Specific angular momentum maps using OHP data

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Angular momentum is a fundamental property of galaxies that plays a crucial role in their formation, evolution, and structural dynamics. The comprehensive picture of how galaxies acquire and redistribute angular momentum across cosmic time and how it shapes galaxy evolution is still under construction. Within the hierarchical framework of galaxy formation in the ΛCDM paradigm, angular momentum originates in the proto-galaxies as a result of their interaction with their surrounding tidal field, as first proposed by Hoyle (1949) and Peebles (1969). From this point on, the galactic angular momentum evolves through a combination of accretion, mergers, and gravitational interactions (White, 1984; Barnes & Efstathiou 1987; Navarro & White 1994; Mo, Mao & White, 1998; Zavala, Okamoto & Frenk 2008).

The first estimates of the specific stellar angular momentum by Fall in 1983, showed a strong correlation of this property with the stellar mass, meaning that $j_\star \propto M_\star^\alpha$. This relation is known as the Fall's relation and has been confirmed by multiple studies in which the dependence of $j_\star$ on the morphological type has also been proved. Late-type galaxies exhibit higher $j_\star$ than early-type galaxies (Graham et al., 2018; Fraser-McKelvie et al., 2021). The high specific angular momentum of spirals explains their extended disks and organized rotation (Romanowsky & Fall, 2012; Cortese et al., 2016). Meanwhile, ellipticals often have more complex angular momentum distributions due to merger-driven evolution, where angular momentum is redistributed and sometimes lost via dynamical friction (Emsellem et al., 2007; Hardwick et al., 2022).

There is a current debate about the origin of angular momentum that drives morphology and star formation in galaxies between the relative importance of secular evolution (internal processes) and external interactions (environmental effects). Secular evolution refers to gradual, internal processes that drive the redistribution of angular momentum and structural transformations within galaxies over long timescales. Key mechanisms include bar-driven instabilities, disk instabilities, and feedback-driven outflows. External processes, such as mergers, tidal interactions, and environmental effects, can significantly alter a galaxy's angular momentum, often leading to morphological transformations (Fall 1983; White 1984; Naab et al. 2014).

In this talk, we present a new methodology that allows us to calculate the total angular momentum of each galaxy and its pixel-by-pixel value. This approach enables us to construct a two-dimensional map of the spatial distribution of $j_\star$ for a sample of 30 spiral and irregular galaxies in the local universe. We then categorize each galaxy depending on whether it stores most of its angular momentum in symmetric structures (such as rings, spiral arms, or bars) or non-symmetric features. This new tool can contribute to the discussion about the evolutionary processes that originated each galaxy, deepening the connection between the galactic regions where the angular momentum is dominant and the processes that gave rise to them, providing complementary information to the Fall's relation.