The sub-maximality of galaxy disks

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Introduction:
One of the main goals of the DiskMass Survey (Bershady et al. 2010a) is to break the so-called “disk-halo degeneracy”, which has hampered rotation-curve mass decompositions of spiral galaxies for a long time. The often used “maximum-disk hypothesis” (van Albada & Sancisi 1986) circumvents this problem by assuming a maximum contribution from the baryons to the total mass content of the galaxy, but still remains unproven. From our stellar and gas kinematical observations of nearly face-on spiral galaxies, we break this degeneracy using the equation \( \sigma_r = \sqrt{z,0} \Sigma_{tot} \), which directly relates the disk mass surface density \( \Sigma_{tot} \) to the vertical velocity dispersion of the disk stars \( \sigma_r \). This posterior presents some main results from a sample of 30 galaxies observed with the IFU PPak, to appear in the PhD thesis of T. Martinsson.

Conclusions:
1. The vertical velocity dispersion \( \sigma_r \) follows a well-defined exponential radial decline, expected for constant M/L and thickness of the disk.
2. A tight linear relation exists between the central velocity dispersion of the disk stars \( \sigma_r \) and the maximum rotation speed \( V_{max} \).
3. The radial HI mass surface density \( \Sigma_{HI} \) profile is surprisingly well fitted by a Gaussian function.
4. Our rotation-curve mass decompositions contradict the maximum-disk hypothesis, showing that the intermediate-to-late-type galaxies in our sample have sub-maximal disks.

PPak: Left: The fiber-based PPak IFU, developed for the DiskMass Survey (Verheijen et al. 2004), has a large field of view, with 331 science fibers and 36 sky fibers. Right: The PPak fiber-footprint overlaid on top of UGC 463, one of the galaxies in our sample.

References:
van Albada & Sancisi, 1986, RSPTA, 320, 447
Verheijen et al., 2004, AN, 325, 151