High-velocity warm molecular gas close to Sgr A*

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The central parsec of the Milky Way harbours a supermassive black hole, Sgr A*, a dense cluster with more than 100 OB-type massive stars, and prominent streamers of ionized gas, the so-called mini-spiral. This is a unique laboratory to understand, at high spatial resolution, the interstellar gas in extreme environmental conditions.

We have mapped a region of 2' x 2' encompassing Sgr A* and the circumnuclear disk (CDN) in the CO (J=3-2) line with the IRAM 30m telescope at ~7''-resolution. We have carried out a line survey toward Sgr A* using Herschel/HIFI in the sub-millimeter. The very high spectral resolution ($R>10^6$) of HIFI allowed us to resolve the velocity structure in the line-of-sight toward Sgr A* [1]. We spectrally resolved the warm molecular gas emission from the central parsec. This gas is detected at high velocities (up to about 300 km s^{-1}) in the wings of the mid-J CO emission ladder. The high-velocity gas is also seen in H_2O ($1_{1,0} - 1_{0,1}$), a tracer of shocked molecular gas; and in [CII]158 μm, a well known tracer of stellar FUV radiation (~6 – 13.6 eV). Using ALMA images we have spatially resolved a collection of ^{12}CO J=3-2 molecular "cloudlets" at similar velocities ($v_{LSR} \simeq$ +150 to 300 km s^{-1}) inside the central parsec [2]. These works add more quantitative evidence to the existence of high-velocity, warm molecular gas (T_k=400 – 2000 K) inside the central cavity, and close to the supermassive black hole. We speculate that the molecular "cloudlets" are leftovers of more massive molecular clouds that fall into the cavity and are tidally disrupted, or that they originate from instabilities in the inner rim of the CND that lead to fragmentation and fall from there.

References

[1] Goicoechea, J.R., Santa-Maria, M. G., Teyssier, D. et al. 2018 A&A, 616 L1

[2] Goicoechea, J.R., Pety, J., Chapillon, E., Cernicharo, J., Gerin, M., Herrera, C., Requena-Torres, M.A., Santa-Maria, M.G., 2018 A&A, 618 A35