

R17a Instability analysis for spiral arms of local galaxies

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We investigate dynamical states of grand-design spiral arms in three local galaxies: M51, NGC3627 and NGC628. Based on linear perturbation analysis considering multiple components in the galaxies, we compute instability parameters of the spiral arms using their observational data and argue whether the arms will fragment by their self-gravity. Our analysis utilises observations of carbon monoxide (CO), 21-centimetre line emission and multi-band photometric images for molecular gas, atomic gas and stellar components in the arms, respectively. We find that the grand-design arms of these galaxies indicate marginally stable states, and hence they are not on the way to fragment. We consider this to be consistent with the commonness of spiral galaxies and the relative rarity of fragmented discs at low redshifts. In the analysis, molecular gas is the dominant component to determine the (in)stability of the arms, whereas atomic gas and stars are far less important. Therefore, the results of our analysis are sensitive to an assumed CO-to-H₂ conversion factor. If we assume a typical scatter of the measurements and admit nearly twice as large a conversion factor as our fiducial value, our analysis results in predicting the instability for the spiral arms. More sophisticated determination of the conversion factor is required for more accurate analysis for the (in)stability of spiral arms.