NGC 1566 from JWST Data: Pitch Angle Estimation in Spiral Arms and Feathers

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Abstract

Spiral galaxies exhibit a wide morphological diversity, varying in the number of arms, pitch angle, surface brightness, and the presence of bars (Carroll & Ostlie 2007). Studying these structures is essential, as spiral arms reflect density perturbations in the galactic disk and play an important role in dynamical evolution and star formation. These galaxies can be classified as grand design (well-defined arms), flocculent (irregular arms), or multi-armed (Elmegreen & Elmegreen 1987). The arms are not continuous, being composed of substructures such as spurs and feathers. Spurs are stellar extensions that project from the main arms toward the inter-arm region, while feathers are gas or dust features, observed by Lynds (1970) as thin dust lanes with large pitch angles crossing the bright arms. These substructures have been studied for years, focusing on their understanding, description, and classification. In this work, we calculate the pitch angle of the main arms and their substructures in the galaxy NGC 1566, using images obtained with the NIRCam and MIRI instruments, covering the 2–21 μm range, from the Physics at High Angular Resolution in Nearby GalaxieS project with the James Webb Space Telescope (PHANGS-JWST), totaling eight filters. The analysis was carried out using the circular window correlation method in (ln (R), θ) space, which allows pitch angles to be determined at different scales, as proposed by Puerari et al. (2014).