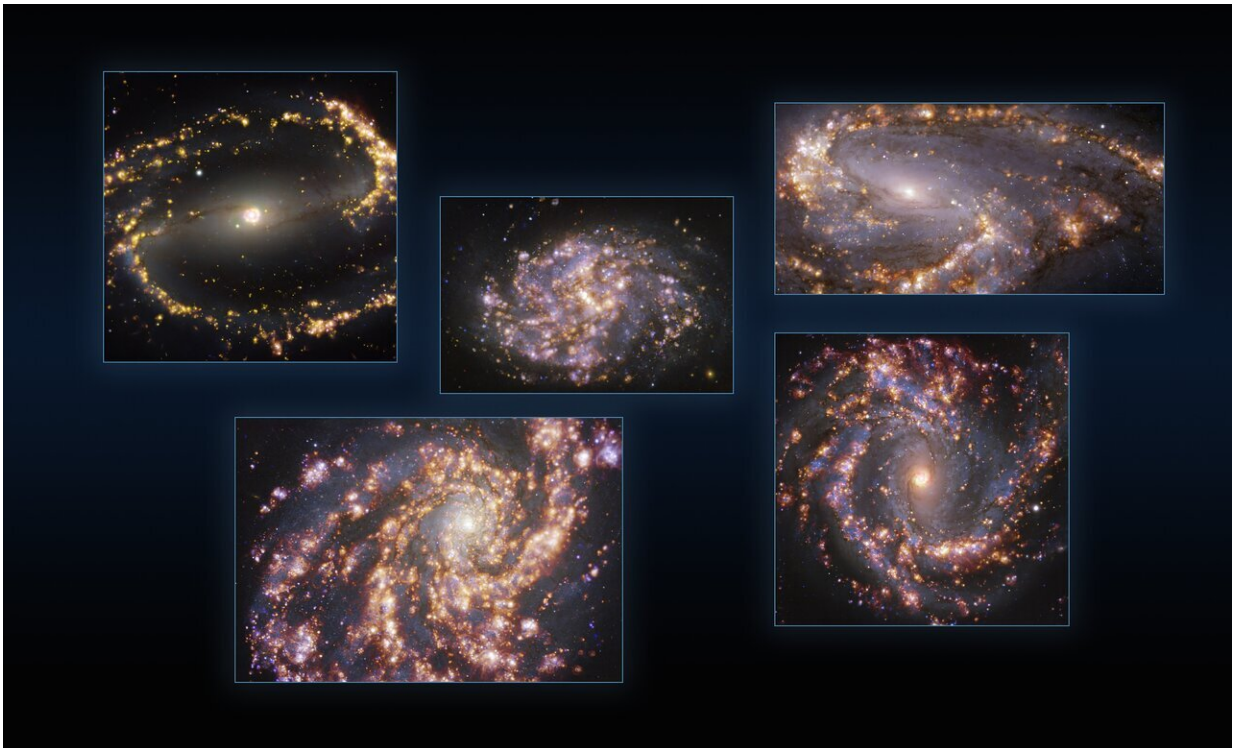


Galactic fireworks: New ESO images reveal stunning features of nearby galaxies

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This image combines observations of the nearby galaxies NGC 1300, NGC 1087, NGC 3627 (top, from left to right), NGC 4254 and NGC 4303 (bottom, from left to right) taken with the Multi-Unit Spectroscopic Explorer (MUSE) on ESO's Very Large Telescope (VLT). Each individual image is a combination of observations conducted at different wavelengths of light to map stellar populations and warm gas. The golden glows mainly correspond to clouds of ionised hydrogen, oxygen and sulphur gas, marking the presence of newly born stars, while the bluish regions in the background reveal the distribution of slightly older stars. Credit: ESO/PHANGS

A team of astronomers has released new observations of nearby galaxies that resemble colorful cosmic fireworks. The images, obtained with the European Southern Observatory's Very Large Telescope (ESO's VLT), show different components of the galaxies in distinct colors, allowing astronomers to pinpoint the locations of young stars and the gas they warm up around them. By combining these new observations with data from the Atacama Large Millimeter/submillimeter Array (ALMA), in which ESO is a partner, the team is helping shed new light on what triggers gas to form stars.

Astronomers know that [stars](#) are born in clouds of gas, but what sets off star formation, and how galaxies as a whole play into it, remains a mystery. To understand this process, a team of researchers has observed various nearby galaxies with powerful telescopes on the ground and in space, scanning the different galactic regions involved in stellar births.

"For the first time we are resolving individual units of star formation over a wide range of locations and environments in a sample that well represents the different types of galaxies," says Eric Emsellem, an astronomer at ESO in Germany and lead of the VLT-based observations conducted as part of the Physics at High Angular resolution in Nearby GalaxieS (PHANGS) project. "We can directly observe the gas that gives birth to stars, we see the [young stars](#) themselves, and we witness their evolution through various phases."

Emsellem, who is also affiliated with the University of Lyon, France, and his team have now released their latest set of galactic scans, taken with the Multi-Unit Spectroscopic Explorer (MUSE) instrument on ESO's VLT in the Atacama Desert in Chile. They used MUSE to trace newborn stars and the warm gas around them, which is illuminated and heated up by the stars and acts as a smoking gun of ongoing star

formation.

The new MUSE images are now being combined with observations of the same galaxies taken with ALMA and released earlier this year. ALMA, which is also located in Chile, is especially well suited to mapping cold gas clouds—the parts of galaxies that provide the raw material out of which stars form.

By combining MUSE and ALMA images astronomers can examine the galactic regions where star formation is happening, compared to where it is expected to happen, so as to better understand what triggers, boosts or holds back the birth of new stars. The resulting images are stunning, offering a spectacularly colorful insight into stellar nurseries in our neighbouring galaxies.

"There are many mysteries we want to unravel," says Kathryn Kreckel from the University of Heidelberg in Germany and PHANGS team member. "Are stars more often born in specific regions of their host galaxies—and, if so, why? And after stars are born how does their evolution influence the formation of new generations of stars?"

Astronomers will now be able to answer these questions thanks to the wealth of MUSE and ALMA data the PHANGS team have obtained. MUSE collects spectra—the "bar codes" astronomers scan to unveil the properties and nature of cosmic objects—at every single location within its field of view, thus providing much richer information than traditional instruments. For the PHANGS project, MUSE observed 30 000 nebulae of warm gas and collected about 15 million spectra of different galactic regions. The ALMA observations, on the other hand, allowed astronomers to map around 100 000 cold-gas regions across 90 nearby galaxies, producing an unprecedentedly sharp atlas of stellar nurseries in the close Universe.

In addition to ALMA and MUSE, the PHANGS project also features observations from the NASA/ESA Hubble Space Telescope. The various observatories were selected to allow the team to scan our galactic neighbours at different wavelengths (visible, near-infrared and radio), with each wavelength range unveiling distinct parts of the observed [galaxies](#). "Their combination allows us to probe the various stages of stellar birth—from the formation of the stellar nurseries to the onset of [star formation](#) itself and the final destruction of the nurseries by the newly born stars—in more detail than is possible with individual observations," says PHANGS team member Francesco Belfiore from INAF-Arcetri in Florence, Italy. "PHANGS is the first time we have been able to assemble such a complete view, taking images sharp enough to see the individual clouds, stars, and nebulae that signify forming stars."

The work carried out by the PHANGS project will be further honed by upcoming telescopes and instruments, such as NASA's James Webb Space Telescope. The data obtained in this way will lay further groundwork for observations with ESO's future Extremely Large Telescope (ELT), which will start operating later this decade and will enable an even more detailed look at the structures of [stellar nurseries](#).

"As amazing as PHANGS is, the resolution of the maps that we produce is just sufficient to identify and separate individual star-forming clouds, but not good enough to see what's happening inside them in detail," pointed out Eva Schinnerer, a research group leader at the Max Planck Institute for Astronomy in Germany and principal investigator of the PHANGS project, under which the new observations were conducted. "New observational efforts by our team and others are pushing the boundary in this direction, so we have decades of exciting discoveries ahead of us."

More information: sites.google.com/view/phangs/home

Provided by ESO

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