

The Origin of Spiral Arms in Disk Galaxies

Prof. Elena D'Onghia
University of Wisconsin–Madison

Tuesday, December 3 ♦ 12:30 P.M.
Room 184 Nieuwland Science Hall

The precise nature of spiral structure in galaxies remains uncertain. Recent studies suggest that spiral arms result from interactions between disks and satellite galaxies. Using high-resolution N-body simulations, I follow the motions of stars under the influence of gravity, and show that mass concentrations with properties similar to those of giant molecular clouds or clumps of gas can induce the development of spiral arms through a process termed swing amplification. However, unlike in earlier work, I will demonstrate that the eventual response of the disk is highly non-linear, significantly modifying the formation and longevity of the resulting patterns. Contrary to expectations, ragged spiral structures can survive at least in a statistical sense long after the original perturbing influence has been removed. These findings thus motivate a new interpretation of many phenomena, including disk heating, radial migration, and galaxy pattern speeds and give a new mechanism for a self-regeneration of new giant molecular clouds. These models predict an “Arm Morphological Classification” of disk galaxies that can be immediately applied to the upcoming SDSS-IV MANGA surveys.