

Inefficient jet-induced star formation in Centaurus A: High resolution ALMA observations of the northern filaments

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Star formation is one of the key mechanisms driving the evolution of galaxies across cosmic times. The physical properties and the multi-scale dynamics of the molecular gas influence the star formation efficiency, therefore looking at large scales is essential to understand the physics of star formation. The environment certainly plays a role in star formation. In particular, recent studies suggest that AGN can regulate the gas accretion and thus slow down star formation. However, evidence of AGN positive feedback is also invoked in a few radio galaxies.

The northern filaments of Centaurus A are a testbed region for positive feedback, here through jet-induced star formation. These filaments extend on scales up to 15 kpc, aligned with the radio-jet, and show evidence of recent star formation [1]. At the intersection of the radio jet and one of the HI shells that surround the galaxy [2], CO emission in the shell has been detected with SEST [3]. With APEX, we mapped the CO emission along the FUV filaments that lie at the jet-HI interaction. In particular, we discovered a large amount of molecular gas outside the HI gas [4], that we interpreted as the result of the HI-to-H₂ transition triggered by the jet-gas interaction.

By confronting the CO emission to archival Herschel-FIR and GALEX-FUV data, we determined that the gas in the filaments is very inefficient to form stars compared to star-forming disc galaxies [4,5]. To understand why star formation is inefficient while the molecular gas reservoir is important, we recently obtained ALMA observations to map the ¹²CO emission along the filaments, at a resolution of ~20 pc [6]. Such resolution enabled us to separate giant molecular clouds and study their physical properties (mass, size, velocity dispersion). While the properties of the molecular clouds in the filaments are very similar to those of molecular clouds in the inner Milky Way, we found that the virial parameter is slightly higher than in the Milky Way.

We concluded that the strong CO emission is an indication that the energy injected by the jet acts positively in the formation of molecular gas. On the other hand, the relatively high virial parameter of the molecular clouds suggests that the injected kinetic energy is too strong for star formation to be efficient. The filaments of Centaurus A are the first evidence of inefficient AGN positive feedback.

Références

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[2] Schiminovich et al. 1994, ApJ, 423, L101

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[5] Salomé et al. 2016, A&A, 586, A45

[6] Salomé et al. 2017, A&A, 608, A98