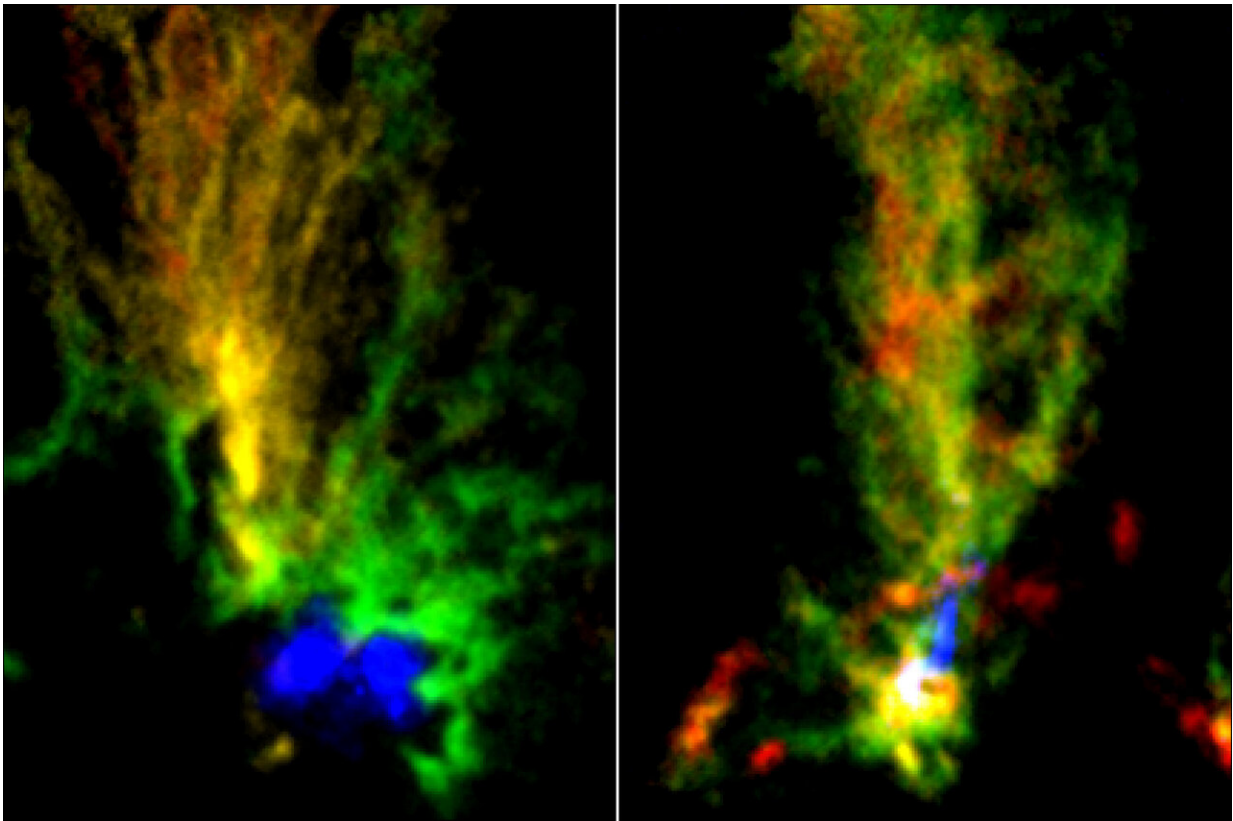


# Two cosmic peacocks show violent history of the magellanic clouds

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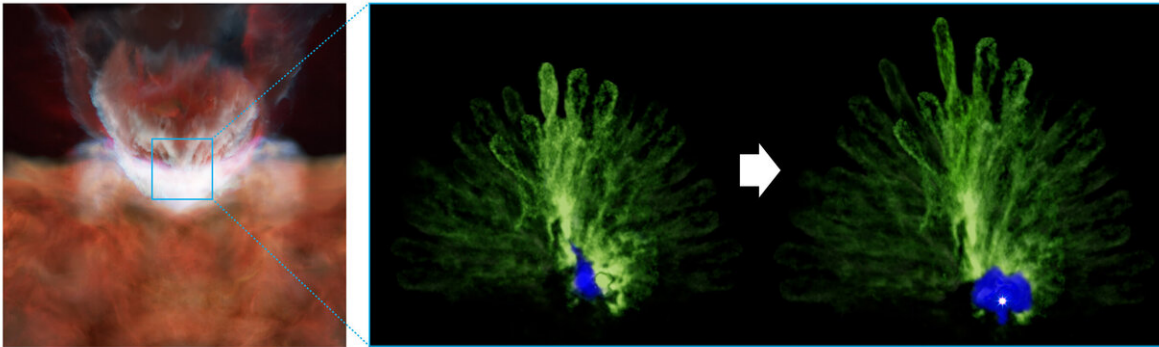
ALMA images of two molecular clouds: N159E-Papillon Nebula (left) and N159W South (right). Red and green show the distributions of molecular gas with different velocities mapped by  $^{13}\text{CO}$  emissions. The blue region in N159E-Papillon Nebula shows the ionized hydrogen gas observed with the Hubble Space Telescope. The blue part in N159W South shows the emissions from dust particles obtained with ALMA. Credit: ALMA (ESO/NAOJ/NRAO)/Fukui et al./Tokuda et al./NASA-ESA Hubble Space Telescope

Two peacock-shaped gaseous clouds were revealed in the Large Magellanic Cloud (LMC) by observations with the Atacama Large Millimeter/submillimeter Array (ALMA). A team of astronomers found several massive baby stars in the complex filamentary clouds, which agrees well with computer simulations of giant collisions of gaseous clouds. The researchers interpret this to mean that the filaments and young stars are telltale evidence of violent interactions between the LMC and the Small Magellanic Cloud (SMC) 200 million years ago.

Astronomers know that [stars](#) are formed in collapsing [clouds](#) in space. However, the formation processes of giant stars, 10 times or more massive than the Sun, are not well understood because it is difficult to pack such a large amount of material into a small region. Some researchers suggest that interactions between galaxies provide a perfect environment for massive star formation. Due to the colossal gravity, clouds in the galaxies are stirred, stretched, and often collide with each other. A huge amount of gas is compressed in an unusually small area, which could form the seeds of massive stars.

A research team used ALMA to study the structure of dense gas in N159, a bustling star formation region in the LMC. Thanks to ALMA's high resolution, the team obtained a detailed map of the clouds in two sub-regions, N159E-Papillon Nebula and N159W South.

Interestingly, the cloud structures in the two regions look very similar: fan-shaped filaments of gas extending to the north with the pivots in the southernmost points. The ALMA observations also found several massive baby stars in the filaments in the two regions.



Artist's impression of the formation process of peacock-shaped clouds. After the collision of two clouds (left), complicated filamentary structures with a pivot in the bottom are formed in the boundary region (center), and a massive star is formed in the dense part with the ionized region shown in blue (right). Credit: NAOJ

"It is unnatural that in two regions separated by 150 light-years, clouds with such similar shapes were formed and that the ages of the baby stars are similar," says Kazuki Tokuda, a researcher at Osaka Prefecture University and the National Astronomical Observatory of Japan. "There must be a common cause of these features. Interaction between the LMC and SMC is a good candidate."

In 2017, Yasuo Fukui, a professor at Nagoya University and his team revealed the motion of hydrogen gas in the LMC and found that a gaseous component right next to N159 has a different velocity than the rest of the clouds. They suggested a hypothesis that the starburst is caused by a massive flow of gas from the SMC to the LMC, and that this flow originated from a close encounter between the two galaxies 200 million years ago.

The pair of peacock-shaped clouds in the two regions revealed by ALMA fits nicely with this hypothesis. Computer simulations show that many filamentary structures are formed in a short time after a collision of two clouds, which also backs this idea.

"For the first time, we uncovered a link between massive star formation and galaxy interactions in very sharp detail," says Fukui, the lead author of one of the research papers. "This is an important step in understanding the formation process of massive star clusters in which galaxy interactions have a big impact."

**More information:** An ALMA view of molecular filaments in the Large Magellanic Cloud I: The formation of high-mass stars and pillars in the N159E-Papillon Nebula triggered by a cloud-cloud collision.

[arxiv.org/abs/1811.00812](https://arxiv.org/abs/1811.00812)

An ALMA view of molecular filaments in the Large Magellanic Cloud II: An early stage of high-mass star formation embedded at colliding clouds in N159W-South: [arxiv.org/abs/1811.04400](https://arxiv.org/abs/1811.04400)

Provided by ALMA

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