"EFFECTS OF NON-CIRCULAR MOTIONS ON AZIMUTHAL COLOR GRADIENTS"

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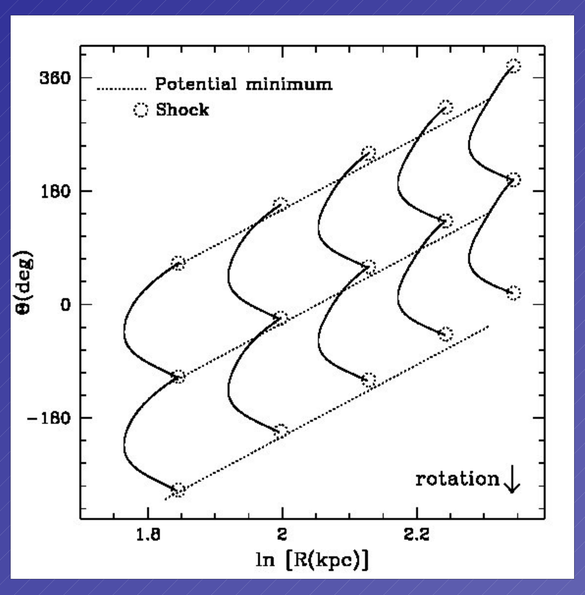
1 ABSTRACT
Assuming that density waves trigger star formation, and that young stars preserve the velocity components of the molecular gas where they are born, we analyze the effects that non-circular gas orbits have on color gradients across spiral arms.

2 METHODS
We try two approaches, one involving semi-analytical solutions for spiral shocks (see figure 1), and another with MHD numerical simulation data (see figure 2, and also Gómez & Martos 2009).



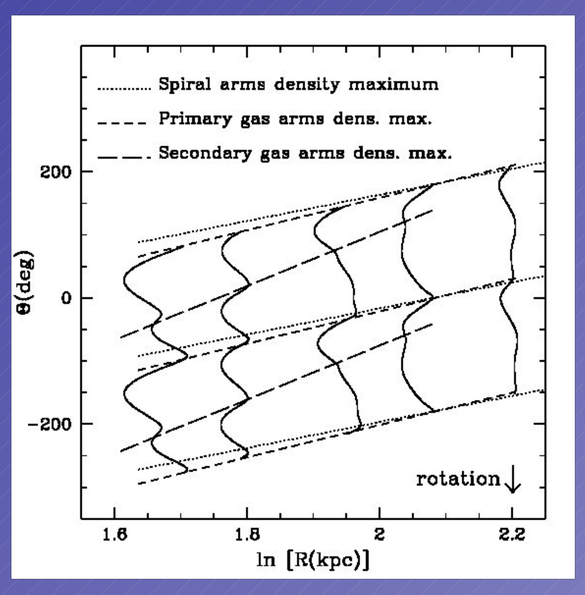
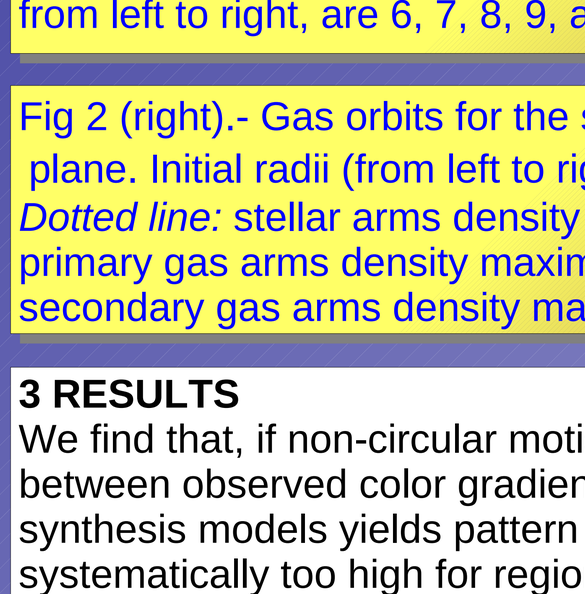


Fig 1 (left).-Typical streamlines obtained from semi-analytical solutions of spiral, trailing type, shocks. *Dotted line:* spiral potential minimum; *dotted circles:* shock position. Average radii, from left to right, are 6, 7, 8, 9, and 10 kpc.

Fig 2 (right).- Gas orbits for the simulation data, in the *ln[R]* vs. *θ* plane. Initial radii (from left to right) are 5.5, 6, 7, 8, and 9 kpc. *Dotted line:* stellar arms density maximum; *short-dashed line:* primary gas arms density maximum; *long-dashed line:* secondary gas arms density maximum.

3 RESULTS
We find that, if non-circular motions are ignored, the comparison between observed color gradients and stellar population synthesis models yields pattern speed values that are systematically too high for regions inside corotation; the difference between the real and the measured pattern speeds increases with decreasing radius (see figures 3 & 4).



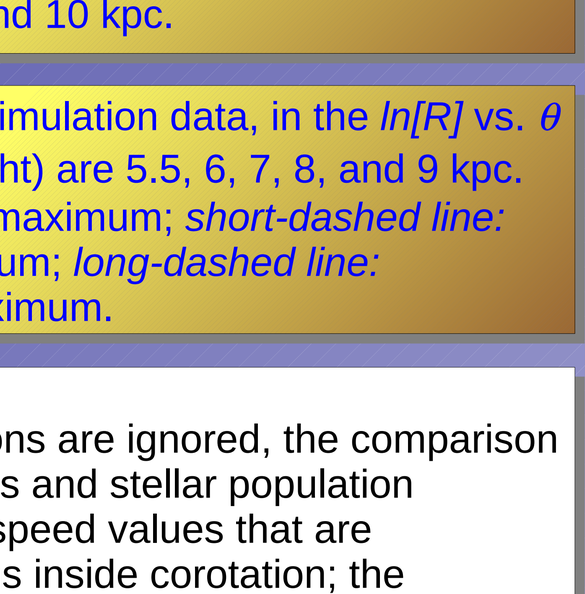


Fig 3 (left).-*Solid line:* Ω_p values obtained at different galactocentric radii, from the numerical semi-analytical solutions of spiral shocks, under the (false) assumption that stars move in circular orbits. *Long dashed line:* spiral perturbation input angular velocity.

Fig 4 (right).- MHD simulation data. Symbols as in figure 3.

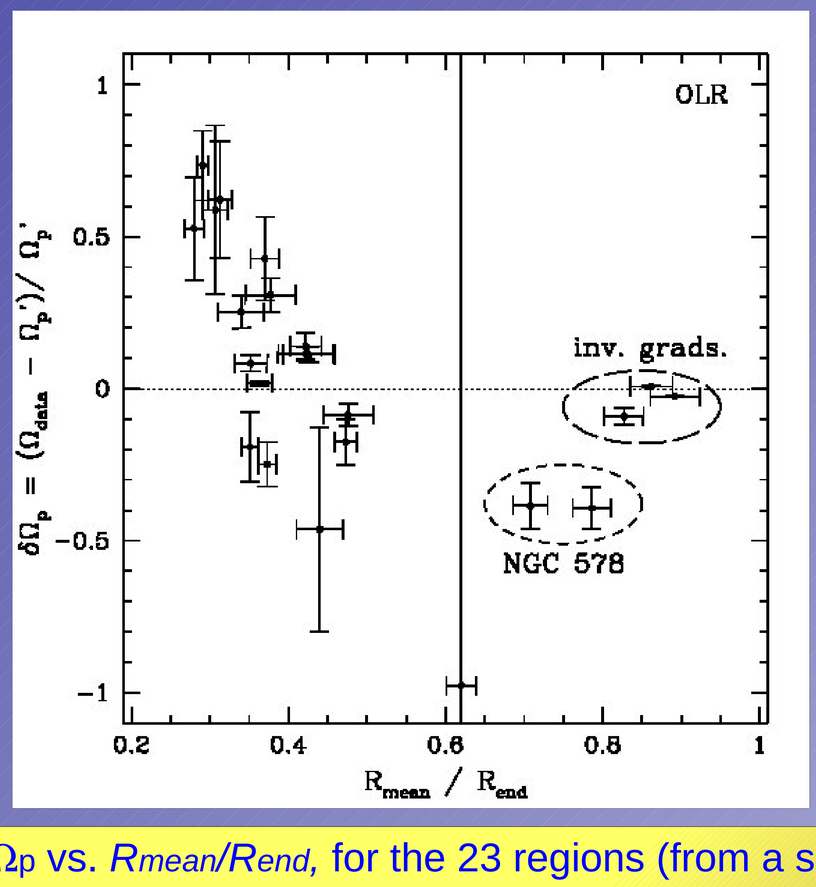


Fig 5 .- $\delta\Omega_p$ vs. R_{mean}/R_{end}, for the 23 regions (from a sample of 13 spiral galaxies of types A and AB) in Table 4 of MG09. Ω_{data} is the pattern speed obtained from the data, by comparing the observed color gradient candidates with the stellar models, under the assumption that stars move in purely circular orbits; Ω'_p is the pattern speed that the spiral should have if it ends at the OLR. The dotted line indicates $\delta\Omega_p=0$ (i.e., no difference between the real and the measured pattern speeds). R_{mean} is the mean orbital radius of the studied region. R_{end} is the observed spiral end point in the deprojected NIR galaxy images. *Long-dashed ellipse:* Surrounds points that presumably correspond to inverse color gradients, outside corotation. *Short-dashed ellipse:* Surrounds points from regions in NGC 578, whose spiral pattern might end at or inside corotation (MG09).

4 CONCLUSIONS
Semi-analytical calculations and MHD simulations show that the spiral pattern speeds derived from the comparison between color gradients and stellar population synthesis models, assuming purely circular motions, would have values systematically higher than the real ones for regions within corotation. The effect decreases with galactocentric radius. With this result, we have been able to detect non-circular motion components in the MG09 (who use the GG96 method) photometric data (see figure 5).

Non-circular motions, on the other hand, do not prevent the detection of azimuthal color gradients in real galaxies when the right technique is applied.

Our analysis confirms a strong link between spiral dynamics and star formation, and also that spiral patterns end at the OLR, rather than at the 4:1 resonance.

REFERENCES
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• **Martínez-García, E. E., González-López lira, R. A., & Gómez, G. C., *ApJ* submitted.**