Trends for Outer Disk Profiles

Peter Erwin, Michael Pohlen, Leonel Gutiérrez, and John E. Beckman

Abstract. The surface-brightness profiles of galaxy disks fall into three main classes, based on whether they are simple exponentials (Type I), bend down at large radii (Type II, “truncations”) or bend up at large radii (Type III, “antitruncations”). Here, we discuss how the frequency of these different profiles depends on Hubble type, environment, and the presence or absence of bars; these trends may herald important new tests for disk formation models.

1. The Diversity of Galaxy Disk Profiles

Recent studies using moderately large samples of nearby disk galaxies have demonstrated that “exponential” disks actually fall into three categories of surface-brightness profiles [Erwin et al. 2005; Pohlen & Trujillo 2006; Erwin et al. 2008]. For a more detailed discussion of the background and context, we direct the reader to those papers and to the contribution by Pohlen et al. (this volume). Here, we briefly discuss some preliminary results relating disk profiles to general galaxy properties, including Hubble type and degree of barredness, as well as evidence for environmental dependence.

2. Trends with Hubble Type and with Bars

The left panel of Figure 1 shows the frequency of different profile types along the Hubble sequence, using the galaxies from Pohlen & Trujillo (2006), Erwin et al. (2008), and Gutiérrez et al. (2008, in prep). For simplicity, we group the profiles into “truncations” (Type II, including both “classical” truncations [CT] and Outer-Lindblad-Resonance [OLR] breaks) and “non-truncations” (Types I and III). It is clear that truncations of various types are most common in the latest Hubble types. This is consistent with the reported high frequency of truncations from studies of edge-on disks (e.g., van der Kruit & Searle 1982; Kregel & van der Kruit 2004), since these studies have concentrated on late-type spirals (principally Sc–Sd).

The right panel of Figure 1 shows the distribution of profiles types as a function of bar strength, using the standard RC3 classifications, for early-type disks (S0–Sb) in the field. The frequency of Type II profiles is clearly higher in barred galaxies; most of this is probably related to the Outer Lindblad Resonance of the bars (Erwin et al. 2007). We can also see that the frequency of Type III profiles is anti-correlated with bars (a trend also present if we use numerical measures of bar strength). This suggests that whatever process produces antitruncations also weakens and destroys bars, or else that bar formation tends to suppress this
process; in either case, this places useful constraints on scenarios of disk profile formation (e.g.,  
Elmegreen & Hunter 2006; Younger et al. 2007).

3. Disk Profiles and Galaxy Environment

We are currently investigating whether outer disk profiles are affected by their environment. Preliminary results point to a dramatic difference in disk profiles between the Virgo Cluster and the local field environment (including galaxies in groups), at least for barred S0–Sb galaxies: about half the field galaxies have Type II profiles, but only 10% of the Virgo galaxies do. This suggests a strong role for the cluster environment in modifying outer disk formation, something of potential relevance for, e.g., models of S0 formation.

References

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