

Dynamics and large-scale star formation in disk galaxies

Rosa A. González-Lópezlira (CRyA, UNAM), Eric E. Martínez-García (INAOE), Gustavo Bruzual-A. (CRyA, UNAM), Gilberto Gómez (CRyA, UNAM) and James R. Graham (DIAA, University of Toronto)

Azimuthal color (age) gradients across spiral arms are one of the main predictions of density wave theory, and a signature of long-lived spirals. In a sample of 13 non-barred (types A and AB) and 11 barred (B) spiral galaxies, we find that 10 non-barred and all barred galaxies harbor regions that match the theoretical predictions. By comparing the observed gradients with stellar population synthesis (SPS) models, the pattern speed and the location of major resonances have been determined.

The resonance positions indicate that 9 of the non-barred galaxies have spiral arms that extend to the outer Lindblad resonance (OLR), while in one the spiral arms reach the corotation (CR) radius. As for the barred galaxies, the bars end at their own corotation. Of the 9 barred galaxies with gradients in both bars and spirals, 6 (67%), 5 of them of an early Hubble type, appear to have a bar and a spiral with similar pattern speeds, while 3 (33%), all of them with a late Hubble type, do not. Arms that are coupled to the bar end at the bar's OLR, while decoupled arms may end at their own CR radius. In all the galaxies with gradients, non-barred or barred, there is a tendency to overestimate the pattern speed derived from the comparison between gradients and SPS models. This trend is caused by non-circular velocities of the stars after the spiral shock, and further confirms the link between gradients and dynamics.

We have searched for other signatures of a long-lived spiral pattern in A and AB galaxies from our sample that, besides age/color gradient candidates, also have a 2-armed grand-design pattern that can be traced in a surface density stellar mass map. Fourier methods reveal additional signatures of long-lived spirals, such as the gradient narrowing and eventual disappearance towards CR, and the behavior of the azimuthal positions of stellar populations of different ages, as traced in multiple wavebands, in at least 50% of these objects.