

Observing density waves in spiral galaxies using birthplaces and NIR photometry

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It has proven surprisingly difficult to observe density waves and their properties in spiral galaxies even though circumstantial evidence exists. One avenue is to study birthplaces of young objects assuming that they mainly are formed in spiral arms. For the Milky Way, this was done by tracing late B-stars with known ages and space velocities back to their places of formation using a potential which included a density wave perturbation. For external galaxies, very young stellar clusters can be used because their ages can be estimated through near-infrared (NIR) photometry. Their average azimuthal location relative to the spiral arms can be determined as a function of their age and used to estimate the angular speed of the star forming front. Another diagnostic for distinguishing density waves from material arms is the location of star formation relative to the arms i.e., an offset is expected for density waves. The exact location and amplitude of the spiral arms are very difficult to observe at visual wavelengths due to the presence of young objects and dust. The NIR provides a much better view of surface brightness variations across arms due to the much smaller attenuation by dust although light from young objects still is significant.

The talk will discuss the usage of birthplaces of young objects to determine the pattern speed of density waves in the Milky Way and external galaxies. NIR surface photometry of nearby, grand-design galaxies will be analyzed to derive accurate measures of the amplitude and shape of spiral arms. This allows a comparison between observations and predictions of the density wave theory such as the location of resonances and large-scale shocks.