We report the existence of spiral arms in the recently formed gaseous and dusty disk of the closest giant elliptical, NGC 5128 (Centaurus A), using high resolution $^{12}$CO(2–1) observations of the central 3′ (3 kpc) obtained with the Submillimeter Array (SMA) [1]. This provides evidence that spiral-like features can develop within ellipticals if enough cold gas exists.

We elucidate the distribution and kinematics of the molecular gas in this region with a resolution of 4.″4 × 1.″9 (80 pc × 40 pc). From the $^{12}$CO(2–1) emission distribution in Fig. 1, we confirm that the molecular gas is preferentially located along two filamentary structures resembling spiral-arm-like features to the SE and NW of the circum-nuclear gas (< 200 pc). The larger field of view of our observations demonstrates that these filamentary structures extend at least 1.″0, and they are curved toward the NE and SW. The general properties of the arms are similar to those in spiral galaxies: they are trailing, their width is ~500±200 pc, and the pitch angle is ~20°.

A consequence of the compression produced by these spiral arms is that it is expected to trigger star formation (SF) on the leading edge. This is consistent with abundant SF traced by Pa$_{\alpha}$, coincident at least with the southern molecular spiral arm (nearest part and thus likely the least obscured). The spiral features seen in the $^{12}$CO emission is also associated with the distribution of certain tracers observed in poorer angular/spectral resolution maps, such as the SCUBA 450 μm emission map as well as the pure rotational line of molecular hydrogen H$_{2}$ ($J=2–0$) S(0) (28.22 μm) emission observed with Spitzer/IRS [2]. The molecular hydrogen transition H$_{2}$ ($J=2–0$) S(0) indicates the presence of gas with T ~ 200 K, which is likely tracing photodissociation regions associated with abundant SF.

A small perturbation could have triggered this spirality, such as a non-axisymmetric weak potential [3] or a minor merger after the disk was relatively well settled. From the HI structure and kinematics [4] we infer that the formation of spiral arms took place in less than 0.3 Gyr, which is likely the most accurate measure of time at our disposal since HI is one of the most sensitive components of interaction. Simulations of gas fueling in the deep potentials of giant ellipticals are needed to investigate the response of the gas under these conditions.

References