Juan Carlos Muñoz Mateo
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TÍTULO:
ANÁLISIS DE LA DISTRIBUCIÓN ESPACIAL DE ESTRELLAS, GAS Y POLVO EN GALAXIAS CERCANAS
ANALYSIS OF THE DISTRIBUTION OF STARS, GAS AND DUST IN NEARBY GALAXIES

Trabajo dirigido por:
Armando Gil de Paz y Jaime Zamorano Calvo (UCM)

RESUMEN/ABSTRACT:

The aim of this thesis is to analyze and quantify the past evolution of nearby galaxies, using the present-day spatial distribution of stars of different ages, gas and dust as fossil tracers of galaxy formation and evolution.

According to the Lambda Cold Dark Matter scenario of galaxy formation, galactic disks are supposed to grow from inside out as time goes by, since gas takes longer to settle onto the disk in the outer parts. To test this prediction, we determined the growth rate of a sample of 161 nearby spiral galaxies. We combined GALEX ultraviolet data, which probe newly-born stars, with 2MASS infrared data, which show the distribution of more evolved stars. Comparing the relative ratio of young to old stars at different distances from each galaxy's center we quantified the growth rate of their disks. Our results are consistent with the inside-out scenario of disk evolution. In particular, we estimated that disks have grown by 25% (on average) since 7-8 giga-years, when the universe was half its present age.

Stars of different ages, gas and dust radiate energy at different wavelengths. Therefore, quantitatively studying the morphology of galaxies at different bands is paramount to determine the spatial distribution of these components. We analyzed the multi-wavelength morphology of the 75 galaxies comprising the Spitzer Survey of Stellar Structure in Galaxies (SINGS). We studied images in a total of 21 bands, ranging from the far UV to the far IR. For all of them we obtained surface brightness profiles and several morphological estimators, such as the concentration index, the asymmetry, the second order moment and the Gini coefficient.

In particular, we later focused on the radial distribution of the physical properties of dust. We measured the radial variation of internal dust extinction, which is essential to recover the intrinsic emission of stars. We found that the same dust column density can yield different amounts of extinction in galaxies of different morphological types. This implies that the spatial distribution of dust relative to the heating stellar sources varies systematically along the Hubble sequence. We also measured the fraction of the dust mass which is the form of Polycyclic Aromatic Hydrocarbons (PAHs), which are possibly the most abundant organic molecules in space. Our results suggest that the abundance of these molecules in kiloparsec scales is mainly determined by the rate of carbon production in Asymptotic Giant Branch stars. Finally, we found that the dust-to-gas ratio decreases with galactocentric distance, which again is consistent with the idea that galactic disks grow from inside out.

Finally, we combined all previous results to address the study of disk evolution with more detailed physical models. We made use of the models of Boissier & Prantzos (2000), which describe disk evolution implementing in a self-consistent way gas accretion, star formation, chemical enrichment and stellar evolution. These models predict the surface brightness profiles of spirals disks as a function of their maximum rotational velocity (Vc) and their spin (lambda). By fitting the extinction-corrected multi-band profiles of the SINGS galaxies with these models we inferred their values of Vc and lambda. The predicted values of Vc agree with those observed in rotation curves, and the distribution of spin values matches the one found in N-body cosmological simulations. According to these models, the galaxies in our sample grow larger and more massive with time, in such a way that the mass-size relation remains roughly constant with time, in agreement with observations of galaxies at different redshifts. In particular, our results imply that galactic disks have grown by 20-25% since z=1, in excellent agreement with our initial estimation.

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CONTACTO: jcmunoz 'at' astrax.fis.ucm.es