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Mass distributions in disk galaxies

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Abstract. We present results on luminous and dark matter mass distributions in disk galaxies from the DiskMass Survey. As expected for normal disk galaxies, stars dominate the baryonic mass budget in the inner region of the disk; however, at about four optical scale lengths (h_R) the atomic gas starts to become the dominant contributor. Unexpectedly, we find the total baryon to dark-matter fraction within a galaxy stays nearly constant with radius from $1h_R$ out to at least $6h_R$, with a baryon fraction of 15–50% among galaxies. On average, only one third of the mass within $2.2h_R$ in a disk galaxy is baryonic and these baryons appear to have had only a minor effect on the distribution of the dark matter.

The DiskMass Survey (DMS; Bershady *et al.* 2010) has used kinematic observations of nearly face-on disk galaxies to break the disk-halo degeneracy and decompose observed rotation curves into their dark and various baryonic components. For the distribution of luminous and dark matter in the 30 galaxies of our DMS sample, we find that:
(1) The atomic gas is distributed in a self-similar way (Martinsson *et al.* 2016), with a radial mass surface density profile surprisingly well described by a single Gaussian profile.
(2) Stars dominate the baryonic mass budget in the inner disk, and molecular gas often dominates over the atomic gas within $1h_R$, but at $4h_R$ the atomic gas starts to become the dominant contributor to the baryonic mass surface density (Martinsson *et al.* 2013).
(3) The baryon-to-dark matter fraction within a galaxy stays rather constant with radius from 1–$6h_R$, with a baryon fraction ranging from 15–50% among galaxies. All galaxies in our sample are submaximal; on average, only 1/3 of the mass within $2.2h_R$ is baryonic (Bershady *et al.* 2011; Martinsson *et al.* 2013).
(4) The dark matter is well fit by a density profile in agreement with dark-matter-only simulations (Martinsson *et al.* 2013), suggesting the baryons in these dark-matter dominated galaxies have had only a minor effect on the distribution of the dark matter.

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