High resolution 2D velocity fields in disk galaxies: Spurs, Feathers, and Interlocking Resonances

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We show how to use the 2D velocity fields of complete disk galaxies at high spatial resolution ($\approx$ 1 arcsec) and high velocity resolution ($\approx$ 8 km·s^{-1}) obtained using Fabry-Perot interferometry on the Hα emission, to derive resonance structure. The basis of the method is the change in sense of the radial component of the velocity field which occurs at a resonance, notably at corotation, and more weakly at the ILR and the OLR. A plot of the radial dependence of the number of independently resolved pixels showing this change is a histogram with a number of well-defined peaks, ranging from 1 to 7 in our sample of 104 galaxies. Most of the peaks can be assigned to multiple corotation radii within a given disk, but we use consistency arguments to identify the peaks which are ILRs or OLRs. We make three sets of inferences about the structure of the resonances. (a) Identifying the strongest peak as the bar corotation, we show that the ratio of corotation radius to bar length takes a mean value of 1.3, and grows from 1.1 in early-type galaxies to 1.4 in late types (b) In double-barred galaxies we find that the ratio of the pattern speeds for the two bars takes a notably constant value of 3.4 (c) We detect a pattern in over 70% of the disks, whereby pairs of corotations are interlinked: the OLR of the inner corotation falls at the outer corotation radius, and the inner 4:1 ultraharmonic resonance of the outer corotation falls at the inner corotation radius. We also discuss limited progress in the detection of the dynamical effects of interarm feathers on the velocity fields.